TKM COLLEGE OF ENGINEERING

(Government Aided and Autonomous)

celebrating 60 years of excellence

B.Tech (Civil Engineering) Curriculum & Syllabus

Submitted to

First Board of Studies Meeting

Department of Civil Engineering

10 October 2022

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OF ENGINEERING

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SEMESTER 1

SEMESTER I

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	22MAT101	LINEAR ALGEBRA AND CALCULUS	3-1-0	4	4
B 1/2	22PHT102	ENGINEERING PHYSICS B	3-1-0	4	4
	22CYT103	ENGINEERING CHEMISTRY	3-1-0	4	4
C 1/2	22EST 104	ENGINEERING MECHANICS	2-1-0	3	3
	22EST 105	ENGINEERING GRAPHICS	2-0-2	4	3
D 1/2	22EST 106	BASICS OF CIVIL & MECHANICAL ENGINEERING	4-0-0	4	4
	22EST 107	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	4-0-0	4	4
E	22MNC108	LIFE SKILLS	2-0-2	4	--
S 1/2	22PHL 109	ENGINEERING PHYSICS LAB	0-0-2	2	1
	22CYL110	ENGINEERING CHEMISTRY LAB	0-0-2	2	1
T 1/2	22ESL 111	CIVIL & MECHANICAL WORKSHOP	0-0-2	2	1
	22ESL 112	ELECTRICAL & ELECTRONICS WORKSHOP	0-0-2	2	1
TOTAL				**23/24 ***	**17**

22MAT101	LINEAR ALGEBRA AND CALCULUS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: This course introduces students to some basic mathematical ideas and tools which are at the core of any engineering course. A brief course in Linear Algebra familiarises students with some basic techniques in matrix theory which are essential for analysing linear systems. The calculus of functions of one or more variables taught in this course are useful in modelling and analysing physical phenomena involving continuous change of variables or parameters and have applications across all branches of engineering.

Prerequisite: A basic course in one-variable calculus and matrix theory**.**

Course Outcomes: After the completion of the course the student will be able to

CO 1	solve systems of linear equations, diagonalize matrices and characterise quadratic forms
CO 2	compute the partial and total derivatives and maxima and minima of multivariable functions
CO 3	compute multiple integrals and apply them to find areas and volumes of geometrical shapes, mass and centre of gravity of plane laminas
CO 4	perform various tests to determine whether a given series is convergent, absolutely convergent or conditionally convergent
CO 5	determine the Taylor and Fourier series expansion of functions and learn their applications.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	2	1			1	2		2
CO 2	3	3	3	3	2	1			1	2		2
CO 3	3	3	3	3	2	1			1	2		2
CO 4	3	2	3	2	1	1			1	2		2
CO 5	3	3	3	3	2	1			1	2		2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

Assignments: Assignment should include specific problems highlighting the applications of the methods introduced in this course in science and engineering.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Solve systems of linear equations, diagonalize matrices and characterise quadratic forms

1. A is a real matrix of order 3×3 and $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$. What can you say about the solution of $AX = 0$ if rank of A is 1? 2 ?3?
2. Given $A = \begin{bmatrix} 3 & 0 & 2 \\ 0 & 2 & 0 \\ -2 & 0 & 0 \end{bmatrix}$, find an orthogonal matrix P that diagonalizes A.
3. Find out what type of conic section the following quadratic form represents
$$17x^2 - 30x_1x_2 + 17x_2^2 = 128$$
4. The matrix $A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$ has an eigen value 5 with corresponding Eigen vector $X = \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$. Find A^5X

Course Outcome 2 (CO2): compute the partial and total derivatives and maxima and minima of multivariable functions

1. Find the slope of the surface $z = x^2y + 5y^3$ in the x-direction at the point (1,-2)

2. Given the function $w = xy + z$, use chain rule to find the instantaneous rate of change of $w$at each point along the curve $x = cost, y = sint, z = t$

3. Determine the dimension of rectangular box open at the top , having a volume 32 cubic ft and requiring the least amount of material for it's construction.

Course Outcome 3(CO3): compute multiple integrals and apply them to find areas and volumes of geometrical shapes, mass and centre of gravity of plane laminas.

1. Evaluate $\iint_D (x + 2y)\, DA$where D is the region bounded by the parabolas $y = 2x^2$and $y = 1 + x^2$

2. Explain how you would find the volume under the surface $z = (x, y)$and over a specific region Din the xyplane using (i) double integral (ii) triple integral?

3. Find the mass and centre of gravity of a triangular lamina with vertices (0,0), (2,1), (0,3) if the density function is $f(x, y) = x + y$

4. Use spherical coordinates to evaluate $\iiint_B (x^2 + y^2 + z^2)^3\, dV$where B is the unit ball defined by $B = \{(x, y, z): x^2 + y^2 + z^2 \leq 1\}$

Course Outcome 4 (CO4): perform various tests to determine whether a given series is convergent, absolutely convergent or conditionally convergent.

1. What is the difference between a sequence and a series and when do you say that they are convergent? Divergent?

2. Determine whether the series $\sum_{n=1}^{n=\infty} \frac{5}{2n^2+4n+3}$ converges or diverges.

3. Is the series $\sum_{n=1}^{n=\infty} \frac{(-1)^{n-1}}{n}$ convergent? Absolutely convergent? Conditionally convergent?

Course Outcome 5 (CO5): determine the Taylor and Fourier series expansion of functions and learn their applications.

1. Assuming the possibility of expansion find the Maclaurin series expansion of

   $(x) = (1 + x)^k$for$|x| < 1$where $k$is any real number. What happens if $k$is a positive

   integer?

2. Use Maclaurin series of $(1 + x), -1 < x \leq 1$to find an approximate value of$ln2$.

3. Find the Fourier series of the function$(x) = x^2, -2 \leq x < 2, f(x + 4) = f(x)$. Hence using Parseval's identity prove that $1 + \frac{1}{2^4} + \frac{1}{3^4} + \ldots = \frac{\pi^4}{90}$

4. Expand the function $f(x) = x\ (0 < x < 1/2)$ into a (i) Fourier sine series (ii) Fourier cosine series.

Syllabus

Module 1 (Linear algebra)

(Text 2: Relevant topics from sections 7.3, 7.4, 7.5, 8.1,8.3,8.4)

Systems of linear equations, Solution by Gauss elimination, row echelon form and rank of a matrix, fundamental theorem for linear systems (homogeneous and non-homogeneous, without proof), Eigen values and eigen vectors. Diagonaliztion of matrices, orthogonal transformation, quadratic forms and their canonical forms.

Module 2 (multivariable calculus-Differentiation)

(Text 1: Relevant topics from sections 13.3, 13.4, 13.5, 13.8)

Concept of limit and continuity of functions of two variables, partial derivatives, Differentials, Local Linear approximations, chain rule, total derivative, Relative maxima and minima, Absolute maxima and minima on closed and bounded set.

Module 3(multivariable calculus-Integration)

(Text 1: Relevant topics from sections 14.1, 14.2, 14.3, 14.5, 14.6, 14.8)

Double integrals (Cartesian), reversing the order of integration, Change of coordinates (Cartesian to polar), finding areas and volume using double integrals, mass and centre of gravity of inhomogeneous laminas using double integral. Triple integrals, volume calculated as triple integral, triple integral in cylindrical and spherical coordinates (computations involving spheres, cylinders).

Module 4 (sequences and series)

(Text 1: Relevant topics from sections 9.1, 9.3, 9.4, 9.5, 9.6)

Convergence of sequences and series, convergence of geometric series and p-series(without proof), test of convergence (comparison, ratio and root tests without proof); Alternating series and Leibnitz test, absolute and conditional convergence.

Module 5 (Series representation of functions)

(Text 1: Relevant topics from sections 9.8, 9.9. Text 2: Relevant topics from sections 11.1, 11.2, 11.6)

Taylor series (without proof, assuming the possibility of power series expansion in appropriate domains), Binomial series and series representation of exponential, trigonometric, logarithmic functions (without proofs of convergence); Fourier series, Euler formulas, Convergence of Fourier series (without proof), half range sine and cosine series, Parseval's theorem (without proof).

Text Books

1. H. Anton, I. Biven,S.Davis, "Calculus", Wiley, 10th edition, 2015.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10thEdition, John Wiley & Sons, 2016.

Reference Books

1. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9 th Edition, Pearson, Reprint, 2002.
3. Peter V. O'Neil, Advanced Engineering Mathematics , Cengage, 7th Edition, 2012
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
5. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36 Edition, 2010.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Linear Algebra (10 hours)**	
1.1	Systems of linear equations, Solution by Gauss elimination	1
1.2	Row echelon form, finding rank from row echelon form, fundamental theorem for linear systems	3
1.3	Eigen values and eigen vectors	2
1.4	Diagonaliztion of matrices, orthogonal transformation, quadratic forms	4

	and their canonical forms.	
2	**Multivariable calculus-Differentiation (8 hours)**	
2.1	Concept of limit and continuity of functions of two variables, partial derivatives	2
2.2	Differentials, Local Linear approximations	2
2.3	Chain rule, total derivative	2
2.4	Maxima and minima	2
3	**Multivariable calculus-Integration (10 hours)**	
3.1	Double integrals (Cartesian)-evaluation	2
3.2	Change of order of integration in double integrals, change of coordinates (Cartesian to polar),	2
3.3	Finding areas and volumes, mass and centre of gravity of plane laminas	3
3.4	Triple integrals	3
4	**Sequences and series (8 hours)**	
4.1	Convergence of sequences and series, geometric and p-series	2
4.2	Test of convergence(comparison, ratio and root)	4
4.3	Alternating series and Leibnitz test, absolute and conditional convergence	2
5	**Series representation of functions (9 hours)**	
5.1	Taylor series, Binomial series and series representation of exponential, trigonometric, logarithmic functions;	3
5.2	Fourier series, Euler formulas, Convergence of Fourier series(Dirichlet’s conditions)	3
5.3	Half range sine and cosine series, Parseval’s theorem.	3

22PHT 102	ENGINEERING PHYSICS B (FOR NON-CIRCUIT BRANCHES)	Category	L	T	P	CREDIT	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: The aim of the Engineering Physics program is to offer students a solid background in the fundamentals of Physics and to impart that knowledge in engineering disciplines. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of Physics with the core programs

Prerequisite: Higher secondary level Physics, Mathematical course on vector calculus, differential equations and linear algebra

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the quantitative aspects of waves and oscillations in engineering systems.
CO 2	Apply the interaction of light with matter through interference, diffraction and identify these phenomena in different natural optical processes and optical instruments.
CO 3	Analyze the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices.
CO 4	Apply the knowledge of ultrasonics in non-destructive testing and use the principles of acoustics to explain the nature and characterization of acoustic design and to provide a safe and healthy environment
CO 5	Apply the comprehended knowledge about laser and fibre optic communication systems in various engineering applications

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2						1	2			1
CO 2	3	2						1	2			1
CO 3	3	2						1	2			1
CO 4	3							1	2			1
CO 5	3	2						1	2			1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	25	25	50

Apply	10	10	20
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	**CIE MARKS**	**ESE MARKS**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project :15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the effect of damping force on oscillators.
2. Distinguish between transverse and longitudinal waves.
3. (a) Derive an expression for the fundamental frequency of transverse vibration in a stretched string.
   (b) Calculate the fundamental frequency of a string of length 2 m weighing 6 g kept stretched by a load of 600 kg.

Course Outcome 2 (CO2):

1. Explain colours in thin films.
2. Distinguish between Fresnel and Fraunhofer diffraction.
3. (a) Explain the formation of Newton's rings and obtain the expression for radii of bright and dark rings in reflected system. Also explain how it is used to determine the wavelength of a monochromatic source of light.
   (b) A liquid of refractive index μ is introduced between the lens and glass plate. What happens to the fringe system? Justify your answer.

Course Outcome 3 (CO3):

1. Give the physical significance of wave function?

2. What are excitons?
3. (a) Solve Schrodinger equation for a particle in a one-dimensional box and obtain its energy eigen values and normalized wave functions.
   (b) Calculate the first three energy values of an electron in a one dimensional box of width 1 A^0 in electron volt.

Course Outcome 4 (CO4):

1. Explain reverberation and reverberation time.
2. How ultrasonic waves are used in non-destructive testing.
3. (a) With a neat diagram explain how ultrasonic waves are produced by a piezoelectric oscillator.
   (b) Calculate frequency of ultrasonic waves that can be produced by a nickel rod of length 4 cm. (Young's Modulus = 207 G Pa, Density = 8900 Kg /m^3)

Course Outcome 5 (CO 5):

1. Distinguish between spontaneous emission and stimulated emission.
2. Explain optical resonators.
3. (a) Explain the construction and working of Ruby Laser.
   (b) Calculate the numerical aperture and acceptance angle of a fibre with a core refractive index of 1.54 and a cladding refractive index of 1.50 when the fibre is inside water of refractive index 1. 33..

Model Question paper

QP CODE: PAGES:3

Reg No:________________

Name :________________

Course Code: 22PHT 102

Course Name: Engineering Physics B

Max.Marks: 100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Compare electrical and mechanical oscillators.

2. Distinguish between longitudinal and transverse waves.

3. Write a short note on antireflection coating.

4. Diffraction of light is not as evident in daily experience as that of sound waves. Give reason.

5. State and explain Heisenberg's Uncertainty principle. With the help of it explain natural line broadening.

6. Explain surface to volume ratio of nanomaterials.

7. Define sound intensity level. Give the values of threshold of hearing and threshold of pain.

8. Describe the method of non-destructive testing using ultra sonic waves

9. Explain the condition of population inversion

10. Distinguish between step index and graded index fibre. (10x3=30)

PART B

Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. (a) Derive the differential equation of damped harmonic oscillator and deduce its solution. Discuss the cases of over damped, critically damped and under damped cases. (10)

(b) The frequency of a tuning fork is 500 Hz and its Q factor is 7×10^{4}. Find the relaxation time. Also calculate the time after which its energy becomes 1/10 of its initial undamped value. (4)

12. (a) Derive an expression for the velocity of propagation of a transverse wave in a stretched string. Deduce laws of transverse vibrations. (10)

(b) The equation of transverse vibration of a stretched string is given by y =0.00327 sin (72.1x-2.72t) m, in which the numerical constants are in S.I units. Evaluate (i) Amplitude (ii) Wavelength (iii) Frequency and (iv) Velocity of the wave. (4)

Module 2

13. (a) Explain the formation of Newton's rings and show that the radius of dark ring is proportional to the square root of natural numbers. How can we use Newton's rings experiment to determine the refractive index of a liquid? (10)

(b) Two pieces of plane glass are placed together with a piece of paper between two at one end. Find the angle of the wedge in seconds if the film is viewed with a monochromatic light of wavelength 4800Å. Given β = 0.0555 cm. (4)

14. (a) Explain the diffraction due to a plane transmission grating. Obtain the grating equation. (10)

(b) A grating has 6000 lines per cm. Find the angular separation of the two yellow lines of mercury of wavelengths 577 nm and 579 nm in the second order. (4)

Module 3

15. (a) Derive time dependent and independent Schrodinger equations. (10)

(b) An electron is confined to one dimensional potential box of length 2Å. Calculate the energies corresponding to the first and second quantum states in eV. (4)

16. (a) Classify nanomaterials based on dimensionality of quantum confinement and explain the following nanostructures. (i) nano sheets (ii) nano wires (iii) quantum dots. (10)

(b) Find the de Broglie wavelength of electron whose kinetic energy is 15 eV. (4)

Module 4

17. (a) Explain reverberation and reverberation time? What is the significance of Reverberation time. Explain the factors affecting the acoustics of a building and their corrective measures? (10)

(b) The volume of a hall is 3000 m^3. It has a total absorption of 100m^2 sabine. If the hall is filled with audience who add another 80 m^2sabine, then find the difference in reverberation time. (4)

18. (a) With a neat diagram explain how ultrasonic waves are produced by piezoelectric oscillator. Also discuss the piezoelectric method of detection of ultrasonic waves. (10)

(b) An ultrasonic source of 0.09 MHz sends down a pulse towards the sea bed which returns after 0.55 sec. The velocity of sound in sea water is 1800 m/s. Calculate the depth of the sea and the wavelength of the pulse. (4)

Module 5

19. (a) Outline the construction and working of Ruby laser. (8)

(b) What is the principle of holography? How is a hologram recorded? (6)

20. (a) Define numerical aperture of an optic fibre and derive an expression for the NA of a step index fibre with a neat diagram. (10)

(b) An optical fibre made with core of refractive index 1.5 and cladding with a fractional index difference of 0.0006. Find refractive index of cladding and numerical aperture. (4)

(14x5=70)

SYLLABUS

ENGINEERING PHYSICS B (FOR NON-CIRCUIT BRANCHES)

Module 1

Oscillations and Waves

Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression, Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators

Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation), Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration

Module 2

Wave Optics

Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference, Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings

Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation, Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)

Module 3

Quantum Mechanics & Nanotechnology

Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening Mechanism, Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)

Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots, Properties of nanomaterials-mechanical, electrical and optical, Applications of nanotechnology (qualitative ideas)

Module 4

Acoustics & Ultrasonics

Acoustics, Classification of sound-Musical sound-Noise, Characteristics of Musical Sounds-Pitch or frequency-Loudness or Intensity-Measurement of Intensity level-Decibel-Quality or timbre, Absorption coefficient, Reverberation-Reverberation time-Significance- Sabine's formula (no derivation), Factors affecting architectural acoustics and their remedies

Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator –Working, Detection of ultrasonic waves - Thermal and Piezoelectric methods, Ultrasonic diffractometer- Expression for the velocity of ultrasonic waves in a liquid, Applications of ultrasonic waves -SONAR, NDT and Medical

Module 5

Laser and Fibre optics

Properties of laser, Absorption and emission of radiation, Spontaneous and stimulated emission, Einstein's coefficients (no derivation), Population inversion, Metastable states, basic components of laser, Active medium, Pumping mechanism, Optical resonant cavity, working principle, Construction and working of Ruby laser and Helium neon laser ,Construction and working of semiconductor laser(Qualitative) ,Applications of laser, Holography, Difference between hologram and photograph, Recording of hologram and reconstruction of image, Applications

Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications, Fibre optic sensors-Intensity Modulated and Phase modulated sensors

Text Books

1. M.N.Avadhanulu, P.G.Kshirsagar,TVS Arun Murthy "A Text book of Engineering Physics", S.Chand &Co., Revised Edition, 2019.

2. H.K.Malik , A.K. Singh, "Engineering Physics" McGraw Hill Education, Second Edition, 2017.

Reference Books

1. Arthur Beiser, "Concepts of Modern Physics ", Tata McGraw Hill Publications, 6th Edition 2003
2. D.K. Bhattacharya, Poonam Tandon, "Engineering Physics", Oxford University Press, 2015
3. Md.N.Khan & S.Panigrahi "Principles of Engineering Physics 1&2", Cambridge University Press, 2016
4. Aruldhas G., "Engineering Physics", PHI Pvt. Ltd., 2015
5. Ajoy Ghatak, "Optics", Mc Graw Hill Education, Sixth Edition, 2017
6. T. Pradeep, "Nano:The Essentials'', McGraw Hill India Ltd, 2007
7. B. B. Laud, "Lasers and Non linear optics", New age International Publishers, 2nd Edition ,2005
8. Premlet B., "Advanced Engineering Physics", Phasor Books,10th edition ,2017
9. I. Dominic and. A. Nahari, "A Text Book of Engineering physics", Owl Books Publishers, Revised edition, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Oscillations and Waves (9 hours)**	
1.1	Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression	2 hrs
1.2	Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators	3hrs
1.3	Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation)	2 hrs
1.4	Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration	2 hrs
2	**Wave Optics (9 hours)**	
2.1	Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference	2 hrs
2.2	Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings	4 hrs
2.3	Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation	2 hrs
2.4	Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)	1 hr
3	**Quantum Mechanics &Nanotechnology (9hours)**	
3.1	Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism	2 hrs
3.2	Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)	4 hrs

3.3	Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots	2 hrs
3.4	Properties of nanomaterials-mechanical, electrical and optical Applications of nanotechnology (qualitative ideas)	1 hr
4	**Acoustics & Ultrasonics (9hrs)**	
4.1	Acoustics, Classification of sound-Musical sound-Noise, Characteristics of Musical Sounds-Pitch or frequency-Loudness or Intensity-Measurement of Intensity level-Decibel-Quality or timbre, Absorption coefficient, Reverberation-Reverberation time-Significance- Sabine's formula (no derivation)	3 hrs
4.2	Factors affecting architectural acoustics and their remedies	1 hr
4.3	Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator – Working, Detection of ultrasonic waves - Thermal and Piezoelectric Methods	3hrs
4.4	Ultrasonic diffractometer- Expression for the velocity of ultrasonic waves in a liquid, Applications of ultrasonic waves -SONAR, NDT and Medical.	2 hr
5	**Laser and Fibre optics (9hours)**	
5.1	Properties of laser, Absorption and emission of radiation, Spontaneous and stimulated emission, Einstein's coefficients (no derivation), Population inversion, Metastable states, basic components of laser, Active medium, Pumping mechanism, Optical resonant cavity, working principle	2 hrs
5.2	Construction and working of Ruby laser and Helium neon laser ,Construction and working of semiconductor laser(Qualitative) Applications of laser	3 hrs
5.3	Holography, Difference between hologram and photograph, Recording of hologram and reconstruction of image, Applications	1 hr
5.4	Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications, Fibre optic sensors-Intensity Modulated and Phase modulated sensors	3 hrs

22CYT 103	ENGINEERING CHEMISTRY	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	3	1	0	4	2019

Preamble: To enable the students to acquire knowledge in the concepts of chemistry for engineering applications and to familiarize the students with different application oriented topics like spectroscopy, electrochemistry, instrumental methods etc. Also familiarize the students with topics like mechanism of corrosion, corrosion prevention methods, SEM, stereochemistry, polymers, desalination etc., which enable them to develop abilities and skills that are relevant to the study and practice of chemistry.

Prerequisite: Concepts of chemistry introduced at the plus two levels in schools

Course outcomes: After the completion of the course the students will be able to

CO 1	Apply the basic concepts of electrochemistry and corrosion to explore its possible applications in various engineering fields.
CO 2	Understand various spectroscopic techniques like UV-Visible, IR, NMR and its applications.
CO 3	Apply the knowledge of analytical method for characterizing a chemical mixture or a compound. Understand the basic concept of SEM for surface characterisation of nanomaterials.
CO 4	Learn about the basics of stereochemistry and its application. Apply the knowledge of conducting polymers and advanced polymers in engineering.
CO 5	Study various types of water treatment methods to develop skills for treating wastewater.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	2	1									
CO 2	1	1		1	2							
CO 3	1	1		1	2							
CO 4	2	1										
CO 5	1			1			3					

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			
Create			

End Semester Examination Pattern: There will be two parts- **Part A** and **Part B. Part A** contains **10** questions (**2** questions from each module), having **3** marks for each question. Students should answer **all** questions. **Part B** contains **2** questions from each module, of which student should answer any one. Each question can have maximum **2** subdivisions and carries **14** marks.

Course Level Assessment Questions

Course Outcome 1 (CO 1):

1. What is calomel electrode? Give the reduction reaction (3 Marks)

2. List three important advantages of potentiometric titration (3 Marks)

3. (a) Explain how electroless plating copper and nickel are carried out (10 Marks)

(b) Calculate the emf of the following cell at 30°C, Z n / Zn^{2+} (0.1M) // Ag^+ (0.01M) // Ag.

Given E^0 Zn^{2+}/Zn = -0.76 V, E^0 Ag^+/Ag = 0.8 V. (4 Marks)

Course Outcome 2 (CO 2)

1. State Beer Lambert's law (3 Marks)

2. List the important applications of IR spectroscopy (3 Marks)

3. (a) What is Chemical shift? What are factors affecting Chemical shift? How ^1H NMR spectrum of CH_3COCH_2Cl interpreted using the concept of chemical shift. (10 Marks)

(b) Calculate the force constant of HF molecule, if it shows IR absorption at 4138 cm^{-1}. Given that atomic masses of hydrogen and fluorine are 1u and 19u respectively. (4 Marks)

Course Outcome 3 (CO 3):

1. Distinguish between TGA and DTA (3 Marks)

2. Give two differences between GSC and GLC (3 Marks)

3. (a) Explain the principle, instrumentation and procedure of HPLC (10 Marks)

(b) Interpret TGA of $CaC_2O_4 . H_2O$ (4 Marks)

Course Outcome 4 (CO 4):

1. Explain the geometrical isomerism in double bonds (3 Marks)

2. What are the rules of assigning R-S notation? (3 Marks)

3. (a) What are conducting polymers? How it is classified? Give the preparation of polyaniline (10 Marks)

(b) Draw the stereoisomers possible for CH_3-$(CHOH)_2$-COOH (4 Marks)

Course Outcome 5 (CO 5):

1. What is degree of hardness? (3 Marks)

2. Define BOD and COD (3 Marks)

3. (a) Explain the EDTA estimation of hardness (10 Marks)

(b) Standard hard water contains 20 g of CaCO3 per liter,50 mL of this required 30mL of EDTA solution, 50mL of sample water required 20mL of EDTA solution. 50mL sample water after boiling required 14 mL EDTA solution. Calculate the temporary hardness of the given sample of water, in terms of ppm. (4 Marks)

TKM COLLEGE OF ENGINEERING, KOLLAM (GOVT. AIDED AUTONOMOUS)

MODEL QUESTION PAPER

Total Pages:

Reg No.:________________ Name:____________________________

FIRST SEMESTER B.TECH DEGREE EXAMINATION

Course Code: 22CYT103,

Course Name: ENGINEERING CHEMISTRY

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks — Marks

1 What is potentiometric titration? How the end point is determined graphically? (3)

2 What is Galvanic series? How is it different from electrochemical series? (3)

3 Which of the following molecules can give IR absorption? Give reason? (3)

(a) O_2 (b) H_2O (c) N_2 (d) HCl

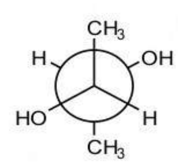
4 Which of the following molecules show UV-Visible absorption? Give reason. (3)

(a) Ethane (b) Butadiene (c) Benzene

5 What are the visualization techniques used in TLC? (3)

6 Write the three important applications of nanomaterials.(3)

7 Draw the Fischer projection formula and find R-S notation of (3)



8 Write the structure of a) Polypyrroleb) Kevlar. (3

9 What is break point chlorination? 3)

10 What is reverse osmosis? (3)

PART B

Answer any one full question from each module, each question carries 14 marks

Module 1

11	a)	Give the construction of Li-ion cell. Give the reactions that take place at the electrodes during charging and discharging. What happens to anodic material when the cell is 100% charged.	(10)
	b)	Calculate the standard electrode potential of Cu, if its electrode potential at 25 °C is 0.296 V and the concentration of Cu^{2+} is 0.015 M.	(4)

OR

12	a)	Explain the mechanism of electrochemical corrosion of iron in oxygen rich and oxygen deficient acidic and basic environments.	(10)
	b)	Given below are reduction potentials of some species	(4)

$MnO_4^- + 8H^+ + 5e \rightarrow Mn^{2+} + 4H_2O$; $E^0 = +1.51$ V

$Cl_2 + 2e \rightarrow 2Cl^-$; $E^0 = +1.36$ V

$S_2O_8^{2-} + 2e \rightarrow 2SO_4^{2-}$; $E^0 = +1.98$ V

Use the above data to examine whether the acids, dil. HCl and dil. H_2SO_4 , can be used to provide acid medium in redox titrations involving $KMnO_4$.

Module 2

13	a)	What is spin-spin splitting? Draw the NMR spectrum of (i) CH_3 CH_2CH_2 Br (ii) $CH_3CH(Br)CH_3$ Explain how NMR spectrum can be used to identify the two isomers.	(10)
	b)	A dye solution of concentration 0.08M shows absorbance of 0.012 at 600 nm; while a test solution of same dye shows absorbance of 0.084 under same conditions. Find the concentration of the test solution.	(4)

OR

14	a)	Explain the basic principle of UV-Visible spectroscopy. What are the possible electronic transitions? Explain with examples.	(10)
	b)	Sketch the vibrational modes of CO_2 and H_2O. Which of them are IR active?	(4)

Module 3

15 a) Explain the principle, instrumentation and procedure involved in gas chromatography. (10)

b) Explain the DTA of $CaC_2O_4.H_2O$ with a neat sketch. (4)

OR

16 a) Explain the various chemical methods used for the synthesis of nanomaterial (10)

b) How TGA is used to analyse the thermal stability of polymers? (4)

Module 4

17 a) What are conformers? Draw the*cis* and *trans*isomers of 1, 3-dimethylcylohexane. Which conformer (chair form) is more stable in each case? (10)

b) What is ABS? Give properties and applications. (4)

OR

18 a) Explain the various structural isomers with suitable example. (10)

b) What is OLED? Draw a labelled diagram. (4)

Module 5

19 a) What are ion exchange resins? Explain ion exchange process for removal of hardness of water? How exhausted resins are regenerated? (10)

b) 50 mL sewage water is diluted to 2000 mL with dilution water; the initial dissolved oxygen was 7.7 ppm. The dissolved oxygen level after 5 days of incubation was 2.4 ppm. Find the BOD of the sewage. (4)

OR

20 a) What are the different steps in sewage treatment? Give the flow diagram. Explain the working of trickling filter. (10)

b) Calculate the temporary and permanent hardness of a water sample which contains $[Ca^{2+}]$ = 160 mg/L, $[Mg^{2+}]$ = 192 mg/L and $[HCO_3^-]$ = 122 mg/L. (4)

Syllabus

Module 1

Electrochemistry and Corrosion

Introduction - Differences between electrolytic and electrochemical cells - Daniel cell - redox reactions - cell representation. Different types of electrodes (brief) - Reference electrodes - SHE - Calomel electrode - Glass Electrode - Construction and Working. Single electrode potential - definition - Helmholtz electrical double layer -Determination of E^0 using calomel electrode.Determination of pH using glass electrode.Electrochemical series and its applications. Free energy and EMF - Nernst Equation - Derivation - single electrode and cell (Numericals) -Application - Variation of emf with temperature. Potentiometric titration - Introduction -Redox titration only.Lithiumion cell - construction and working.Conductivity- Measurement of conductivity of a solution (Numericals).

Corrosion-Electrochemicalcorrosion – mechanism. Galvanic series- cathodic protection - electroless plating –Copper and Nickel plating.

Module 2

Spectroscopic Techniques and Applications

Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numericals). UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications.IR-Spectroscopy – Principle - Number of vibrational modes - Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications. ^{1}H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief). **Module 3**

Instrumental Methods and Nanomaterials

Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $CaC_2O_4.H_2O$ and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of $CaC_2O_4.H_2O$. Chromatographic methods - Basic principles and applications of column and TLC-Retention factor. GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications.

Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nanomaterials - Surface characterisation -SEM – Principle and instrumentation (block diagram).

Module 4

Stereochemistry and Polymer Chemistry

Isomerism-Structural, chain, position, functional, tautomerism and matamerism - Definition with examples - Representation of 3D structures-Newman, Sawhorse, Wedge and Fischer projection of substituted methane and ethane. Stereoisomerism - Geometrical isomerism in double bonds and cycloalkanes (cis-trans and E-Z notations). R-S Notation – Rules and examples - Optical isomerism, Chirality, Enantiomers and Diastereoisomers-Definition with examples.Conformational analysis of ethane, butane, cyclohexane, mono and di methyl substituted cyclohexane.

Copolymers - Definition - Types - Random, Alternating, Block and Graft copolymers - ABS - preparation, properties and applications.Kevlar-preparation, properties and applications.Conducting polymers - Doping -Polyaniline and Polypyrrole - preparation properties and applications. OLED - Principle, construction and advantages.

Module 5

Water Chemistry and Sewage Water Treatment

Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages. Municipal water treatment (brief) - Disinfection methods - chlorination, ozone andUV irradiation.

Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD-definition, estimation (only brief procedure) and significance (Numericals). Sewage water treatment - Primary, Secondary and Tertiary - Flow diagram -Trickling filter and UASB process.

Text Books

1. B. L. Tembe, Kamaluddin, M. S. Krishnan, "Engineering Chemistry (NPTEL Web-book)", 2018.

2. P. W. Atkins, "Physical Chemistry", Oxford University Press, 10th edn., 2014.

Reference Books

1. C. N. Banwell, "Fundamentals of Molecular Spectroscopy", McGraw-Hill, 4thedn., 1995.
2. Donald L. Pavia, "Introduction to Spectroscopy", Cengage Learning India Pvt. Ltd., 2015.
3. B. R. Puri, L. R. Sharma, M. S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Co., 47th Edition, 2017.
4. H. H. Willard, L. L. Merritt, "Instrumental Methods of Analysis", CBS Publishers, 7th Edition, 2005.
5. Ernest L. Eliel, Samuel H. Wilen, "Stereo-chemistry of Organic Compounds", WILEY, 2008.
6. Raymond B. Seymour, Charles E. Carraher, "Polymer Chemistry: An Introduction", Marcel Dekker Inc; 4th Revised Edition, 1996.
7. MuhammedArif, Annette Fernandez, Kavitha P. Nair "Engineering Chemistry", Owl Books, 2019.
8. Ahad J., "Engineering Chemistry", Jai Publication, 2019.
9. Roy K. Varghese, "Engineering Chemistry", Crownplus Publishers, 2019.
10. Soney C. George,RinoLaly Jose, "Text Book of Engineering Chemistry", S. Chand & Company Pvt Ltd, 2019.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures (hrs)
1	**Electrochemistry and Corrosion**	**9**
1.1	Introduction - Differences between electrolytic and electrochemical cells- Daniel cell - redox reactions - cell representation. Different types of electrodes (brief) - Reference electrodes- SHE - Calomel electrode - Glass Electrode - Construction and Working.	**2**
1.2	Single electrode potential – definition - Helmholtz electrical double layer - Determination of E^0 using calomel electrode. Determination of pH using glass electrode. Electrochemical series and its applications. Free energy and EMF - Nernst Equation – Derivation - single electrode and cell (Numericals) -Application -Variation of emf with temperature.	**3**
1.3	Potentiometric titration - Introduction -Redox titration only. Lithiumion cell - construction and working. Conductivity- Measurement of conductivity of a solution (Numericals).	**2**
1.4	Corrosion-Electrochemicalcorrosion – mechanism. Galvanic series- cathodic protection - electroless plating –Copper and Nickel plating.	**2**
2	**Spectroscopic Techniques and Applications**	**9**
2.1	Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numericals).	**2**
2.2	UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications.	**2**
2.3	IR-Spectroscopy – Principle - Number of vibrational modes -Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications.	**2**
2.4	^{1}H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief).	**3**
3	**Instrumental Methods and Nanomaterials**	**9**
3.1	Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $CaC_2O_4.H_2O$ and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of $CaC_2O_4.H_2O$.	**2**

3.2	Chromatographic methods - Basic principles and applications of column and TLC-Retention factor.	**2**
3.3	GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications.	**2**
3.4	Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nanomaterials - Surface characterisation -SEM – Principle and instrumentation (block diagram).	**3**
4	**Stereochemistry and Polymer Chemistry**	**9**
4.1	Isomerism-Structural, chain, position, functional, tautomerism and matamerism - Definition with examples - Representation of 3D structures-Newman, Sawhorse, Wedge and Fischer projection of substituted methane and ethane. Stereoisomerism - Geometrical isomerism in double bonds and cycloalkanes (cis-trans and E-Z notations).	**2**
4.2	R-S Notation – Rules and examples - Optical isomerism, Chirality, Enantiomers and Diastereoisomers-Definition with examples.	**1**
4.3	Conformational analysis of ethane, butane, cyclohexane, mono and di methyl substituted cyclohexane.	**2**
4.4	Copolymers - Definition - Types - Random, Alternating, Block and Graft copolymers - ABS - preparation, properties and applications. Kevlar-preparation, properties and applications. Conducting polymers - Doping -Polyaniline and Polypyrrole - preparation properties and applications. OLED - Principle, construction and advantages.	**4**
5	**Water Chemistry and Sewage Water Treatment**	**9**
5.1	Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages.	**3**
5.2	Municipal water treatment (brief) - Disinfection methods - chlorination, ozone andUV irradiation.	**2**
5.3	Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD-definition, estimation (only brief procedure) and significance (Numericals).	**2**
5.4	Sewage water treatment - Primary, Secondary and Tertiary - Flow diagram - Trickling filter and UASB process.	**2**

22EST 104	ENGINEERING MECHANICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		ESC	2	1	0	3	2019

Preamble: Goal of this course is to expose the students to the fundamental concepts of mechanics and enhance their problem-solving skills. It introduces students to the influence of applied force system and the geometrical properties of the rigid bodies while stationary or in motion. After this course students will be able to recognize similar problems in real-world situations and respond accordingly.

Prerequisite: Nil

Course Outcomes: After completion of the course the student will be able to:

CO 1	Recall principles and theorems related to rigid body mechanics
CO 2	Identify and describe the components of system of forces acting on the rigid body
CO 3	Apply the conditions of equilibrium to various practical problems involving different force system.
CO 4	Choose appropriate theorems, principles or formulae to solve problems of mechanics.
CO 5	Solve problems involving rigid bodies, applying the properties of distributed areas and masses

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-
CO 3	3	3	-	-	-	-	-	-	-	-	-	-
CO 4	3	3	-	-	-	-	-	-	-	-	-	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	15
Understand	10	10	15
Apply	30	30	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions:

Part A

Course Outcome 1 (CO1): (One question from each module to meet the course objective 1: *To recall principles and theorems related to rigid body mechanics*)

1. Explain D'Alembert's principle

2. Distinguish static and dynamic friction

3. State and explain perpendicular axis theorem

Course Outcome 2 (CO2) (One question from each module to meet the course objective 2: *To identify and describe the components of system of forces acting on the rigid body*)

1. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.

2. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling. Diagram the forces acting on the combination of gymnast and bar

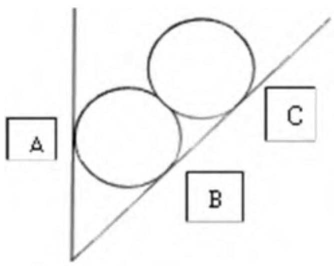
3. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?

Part B

All the questions under this section shall assess the learning levels corresponding to the course outcomes listed below.

CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses

1. Two rollers each of weight 100 N are supported by an inclined plane and a vertical wall. Find the reaction at the points of contact A, B, C. Assume all the surfaces to be smooth.

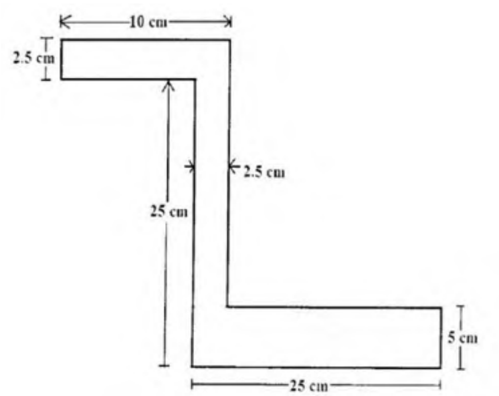


Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent equilibrium state of the body)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

2. A cylindrical disc, 50 cm diameter and cm thickness, is in contact with a horizontal conveyor belts running at uniform speeds of 5 m/s. Assuming there is no slip at points of contact determine (i) angular velocity of disc (ii) Angular acceleration of disc if velocity of conveyor changes to 8 m/s. Also compute the moment acting about the axis of the disc in both cases.

Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent state of the body)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

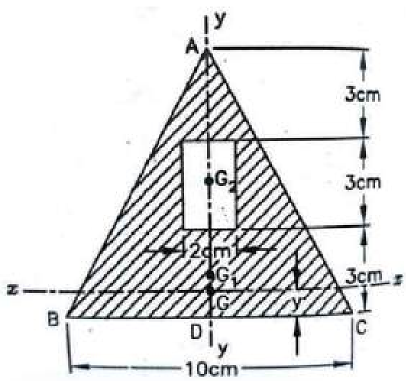
3. Determine the centroid of the given section



Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Illustrate the computation of centroid for the given geometrical shape)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed	Applying (Solve the problem based on the descriptions	6

	areas and masses	given in CO3 and CO4)	
Total			14

4. A rectangular hole is made in a triangular section as shown. Find moment of inertia about the section x-x passing through the CG of the section and parallel to BC.



Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Illustrate the computation of moment of inertia for the given geometrical shape)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

TKM COLLEGE OF ENGINEERING, KOLLAM (GOVT. AIDED AUTONOMOUS)

Model Question Paper

QP CODE:

Reg No.:________________

Name:________________________________

Course Code:22 EST 104

ENGINEERING MECHANICS

Max. Marks: 100 Duration: 3 hours

Part A

(Answer all questions; each question carries 3 marks)

1. Explain D'Alembert's principle

2. Distinguish static and dynamic frictioni.

3. State and explain perpendicular axis theorem.

4. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.

5. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling. Diagram the forces acting on the combination of gymnast and bar

6. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?

7. Compare damped and undamped free vibrations.

8. State the equation of motion of a rotating rigid body, rotating about its fixed axis.

9. Illustrate the significance of instantaneous centre in the analysis of rigid body undergoing rotational motion.

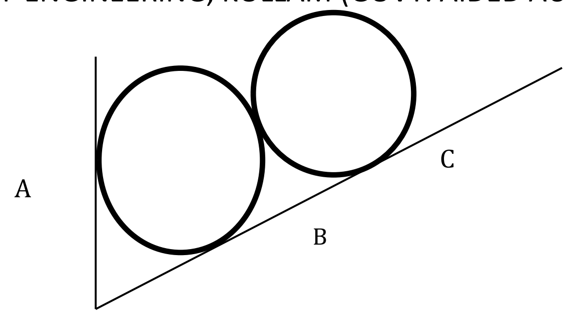
10. Highlight the principles of mechanics applied in the evaluation of elastic collusion of rigid bodies.

PART B

(Answer **one full** question from each module, each question carries **14** marks)

Module -I

11. Two identical rollers each of weight 100 N are supported by an inclined plane, making an angle of 30^{o} with the vertical, and a vertical wall. Find the reaction at the points of contact A, B, C. Assume all the surfaces to be smooth. (14 marks)

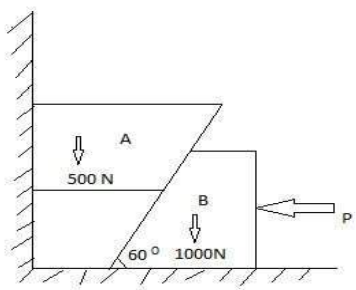


12. A string tied to a wall is made to pass over a pulley placed 2m away from it. A weight P is attached to the string such that the string stretches by 2m from the support on the wall to the location of attachment of weight. Determine the force P required to maintain 200 kg body in position for θ = 30°, The diameter of pulley B is negligible. (14 marks)

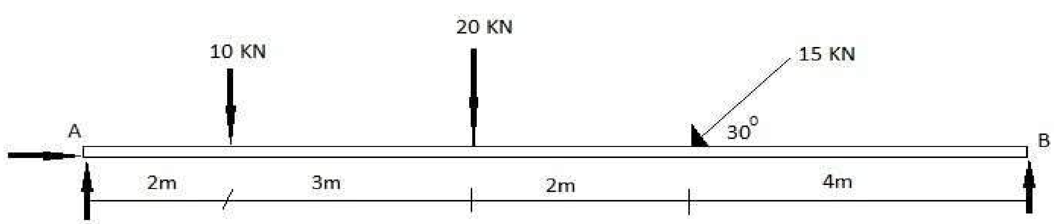
Module – 2

13. Two blocks A & B are resting against a wall and the floor as shown in figure below. Find the value of horizontal force P applied to the lower block that will hold the system in equilibrium. Coefficient of friction are : 0.25 at the floor, 0.3 at the wall and 0.2 between the blocks.

(14 marks)

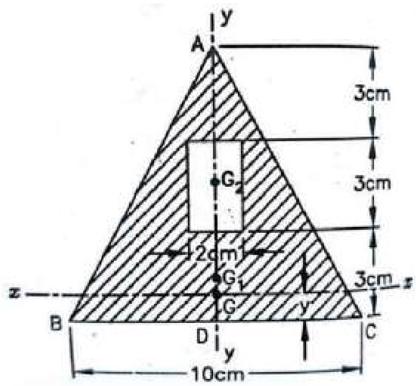


14. A beam is hinged at A and roller supported at B. It is acted upon by loads as shown below. Find the reactions at A & B. (14 marks)

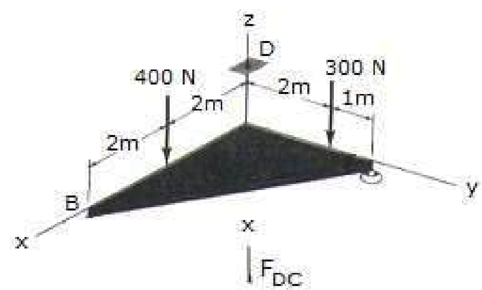


Module – 3

15. A rectangular hole is made in a triangular section as shown. Find moment of inertia about the section x-x passing through the CG of the section and parallel to BC. (14 marks)



16. Support A has ball and socket connection. Roller support at B prevents motion in the —z direction. Corner *C* is tied to *D* by a rope. The triangle is weightless. Determine the unknown force components acting at *A*, *B*, and *C*. (14 marks)



Module - 4

17. A cricket ball is thrown by a fielder from a height of 2m at an angle of 30^0 to the horizontal with an initial velocity of 20 m/s , hits the wickets at a height of 0.5 m from the ground. How far was the fielder from the wicket? (14 marks)

18. An engine of weight 500 kN pull a train weighing 1500 kN up an incline of 1 in 100. The train starts from rest and moves with constant acceleration against a resistance of 5 N/kN. It attains a maximum speed of 36 kmph in 1 km distance. Determine the tension in the coupling between train and engine and the traction force developed by the engine. (14marks)

Module – 5

19. A cylindrical disc, 50 cm diameter and 10 cm thickness having mass of 10 kg, is in contact with a horizontal conveyor belt running at uniform speeds of 5 m/s. Assuming there is no slip at points of contact determine (i) angular velocity of disc (ii) Angular acceleration of disc if velocity of conveyor changes to 8 m/s in 10 seconds. Also compute the moment acting about the axis of the disc in both cases. (14 marks)

20. A wheel rotating about fixed axis at 20 rpm is uniformly accelerated for 70 seconds during which time it makes 50 revolutions. Find the (i) angular velocity at the end of this interval and (ii) time required for the velocity to reach 100 revolutions per minute. (14 marks)

SYLLABUS

Module 1

Introduction to Engineering Mechanics-statics-basic principles of statics-Parallelogram law, equilibrium law, principles of superposition and transmissibility, law of action and reaction(review) free body diagrams.

Concurrent coplanar forces-composition and resolution of forces-resultant and equilibrium equations – methods of projections – methods of moments – Varignon's Theorem of moments.

Module 2

Friction – sliding friction - Coulomb's laws of friction – analysis of single bodies –wedges, ladder-analysis of connected bodies .

Parallel coplanar forces – couple - resultant of parallel forces – centre of parallel forces – equilibrium of parallel forces – Simple beam subject to concentrated vertical loads. General coplanar force system - resultant and equilibrium equations.

Module 3

Centroid of composite areas- – moment of inertia-parallel axis and perpendicular axis theorems. Polar moment of inertia,radius of gyration,mass moment of inertia-ring,cylinder and disc.

Theorem of Pappus Guldinus(demonstration only)

Forces in space - vectorial representation of forces, moments and couples –resultant and equilibrium equations – concurrent forces in space (simple problems only)

Module 4

Dynamics – rectilinear translation - equations of kinematics(review)

kinetics – equation of motion – D'Alembert's principle. – motion on horizontal and inclined surfaces, motion of connected bodies. Impulse momentum equation and work energy equation (concepts only).

Curvilinear translation - equations of kinematics –projectile motion(review), kinetics – equation of motion. Moment of momentum and work energy equation (concepts only).

Module 5

Rotation – kinematics of rotation- equation of motion for a rigid body rotating about a fixed axis – rotation under a constant moment.

Plane motion of rigid body – instantaneous centre of rotation (concept only).

Simple harmonic motion – free vibration –degree of freedom- undamped free vibration of spring mass system-effect of damping(concept only)

Text Books

1. Timoshenko and Young, Engineering Mechanics, McGraw Hill Publishers
2. Shames, I. H., Engineering Mechanics - Statics and Dynamics, Prentice Hall of India.
3. R. C. Hibbeler and Ashok Gupta, Engineering Mechanics, Vol. I statics, Vol II Dynamics, Pearson Education.

References

1. Merriam J. L and Kraige L. G., Engineering Mechanics - Vols. 1 and 2, John Wiley.
2. Tayal A K, Engineering Mechanics – Statics and Dynamics, Umesh Publications
3. Bhavikkatti, S.S., Engineering Mechanics, New Age International Publishers
4. F.P.Beer abd E.R.Johnston (2011), Vector Mechanics for Engineers, Vol.I-Statics, Vol.II-Dynamics, 9th Ed, Tata McGraw Hill
5. Rajasekaran S and Sankarasubramanian G, Engineering Mechanics - Statics and Dynamics, Vikas Publishing House Pvt Ltd.

Course Contents and Lecture Schedule:

Module	Topic	Course outcomes addressed	No. of Hours
1	**Module 1**		**Total: 7**
1.1	Introduction to engineering mechanics – introduction on statics and dynamics - Basic principles of statics – Parellogram law, equilibrium law – Superposition and transmissibility, law of action and reaction (review the topics)	CO1 and CO2	1
1.2	Free body diagrams. Degree of freedom-types of supports and nature of reactions - exercises for free body diagram preparation – composition and resolution of forces, resultant and equilibrium equations (review the topics) - numerical exercises for illustration.	CO1 and CO2	1
1.3	Concurrent coplanar forces - analysis of concurrent forces -methods of projections – illustrative numerical exercise – teacher assisted problem solving.	CO1 and CO2	1
1.4	Analysis of concurrent forces -methods of moment-Varignon's Theorem of Moments - illustrative numerical exercise– teacher assisted problem solving.	CO1 and CO2	1
1.5	Analysis of concurrent force systems – extended problem solving - Session I.	CO3,CO4 and CO5	1
1.6	Analysis of concurrent force systems – extended problem solving - Session II – learning review quiz.	CO3,CO4 and CO5	1
1.7	Analysis of concurrent force systems – extended problem solving - Session III.	CO3,CO4 and CO5	1
2	**Module 2**		**Total: 7**
2.1	Friction – sliding friction - Coulomb's laws of friction – analysis of single bodies –illustrative examples on wedges and ladder-teacher	CO1 and CO2	1

	assisted problem solving tutorials using problems from wedges and ladder.		
2.2	Problems on friction - analysis of connected bodies. illustrative numerical exercise– teacher assisted problem solving.	CO3, CO4 and CO5	1
2.3	Problems on friction-extended problem solving	CO3,C04 and CO5	1
2.4	Parallel coplanar forces – couple - resultant of parallel forces – centre of parallel forces – equilibrium of parallel forces – Simple beam subject to concentrated vertical loads.	CO1 and CO2	1
2.5	General coplanar force system - resultant and equilibrium equations - illustrative examples- teacher assisted problem solving.	CO and CO2	1
2.6	General coplanar force system-resultant and equilibrium equations - illustrative examples	CO3, CO4 and CO5	1
2.7	General coplanar force system - Extended problem solving - Quiz to evaluate learning level.	CO3, CO4 and CO5	1
3	**Module 3**		**Total: 7**
3.1	Centroid of simple and regular geometrical shapes – centroid of figures in combination - composite areas- examples for illustration – problems for practice to be done by self.	CO1 a nd CO2	1
3.2	Moment of inertia- parallel axis theorem –examples for illustration - problems for practice to be done by self.	CO1 a nd CO2	1
3.3	Moment of inertia - perpendicular axis theorem - example for illustration to be given as hand out and discussion on the solved example.	CO1 a nd CO2	1
3.4	Solutions to practice problems – problems related to centroid and moment of inertia - problems for practice to be done by self.	CO3, CO4 and CO5	1
3.5	Polar moment of inertia, Radius of gyration. Mass moment of inertia of ring, cylinder and uniform disc. Theorem of Pappus Guldinus - Demonstration	CO1 a nd CO2	1
3.6	Introduction to forces in space – vectorial representation of forces, moments and couples – simple problems to illustrate vector representations of forces, moments and couples to be done in class.	CO1,and CO2	1
3.7	Solution to practice problems - resultant and equilibrium equations for concurrent forces in space – concurrent forces in space - 2 simple problems to illustrate the application of resultant and equilibrium equations for concurrent forces in space.	CO3,CO4 and CO5	1
4	**Module 4**		**Total: 7**

4.1	Introduction to dynamics – review of rectilinear translation - equations of kinematics – problems to review the concepts – additional problems involving extended application as exercises .	CO1and CO2	1
4.2	Solutions to exercises with necessary explanation given as hand out – introduction to kinetics – equation of motion – D'Alembert's principle – illustration of the concepts using one numerical exercise from motion on horizontal and inclined surfaces.	CO1and CO2	1
4.3	Motion of connected bodies - example for illustration to be given as hand out and discussion on the solved example – problems for practice to be done by self.	CO3, CO4 and CO5	1
4.4	Motion of connected bodies-extended problem solving.	CO3, CO4 & CO5	1
4.5	Curvilinear translation - Review of kinematics –projectile motion – simple problems to review the concepts – introduction to kinetics – equation of motion – illustration of the concepts using numerical exercises.	CO3, CO4 & CO5	1
4.6	Extended problem solving – rectilinear and curvilinear translation.	CO3, CO4 & CO5	1
4.7	Concepts on Impulse momentum equation and work energy equation (rectilinear translation – discussions to bring out difference between elastic and inelastic collusions). Concepts on Moment of momentum and work energy equation (curvilinear translation).	CO1and CO2	1
5	**Module 5**		**Total: 7**
5.1	Rotation – kinematics of rotation- equation of motion for a rigid body rotating about a fixed axis – simple problems for illustration.	CO1and CO2	1
5.2	Rotation under a constant moment – teacher assisted problem solving.	CO3,CO4 and CO5	1
5.3	Rotation under a constant moment - extended problem solving.	CO3, CO4 and CO5	1
5.4	Plane motion of rigid body- instantaneous centre of rotation (concept only).	CO1and CO2	1

5.5	Introduction to harmonic oscillation –free vibrations - simple harmonic motion – differential equation and solution. Degree of freedom – examples of single degree of freedom (SDOF) systems – Idealisation of mechanical systems as spring-mass systems (concept only).	CO1and CO2	1
5.6	SDOF spring mass system –equation of motion – undamped free vibration response - concept of natural frequency. Free vibration response due to initial conditions. Simple problems on determination of natural frequency and free vibration response to test the understanding level.	CO1and CO2	1
5.7	Free vibration analysis of SDOF spring-mass systems – Problem solving Effect of damping on free vibration response (concept only).	CO1and CO2	1

22EST105	ENGINEERING GRAPHICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		ESC	2	0	2	3	2019

Preamble: To enable the student to effectively perform technical communication through graphical representation as per global standards.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Draw the projection of points and lines located in different quadrants
CO 2	Prepare multiview orthographic projections of objects by visualizing them in different Positions
CO 3	Draw sectional views and develop surfaces of a given object
CO 4	Prepare pictorial drawings using the principles of isometric and perspective projections to visualize objects in three dimensions.
CO 5	Convert 3D views to orthographic views
CO 6	Obtain multiview projections and solid models of objects using CAD tools

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3											
CO 2	3											
CO 3	3	1										
CO 4	3									1		
CO 5	3									2		
CO 6	3				3					3		

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (100 Marks)
	Test 1 (15 Marks)	Test 2 (15 Marks)	
Remember			
Understand	5		20
Apply	10	10	80
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

CIA for section A carries 25 marks (15 marks for 1 test and Class work 10 marks)

CIA for section B carries 15 marks (10 marks for 1 test and Class work 5 marks)

End Semester Examination Pattern:

ESE will be of 3 hour duration on A4 size answer booklet and will be for 100 marks. The question paper shall contain two questions from each module of Section A only. Student has to answer any one question from each module. Each question carries 20 marks.

Course Level Assessment Questions

(Questions may be framed based on the outline given under each course outcome)

Course Outcome 1 (CO1):

1. Locate points in different quadrants as per given conditions.
2. Problems on lines inclined to both planes .
3. Find True length, Inclinations and Traces of lines.

Course Outcome 2 (CO2)

1. Draw orthographic views of solids and combination solids
2. Draw views of solids inclined to any one reference plane.
3. Draw views of solids inclined to both reference planes.

Course Outcome 3 (CO3):

1. Draw views of solids sectioned by a cutting plane
2. Find location and inclination of cutting plane given true shape of the section
3. Draw development of lateral surface of solids and also its sectioned views

Course Outcome 4 (CO4):

1. Draw Isometric views/projections of soilds
2. Draw Isometric views/projections of combination of soilds
3. Draw Perspective views of Soilds

Course Outcome 5 (CO5):

1. Draw Orthographic views of solids from given three dimensional view

Course Outcome 6 (CO6):

1. Draw the given figure including dimensions using 2D software
2. Create 3D model using modelling software from the given orthographic views or 3D figure or from real 3D objects

Model Question paper

QP CODE: PAGES:3

Reg No:________________

Name :________________

Course Code: 22EST 105

ENGINEERING GRAPHICS

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

Instructions: Retain necessary Construction lines
Show necessary dimensions
Answer any ONE question from each module
Each question carries 20 marks

MODULE I

1. The end point A of a line is 20mm above HP and 10mm in front of VP. The other end of the line is 50mm above HP and 15mm behind VP. The distance between the end projectors is 70mm. Draw the projections of the line. Find the true length and true inclinations of the line with the principal planes. Also locate the traces of the line.
2. One end of a line is 20mm from both the principal planes of projection. The other end of the line is 50mm above HP and 40mm in front of VP. The true length of the line is 70mm. Draw the projections of the line. Find its apparent inclinations, elevation length and plan length. Also locate its traces.

MODULE II

3. A pentagonal pyramid of base side 25mm and height 40mm, is resting on the ground on one of its triangular faces. The base edge of that face is inclined 30^o to VP. Draw the projections of the solid.

4. A hexagonal prism has side 25mm and height 50mm has a corner of its base on the ground and the long edge containing that corner inclined at 30^{o} to HP and 45^{o} to VP. Draw the projections of the solid.

MODULE III

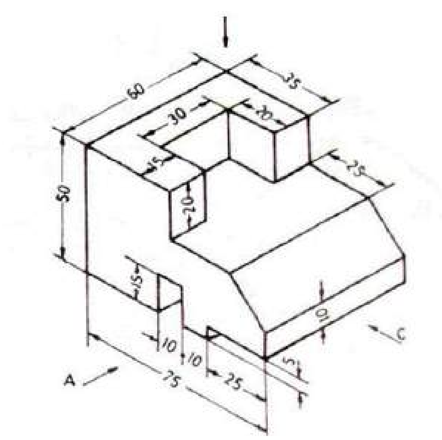
5. A triangular prism of base side 40mm and height 70mm is resting with its base on the ground and having an edge of the base perpendicular to VP. Section the solid such that the true shape of the section is a trapezium of parallel sides 30mm and 10mm. Draw the projections showing the true shape. Find the inclination of the cutting plane with the ground plane.
6. Draw the development of a pentagonal pyramid of base side 30mm and height 50mm. A string is wound from a corner of the base round the pyramid and back to the same point through the shortest distance. Show the position of the string in the elevation and plan.

MODULE IV

7. The frustum of a cone has base diameter 50mm and top diameter 40mm has a height of 60mm. It is paced centrally on top of a rectangular slab of size 80x60mm and of thickness 20mm. Draw the isometric view of the combination.
8. A hexagonal prism has base side 35mm and height 60mm. A sphere of diameter 40mm is placed centrally on top of it. Draw the isometric projection of the combination.

MODULE V

9. Draw the perspective view of a pentagonal prism, 20mm side and 45mm long lying on one of its rectangular faces on the ground and having its axis perpendicular to picture plane. One of its pentagonal faces touches the picture plane and the station point is 50mm in front of PP, 25mm above the ground plane and lies in a central plane, which is 70mm to the left of the center of the prism.
10. Draw three orthographic views with dimensions of the object shown in figure below.



(20X5=100)

Time : 3 hours **22EST105 ENGINEERING GRAPHICS** **Max. Marks: 100**

SCHEME OF VALUATION

1. Locating the points and drawing the projections of the line – 4 marks
   Finding true length by any one method – 6 marks
   Finding true inclination with VP – 2 marks
   Finding true inclination with HP – 2 marks
   Locating horizontal trace – 2 marks
   Locating vertical trace – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

2. Locating the points and drawing true length of the line – 4 marks
   Finding projections by any method – 6 marks
   Finding length of elevation and plan – 2 marks
   Finding apparent inclinations – 2 marks
   Locating horizontal trace – 2 marks
   Locating vertical trace – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

3. Drawing initial position plan and elevation – 4 marks
   First inclination views – 4 marks
   Second inclination views -8 marks
   Marking invisible edges – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

   (Any one method or combination of methods for solving can be used.
   If initial position is wrong then maximum 50% marks may be allotted for the answer)

4. Drawing initial position plan and elevation – 4 marks
   First inclination views – 4 marks
   Second inclination views -8 marks
   Marking invisible edges – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

   (Any one method or combination of methods for solving can be used

   If initial position is wrong then maximum 50% marks may be allotted for the answer)

5. Drawing initial position plan and elevation – 4 marks
   Locating section plane as per given condition – 5 marks
   Drawing true shape -5 marks
   Finding inclination of cutting plane – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

6. Drawing initial position plan and elevation – 4 marks
   Development of the pyramid – 6 marks

Locating string in development -2 marks
Locating string in elevation – 3 marks
Locating string in plan – 3 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

7. Drawing initial positions – 4 marks
   Isometric View of Slab -6 marks
   Isometric View of Frustum – 10 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

   (Initial position is optional, hence redistribute if needed.
   Reduce 4 marks if Isometric scale is taken)

8. Drawing initial positions – 4 marks
   Isometric scale – 4 marks
   Isometric projection of prism -5 marks
   Isometric projection of sphere – 5 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

   (Initial position is optional, hence redistribute if needed.

9. Drawing the planes and locating the station point – 4 marks
   Locating elevation points – 2 marks
   Locating plan points – 2 marks
   Drawing the perspective view – 10 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

10. Drawing the elevation – 8marks
    Drawing the plan – 4 marks
    Drawing the side view – 4 marks
    Marking invisible edges – 2 marks
    Dimensioning and neatness – 2 marks

    Total = 20 marks

SYLLABUS

General Instructions:

- First angle projection to be followed
- Section A practice problems to be performed on A4 size sheets
- Section B classes to be conducted on CAD lab

SECTION A

Module 1

Introduction : Relevance of technical drawing in engineering field. Types of lines, Dimensioning, BIS code of practice for technical drawing.
Orthographic projection of Points and Lines: Projection of points in different quadrants, Projection of straight lines inclined to one plane and inclined to both planes. Trace of line. Inclination of lines with reference planes True length of line inclined to both the reference planes.

Module 2

Orthographic projection of Solids: Projection of Simple solids such as Triangular, Rectangle, Square, Pentagonal and Hexagonal Prisms, Pyramids, Cone and Cylinder. Projection of solids in simple position including profile view. Projection of solids with axis inclined to one of the reference planes and with axis inclined to both reference planes.

Module 3

Sections of Solids: Sections of Prisms, Pyramids, Cone, Cylinder with axis in vertical position and cut by different section planes. True shape of the sections. Also locating the section plane when the true shape of the section is given.
Development of Surfaces: Development of surfaces of the above solids and solids cut by different section planes. Also finding the shortest distance between two points on the surface.

Module 4

Isometric Projection: Isometric View and Projections of Prisms, Pyramids, Cone , Cylinder, Frustum of Pyramid, Frustum of Cone, Sphere, Hemisphere and their combinations.

Module 5

Perspective Projection: Perspective projection of Prisms and Pyramids with axis perpendicular to the ground plane, axis perpendicular to picture plane.
Conversion of Pictorial Views: Conversion of pictorial views into orthographic views.

SECTION B

(To be conducted in CAD Lab)

Introduction to Computer Aided Drawing: Role of CAD in design and development of new products, Advantages of CAD. Creating two dimensional drawing with dimensions using suitable software. (Minimum 2 exercises mandatory)
Introduction to Solid Modelling: Creating 3D models of various components using suitable modelling software. (Minimum 2 exercises mandatory)

Text Books

1. Bhatt, N.D., Engineering Drawing, Charotar Publishing House Pvt. Ltd.
2. John, K.C. Engineering Graphics, Prentice Hall India Publishers.

Reference Books

1. Anilkumar, K.N., Engineering Graphics, Adhyuth narayan Publishers
2. Agrawal, B. And Agrawal, C.M., Engineering Darwing, Tata McGraw Hill Publishers.
3. Benjamin, J., Engineering Graphics, Pentex Publishers- 3rd Edition, 2017
4. Duff, J.M. and Ross, W.A., Engineering Design and Visualisation, Cengage Learning.
5. Kulkarni, D.M., Rastogi, A.P. and Sarkar, A.K., Engineering Graphics with AutoCAD, PHI.
6. Luzaddff, W.J. and Duff, J.M., Fundamentals of Engineering Drawing, PHI.
7. Varghese, P.I., Engineering Graphics, V I P Publishers
8. Venugopal, K., Engineering Drawing and Graphics, New Age International Publishers.

Course Contents and Lecture Schedule

No	**SECTION A**	No. of Hours
1	**MODULE I**	
1.1	Introduction to graphics, types of lines, Dimensioning	1
1.2	Concept of principle planes of projection, different quadrants, locating points on different quadrants	2
1.3	Projection of lines, inclined to one plane. Lines inclined to both planes, trapezoid method of solving problems on lines.	2
1.4	Problems on lines using trapezoid method	2
1.5	Line rotation method of solving, problems on line rotation method	2
2	**MODULE II**	
2.1	Introduction of different solids, Simple position plan and elevation of solids	2
2.2	Problems on views of solids inclined to one plane	2
2.3	Problems on views of solids inclined to both planes	2
2.4	Practice problems on solids inclined to both planes	2

3	**MODULE III**	
3.1	Introduction to section planes. AIP and AVP. Principle of locating cutting points and finding true shape	2
3.2	Problems on sections of different solids	2
3.3	Problems when the true shape is given	2
3.4	Principle of development of solids, sectioned solids	2
4	**MODULE IV**	
4.1	Principle of Isometric View and Projection, Isometric Scale. Problems on simple solids	2
4.2	Isometric problems on Frustum of solids, Sphere and Hemisphere	2
4.3	Problems on combination of different solids	2
5	**MODULE V**	
5.1	Introduction to perspective projection, different planes, station point etc. Perspective problems on pyramids	2
5.2	Perspective problems on prisms	2
5.3	Practice on conversion of pictorial views into orthographic views	2
	SECTION B (To be conducted in CAD lab)	
1	Introduction to CAD and software. Familiarising features of 2D software. Practice on making 2D drawings	2
2	Practice session on 2D drafting	2
3	Introduction to solid modelling and software	2
4	Practice session on 3D modelling	2

22EST 106	BASICS OF CIVIL & MECHANICAL ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	4	0	0	4	2019

Preamble:

Objective of this course is to provide an insight and inculcate the essentials of Civil Engineering discipline to the students of all branches of Engineering and to provide the students an illustration of the significance of the Civil Engineering Profession in satisfying the societal needs.

To introduce the students to the basic principles of mechanical engineering

Prerequisite: NIL

Course Outcomes: After completion of the course, the student will be able to

CO 1	Recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering.
CO 2	Explain different types of buildings, building components, building materials and building construction
CO 3	Describe the importance, objectives and principles of surveying.
CO 4	Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps
CO 5	Discuss the Materials, energy systems, water management and environment for green buildings.
CO 6	Analyse thermodynamic cycles and calculate its efficiency
CO 7	Illustrate the working and features of IC Engines
CO 8	Explain the basic principles of Refrigeration and Air Conditioning
CO 9	Describe the working of hydraulic machines
CO 10	Explain the working of power transmission elements
CO 11	Describe the basic manufacturing, metal joining and machining processes

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	3	2	2	-	-	-	-
CO2	3	2	-	1	3	-	-	3	-	-	-	-
CO3	3	2	-	-	3	-	-	-	2	-	-	-

CO4	3	2	-	-	3	-	-	-	2	-	-	-
CO5	3	2	-	-	3	2	3	-	2	-	-	-
CO6	3	2										
CO7	3	1										
CO8	3	1										
CO9	3	2										
CO10	3	1										
CO11	3											

Assessment Pattern

	Basic Civil Engineering			**Basic Mechanical Engineering**		
Bloom's Category	**Continuous Assessment**		**End Semester Examination (marks)**	**Continuous Assessment**		**End Semester Examination (marks)**
	Test 1 marks	**Test 2 marks**		**Test 1 marks**	**Test 2 marks**	
Remember	5	5	10	7.5	7.5	15
Understand	20	20	40	12.5	12.5	25
Apply				5	5	10
Analyse						
Evaluate						
Create						

Mark distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern:

There will be two parts; Part I – Basic Civil Engineering and Part II – Basic Mechanical Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts -

Part A and Part B. Part A contain 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module out of which one to be answered. Each question carries 10 mark and can have maximum 2 sub-divisions. The pattern for end semester examination for part II is same as that of part I. **However, student should answer both part I and part 2 in separate answer booklets.**

Course Level Assessment Questions:

Course Outcome CO1: *To recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering.*

1.Explain relevance of Civil engineering in the overall infrastructural development of the country.
Course outcome 2 (CO2) (One question from each module and not more than two)

Explain different types of buildings, building components, building materials and building construction

1. Discuss the difference between plinth area and carpet area.

Course outcome 3 (CO3) (One question from each module and not more than two)

Describe the importance, objectives and principles of surveying.

1. Explain the importance of surveying in Civil Engineering

Course outcome 4 (CO4) (One question from each module and not more than two)

Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps

1. Explain the civil engineering aspects of elevators, escalators and ramps in buildings

Course outcome 5 (CO5) (One question from each module and not more than two)

Discuss the Materials, energy systems, water management and environment for green buildings.

1. Discuss the relevance of Green building in society

Section II *Answer any 1 full question from each module. Each full question carries 10 marks*

Course Outcome 1 (CO1) (Two full question from each module and each question can have maximum 2 sub-divisions)

To recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering
CO Questions

1. a List out the types of building as per occupancy. Explain any two, each in about five sentences.
b. Discuss the components of a building with a neat figure.
2. a. What are the major disciplines of civil engineering and explain their role in the infrastructural framework.

b. Explain the role of NBC, KBR & CRZ norms in building rules and regulations prevailing in our country.

Course Outcome 2 (CO2) & Course Outcome 3 (CO3) (Two full question from each module and each question can have maximum 2 sub-divisions)

Explain different types of buildings, building components, building materials and building construction & Describe the importance, objectives and principles of surveying.

CO Questions

1. a. What are the different kinds of cement available and what is their use.
b. List the properties of good building bricks. Explain any five.
2. a. List and explain any five modern construction materials used for construction.
b. Explain the objectives and principles of surveying

Course outcome 4 (CO4) & Course outcome 5 (CO5) (Two full question from each module and each question can have maximum 2 sub-divisions)

Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps & Discuss the Materials, energy systems, water management and environment for green buildings.

CO Questions

1. a. Draw the elevation and plan of one brick thick wall with English bond
b. Explain the energy systems and water management in Green buildings

2. a. Draw neat sketch of the following foundations: (i) Isolated stepped footing; (ii) Cantilever footing; and (iii) Continuous footing.

b. Discuss the civil engineering aspect of MEP and HVAC in a commercial building

Course Outcome 6 (CO6):

1. In an air standard Otto cycle the compression ratio is 7 and compression begins at 35°C, 0.1 MPa. The maximum temperature of the cycle is 1100°C. Find
   i) Heat supplied per kg of air,
   ii) Work done per kg of air,
   iii) Cycle efficiency
   Take Cp = 1.005 kJ/kgK and Cv=0.718 kJ/kgK
2. A Carnot cycle works with adiabatic compression ratio of 5 and isothermal expansion ratio of 2. The volume of air at the beginning of isothermal expansion is 0.3 m^3. If the maximum temperature and pressure is limited to 550K and 21 bar, determine the minimum temperature in the cycle and efficiency of the cycle.
3. In an ideal diesel cycle, the temperature at the beginning and end of compression is 65°C and 620°C respectively. The temperature at the beginning and end of the expansion is 1850°C and 850 °C. Determine the ideal efficiency of the cycle.

4. Explain the concepts of CRDI and MPFI in IC Engines.

Course Outcome 7 (CO7)

1. With the help of a neat sketch explain the working of a 4 stroke SI engine
2. Compare the working of 2 stroke and 4 stroke IC engines
3. Explain the classification of IC Engines.

Course Outcome 8(CO8):

1. Explain the working of vapour compression refrigeration system.
2. With the help of suitable sketch explain the working of a split air conditioner.
3. Define: COP, specific humidity, relative humidity and dew point temperature.

Course Outcome 9 (CO9):

1. Explain the working of a single stage centrifugal pump with sketches.
2. With the help of a neat sketch, explain the working of a reciprocating pump.
3. A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 m^3/s. If the overall efficiency of the turbine is 90%. Determine the power developed by the turbine.

Course Outcome 10 (CO10):

1. Explain the working of belt drive and gear drive with the help of neat sketches
2. Explain a single plate clutch.
3. Sketch different types of gear trains and explain.

Course Outcome 11 (CO11):

1. Describe the operations which can be performed using drilling machine.
2. Explain the functions of runners and risers used in casting.
3. With a neat sketch, explain the working and parts of a lathe.

Model Question Paper

QP CODE: **EST106** page:3

Reg No:____________________

Name:_______________________________

Course Code:22 EST 106

Course Name: BASICS OF CIVIL AND MECHANICAL ENGINEERING

Max. Marks: 100 Duration: 3 hours

Answer both part I and part 2 in separate answer booklets

PART I: BASIC CIVIL ENGINEERING

PART A

(Answer all questions. Each question carries 4 marks)

1. Explain relevance of Civil engineering in the overall infrastructural development of the country.
2. Discuss the difference between plinth area and carpet area.
3. Explain different types of steel with their properties.
4. What are the different kinds of cement available and what is their use?
5. Define bearing capacity of soil.

(5 x 4 = 20)

Part B

Answer one full question from each module.

MODULE I

6a. List out the types of building as per occupancy. Explain any two, each in about five sentences. (5)

b. Discuss the components of a building with a neat figure. (5)

OR

7a. What are the major disciplines of civil engineering and explain their role in the infrastructural framework. (5)

b. Explain the role of NBC, KBR & CRZ norms in building rules and regulations prevailing in our country. (5)

MODULE II

8a. What are the different kinds of cement available and what is their use. (5)

b. List the properties of good building bricks. Explain any five. (5)

OR

9a. List and explain any five modern construction materials used for construction. (5)

b. Explain the objectives and principles of surveying (5)

MODULE III

10a. Draw the elevation and plan of one brick thick wall with English bond (5)

b. Explain the energy systems and water management in Green buildings (5)

OR

11a. Draw neat sketch of the following foundations: (i) Isolated stepped footing; (ii) Cantilever footing; and (iii) Continuous footing. (5)

b. Discuss the civil engineering aspect of MEP and HVAC in a commercial building (5)

[10 x 3 = 30]

PART II: BASIC MECHANICAL ENGINEERING

PART A

Answer all questions. Each question carries 4 marks

1. Sketch the P-v and T-s diagram of a Carnot cycle and List the processes.
2. Illustrate the working of an epicyclic gear train.
3. Explain cooling and dehumidification processes.
4. Differentiate between soldering and brazing.
5. Explain the principle of Additive manufacturing.

4 x 5 = 20 marks

Part B

Answer one full question from each module.

MODULE I

6. In an air standard Otto cycle the compression ratio is 7 and compression begins at 35^{o}C, 0.1MPa. The maximum temperature of the cycle is 1100^{o}C. Find
   i) Heat supplied per kg of air,
   ii) Work done per kg of air,
   iii)Cycle efficiency
   Take C_p = 1.005 kJ/kgK and C_v=0.718 kJ/kgK 10 marks

OR

7. a) Explain the working of a 4 stroke SI engine with neat sketches. 7 marks
   b) Explain the fuel system of a petrol engine. 3 marks

MODULE II

8. a) Explain the working of a vapour compression system with help of a block diagram. 7 marks
   b) Define: Specific humidity, relative humidity and dew point temperature. 3 marks

OR

9. With the help of a neat sketch, explain the working of a centrifugal pump. 10 marks

MODULE III

10. Explain the two high, three high, four high and cluster rolling mills with neat sketches. 10 marks

OR

11. a) Describe the arc welding process with a neat sketch. 6 marks
    b) Differentiate between up-milling and down-milling operations. 4 marks

SYLLABUS

Module 1

General Introduction to Civil Engineering: Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment. Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.

Introduction to buildings: Types of buildings, selection of site for buildings, components of a residential building and their functions.

Building rules and regulations: Relevance of NBC, KBR & CRZ norms (brief discussion only).

Building area: Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.

Module 2

Surveying: Importance, objectives and principles.

Construction materials, Conventional construction materials**:** types, properties and uses of building materials: bricks, stones, cement, sand and timber

Cement concrete: Constituent materials, properties and types.

Steel: Steel sections and steel reinforcements, types and uses.

Modern construction materials:- Architectural glass, ceramics, Plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials. Modern uses of gypsum, pre-fabricated building components (brief discussion only).

Module 3

Building Construction: Foundations: Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only). Load bearing and framed structures (concept only).

Brick masonry: - Header and stretcher bond, English bond & Flemish bond random rubble masonry.

Roofs and floors: - Functions, types; flooring materials (brief discussion only).

Basic infrastructure services: MEP, HVAC, elevators, escalators and ramps (Civil Engineering aspects only), fire safety for buildings.

Green buildings:- Materials, energy systems, water management and environment for green buildings. (brief discussion only).

Module 4

Analysis of thermodynamic cycles: Carnot, Otto, Diesel cycles, Derivation of efficiency of these cycles, Problems to calculate heat added, heat rejected, net work and efficiency. IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines. Efficiencies of IC Engines(Definitions only), Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines.

Module 5

Refrigeration: Unit of refrigeration, reversed Carnot cycle,COP, vapour compression cycle (only description and no problems); Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners.
Description about working with sketches of: Reciprocating pump, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan turbine. Overall efficiency, Problems on calculation of input and output power of pumps and turbines (No velocity triangles)
Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches.

Module 6

Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications.
Metal Joining Processes: List types of welding, Description with sketches of Arc Welding, Soldering and Brazing and their applications
Basic Machining operations: Turning, Drilling, Milling and Grinding.
Description about working with block diagram of: Lathe, Drilling machine, Milling machine, CNC Machine. Principle of CAD/CAM, Rapid and Additive manufacturing.

Text Books:

1. Rangwala, S. C., Essentials of Civil Engineering, Charotar Publishing House
2. Mckay, W.B. and Mckay, J. K., Building Construction, Volumes 1 to 4, Pearson India Education Services

References Books:

1. Chen W.F and Liew J Y R (Eds), The Civil Engineering Handbook. II Edition CRC Press (Taylor and Francis)
2. Chudley, R and Greeno R, Building construction handbook, Addison Wesley, Longman group, England
3. Chudley, R, Construction Technology, Vol. I to IV, Longman group, England Course Plan
4. Kandya A A, Elements of Civil Engineering, Charotar Publishing house
5. Mamlouk, M. S., and Zaniewski, J. P., Materials for Civil and Construction Engineering, Pearson Publishers
6. Rangwala S.C and Dalal K B Building Construction Charotar Publishing house
7. Clifford, M., Simmons, K. and Shipway, P., An Introduction to Mechanical Engineering Part I - CRC Press
8. Roy and Choudhary, Elements of Mechanical Engineering, Media Promoters &Publishers Pvt. Ltd., Mumbai.
9. Sawhney, G. S., Fundamentals of Mechanical Engineering, PHI
10. G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018
11. Benjamin,J.,Basic Mechanical Engineering,Pentex Books,9th Edition,2018
12. Balachandran, P.Basic Mechanical Engineering,Owl Books

Course Contents and Lecture Schedule:

No	Topic	Course outcomes addressed	No. of Lectures
1	**Module I**		**Total: 7**
1.1	*General Introduction to Civil Engineering*: Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment.	CO1	1
1.2	Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.	CO1	2
1.3	*Introduction to buildings:* Types of buildings, selection of site for buildings, components of a residential building and their functions.	CO2	2
1.4	*Building rules and regulations:* Relevance of NBC, KBR & CRZ norms (brief discussion only)	CO2	1
1.5	*Building area:* Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.	CO2	1
2	**Module 2**		**Total: 7**
2.1	*Surveying:* Importance, objectives and principles.	CO3	1
2.2	Bricks: - Classification, properties of good bricks, and tests on Bricks	CO2	1
2.3	Stones: - *Qualities* of good stones, types of stones and their uses. Cement: - Good qualities of cement, types of cement and their uses.	CO2	1
2.4	Sand: - Classification, qualities of good sand and sieve analysis (basics only). Timber: - Characteristics, properties and uses.	CO2	1
2.5	Cement concrete: - Constituent materials, properties and types, Steel: - Steel sections and steel reinforcements, types and uses.	CO2	1

2.6	Modern construction materials: - Architectural glass, ceramics, plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials, modern uses of gypsum, pre-fabricated building components (brief discussion only)	CO2	2
3	**Module 3**		**Total: 7**
3.1	Foundations: - Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only). Brick masonry: - Header and stretcher bond, English bond & Flemish bond– elevation and plan (one & one and a half brick wall only). Random rubble masonry.	CO2	2
3.2	Roofs: Functions, types; roofing materials (brief discussion only) Floors: Functions, types; flooring materials (brief discussion only)	CO2	2
3.3	*Basic infrastructure services:* MEP, HVAC, Elevators, escalators and ramps (Civil Engineering aspects only) fire safety for buildings	CO4	2
3.4	*Green buildings:*- Materials, energy systems, water management and environment for green buildings. (brief discussion only)	CO5	1
4	**MODULE 4**		
4.1	Analysis of thermodynamic cycles: Carnot, Otto, and Diesel cycle- Derivation of efficiency of these cycles, Problems to calculate heat added, heat rejected, net work and efficiency	4	
4.2	IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines, efficiencies of IC Engines(Description only)	2	
4.3	Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines	2	
5	**MODULE 5**		
5.1	Refrigeration: Unit of refrigeration, reversed Carnot cycle, COP, vapour compression cycle (only description and no problems)	1	
5.2	Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners.	1	

5.3	Description about working with sketches : Reciprocating pump, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan turbine. Overall efficiency, Problems on calculation of input and output power of pumps and turbines (No velocity triangles)	4
5.4	Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches	3
6	**MODULE 6**	
6.1	Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications.	2
6.2	Metal Joining Processes :List types of welding, Description with sketches of Arc Welding, Soldering and Brazing, and their applications	1
6.3	Basic Machining operations: Turning, Drilling, Milling and Grinding Description about working with block diagrams of: Lathe, Drilling machine, Milling machine, CNC Machine	3
6.4	Principle of CAD/CAM, Rapid and Additive manufacturing	1

22E ST 107	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	4	0	0	4	2019

Preamble:

This course aims to (1) equip the students with an understanding of the fundamental principles of electrical engineering(2) provide an overview of evolution of electronics, and introduce the working principle and examples of fundamental electronic devices and circuits (3) provide an overview of evolution of communication systems, and introduce the basic concepts in radio communication.

Prerequisite: Physics and Mathematics (Pre-university level)

Course Outcomes: After the completion of the course the student will be able to

CO 1	Apply fundamental concepts and circuit laws to solve simple DC electric circuits
CO 2	Develop and solve models of magnetic circuits
CO 3	Apply the fundamental laws of electrical engineering to solve simple ac circuits in steady State
CO 4	Describe working of a voltage amplifier
CO 5	Outline the principle of an electronic instrumentation system
CO 6	Explain the principle of radio and cellular communication

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	-	-	-	-	-	-	-	-	-	2
CO 2	3	1	-	-	-	-	-	-	-	-	-	2
CO 3	3	1	-	-	-	-	-	-	-	-	-	2
CO 4	2	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	2
CO 6	2	-	-	-	-	-	-	-	-	-	-	2

Assessment Pattern

	Basic Electrical Engineering			Basic Electronics Engineering		
Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (Marks)**	**Continuous Assessment Tests**		**End Semester Examination (Marks)**
	Test 1 (Marks)	**Test 2 (Marks)**		**Test 1 (Marks)**	**Test 2 (Marks)**	
Remember	0	0	10	10	10	20
Understand	12.5	12.5	20	15	15	30
Apply	12.5	12.5	20			
Analyse						
Evaluate						
Create						

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part I – Basic Electrical Engineering and Part II – Basic Electronics Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts - Part A and Part B. Part A contain 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module out of which one to be answered. Each question carries 10 mark and can have maximum 2 sub-divisions. The pattern for end semester examination for part II is same as that of part I. **However, student should answer both part I and part 2 in separate answer booklets.**

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Solve problems based on current division rule.

2. Solve problems with Mesh/node analysis.

3. Solve problems on Wye-Delta Transformation.

Course Outcome 2 (CO2):

1. Problems on series magnetic circuits

2. Problems on parallel magnetic circuits

3. Problems on composite magnetic ciruits

4. **Course Outcome 3 (CO3):**

1. problems on self inductance, mutual inductance and coefficient of coupling

2. problems on rms and average values of periodic waveforms

3. problems on series ac circuits

4. Compare star and Delta connected 3 phase AC systems.

Course Outcome 4 (CO4): Describe working of a voltage amplifier

1. What is the need of voltage divider biasing in an RC coupled amplifier?

2. Define operating point in the context of a BJT amplifier.

3. Why is it required to have a voltage amplifier in a public address system?

Course Outcome 5 (CO5): Outline the principle of an electronic instrumentation system

1. Draw the block diagram of an electronic instrumentation system.

2. What is a transducer?

3. Explain the working principle of operation of digital multimeter.

Course Outcome 6 (CO6): Explain the principle of radio and cellular communication

1. What is the working principle of an antenna when used in a radio transmitter?

2. What is the need of two separate sections RF section and IF section in a super heterodyne receiver?

3. What is meant by a cell in a cellular communication?

Model Question Paper

QP CODE: Pages: 3

Reg No.:_________________

Name:___________________

Course Code:22 EST 107

Course Name: BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

Max. Marks: 100 Duration: 3 hours

Answer both part I and part 2 in separate answer booklets

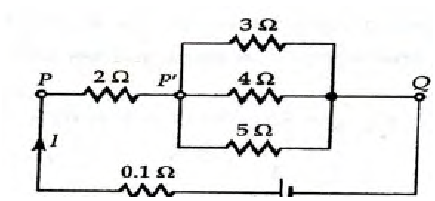
PART I

BASIC ELECTRICAL ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Calculate the current through the 4Ω resistor in the circuit shown, applying current division rule:



2. Calculate the RMS and average values of a purely sinusoidal current having peak value 15A.

3. An alternating voltage of (80+j60)V is applied to an RX circuit and the current flowing through the circuit is (-4+j10)A. Calculate the impedance of the circuit in rectangular and polar forms. Also determine if X is inductive or capacitive. (6 marks)

4. Derive the relation between line and phase values of voltage in a three phase star connected system.

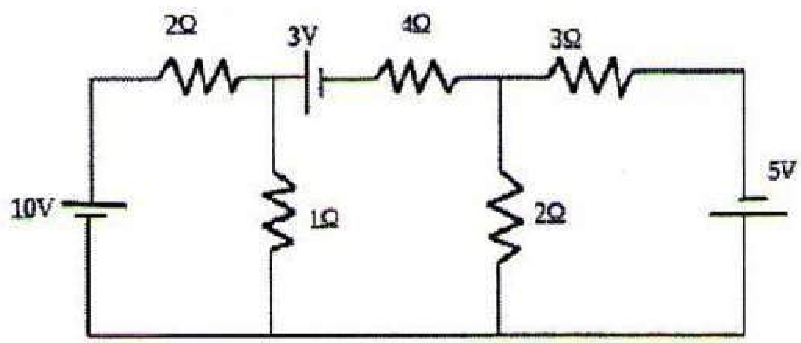
5. Compare electric and magnetic circuits. *(5x4=20)*

PART B

Answer one question from each module; each question carries 10 marks.

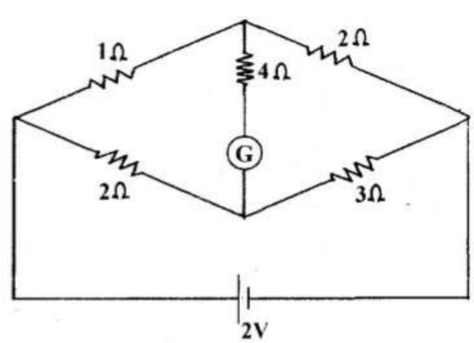
Module 1

6. . Calculate the node voltages in the circuit shown, applying node analysis:



7. (a) State and explain Kirchhoff's laws. (4 marks)

(b) Calculate the current through the galvanometer (G) in the circuit shown:



Module 2

8. (a) State and explain Faraday's laws of electromagnetic induction with examples. (4 marks)

(b) Differentiate between statically and dynamically induced emf. A conductor of length 0.5m moves in a uniform magnetic field of flux density 1.1T at a velocity of 30m/s. Calculate the emf induced in the conductor if the direction of motion of the conductor is inclined at 60^0 to the direction of field. (6 marks)

9. (a) Derive the amplitude factor and form factor of a purely sinusoidal waveform. (5 marks)

(b) A current wave is made up of two components-a 5A dc component and a 50Hz ac component, which is a sinusoidal wave with a peak value of 5A. Sketch the resultant waveform and determine its RMS and average values. (5 marks)

Module 3

10. Draw the power triangle and define active, reactive and apparent powers in ac circuits. Two coils A and B are connected in series across a 240V, 50Hz supply. The resistance of A is 5Ω and the inductance of B is 0.015H. If the input from the supply is 3kW and 2kVAR, find the inductance of A and the resistance of B. Also calculate the voltage across each coil.

11. A balanced three phase load consists of three coils each having resistance of 4Ω and inductance 0.02H. It is connected to a 415V, 50Hz, 3-phase ac supply. Determine the phase voltage, phase current, power factor and active power when the loads are connected in (i) star (ii) delta.

(3x10=30)

PART II

BASIC ELECTRONICS ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Give the specifications of a resistor. The colour bands marked on a resistor are Blue, Grey, Yellow and Gold. What are the minimum and maximum resistance values expected from that resistance?
2. What is meant by avalanche breakdown?
3. Explain the working of a full-wave bridge rectifier.
4. Discuss the role of coupling and bypass capacitors in a single stage RC coupled amplifier.
5. Differentiate AM and FM communication systems.

(5x4=20)

PART B

Answer one question from each module; each question carries 10 marks.

Module 4

6. a) Explain with diagram the principle of operation of an NPN transistor. (5)
   b) Sketch and explain the typical input-output characteristics of a BJT when connected in common emitter configuration. (5)

OR

7. a) Explain the formation of a potential barrier in a P-N junction diode. (5)
   b) What do you understand by Avalanche breakdown? Draw and explain the V-I characteristics of a P-N junction and Zener diode. (5)

Module 5

8. a) With a neat circuit diagram, explain the working of an RC coupled amplifier. (6)
   b) Draw the frequency response characteristics of an RC coupled amplifier and state the reasons for the reduction of gain at lower and higher frequencies. (4)

OR

9. a) With the help of block diagram, explain how an electronic instrumentation system. (6)
   b) Explain the principle of an antenna. (4)

Module 6

10. a) With the help of a block diagram, explain the working of Super hetrodyne receiver. (6)
    b) Explain the importance of antenna in a communication system. (4)

OR

11. a) With neat sketches explain a cellular communication system. (5)
    b) Explain GSM communication with the help of a block diagram. (5)

(3x10=30)

SYLLABUS

MODULE 1: Elementary Concepts of Electric Circuits

Elementary concepts of DC electric circuits: Basic Terminology including voltage, current, power, resistance, emf; Resistances in series and parallel; Current and Voltage Division Rules; Capacitors & Inductors: V-I relations and energy stored. Ohms Law and Kirchhoff's laws-Problems; Star-delta conversion (resistive networks only-derivation not required)-problems.

Analysis of DC electric circuits: Mesh current method - Matrix representation - Solution of network equations. Node voltage methods-matrix representation-solution of network equations by matrix methods. Numerical problems.

MODULE 2: Elementary Concepts of Magnetic circuits, Electromagnetic Induction and AC fundamentals

Magnetic Circuits: Basic Terminology: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits- Series and parallel magnetic circuits with composite materials, numerical problems.

Electromagnetic Induction: Faraday's laws, problems, Lenz's law- statically induced and dynamically induced emfs - Self-inductance and mutual inductance, coefficient of coupling

Alternating Current fundamentals: Generation of alternating voltages-Representation of sinusoidal waveforms: frequency, period, Average, RMS values and form factor of waveforms-Numerical Problems.

MODULE 3: AC Circuits

AC Circuits: Phasor representation of sinusoidal quantities. Trignometric, Rectangular, Polar and complex forms. Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power Power factor. Analysis of RL, RC and RLC series circuits-active, reactive and apparent power. Simple numerical problems.

Three phase AC systems: Generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- Numerical problems

MODULE 4

Introduction to Semiconductor devices: Evolution of electronics – Vacuum tubes to nano electronics. Resistors, Capacitors and Inductors (constructional features not required): types, specifications. Standard values, color coding. PN Junction diode: Principle of operation, V-I characteristics, principle of avalanche breakdown. Bipolar Junction Transistors: PNP and NPN structures, Principle of operation, relation between current gains in CE, CB and CC, input and output characteristics of common emitter configuration.

MODULE 5

Basic electronic circuits and instrumentation: Rectifiers and power supplies: Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

MODULE 6

Introduction to Communication Systems: Evolution of communication systems – Telegraphy to 5G. Radio communication: principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver, Principle of antenna – radiation from accelerated charge. Mobile communication: basic principles of cellular communications, principle and block diagram of GSM.

Text Books

1. D P Kothari and I J Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. D C Kulshreshtha, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
3. ChinmoySaha, Arindham Halder and Debarati Ganguly, Basic Electronics - Principles and Applications, Cambridge University Press, 2018.
4. M.S.Sukhija and T.K.Nagsarkar, Basic Electrical and Electronics Engineering, Oxford University Press, 2012.
5. Wayne Tomasi and Neil Storey, A Textbook On Basic Communication and Information Engineering, Pearson, 2010.

Reference Books

1. Del Toro V, “Electrical Engineering Fundamentals”, Pearson Education.
2. T. K. Nagsarkar, M. S. Sukhija, “Basic Electrical Engineering”, Oxford Higher Education.
3. Hayt W H, Kemmerly J E, and Durbin S M, “Engineering Circuit Analysis”, Tata McGraw-Hill
4. Hughes, “Electrical and Electronic Technology”, Pearson Education.
5. V. N. Mittle and Arvind Mittal, “Basic Electrical Engineering,” Second Edition, McGraw Hill.
6. Parker and Smith, “Problems in Electrical Engineering”, CBS Publishers and Distributors.
7. S. B. Lal Seksena and Kaustuv Dasgupta, “Fundamentals of Electrical Engineering”, Cambridge University Press.
8. Anant Agarwal, Jeffrey Lang, Foundations of Analog and Digital Electronic Circuits, Morgan Kaufmann Publishers, 2005.
9. Bernard Grob, Ba sic Electronics, McGraw Hill.
10. A. Bruce Carlson, Paul B. Crilly, Communication Systems: An Introduction to Signals and Noise in Electrical Communication, Tata McGraw Hill, 5th Edition.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lectures
1	***Elementary Concepts of Electric Circuits***	
1.1	**Elementary concepts of DC electric circuits:** Basic Terminology including voltage, current, power, resistance, emf; Resistances in series and parallel; Current and Voltage Division Rules; Capacitors & Inductors: V-I relations and energy stored. Ohms Law and Kirchhoff's laws-Problems; Star-delta conversion (resistive networks only-derivation not required)-problems.	1 2 1
1.2	**Analysis of DC electric circuits:** Mesh current method - Matrix representation - Solution of network equations. Node voltage methods-matrix representation-solution of network equations by matrix methods. Numerical problems.	1 1 2
2	**Elementary Concepts of Magnetic circuits, Electromagnetic Induction and AC fundamentals**	
2.1	**Magnetic Circuits:** Basic Terminology: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits- Series and parallel magnetic circuits with composite materials, numerical problems.	1 2
2.2	**Electromagnetic Induction:** Faraday's laws, problems, Lenz's law-statically induced and dynamically induced emfs - Self-inductance and mutual inductance, coefficient of coupling	1 2
2.3	**Alternating Current fundamentals:** Generation of alternating voltages-Representation of sinusoidal waveforms: frequency, period, Average, RMS values and form factor of waveforms-Numerical Problems.	2
3	**AC Circuits**	

3.1	**AC Circuits:** Phasor representation of sinusoidal quantities. Trigonometric, Rectangular, Polar and complex forms. Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power, Power factor. Analysis of RL, RC and RLC series circuits-active, reactive and apparent power. Simple numerical problems.	1 2 1 2
3.2	**Three phase AC systems:** Generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- Numerical problems.	2
4	**Introduction to Semiconductor devices**	
4.1	Evolution of electronics – Vacuum tubes to nano electronics (In evolutional perspective only)	1
4.2	Resistors, Capacitors and Inductors: types, specifications. Standard values, color coding (No constructional features)	2
4.3	**PN Junction diode**: Principle of operation, V-I characteristics, principle of avalanche breakdown	2
4.4	**Bipolar Junction Transistors:** PNP and NPN structures, Principle of operation, relation between current gains in CE, CB and CC, input and output characteristics of common emitter configuration	3
5	**Basic electronic circuits and instrumentation**	
5.1	**Rectifiers and power supplies:** Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator	3
5.2	**Amplifiers:** Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing	4
5.3	**Electronic Instrumentation:** Block diagram of an electronic instrumentation system	2
6	**Introduction to Communication Systems**	
6.1	Evolution of communication systems – Telegraphy to 5G	1

6.2	**Radio communication:** principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver, Principle of antenna – radiation from accelerated charge	4
6.3	**Mobile communication:** basic principles of cellular communications, principle and block diagram of GSM.	2

Suggested Simulation Assignments for Basic Electronics Engineering

1. Plot V-I characteristics of Si and Ge diodes on a simulator
2. Plot Input and Output characteristics of BJT on a simulator
3. Implementation of half wave and full wave rectifiers
4. Simulation of RC coupled amplifier with the design supplied
5. Generation of AM signal

Note: The simulations can be done on open tools such as QUCS, KiCad, GNURadio or similar software to augment the understanding.

		CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
22MNC 108	**LIFE SKILLS**	MNC	2	0	2	---	**2019**

Preamble: Life skills are those competencies that provide the means for an individual to be resourceful and positive while taking on life's vicissitudes. Development of one's personality by being aware of the self, connecting with others, reflecting on the abstract and the concrete, leading and generating change, and staying rooted in time-tested values and principles is being aimed at. This course is designed to enhance the employability and maximize the potential of the students by introducing them to the principles that underly personal and professional success, and help them acquire the skills needed to apply these principles in their lives and careers.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to

CO 1	Define and Identify different life skills required in personal and professional life
CO 2	Develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.
CO 3	Explain the basic mechanics of effective communication and demonstrate these through presentations.
CO 4	Take part in group discussions
CO 5	Use appropriate thinking and problem solving techniques to solve new problems
CO 6	Understand the basics of teamwork and leadership

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2		1	2	2	1	3
CO 2									3			2
CO 3						1			1	3		
CO 4										3		1
CO 5		3	2	1								
CO 6						1			3			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	50	50	2 hours

Continuous Internal Evaluation
Total Marks: 50

Attendance	: 10 marks
Regular assessment	: 15 marks
Series test (one test only, should include first three modules)	: 25 marks

Regular assessment

➢ Group Discussion (Marks: 9)

Create groups of about 6 students each and engage them on a GD on a suitable topic for about 20 minutes. Parameters to be used for evaluation are as follows:

- Communication Skills : 3 marks
- Subject Clarity : 2 marks
- Group Dynamics : 2 marks
- Behaviours & Mannerisms : 2 marks

➢ Presentation Skills (Marks: 6)

Identify a suitable topic and ask the students to prepare a presentation (preferably a power point presentation) for about 10 minutes. Parameters to be used for evaluation are as follows:

- Communication Skills : 2 marks
- Platform Skills : 2 marks
- Subject Clarity/Knowledge : 2 marks

End Semester Examination
Total Marks: 50 **Time: 2 hrs.**

Part A: Short answer question (25 marks)
There will be one question from each MODULE (five questions in total, five marks each). Each question should be written in about maximum of 400 words. Parameters to be used for evaluation are as follows:
(i) Content Clarity/Subject Knowledge
(ii) Presentation style
(iii) Organization of content

Part B: Case Study (25 marks)
The students will be given a case study with questions at the end. The students have to analyze the case and answer the question at the end. Parameters to be used for evaluation are as follows:
(i) Analyze the case situation
(ii) Key players/characters of the case
(iii) Identification of the problem (both major & minor if exists)
(iv) Bring out alternatives
(v) Analyze each alternative against the problem
(vi) Choose the best alternative
(vii) Implement as solution
(viii) Conclusion

(ix) Answer the question at the end of the case

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. List 'life skills' as identified by WHO
2. What do you mean by effective communication?
3. What are the essential life skills required by a professional?

Course Outcome 2 (CO2)

1. Identify an effective means to deal with workplace stress.
2. How can a student apply journaling to stress management?
3. What is the PATH method? Describe a situation where this method can be used effectively.

Course Outcome 3(CO3):

1. Identify the communication network structure that can be observed in the given situations. Describe them.

   (a) A group discussion on development.

   (b) An address from the Principal regarding punctuality.

   (c) A reporter interviewing a movie star.

   (d) Discussing the answers of a test with a group of friends.

2. Elucidate the importance of non-verbal communication in making a presentation
3. Differentiate between kinesics, proxemics, and chronemics with examples.

Course Outcome 4 (CO4):

1. How can a participant conclude a group discussion effectively?
2. 'Listening skills are essential for effectively participating in a group discussion.' Do you agree? Substantiate your answer.

Course Outcome 5 (CO5):

1. Illustrate the creative thinking process with the help of a suitable example
2. Translate the following problem from verbal to graphic form and find the solution : *In a quiz, Ananth has 50 points more than Bimal, Chinmay has 60 points less than Ananth, and Dharini is 20 points ahead of Chinmay. What is the difference in points between Bimal and Dharini?*

3. List at least five ways in which the problem "How to increase profit?" can be redefined

Course Outcome 6 (CO6):

1. A group of engineers decided to brainstorm a design issue on a new product. Since no one wanted to disagree with the senior members, new ideas were not flowing freely. What group dynamics technique would you suggest to avoid this 'groupthink'? Explain the procedure.
2. "A group focuses on individual contribution, while a team must focus on synergy." Explain.
3. Identify the type of group formed / constituted in each of the given situations

    a) A Police Inspector with subordinates reporting to him

    b) An enquiry committee constituted to investigate a specific incident

    c) The Accounts Department of a company

    d) A group of book lovers who meet to talk about reading

Syllabus

Module 1

Overview of Life Skills: Meaning and significance of life skills, Life skills identified by WHO: Self-awareness, Empathy, Critical thinking, Creative thinking, Decision making, problem solving, Effective communication, interpersonal relationship, coping with stress, coping with emotion.

Life skills for professionals: positive thinking, right attitude, attention to detail, having the big picture, learning skills, research skills, perseverance, setting goals and achieving them, helping others, leadership, motivation, self-motivation, and motivating others, personality development, IQ, EQ, and SQ

Module 2

Self-awareness: definition, need for self-awareness; Coping With Stress and Emotions, Human Values, tools and techniques of SA: questionnaires, journaling, reflective questions, meditation, mindfulness, psychometric tests, feedback.

Stress Management: Stress, reasons and effects, identifying stress, stress diaries, the four A's of stress management, techniques, Approaches: action-oriented, emotion-oriented, acceptance-oriented, resilience, Gratitude Training,

Coping with emotions: Identifying and managing emotions, harmful ways of dealing with emotions, PATH method and relaxation techniques.

Morals, Values and Ethics: Integrity, Civic Virtue, Respect for Others, Living Peacefully. Caring, Sharing, Honesty, Courage, Valuing Time, Time management, Co operation, Commitment, Empathy, Self-Confidence, Character, Spirituality, Avoiding Procrastination, Sense of Engineering Ethics.

Module 3

21st century skills: Creativity, Critical Thinking, Collaboration, Problem Solving, Decision Making, Need for Creativity in the 21st century, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity, Critical thinking Vs Creative thinking, Functions of Left Brain & Right brain, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence.

Steps in problem solving: Problem Solving Techniques, Six Thinking Hats, Mind Mapping, Forced Connections. Analytical Thinking, Numeric, symbolic, and graphic reasoning. Scientific temperament and Logical thinking.

Module 4

Group and Team Dynamics: Introduction to Groups: Composition, formation, Cycle, thinking, Clarifying expectations, Problem Solving, Consensus, Dynamics techniques, Group vs Team, Team Dynamics, Virtual Teams. Managing team performance and managing conflicts, Intrapreneurship.

Module 5

Leadership: Leadership framework, entrepreneurial and moral leadership, vision, cultural dimensions. Growing as a leader, turnaround leadership, managing diverse stakeholders, crisis management. Types of Leadership, Traits, Styles, VUCA Leadership, Levels of Leadership, Transactional vs Transformational Leaders, Leadership Grid, Effective Leaders.

Lab Activities

Verbal

Effective communication and Presentation skills.
Different kinds of communication; Flow of communication; Communication networks, Types of barriers; Miscommunication
Introduction to presentations and group discussions.
Learning styles: visual, aural, verbal, kinaesthetic, logical, social, solitary; Previewing, KWL table, active listening, REAP method
Note-taking skills: outlining, non-linear note-taking methods, Cornell notes, three column note taking.
Memory techniques: mnemonics, association, flashcards, keywords, outlines, spider diagrams and mind maps, spaced repetition.
Time management: auditing, identifying time wasters, managing distractions, calendars and checklists; Prioritizing - Goal setting, SMART goals; Productivity tools and apps, Pomodoro technique.

Non Verbal:
Non-verbal Communication and Body Language: Forms of non-verbal communication; Interpreting body-language cues; Kinesics; Proxemics; Chronemics; Effective use of body language, Communication in a multi cultural environment.

Reference Books

1. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
2. Barun K. Mitra, “Personality Development & Soft Skills”, Oxford Publishers, Third impression, 2017.
3. ICT Academy of Kerala, "Life Skills for Engineers", McGraw Hill Education (India) Private Ltd., 2016.
4. Caruso, D. R. and Salovey P, “The Emotionally Intelligent Manager: How to Develop and Use the Four Key Emotional Skills of Leadership”, John Wiley & Sons, 2004.
5. Kalyana, “Soft Skill for Managers”; First Edition; Wiley Publishing Ltd, 2015.
6. Larry James, “The First Book of Life Skills”; First Edition, Embassy Books, 2016.
7. Shalini Verma, “Development of Life Skills and Professional Practice”; First Edition; Sultan Chand (G/L) & Company, 2014.
8. Daniel Goleman, "Emotional Intelligence"; Bantam, 2006.
9. Remesh S., Vishnu R.G., "Life Skills for Engineers", Ridhima Publications, First Edition, 2016.
10. Butterfield Jeff, “Soft Skills for Everyone”, Cengage Learning India Pvt Ltd; 1 edition, 2011.
11. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India; 6 edition, 2015.
12. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1 edition, 2013.

22PHL 109	ENGINEERING PHYSICS LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	0	0	2	1	2019

Preamble: The aim of this course is to make the students gain practical knowledge to co-relate with the theoretical studies and to develop practical applications of engineering materials and use the principle in the right way to implement the modern technology.

Prerequisite: Higher secondary level Physics

Course Outcomes: After the completion of the course the student will be able to

CO 1	Develop analytical/experimental skills and impart prerequisite hands on experience for engineering laboratories
CO 2	Understand the need for precise measurement practices for data recording
CO 3	Understand the principle, concept, working and applications of relevant technologies and comparison of results with theoretical calculations
CO 4	Analyze the techniques and skills associated with modern scientific tools such as lasers and fiber optics
CO 5	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3				3			1	2			1
CO 2	3				3			1	2			1
CO 3	3				3			1	2			1
CO 4	3				3			1	2			1
CO 5	3				3			1	2			1

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment /Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

LIST OF EXPERIMENTS

(Minimum 8 experiments should be completed)

1. CRO-Measurement of frequency and amplitude of wave forms
2. Measurement of strain using strain gauge and wheatstone bridge
3. LCR Circuit – Forced and damped harmonic oscillations
4. Melde's string apparatus- Measurement of frequency in the transverse and longitudinal mode
5. Wave length measurement of a monochromatic source of light using Newton's Rings method.
6. Determination of diameter of a thin wire or thickness of a thin strip of paper using air wedge method.
7. To measure the wavelength using a millimeter scale as a grating.
8. Measurement of wavelength of a source of light using grating.
9. Determination of dispersive power and resolving power of a plane transmission grating
10. Determination of the particle size of lycopodium powder
11. Determination of the wavelength of He-Ne laser or any standard laser using diffraction grating
12. Calculate the numerical aperture and study the losses that occur in optical fiber cable.
13. I-V characteristics of solar cell.
14. LED Characteristics.
15. Ultrasonic Diffractometer- Wavelength and velocity measurement of ultrasonic waves in a liquid
16. Deflection magnetometer-Moment of a magnet- Tan A position.

Reference books

1. S.L.Gupta and Dr.V.Kumar, "Practical physics with viva voice", Pragati PrakashanPublishers, Revised Edition, 2009

2. M.N.Avadhanulu, A.A.Dani and Pokely P.M, "Experiments in Engineering Physics", S.Chand&Co,2008

3. S. K. Gupta, "Engineering physics practicals", Krishna Prakashan Pvt. Ltd., 2014

4. P. R. Sasikumar "Practical Physics", PHI Ltd., 2011.

22CYL 110	ENGINEERING CHEMISTRY LAB	CATEGORY	L	T	P	CREDIT
		BSC	0	0	2	1

Preamble: To impart scientific approach and to familiarize with the experiments in chemistry relevant for research projects in higher semesters

Prerequisite: Experiments in chemistry introduced at the plus two levels in schools

Course outcomes: After the completion of the course the students will be able to

CO 1	Understand and practice different techniques of quantitative chemical analysis to generate experimental skills and apply these skills to various analyses
CO 2	Develop skills relevant to synthesize organic polymers and acquire the practical skill to use TLC for the identification of drugs
CO 3	Develop the ability to understand and explain the use of modern spectroscopic techniques for analysing and interpreting the IR spectra and NMR spectra of some organic compounds
CO 4	Acquire the ability to understand, explain and use instrumental techniques for chemical Analysis
CO 5	Learn to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments
CO 6	Function as a member of a team, communicate effectively and engage in further learning. Also understand how chemistry addresses social, economical and environmental problems and why it is an integral part of curriculum

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3				2							3
CO 2	3				3							3
CO 3	3				3							3
CO 4	3				3							3
CO 5	3				1							3
CO 6	3				1							3

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment /Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

LIST OF EXPERIMENTS (MINIMUM 8 MANDATORY)

1. Estimation of total hardness of water-EDTA method
2. Potentiometric titration
3. Determination of cell constant and conductance of solutions.
4. Calibration of pH meter and determination of pH of a solution
5. Estimation of chloride in water
6. Identification of drugs using TLC
7. Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} in solution
8. Determination of molar absorptivity of a compound ($KMnO_4$ or any water soluble food colorant)
9. Synthesis of polymers (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin
10. Estimation of iron in iron ore
11. Estimation of copper in brass
12. Estimation of dissolved oxygen by Winkler's method
13. (a) Analysis of IR spectra (minimum 3 spectra) (b) Analysis of ^1H NMR spectra (minimum 3 spectra)
14. Flame photometric estimation of Na^+ to find out the salinity in sand
15. Determination of acid value of a vegetable oil
16. Determination of saponification of a vegetable oil

Reference Books

1. G. Svehla, B. Sivasankar, "Vogel's Qualitative Inorganic Analysis", Pearson, 2012.
2. R. K. Mohapatra, "Engineering Chemistry with Laboratory Experiments", PHI Learning, 2017.
3. Muhammed Arif, "Engineering Chemistry Lab Manual", Owl publishers, 2019.
4. Ahad J., "Engineering Chemistry Lab manual", Jai Publications, 2019.
5. Roy K Varghese, "Engineering Chemistry Laboratory Manual", Crownplus Publishers, 2019.
6. Soney C George, Rino Laly Jose, "Lab Manual of Engineering Chemistry", S. Chand & Company Pvt Ltd, New Delhi, 2019.

22ESL 111	CIVIL & MECHANICAL WORKSHOP	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
			0	0	2	1	2019

Preamble: The course is designed to train the students to identify and manage the tools, materials and methods required to execute an engineering project. Students will be introduced to a team working environment where they develop the necessary skills for planning, preparing and executing an engineering project.

To enable the student to familiarize various tools, measuring devices, practices and different methods of manufacturing processes employed in industry for fabricating components.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to:

Course Outcome	Course Outcome Description
CO 1	Name different devices and tools used for civil engineering measurements
CO 2	Explain the use of various tools and devices for various field measurements
CO 3	Demonstrate the steps involved in basic civil engineering activities like plot measurement, setting out operation, evaluating the natural profile of land, plumbing and undertaking simple construction work.
CO 4	Choose materials and methods required for basic civil engineering activities like field measurements, masonry work and plumbing.
CO 5	Compare different techniques and devices used in civil engineering measurements
CO 6	Identify Basic Mechanical workshop operations in accordance with the material and Objects
CO 7	Apply appropriate Tools and Instruments with respect to the mechanical workshop Trades
CO 8	Apply appropriate safety measures with respect to the mechanical workshop trades

Mapping of course outcomes with program outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	-	-	-	1	1	-	-	2	2	-	-
CO 2	1	-	-	-	1	1	-	-	2	2	-	-
CO 3	1	-	-	-	1	1	-	2	2	2	1	-
CO 4	1	-	-	-	1	1	-	2	2	2	1	1
CO 5	1	-	-	-	1	1	-	-	2	2		1
CO 6	2											

CO 7	2											
CO 8	2											

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	70	30	1 hour

Assessment Procedure: Total marks allotted for the course is 100 marks. CIE shall be conducted for 70 marks and ESE for 30 marks. CIE should be done for the work done by the student and also viva voce based on the work done on each practical session. ESE shall be evaluated by written examination of one hour duration conducted internally by the institute.

Continuous Internal Evaluation Pattern:

Attendance : 20 marks
Class work/ Assessment /Viva-voce : 50 marks
End semester examination (Internally by college) : 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

PART 1

CIVIL WORKSHOP

Exercise 1. Calculate the area of a built-up space and a small parcel of land- Use standard measuring tape and digital distance measuring devices

Exercise 2. (a) Use screw gauge and vernier calliper to measure the diameter of a steel rod and thickness of a flat bar

(b) Transfer the level from one point to another using a water level

(c) Set out a one room building with a given plan and measuring tape

Exercise 3. Find the level difference between any two points using dumpy level

Exercise 4. (a) Construct a $1\frac{1}{2}$ thick brick wall of 50 cm height and 60 cm length using English bond. Use spirit level to assess the tilt of walls.

(b) Estimate the number of different types of building blocks to construct this wall.

Exercise 5. (a) Introduce the students to plumbing tools, different types of pipes, type of connections, traps, valves ,fixtures and sanitary fittings.

(b) Install a small rainwater harvesting installation in the campus

Reference Books:

1. Khanna P.N, "Indian Practical Civil Engineering Handbook", Engineers Publishers.
2. Bhavikatti. S, "Surveying and Levelling (Volume 1)", I.K. International Publishing House
3. Arora S.P and Bindra S.P, " Building Construction", Dhanpat Rai Publications
4. S. C. Rangwala, "Engineering Materials," Charotar Publishing House.

PART II

MECHANICAL WORKSHOP

LIST OF EXERCISES

(Minimum EIGHT units mandatory and FIVE models from Units 2 to 8 mandatory)

UNIT 1:- General : Introduction to workshop practice, Safety precautions, Shop floor ethics, Basic First Aid knowledge.

Study of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc and accessories (b) bearings, seals, O-rings, circlips, keys etc.

UNIT 2:- Carpentry : Understanding of carpentry tools

Minimum any one model

1. T –Lap joint 2. Cross lap joint 3. Dovetail joint 4. Mortise joints

UNIT 3:- Foundry : Understanding of foundry tools

Minimum any one model

1.Bench Molding 2. Floor Molding 3. Core making 4. Pattern making

UNIT 4: - Sheet Metal : Understanding of sheet metal working tools

Minimum any one model

1. Cylindrical shape
2. Conical shape
3. Prismatic shaped job from sheet metal

UNIT 5: - Fitting : Understanding of tools used for fitting

Minimum any one model

1. Square Joint
2. V- Joint
3. Male and female fitting

UNIT 6: - Plumbing : Understanding of plumbing tools, pipe joints

Any one exercise on joining of pipes making use of minimum three types of pipe joints

UNIT 7: - Smithy: Understanding of tools used for smithy.

Demonstrating the forge-ability of different materials (MS, Al, alloy steel and cast steels) in cold and hot states.
Observing the qualitative difference in the hardness of these materials
Minimum any one exercise on smithy

1. Square prism
2. Hexagonal headed bolt
3. Hexagonal prism
4. Octagonal prism

UNIT 8: -Welding: Understanding of welding equipments
Minimum any one welding practice
Making Joints using electric arc welding. bead formation in horizontal, vertical and over head positions

UNIT 9: - Assembly: Demonstration only
Dissembling and assembling of

1. Cylinder and piston assembly
2. Tail stock assembly
3. Bicycle
4. Pump or any other machine

UNIT 10: - Machines: Demonstration and applications of the following machines
Shaping and slotting machine; Milling machine; Grinding Machine; Lathe; Drilling Machine.
UNIT 11: - Modern manufacturing methods: Power tools, CNC machine tools, 3D printing, Glass cutting.

Course Contents and Lecture Schedule:

No	Topic	No of Sessions
1	**INTRODUCTION**	
1.1	Workshop practice, shop floor precautions, ethics and First Aid knowledge. Studies of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc and accessories (b) bearings, seals, O-rings, circlips, keys etc	1
2	**CARPENTRY**	
2.1	Understanding of carpentry tools and making minimum one model	2

3	**FOUNDRY**	
3.1	Understanding of foundry tools and making minimum one model	2
4	**SHEET METAL**	
4.1	Understanding of sheet metal working tools and making minimum one model	2
5	**FITTING**	
5.1	Understanding of fitting tools and making minimum one model	2
6	**PLUMBING**	
6.1	Understanding of pipe joints and plumbing tools and making minimum one model	2
7	**SMITHY**	
7.1	Understanding of smithy tools and making minimum one model	2
8	**WELDING**	
8.1	Understanding of welding equipments and making minimum one model	2
9	**ASSEMBLY**	
9.1	Demonstration of assembly and dissembling of multiple parts components	1
10	**MACHINES**	
10.1	Demonstration of various machines	1
11	**MODERN MANUFACTURING METHODS**	
11.1	Demonstrations of: power tools, CNC Machine tools, 3D printing, Glass cutting	1

22ESL 112	ELECTRICAL & ELECTRONICS WORKSHOP	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	0	0	2	1	2019

Preamble: Electrical Workshop is intended to impart skills to plan and carry out simple electrical wiring. It is essential for the practicing engineers to identify the basic practices and safety measures in electrical wiring.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Demonstrate safety measures against electric shocks.
CO 2	Identify the tools used for electrical wiring, electrical accessories, wires, cables, batteries and standard symbols
CO 3	Develop the connection diagram, identify the suitable accessories and materials necessary for wiring simple lighting circuits for domestic buildings
CO 4	Identify and test various electronic components
CO 5	Draw circuit schematics with EDA tools
CO 6	Assemble and test electronic circuits on boards
CO 7	Work in a team with good interpersonal skills

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	3	-	-	-	-	-	1
CO 2	2	-	-	-	-	-	-	-	-	1	-	-
CO 3	2	-	-	1	-	1	-	1	2	2	-	2
CO 4	3	-	-	-	-	-	-	-	-	-	-	2
CO 5	3	-	-	-	2	-	-	-	-	-	-	2
CO 6	3	-	-	-	2	-	-	-	-	-	-	1
CO 7	-	-	-	-	-	-	-	-	3	2	-	2

Mark distribution

Total Marks	CIE	ESE	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment /Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

Syllabus

PART 1

ELECTRICAL

List of Exercises / Experiments

1. a) Demonstrate the precautionary steps adopted in case of Electrical shocks.

   b)Identify different types of cables, wires, switches, fuses, fuse carriers, MCB, ELCB and MCCB with ratings.
2. Wiring of simple light circuit for controlling light/ fan point (PVC conduit wiring)
3. Wiring of light/fan circuit using Two way switches . (Staircase wiring)
4. Wiring of Fluorescent lamps and light sockets (6A) with a power circuit for controlling power device. (16A socket)
5. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and Energy meter.
6. a)Identify different types of batteries with their specifications.

   b)Demonstrate the Pipe and Plate Earthing Schemes using Charts/Site Visit.

PART II

ELECTRONICS

List of Exercises / Experiments (Minimum of 7 mandatory)

1. Familiarization/Identification of electronic components with specification (Functionality, type, size, colour coding, package, symbol, cost etc. [Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals, Displays, Fasteners, Heat sink etc.)

2. Drawing of electronic circuit diagrams using BIS/IEEE symbols and introduction to EDA tools (such as Dia or XCircuit), Interpret data sheets of discrete components and IC's, Estimation and costing.

3. Familiarization/Application of testing instruments and commonly used tools. [Multimeter, Function generator, Power supply, DSO etc.] [Soldering iron, De-soldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers, Crimping tool, Hot air soldering and de- soldering station etc.]

4. Testing of electronic components [Resistor, Capacitor, Diode, Transistor and JFET using multimeter.]

5. Inter-connection methods and soldering practice. [Bread board, Wrapping, Crimping, Soldering - types - selection of materials and safety precautions, soldering practice in connectors and general purpose PCB, Crimping.]

6. Printed circuit boards (PCB) [Types, Single sided, Double sided, PTH, Processing methods, Design and fabrication of a single sided PCB for a simple circuit with manual etching (Ferric chloride) and drilling.]

7. Assembling of electronic circuits using SMT (Surface Mount Technology) stations.

8. Assembling of electronic circuit/system on general purpose PCB, test and show the functioning (**Any Two circuits).**

1. Fixed voltage power supply with transformer, rectifier diode, capacitor filter, zener/IC regulator.

2. Square wave generation using IC 555 timer in IC base.

3. Sine wave generation using IC 741 OP-AMP in IC base.

4. RC coupled amplifier with transistor BC107.

SEMESTER 2

SEMESTER II

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	22MAT201	VECTOR CALCULUS,DIFFERENTIAL EQUATIONS AND TRANSFORMS	3-1-0	4	4
B 1/2	22PHT 202	ENGINEERING PHYSICS B	3-1-0	4	4
	22CYT 203	ENGINEERING CHEMISTRY	3-1-0	4	4
C 1/2	22EST 204	ENGINEERING MECHANICS	2-1-0	3	3
	22EST 205	ENGINEERING GRAPHICS	2-0-2	4	3
D 1/2	22EST 206	BASICS OF CIVIL & MECHANICAL ENGINEERING	4-0-0	4	4
	22EST 207	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	4-0-0	4	4
E	22HUT 208	PROFESSIONAL COMMUNICATION	2-0-2	4	--
F	22EST 209	PROGRAMMING IN C	2-1-2	5	4
S 1/2	22PHL 210	ENGINEERING PHYSICS LAB	0-0-2	2	1
	22CYL 211	ENGINEERING CHEMISTRY LAB	0-0-2	2	1
T 1/2	22ESL 212	CIVIL & MECHANICAL WORKSHOP	0-0-2	2	1
	22ESL 213	ELECTRICAL & ELECTRONICS WORKSHOP	0-0-2	2	1
TOTAL				**28/29**	**21**

22MAT 201	VECTOR CALCULUS, DIFFERENTIAL EQUATIONS AND TRANSFORMS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: This course introduces the concepts and applications of differentiation and integration of vector valued functions, differential equations, Laplace and Fourier Transforms. The objective of this course is to familiarize the prospective engineers with some advanced concepts and methods in Mathematics which include the Calculus of vector valued functions, ordinary differential equations and basic transforms such as Laplace and Fourier Transforms which are invaluable for any engineer's mathematical tool box. The topics treated in this course have applications in all branches of engineering.

Prerequisite: Calculus of single and multi-variable functions.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the derivatives and line integrals of vector functions and learn their applications
CO 2	Evaluate surface and volume integrals and learn their inter-relations and applications.
CO 3	Solve homogeneous and non-homogeneous linear differential equation with constant Coefficients
CO 4	Compute Laplace transform and apply them to solve ODEs arising in engineering
CO 5	Determine the Fourier transforms of functions and apply them to solve problems arising in Engineering

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	2	1			1	2		2
CO 2	3	3	3	3	2	1			1	2		2
CO 3	3	3	3	3	2	1			1	2		2
CO 4	3	3	3	3	2	1			1	2		2
CO 5	3	3	3	3	2	1			1	2		2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination(Marks)
	Test 1 (Marks	Test 2 (Marks)	
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	**CIE** (Marks)	**ESE** (Marks)	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

Assignments: Assignment should include specific problems highlighting the applications of the methods introduced in this course in science and engineering.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Compute the derivatives and line integrals of vector functions and learn their applications

1. How would you calculate the speed, velocity and acceleration at any instant of a particle moving in space whose position vector at time $t$is $\boldsymbol{r}(t)$?
2. Find the work done by the force field $F = (e^x - y^3) + (\cos y + x^3)$ on a particle that travelsonce around the unit circle centred at origin having radius 1.
3. When do you say that a vector field is conservative? What are the implications if a vector field is conservative?

Course Outcome 2 (CO2): Evaluate surface and volume integrals and learn their inter-relations and applications

1. Write any one application each of line integral, double integral and surface integral.
2. Use the divergence theorem to find the outward flux of the vector field $F(x, y, z) = z\boldsymbol{k}$across the

$$x^2 + y^2 + z^2 = a^2$$

3. State Greens theorem. Use Green's theorem to express the area of a plane region bounded by a curve as a line integral.

Course Outcome 3 (CO3): Solve homogeneous and non-homogeneous linear differential equation with constant coefficients

1. If $y_1(x)$ and $y_2(x)$ are solutions of $y'' + py' + qy = 0$, where p, q are constants, show that $y_1(x) + y_2(x)$ is also a solution.

2. Solve the differential equation $y'' + y = 0.001x^2$ using method of undetermined coefficient.

3. Solve the differential equation of $y''' - 3y'' + 3y' - y = e^x - x - 1$.

Course Outcome 4 (CO4): Compute Laplace transform and apply them to solve ODEs arising in engineering

1. What is the inverse Laplace Transform of $(s) = \frac{3s-137}{s^2+2s+4}$?

2. Find Laplace Transform of Unit step function.

3. Solve the differential equation of $y'' + 9y = \delta\left(t - \frac{\pi}{2}\right)$? Given $y(0) = 2,\ y'(0) = 0$

Course Outcome 5(CO5): Determine the Fourier transforms of functions and apply them to solve problems arising in engineering

1. Find the Fourier integral representation of function defined by $f(x) = e^{-x}$ for $x > 0$ and $f(x) = 0$ for $x < 0$.

2. What are the conditions for the existence of Fourier Transform of a function $f(x)$?

3. Find the Fourier transform of $f(x) = 1$ for $|x| < 1$ and $f(x) = 0$ otherwise.

Model Question paper

QP CODE: PAGES:3

Reg No:________________

Name :________________

Course Code: 22MAT 201

Max. Marks: 100 **Duration: 3 Hours**

VECTOR CALCULUS, DIFFERENTIAL EQUATIONS AND TRANSFORMS

(2019-Scheme)

(Common to all branches)

PART A

(Answer all questions. Each question carries 3 marks)

1. Is the vector $\boldsymbol{r}$ **where** $\boldsymbol{r} = x\boldsymbol{i} + y\boldsymbol{j} + z\boldsymbol{k}$ conservative. Justify your answer.
2. State Greens theorem including all the required hypotheses
3. What is the outward flux of $(\boldsymbol{x}, \boldsymbol{y}, \boldsymbol{z}) = x\boldsymbol{i} + y\boldsymbol{j} + z\boldsymbol{k}$ across any unit cube.
4. What is the relationship between Green's theorem and Stokes theorem?
5. Solve $y'' + 4y' + 2.5y = 0$
6. Does the function $y = C_1 \cos x + C_2\ sinx$form a solution of$y'' + y = 0$?. Is it the general solution? Justify your answer.
7. Find the Laplace transform of $e^{-t} \sinh 4t$
8. Find the Laplace inverse transform of $\frac{1}{s(s^2+\omega^2)}$.
9. Given the Fourier transform $\frac{1}{\sqrt{2}} e^{-\frac{\omega^2}{4}}$ of $f(x) = e^{-x^2}$, find the Fourier transform of e^{-x^2}
10. State the convolution theorem for Fourier transform

PART B

(Answer one full question from each module. Each full question carries 14 marks)

MODULE 1

11a) Prove that the force field $\boldsymbol{F} = e^y\boldsymbol{i} + xe^y\boldsymbol{j}$is conservative in the entire xy-plane

b) Use Greens theorem to find the area enclosed by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

12 a) Find the divergence of the vector field$\boldsymbol{F} = \frac{c}{(\boldsymbol{x}^2+\boldsymbol{y}^2+\boldsymbol{z}^2)^{3/2}}(x\boldsymbol{i} + y\boldsymbol{j} + z\boldsymbol{k})$

b) Find the work done by the force field$(x, y, z) = xy\boldsymbol{i} + yz\boldsymbol{j} + xz\boldsymbol{k}$along C whereC

is the curve$\boldsymbol{r}(t) = t\boldsymbol{i} + t^2\boldsymbol{j} + t^3\boldsymbol{k}$

MODULE II

13 a) Use divergence theorem to find the outward flux of the vector field

$\boldsymbol{F} = 2x\boldsymbol{i} + 3y\boldsymbol{j} + z^3\boldsymbol{k}$acrossthe unit cube bounded by or $x = 0$, $y = 0$, $= 0, x = 1$,$y = 1$,$z = 1$

b) Find the circulation of $\boldsymbol{F} = (x - z)\boldsymbol{i} + (y - x)\boldsymbol{j} + (\boldsymbol{z} - \boldsymbol{xy})\boldsymbol{k}$ using Stokes theorem around the triangle with vertices $A(1,0,0)$, $B(0,2,0)$and $C(0,0,1)$

14 a) Use divergence theorem to find the volume of the cylindrical solid bounded by $^2 + 4x + y^2 = 7$, $z = -1$, $z = 4$, given the vector field $\boldsymbol{F} = \boldsymbol{x}i + \boldsymbol{y}j + \boldsymbol{z}k$ across surfaceof the cylinder

b) Use Stokes theorem to evaluate$\int_C \boldsymbol{F}.\boldsymbol{dr}$where$\boldsymbol{F} = x^2\boldsymbol{i} + 3x\boldsymbol{j} - y^3\boldsymbol{k}$where Cis the circle $x^2 + y^2 = 1$ in the xy- plane with counterclockwise orientation looking down the positive z-axis

MODULE III

15 a) Solve $y'' + 4y' + 4y = x^2 + e^{-x} \cos x$

b) Solve $y''' - 3y'' + 3y' - y = e^x - x - 1$

16 a) Solve $\boldsymbol{y'''} + \mathbf{3}y'' + 3y' + y = 30e^{-x}$ given $(0) = 3, y'(0) = -3$ **,** $y''(0) = -47$

b) Using method of variation of parameters, solve $y'' + y = sec\, x$

MODULE IV

17 a) Find the inverse Laplace transform of $(s) = \frac{2(e^{-s} - e^{-3s})}{4} s^2 -$

b) Solve the differential equation $y'' + 16y = 4(t - 3\pi)$; $y(0) = 2, y'(0) = 0$ using Laplace transform

18 a) Solve $y'' + 3y' + 2y = f(t)$ where $f(t) = 1$ for $0 < t < 1$ and $f(t) = 1$ for $t > 1$ using Laplace transform

b) Apply convolution theorem to find the Laplace inverse transform of $\frac{1}{s^2(s^2+\omega^2)}$

MODULE V

19 a) Find the Fourier cosine integral representation for $f(x) = e^{-kx}$ for $x > 0$ and $k > 0$ and hence evaluate $\int_0^\infty \frac{\cos wx}{k^2+w^2}$ the function

b) Does the Fourier sine transform $f(x) = x^{-1} \sin x$ for $0 < x < \infty$ exist? Justify your answer

20 a) Find the Fourier transform of $f(x) = |x|$ for $|x| < 1$ and $f(x) = 0$ otherwise

b) Find the Fourier cosine transform of $f(x) = e^{-ax}$ for a > 0

Syllabus

Module 1 (Calculus of vector functions)

(Text 1: Relevant topics from sections 12.1, 12.2, 12.6, 13.6, 15.1, 15.2, 15.3)

Vector valued function of single variable, derivative of vector function and geometrical interpretation, motion along a curve-velocity, speed and acceleration. Concept of scalar and vector fields , Gradient and its properties, directional derivative , divergence and curl, Line integrals of vector fields, work as line integral, Conservative vector fields , independence of path and potential function(results without proof).

Module 2 (Vector integral theorems)

(Text 1: Relevant topics from sections 15.4, 15.5, 15.6, 15.7, 15.8)

Green's theorem (for simply connected domains, without proof) and applications to evaluating line integrals and finding areas. Surface integrals over surfaces of the form z = g(x, y), y = g(x, z) or x = g(y, z) , Flux integrals over surfaces of the form z = g(x, y), y = g(x, z) or x = g(y, z), divergence theorem (without proof) and its applications to finding flux integrals, Stokes' theorem (without proof) and its applications to finding line integrals of vector fields and work done.

Module- 3 (Ordinary differential equations)

(Text 2: Relevant topics from sections 2.1, 2.2, 2.5, 2.6, 2.7, 2.10, 3.1, 3.2, 3.3)

Homogenous linear differential equation of second order, superposition principle,general solution, homogenous linear ODEs with constant coefficients-general solution. Solution of Euler-Cauchy equations (second order only).Existence and uniqueness (without proof). Non homogenous linear ODEs-general solution, solution by the method of undetermined coefficients (for the right hand side of the form x^n,^{kx},$sinax$,$cosax$,$e^{kx}sinaxe^{kx}cosax$and their linear combinations), methods of variation of parameters. Solution of higher order equations-homogeneous and non-homogeneous with constant coefficient using method of undetermined coefficient.

Module- 4 (Laplace transforms)

(Text 2: Relevant topics from sections 6.1,6.2,6.3,6.4,6.5)

Laplace Transform and its inverse ,Existence theorem (without proof) , linearity,Laplace transform of basic functions, first shifting theorem, Laplace transform of derivatives and integrals, solution of differential equations using Laplace transform, Unit step function, Second shifting theorems. Dirac delta function and its Laplace transform, Solution of ordinary differential equation involving unit step function and Dirac delta functions. Convolution theorem(without proof)and its application to finding inverse Laplace transform of products of functions.

Module-5 (Fourier Tranforms)

(Text 2: Relevant topics from sections 11.7,11.8, 11.9)

Fourier integral representation, Fourier sine and cosine integrals. Fourier sine and cosine transforms, inverse sine and cosine transform. Fourier transform and inverse Fourier transform, basic properties. The Fourier transform of derivatives. Convolution theorem (without proof)

Text Books

1. H. Anton, I. Biven S.Davis, “Calculus”, Wiley, 10th edition, 2015.
2. Erwin Kreyszig, “Advanced Engineering Mathematics”, Wiley, 10th edition, 2015.

Reference Books

1. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9 th Edition, Pearson,Reprint, 2002.
3. Peter O Neil, Advanced Engineering Mathematics, 7th Edition, Thomson, 2007.
4. Louis C Barret, C Ray Wylie, “Advanced Engineering Mathematics”, Tata McGraw Hill, 6th edition, 2003.
5. VeerarajanT.”Engineering Mathematics for first year”, Tata McGraw - Hill, 2008.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th edition , 2010.
7. Srimanta Pal, Subodh C. Bhunia, “Engineering Mathematics”, Oxford University Press, 2015.
8. Ronald N. Bracewell, “The Fourier Transform and its Applications”, McGraw – Hill International Editions, 2000.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Calculus of vector functions (9 hours)**	
1.1	Vector valued function of a scalar variable - derivative of vector valued function of scalar variable t-geometrical meaning	2
1.2	Motion along a curve-speed , velocity, acceleration	1
1.3	Gradient and its properties, directional derivative , divergent and curl	3
1.4	Line integrals with respect to arc length, line integrals of vector fields. Work done as line integral	2
1.5	Conservative vector field, independence of path, potential function	1

2	**Vector integral theorems**(**9 hours**)	
2.1	Green's theorem and it's applications	2
2.2	Surface integrals , flux integral and their evaluation	3
2.3	Divergence theorem and applications	2
2.4	Stokes theorem and applications	2
3	**Ordinary Differential Equations** (**9 hours**)	
3.1	Homogenous linear equation of second order, Superposition principle, general solution	1
3.2	Homogenous linear ODEs of second order with constant coefficients	2
3.3	Second order Euler-Cauchy equation	1
3.4	Non homogenous linear differential equations of second order with constant coefficient-solution by undetermined coefficients, variation of parameters.	3
3.5	Higher order equations with constant coefficients	2
4	**Laplace Transform** (**10 hours**)	
4.1	Laplace Transform , inverse Transform, Linearity, First shifting theorem, transform of basic functions	2
4.2	Transform of derivatives and integrals	1
4.3	Solution of Differential equations, Initial value problems by Laplace transform method.	2
4.4	Unit step function --- Second shifting theorem	2
4.5	Dirac Delta function and solution of ODE involving Dirac delta function	2
4.6	Convolution and related problems.	1
5	**Fourier Transform** (**8 hours**)	
5.1	Fourier integral representation	1
5.2	Fourier Cosine and Sine integrals and transforms	2
5.3	Complex Fourier integral representation, Fourier transform and its inverse transforms, basic properties	3
5.4	Fourier transform of derivatives, Convolution theorem	2

22PHT 202	ENGINEERING PHYSICS B (FOR NON-CIRCUIT BRANCHES)	Category	L	T	P	CREDIT	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: The aim of the Engineering Physics program is to offer students a solid background in the fundamentals of Physics and to impart that knowledge in engineering disciplines. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of Physics with the core programmes

Prerequisite: Higher secondary level Physics, Mathematical course on vector calculus, differential equations and linear algebra

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the quantitative aspects of waves and oscillations in engineering systems.
CO 2	Apply the interaction of light with matter through interference, diffraction and identify these phenomena in different natural optical processes and optical instruments.
CO 3	Analyze the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices.
CO 4	Apply the knowledge of ultrasonics in non-destructive testing and use the principles of acoustics to explain the nature and characterization of acoustic design and to provide a safe and healthy environment
CO 5	Apply the comprehended knowledge about laser and fibre optic communication systems in various engineering applications

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2						1	2			1
CO 2	3	2						1	2			1
CO 3	3	2						1	2			1
CO 4	3							1	2			1
CO 5	3	2						1	2			1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	**CIE MARKS**	**ESE MARKS**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the effect of damping force on oscillators.
2. Distinguish between transverse and longitudinal waves.
3. (a) Derive an expression for the fundamental frequency of transverse vibration in a stretched string.
   (b) Calculate the fundamental frequency of a string of length 2 m weighing 6 g kept stretched by a load of 600 kg.

Course Outcome 2 (CO2):

1. Explain colours in thin films.
2. Distinguish between Fresnel and Fraunhofer diffraction.
3. (a) Explain the formation of Newton's rings and obtain the expression for radii of bright and dark rings in reflected system. Also explain how it is used to determine the wavelength of a monochromatic source of light.
   (b) A liquid of refractive index μ is introduced between the lens and glass plate. What happens to the fringe system? Justify your answer.

Course Outcome 3 (CO3):

1. Give the physical significance of wave function?

2. What are excitons ?
3. (a) Solve Schrodinger equation for a particle in a one dimensional box and obtain its energy eigen values and normalised wave functions.

   (b) Calculate the first three energy values of an electron in a one dimensional box of width 1 A^0 in electron volt.

Course Outcome 4 (CO4):

1. Explain reverberation and reverberation time.
2. How ultrasonic waves are used in non-destructive testing.
3. (a) With a neat diagram explain how ultrasonic waves are produced by a piezoelectric oscillator.

   (b) Calculate frequency of ultrasonic waves that can be produced by a nickel rod of length 4 cm. (Young's Modulus = 207 G Pa, Density = 8900 Kg /m^3)

Course Outcome 5 (CO 5):

1. Distinguish between spontaneous emission and stimulated emission.
2. Explain optical resonators.
3. (a) Explain the construction and working of Ruby Laser.

   (b) Calculate the numerical aperture and acceptance angle of a fibre with a core refractive index of 1.54 and a cladding refractive index of 1.50 when the fibre is inside water of refractive index 1.33.

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Model Question paper

QP CODE: PAGES:3

Reg No:________________

Name :________________

Course Code: 22PHT 202

Course Name: Engineering Physics B

Max.Marks: 100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Compare electrical and mechanical oscillators.

2. Distinguish between longitudinal and transverse waves.

3. Write a short note on antireflection coating.

4. Diffraction of light is not as evident in daily experience as that of sound waves. Give reason.

5. State and explain Heisenberg's Uncertainty principle. With the help of it explain natural line broadening.

6. Explain surface to volume ratio of nanomaterials.

7. Define sound intensity level. Give the values of threshold of hearing and threshold of pain.

8. Describe the method of non-destructive testing using ultra sonic waves

9. Explain the condition of population inversion

10. Distinguish between step index and graded index fibre. (10x3=30)

PART B

Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. (a) Derive the differential equation of damped harmonic oscillator and deduce its solution. Discuss the cases of over damped, critically damped and under damped cases. (10)

(b) The frequency of a tuning fork is 500 Hz and its Q factor is 7×10^{4}. Find the relaxation time. Also calculate the time after which its energy becomes 1/10 of its initial undamped value. (4)

12. (a) Derive an expression for the velocity of propagation of a transverse wave in a stretched string. Deduce laws of transverse vibrations. (10)

(b) The equation of transverse vibration of a stretched string is given by y =0.00327 sin (72.1x- 2.72t) m, in which the numerical constants are in S.I units. Evaluate (i) Amplitude (ii) Wavelength (iii) Frequency and (iv) Velocity of the wave. (4)

Module 2

13. (a) Explain the formation of Newton's rings and show that the radius of dark ring is proportional to the square root of natural numbers. How can we use Newton's rings experiment to determine the refractive index of a liquid? (10)

(b) Two pieces of plane glass are placed together with a piece of paper between two at one end. Find the angle of the wedge in seconds if the film is viewed with a monochromatic light of wavelength 4800Å. Given β = 0.0555 cm. (4)

14. (a) Explain the diffraction due to a plane transmission grating. Obtain the grating equation. (10)

(b) A grating has 6000 lines per cm. Find the angular separation of the two yellow lines of mercury of wavelengths 577 nm and 579 nm in the second order. (4)

Module 3

15. (a) Derive time dependent and independent Schrodinger equations. (10)

(b) An electron is confined to one dimensional potential box of length 2Å. Calculate the energies corresponding to the first and second quantum states in eV. (4)

16. (a) Classify nanomaterials based on dimensionality of quantum confinement and explain the following nanostructures. (i) nano sheets (ii) nano wires (iii) quantum dots. (10)

(b) Find the de Broglie wavelength of electron whose kinetic energy is 15 eV. (4)

Module 4

17. (a) Explain reverberation and reverberation time? What is the significance of Reverberation time. Explain the factors affecting the acoustics of a building and their corrective measures? (10)

(b) The volume of a hall is 3000 m^3. It has a total absorption of 100m^2 sabine. If the hall is filled with audience who add another 80 m^2sabine, then find the difference in reverberation time. (4)

18. (a) With a neat diagram explain how ultrasonic waves are produced by piezoelectric oscillator. Also discuss the piezoelectric method of detection of ultrasonic waves. (10)

(b) An ultrasonic source of 0.09 MHz sends down a pulse towards the sea bed which returns after 0.55 sec. The velocity of sound in sea water is 1800 m/s. Calculate the depth of the sea and the wavelength of the pulse. (4)

Module 5

19. (a) Outline the construction and working of Ruby laser. (8)

(b) What is the principle of holography? How is a hologram recorded? (6)

20. (a) Define numerical aperture of an optic fibre and derive an expression for the NA of a step index fibre with a neat diagram. (10)

(b) An optical fibre made with core of refractive index 1.5 and cladding with a fractional index difference of 0.0006. Find refractive index of cladding and numerical aperture. (4)

(14x5=70)

SYLLABUS

ENGINEERING PHYSICS B (FOR NON-CIRCUIT BRANCHES)

Module 1

Oscillations and Waves

Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression, Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators

Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation), Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration

Module 2

Wave Optics

Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference, Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings

Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation, Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)

Module 3

Quantum Mechanics & Nanotechnology

Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening Mechanism, Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)

Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots, Properties of nanomaterials-mechanical, electrical and optical, Applications of nanotechnology (qualitative ideas)

Module 4

Acoustics & Ultrasonics

Acoustics, Classification of sound-Musical sound-Noise, Characteristics of Musical Sounds-Pitch or frequency-Loudness or Intensity-Measurement of Intensity level-Decibel-Quality or timbre, Absorption coefficient, Reverberation-Reverberation time-Significance- Sabine's formula (no derivation), Factors affecting architectural acoustics and their remedies

Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator –Working, Detection of ultrasonic waves - Thermal and Piezoelectric methods, Ultrasonic diffractometer- Expression for the velocity of ultrasonic waves in a liquid , Applications of ultrasonic waves -SONAR,NDT and Medical

Module 5

Laser and Fibre optics

Properties of laser, Absorption and emission of radiation, Spontaneous and stimulated emission, Einstein's coefficients (no derivation), Population inversion, Metastable states, basic components of laser, Active medium, Pumping mechanism, Optical resonant cavity, working principle, Construction and working of Ruby laser and Helium neon laser ,Construction and working of semiconductor laser(Qualitative) ,Applications of laser, Holography, Difference between hologram and photograph, Recording of hologram and reconstruction of image, Applications

Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications, Fibre optic sensors-Intensity Modulated and Phase modulated sensors

Text Books

1. M.N.Avadhanulu, P.G.Kshirsagar,TVS Arun Murthy "A Text book of Engineering Physics", S.Chand &Co., Revised Edition, 2019.

2. H.K.Malik , A.K. Singh, "Engineering Physics" McGraw Hill Education, Second Edition, 2017.

Reference Books

1. Arthur Beiser, "Concepts of Modern Physics ", Tata McGraw Hill Publications, 6th Edition 2003
2. D.K. Bhattacharya, Poonam Tandon, "Engineering Physics", Oxford University Press, 2015
3. Md.N.Khan & S.Panigrahi "Principles of Engineering Physics 1&2", Cambridge University Press, 2016
4. Aruldhas G., "Engineering Physics", PHI Pvt. Ltd., 2015
5. Ajoy Ghatak, "Optics", Mc Graw Hill Education, Sixth Edition, 2017
6. T. Pradeep, "Nano:The Essentials'', McGraw Hill India Ltd, 2007
7. B. B. Laud, "Lasers and Non linear optics", New age International Publishers, 2nd Edition ,2005
8. Premlet B., "Advanced Engineering Physics", Phasor Books,10th edition ,2017
9. I. Dominic and. A. Nahari, "A Text Book of Engineering physics", Owl Books Publishers, Revised edition, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Oscillations and Waves (9 hours)**	
1.1	Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression	2 hrs
1.2	Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators	3hrs
1.3	Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation)	2 hrs
1.4	Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration	2 hrs
2	**Wave Optics (9 hours)**	
2.1	Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference	2 hrs
2.2	Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings	4 hrs
2.3	Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation	2 hrs
2.4	Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)	1 hr
3	**Quantum Mechanics &Nanotechnology (9hours)**	
3.1	Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism	2 hrs
3.2	Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)	4 hrs
3.3	Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots	2 hrs
3.4	Properties of nanomaterials-mechanical, electrical and optical Applications of nanotechnology (qualitative ideas)	1 hr
4	**Acoustics & Ultrasonics (9hrs)**	
4.1	Acoustics, Classification of sound-Musical sound-Noise, Characteristics	3 hrs

	of Musical Sounds-Pitch or frequency-Loudness or Intensity-Measurement of Intensity level-Decibel-Quality or timbre, Absorption coefficient, Reverberation-Reverberation time-Significance- Sabine's formula (no derivation)	
4.2	Factors affecting architectural acoustics and their remedies	1 hr
4.3	Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator – Working, Detection of ultrasonic waves - Thermal and Piezoelectric methods	3hrs
4.4	Ultrasonic diffractometer- Expression for the velocity of ultrasonic waves in a liquid ,Applications of ultrasonic waves -SONAR,NDT and Medical.	2 hr
5	**Laser and Fibre optics (9hours)**	
5.1	Properties of laser, Absorption and emission of radiation, Spontaneous and stimulated emission, Einstein's coefficients (no derivation), Population inversion, Metastable states, basic components of laser, Active medium, Pumping mechanism, Optical resonant cavity, working principle	2 hrs
5.2	Construction and working of Ruby laser and Helium neon laser ,Construction and working of semiconductor laser(Qualitative) Applications of laser	3 hrs
5.3	Holography, Difference between hologram and photograph, Recording of hologram and reconstruction of image, Applications	1 hr
5.4	Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications, Fibre optic sensors-Intensity Modulated and Phase modulated sensors	3 hrs

22CYT 203	ENGINEERING CHEMISTRY	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	3	1	0	4	2019

Preamble: To enable the students to acquire knowledge in the concepts of chemistry for engineering applications and to familiarize the students with different application oriented topics like spectroscopy, electrochemistry, instrumental methods etc. Also familiarize the students with topics like mechanism of corrosion, corrosion prevention methods, SEM, stereochemistry, polymers, desalination etc., which enable them to develop abilities and skills that are relevant to the study and practice of chemistry.

Prerequisite: Concepts of chemistry introduced at the plus two levels in schools

Course outcomes: After the completion of the course the students will be able to

CO 1	Apply the basic concepts of electrochemistry and corrosion to explore its possible applications in various engineering fields.
CO 2	Understand various spectroscopic techniques like UV-Visible, IR, NMR and its applications.
CO 3	Apply the knowledge of analytical method for characterizing a chemical mixture or a compound. Understand the basic concept of SEM for surface characterisation of nanomaterials.
CO 4	Learn about the basics of stereochemistry and its application. Apply the knowledge of conducting polymers and advanced polymers in engineering.
CO 5	Study various types of water treatment methods to develop skills for treating wastewater.

Mapping of course outcomes with program outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1	1	2	1									
CO 2	1	1		1	2							
CO 3	1	1		1	2							
CO 4	2	1										
CO 5	1			1			3					

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			
Create			

End Semester Examination Pattern: There will be two parts- **Part A** and **Part B. Part A** contains **10** questions (**2** questions from each module), having **3** marks for each question. Students should answer **all** questions. **Part B** contains **2** questions from each module, of which student should answer any one. Each question can have maximum **2** subdivisions and carries **14** marks.

Course Level Assessment Questions

Course Outcome 1 (CO 1):

1. What is calomel electrode? Give the reduction reaction (3 Marks)

2. List three important advantages of potentiometric titration (3 Marks)

3. (a) Explain how electroless plating copper and nickel are carried out (10 Marks)

(b) Calculate the emf of the following cell at $30^{o}C$, Z n / Zn^{2+} (0.1M) // Ag^{+} (0.01M) // Ag.

Given E^0 Zn^{2+}/Zn = -0.76 V, E^0 Ag^{+}/Ag = 0.8 V. (4 Marks)

Course Outcome 2 (CO 2)

1. State Beer Lambert's law (3 Marks)

2. List the important applications of IR spectroscopy (3 Marks)

3. (a) What is Chemical shift? What are factors affecting Chemical shift? How ^{1}H NMR spectrum of CH_3COCH_2Cl interpreted using the concept of chemical shift. (10 Marks)

(b) Calculate the force constant of HF molecule, if it shows IR absorption at 4138 cm^{-1}. Given that atomic masses of hydrogen and fluorine are 1u and 19u respectively. (4 Marks)

Course Outcome 3 (CO 3):

1. Distinguish between TGA and DTA (3 Marks)

2. Give two differences between GSC and GLC (3 Marks)

3. (a) Explain the principle, instrumentation and procedure of HPLC (10 Marks)

(b) Interpret TGA of $CaC_2O_4 . H_2O$ (4 Marks)

Course Outcome 4 (CO 4):

1. Explain the geometrical isomerism in double bonds (3 Marks)

2. What are the rules of assigning R-S notation? (3 Marks)

3. (a) What are conducting polymers? How it is classified? Give the preparation of polyaniline (10 Marks)

(b) Draw the stereoisomers possible for CH_3-$(CHOH)_2$-COOH (4 Marks)

Course Outcome 5 (CO 5):

1. What is degree of hardness? (3 Marks)

2. Define BOD and COD (3 Marks)

3. (a) Explain the EDTA estimation of hardness (10 Marks)

(b) Standard hard water contains 20 g of CaCO3 per liter,50 mL of this required 30mL of EDTA solution, 50mL of sample water required 20mL of EDTA solution. 50mL sample water after boiling required 14 mL EDTA solution. Calculate the temporary hardness of the given sample of water, in terms of ppm. (4 Marks)

MODEL QUESTION PAPER

Total Pages:

Reg No.:________________ Name:___________________________

Course Code:
22CYT203,

Course Name: ENGINEERING CHEMISTRY

Max. Marks: 100 Duration: 3 Hours

PART A

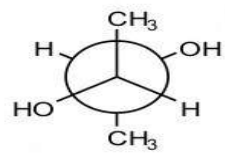
	Answer all questions, each carries 3 marks	Marks	
1	What is potentiometric titration? How the end point is determined graphically?	(3)	
2	What is Galvanic series? How is it different from electrochemical series?	(3)	
3	Which of the following molecules can give IR absorption? Give reason? (a) O_2 (b) H_2O (c) N_2 (d) HCl	4	W h

ich of the following molecules show UV-Visible absorption? Give reason. (3)

(a) Ethane (b) Butadiene (c) Benzene

(3)

5	What are the visualization techniques used in TLC?	(3)
6	Write the three important applications of nanomaterials.	(3)
7	Draw the Fischer projection formula and find R-S notation of	(3)



8	Write the structure of a) Polypyrroleb) Kevlar.	(3
9	What is break point chlorination?	(3)
10	What is reverse osmosis?	(3)

PART B

Answer any one full question from each module, each question carries 14 marks

Module 1

11 a) Give the construction of Li-ion cell. Give the reactions that take place at the electrodes during charging and discharging. What happens to anodic material when the cell is 100% charged. (10)

b) Calculate the standard electrode potential of Cu, if its electrode potential at 25 °C is 0.296 V and the concentration of Cu^{2+} is 0.015 M. (4)

OR

12 a) Explain the mechanism of electrochemical corrosion of iron in oxygen rich and oxygen deficient acidic and basic environments. (10)

b) Given below are reduction potentials of some species (4)

$MnO_4^- + 8H^+ + 5e \rightarrow Mn^{2+} + 4H_2O$; $E^0 = +1.51$ V

$Cl_2 + 2e \rightarrow 2Cl^-$; $E^0 = +1.36$ V

$S_2O_8^{2-} + 2e \rightarrow 2SO_4^{2-}$; $E^0 = +1.98$ V

Use the above data to examine whether the acids, dil. HCl and dil. H_2SO_4 , can be used to provide acid medium in redox titrations involving $KMnO_4$.

Module 2

13 a) What is spin-spin splitting? Draw the NMR spectrum of (i) CH_3 CH_2CH_2 Br (ii) $CH_3CH(Br)CH_3$ Explain how NMR spectrum can be used to identify the two isomers. (10)

b) A dye solution of concentration 0.08M shows absorbance of 0.012 at 600 nm; while atest solution of same dye shows absorbance of 0.084 under same conditions. Find the concentration of the test solution. (4)

OR

14 a

)

Explain the basic principle of UV-Visible spectroscopy. What are the possible electronic transitions? Explain with examples. (10)

b) Sketch the vibrational modes of CO_2 and H_2O. Which of them are IR active? (4)

15 a) Explain the principle, instrumentation and procedure involved in gas chromatography. (10)
b) Explain the DTA of $CaC_2O_4.H_2O$ with a neat sketch. (4)

OR

16 a) Explain the various chemical methods used for the synthesis of nanomaterial (10)
b) How TGA is used to analyse the thermal stability of polymers? (4)

Module 4

17 a) What are conformers? Draw the*cis* and *trans*isomers of 1, 3-dimethylcylohexane. Which conformer (chair form) is more stable in each case? (10)

b) What is ABS? Give properties and applications. (4)

OR

18 a) Explain the various structural isomers with suitable example. (10)
b) What is OLED? Draw a labelled diagram. (4)

Module 5

19 a) What are ion exchange resins? Explain ion exchange process for removal of hardness of water? How exhausted resins are regenerated? (10)
b) 50 mL sewage water is diluted to 2000 mL with dilution water; the initial dissolved oxygen was 7.7 ppm. The dissolved oxygen level after 5 days of incubation was 2.4 ppm. Find the BOD of the sewage. (4)

OR

20 a) What are the different steps in sewage treatment? Give the flow diagram. Explain theworking of trickling filter.
b) Calculate the temporary and permanent hardness of a water sample which contains[Ca^{2+}] = 160 mg/L, [Mg^{2+}] = 192 mg/L and [HCO_3^-] = 122 mg/L.

Module 3

(10)

(4)

Syllabus

Module 1

Electrochemistry and Corrosion

Introduction - Differences between electrolytic and electrochemical cells - Daniel cell - redox reactions - cell representation. Different types of electrodes (brief) - Reference electrodes - SHE - Calomel electrode - Glass Electrode - Construction and Working. Single electrode potential - definition - Helmholtz electrical double layer -Determination of E^0 using calomel electrode.Determination of pH using glass electrode.Electrochemical series and its applications. Free energy and EMF - Nernst Equation - Derivation - single electrode and cell (Numericals) -Application - Variation of emf with temperature. Potentiometric titration - Introduction -Redox titration only.Lithiumion cell - construction and working.Conductivity- Measurement of conductivity of a solution (Numericals).

Corrosion-Electrochemicalcorrosion – mechanism. Galvanic series- cathodic protection - electroless plating –Copper and Nickel plating.

Module 2

Spectroscopic Techniques and Applications

Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numericals). UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications.IR-Spectroscopy – Principle - Number of vibrational modes - Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications. ^{1}H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief).

Module 3

Instrumental Methods and Nanomaterials

Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $CaC_2O_4.H_2O$ and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of $CaC_2O_4.H_2O$. Chromatographic methods - Basic principles and applications of column and TLC-Retention factor. GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications.

Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nanomaterials - Surface characterisation -SEM – Principle and instrumentation (block diagram).

Module 4

Stereochemistry and Polymer Chemistry

Isomerism-Structural, chain, position, functional, tautomerism and matamerism - Definition with examples - Representation of 3D structures-Newman, Sawhorse, Wedge and Fischer projection of substituted methane and ethane. Stereoisomerism - Geometrical isomerism in double bonds and cycloalkanes (cis-trans and E-Z notations). R-S Notation – Rules and examples - Optical isomerism, Chirality, Enantiomers and Diastereoisomers-Definition with examples.Conformational analysis of ethane, butane, cyclohexane, mono and di methyl substituted cyclohexane.

Copolymers - Definition - Types - Random, Alternating, Block and Graft copolymers - ABS - preparation, properties and applications.Kevlar-preparation, properties and applications.Conducting polymers - Doping -Polyaniline and Polypyrrole - preparation properties and applications. OLED - Principle, construction and advantages.

Module 5

Water Chemistry and Sewage Water Treatment

Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages. Municipal water treatment (brief) - Disinfection methods - chlorination, ozone andUV irradiation.

Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD-definition, estimation (only brief procedure) and significance (Numericals). Sewage water treatment - Primary, Secondary and Tertiary - Flow diagram -Trickling filter and UASB process.

Text Books

1. B. L. Tembe, Kamaluddin, M. S. Krishnan, “Engineering Chemistry (NPTEL Web-book)”, 2018.

2. P. W. Atkins, “Physical Chemistry”, Oxford University Press, 10^{th} edn., 2014.

Reference Books

1. C. N. Banwell, “Fundamentals of Molecular Spectroscopy”, McGraw-Hill, 4^{th}edn., 1995.
2. Donald L. Pavia, “Introduction to Spectroscopy”, Cengage Learning India Pvt. Ltd., 2015.
3. B. R. Puri, L. R. Sharma, M. S. Pathania, “Principles of Physical Chemistry”, Vishal Publishing Co., 47^{th} Edition, 2017.
4. H. H. Willard, L. L. Merritt, “Instrumental Methods of Analysis”, CBS Publishers, 7^{th} Edition, 2005.
5. Ernest L. Eliel, Samuel H. Wilen, “Stereo-chemistry of Organic Compounds”, WILEY, 2008.
6. Raymond B. Seymour, Charles E. Carraher, “Polymer Chemistry: An Introduction”, Marcel Dekker Inc; 4th Revised Edition, 1996.
7. MuhammedArif, Annette Fernandez, Kavitha P. Nair “Engineering Chemistry”, Owl Books, 2019.
8. Ahad J., “Engineering Chemistry”, Jai Publication, 2019.
9. Roy K. Varghese, “Engineering Chemistry”, Crownplus Publishers, 2019.
10. Soney C. George,RinoLaly Jose, “Text Book of Engineering Chemistry”, S. Chand & Company Pvt Ltd, 2019.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures (hrs)
1	**Electrochemistry and Corrosion**	**9**
1.1	Introduction - Differences between electrolytic and electrochemical cells- Daniel cell - redox reactions - cell representation. Different types of electrodes (brief) - Reference electrodes- SHE - Calomel electrode - Glass Electrode - Construction and Working.	**2**
1.2	Single electrode potential – definition - Helmholtz electrical double layer - Determination of E^0 using calomel electrode. Determination of pH using glass electrode. Electrochemical series and its applications. Free energy and EMF - Nernst Equation – Derivation - single electrode and cell (Numericals) -Application -Variation of emf with temperature.	**3**
1.3	Potentiometric titration - Introduction -Redox titration only. Lithiumion cell - construction and working. Conductivity- Measurement of conductivity of a solution (Numericals).	**2**
1.4	Corrosion-Electrochemicalcorrosion – mechanism. Galvanic series- cathodic protection - electroless plating –Copper and Nickel plating.	**2**
2	**Spectroscopic Techniques and Applications**	**9**
2.1	Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numericals).	**2**
2.2	UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation ofUV-Visible spectrometer and applications.	**2**
2.3	IR-Spectroscopy – Principle - Number of vibrational modes -Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications.	**2**
2.4	^1H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief).	**3**
3	**Instrumental Methods and Nanomaterials**	**9**
3.1	Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $CaC_2O_4.H_2O$ and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of $CaC_2O_4.H_2O$.	**2**

3.2	Chromatographic methods - Basic principles and applications of column and TLC- Retention factor.	**2**
3.3	GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications.	**2**
3.4	Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nanomaterials - Surface characterisation -SEM – Principle and instrumentation (block diagram).	**3**
4	**Stereochemistry and Polymer Chemistry**	**9**
4.1	Isomerism-Structural, chain, position, functional, tautomerism and matamerism - Definition with examples - Representation of 3D structures-Newman, Sawhorse, Wedge and Fischer projection of substituted methane and ethane. Stereoisomerism - Geometrical isomerism in double bonds and cycloalkanes (cis-trans and E-Z notations).	**2**
4.2	R-S Notation – Rules and examples - Optical isomerism, Chirality, Enantiomers and Diastereoisomers-Definition with examples.	**1**
4.3	Conformational analysis of ethane, butane, cyclohexane, mono and di methyl substituted cyclohexane.	**2**
4.4	Copolymers - Definition - Types - Random, Alternating, Block and Graft copolymers - ABS - preparation, properties and applications. Kevlar-preparation, properties and applications. Conducting polymers - Doping -Polyaniline and Polypyrrole - preparation properties and applications. OLED - Principle, construction and advantages.	**4**
5	**Water Chemistry and Sewage Water Treatment**	**9**
5.1	Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages.	**3**
5.2	Municipal water treatment (brief) - Disinfection methods - chlorination, ozone andUV irradiation.	**2**
5.3	Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD-definition, estimation (only brief procedure) and significance (Numericals).	**2**
5.4	Sewage water treatment - Primary, Secondary and Tertiary - Flow diagram - Trickling filter and UASB process.	**2**

22EST 204	ENGINEERING MECHANICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		ESC	2	1	0	3	2019

Preamble: Goal of this course is to expose the students to the fundamental concepts of mechanics and enhance their problem-solving skills. It introduces students to the influence of applied force system and the geometrical properties of the rigid bodies while stationary or in motion. After this course students will be able to recognize similar problems in real-world situations and respond accordingly.

Prerequisite: Nil

Course Outcomes: After completion of the course the student will be able to:

CO 1	Recall principles and theorems related to rigid body mechanics
CO 2	Identify and describe the components of system of forces acting on the rigid body
CO 3	Apply the conditions of equilibrium to various practical problems involving different force system.
CO 4	Choose appropriate theorems, principles or formulae to solve problems of mechanics.
CO 5	Solve problems involving rigid bodies, applying the properties of distributed areas and masses

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-
CO 3	3	3	-	-	-	-	-	-	-	-	-	-
CO 4	3	3	-	-	-	-	-	-	-	-	-	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	15
Understand	10	10	15
Apply	30	30	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions:

Part A

Course Outcome 1 (CO1): (One question from each module to meet the course objective 1: *To recall principles and theorems related to rigid body mechanics***)**

1. Explain D'Alembert's principle

2. Distinguish static and dynamic friction

3. State and explain perpendicular axis theorem

Course Outcome 2 (CO2) (One question from each module to meet the course objective 2: *To identify and describe the components of system of forces acting on the rigid body***)**

1. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.

2. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling. Diagram the forces acting on the combination of gymnast and bar

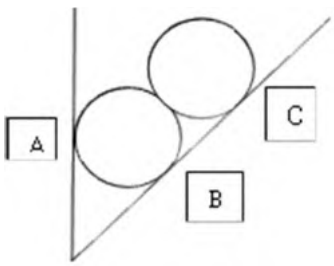
3. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?

Part B

All the questions under this section shall assess the learning levels corresponding to the course outcomes listed below.

CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses

1. Two rollers each of weight 100 N are supported by an inclined plane and a vertical wall. Find the reaction at the points of contact A, B, C. Assume all the surfaces to be smooth.

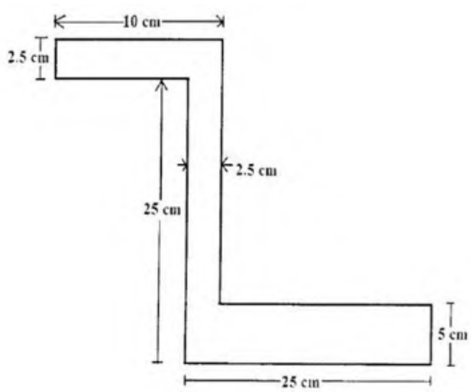


Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the freebody diagram that represent equilibrium state of the body)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

2. A cylindrical disc, 50 cm diameter and cm thickness, is in contact with a horizontal conveyor belts running at uniform speeds of 5 m/s. Assuming there is no slip at points of contact determine (i) angular velocity of disc (ii) Angular acceleration of disc if velocity of conveyor changes to 8 m/s. Also compute the moment acting about the axis of the disc in both cases.

Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent state of the body)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

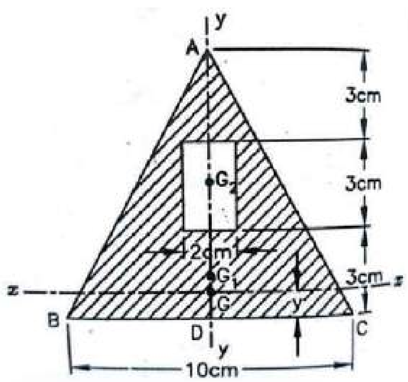
3. Determine the centroid of the given section



Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Illustrate the computation of centroid for the given geometrical shape)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed	Applying (Solve the problem based on the descriptions	6

	areas and masses	given in CO3 and CO4)	
Total			14

4. A rectangular hole is made in a triangular section as shown. Find moment of inertia about the section x-x passing through the CG of the section and parallel to BC.



Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Illustrate the computation of moment of inertia for the given geometrical shape)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

TKM COLLEGE OF ENGINEERING, KOLLAM (GOVT. AIDED AUTONOMOUS)

Model Question Paper

QP CODE:

Reg No.:________________

Name:___________________________ ____

Course Code: 22EST204

ENGINEERING MECHANICS

Max. Marks: 100 Duration: 3 hours

Part A

(Answer all questions; each question carries 3 marks)

1. Explain D'Alembert's principle

2. Distinguish static and dynamic frictioni.

3. State and explain perpendicular axis theorem.

4. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.

5. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling. Diagram the forces acting on the combination of gymnast and bar

6. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?

7. Compare damped and undamped free vibrations.

8. State the equation of motion of a rotating rigid body, rotating about its fixed axis.

9. Illustrate the significance of instantaneous centre in the analysis of rigid body undergoing rotational motion.

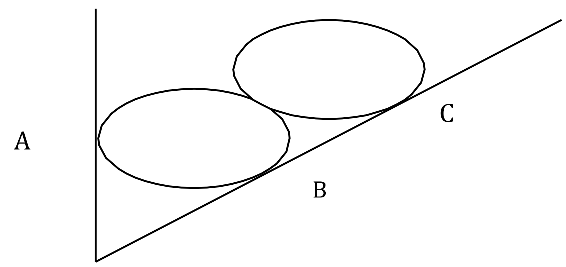
10. Highlight the principles of mechanics applied in the evaluation of elastic collusion of rigid bodies.

PART B

(Answer **one full** question from each module, each question carries **14** marks)

Module -I

11. Two identical rollers each of weight 100 N are supported by an inclined plane, making an angle of 30^o with the vertical, and a vertical wall. Find the reaction at the points of contact A, B, C. Assume all the surfaces to be smooth. (14 marks)

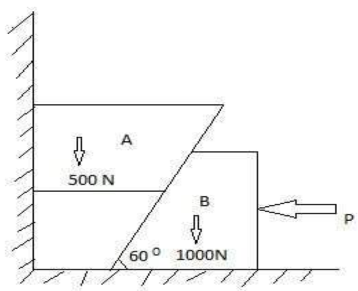


12. A string tied to a wall is made to pass over a pulley placed 2m away from it. A weight P is attached to the string such that the string stretches by 2m from the support on the wall to the location of attachment of weight. Determine the force P required to maintain 200 kg body in position for = 30°, The diameter of pulley B is negligible. (14 marks)

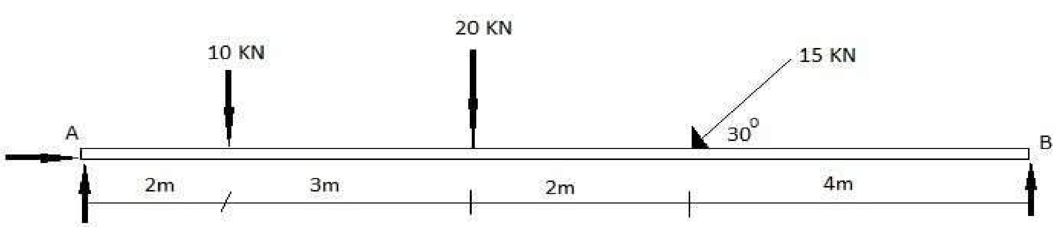
Module – 2

13. Two blocks A & B are resting against a wall and the floor as shown in figure below. Find the value of horizontal force P applied to the lower block that will hold the system in equilibrium. Coefficient of friction are : 0.25 at the floor, 0.3 at the wall and 0.2 between the blocks.

(14 marks)

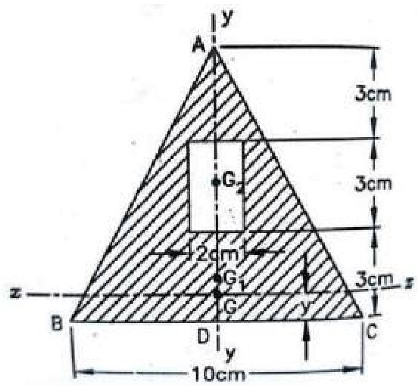


14. A beam is hinged at A and roller supported at B. It is acted upon by loads as shown below. Find the reactions at A & B. (14 marks)

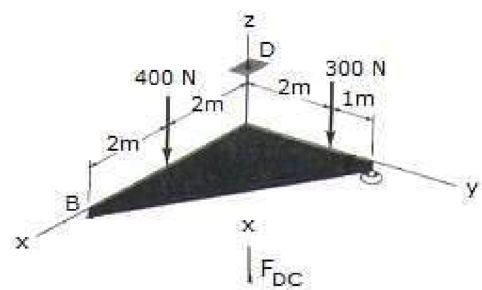


Module – 3

15. A rectangular hole is made in a triangular section as shown. Find moment of inertia about the section x-x passing through the CG of the section and parallel to BC. (14 marks)



16. Support A has ball and socket connection. Roller support at B prevents motion in the —z direction. Corner *C* is tied to *D* by a rope. The triangle is weightless. Determine the unknown force components acting at *A*, *B*, and *C*. (14 marks)



Module - 4

17. A cricket ball is thrown by a fielder from a height of 2m at an angle of 30^0 to the horizontal with an initial velocity of 20 m/s , hits the wickets at a height of 0.5 m from the ground. How far was the fielder from the wicket? (14 marks)

18. An engine of weight 500 kN pull a train weighing 1500 kN up an incline of 1 in 100. The train starts from rest and moves with constant acceleration against a resistance of 5 N/kN. It attains a maximum speed of 36 kmph in 1 km distance. Determine the tension in the coupling between train and engine and the traction force developed by the engine. (14marks)

Module – 5

19. A cylindrical disc, 50 cm diameter and 10 cm thickness having mass of 10 kg, is in contact with a horizontal conveyor belt running at uniform speeds of 5 m/s. Assuming there is no slip at points of contact determine (i) angular velocity of disc (ii) Angular acceleration of disc if velocity of conveyor changes to 8 m/s in 10 seconds. Also compute the moment acting about the axis of the disc in both cases. (14 marks)

20. A wheel rotating about fixed axis at 20 rpm is uniformly accelerated for 70 seconds during which time it makes 50 revolutions. Find the (i) angular velocity at the end of this interval and (ii) time required for the velocity to reach 100 revolutions per minute. (14 marks)

SYLLABUS

Module 1

Introduction to Engineering Mechanics-statics-basic principles of statics-Parallelogram law, equilibrium law, principles of superposition and transmissibility, law of action and reaction(review) free body diagrams.

Concurrent coplanar forces-composition and resolution of forces-resultant and equilibrium equations – methods of projections – methods of moments – Varignon's Theorem of moments.

Module 2

Friction – sliding friction - Coulomb's laws of friction – analysis of single bodies –wedges, ladder-analysis of connected bodies .

Parallel coplanar forces – couple - resultant of parallel forces – centre of parallel forces – equilibrium of parallel forces – Simple beam subject to concentrated vertical loads. General coplanar force system - resultant and equilibrium equations.

Module 3

Centroid of composite areas- – moment of inertia-parallel axis and perpendicular axis theorems. Polar moment of inertia,radius of gyration,mass moment of inertia-ring,cylinder and disc.

Theorem of Pappus Guldinus(demonstration only)

Forces in space - vectorial representation of forces, moments and couples –resultant and equilibrium equations – concurrent forces in space (simple problems only)

Module 4

Dynamics – rectilinear translation - equations of kinematics(review)

kinetics – equation of motion – D'Alembert's principle. – motion on horizontal and inclined surfaces, motion of connected bodies. Impulse momentum equation and work energy equation (concepts only).

Curvilinear translation - equations of kinematics –projectile motion(review), kinetics – equation of motion. Moment of momentum and work energy equation (concepts only).

Module 5

Rotation – kinematics of rotation- equation of motion for a rigid body rotating about a fixed axis – rotation under a constant moment.

Plane motion of rigid body – instantaneous centre of rotation (concept only).

Simple harmonic motion – free vibration –degree of freedom- undamped free vibration of spring mass system-effect of damping(concept only)

Text Books

1. Timoshenko and Young, Engineering Mechanics, McGraw Hill Publishers
2. Shames, I. H., Engineering Mechanics - Statics and Dynamics, Prentice Hall of India.
3. R. C. Hibbeler and Ashok Gupta, Engineering Mechanics, Vol. I statics, Vol II Dynamics, Pearson Education.

References

1. Merriam J. L and Kraige L. G., Engineering Mechanics - Vols. 1 and 2, John Wiley.
2. Tayal A K, Engineering Mechanics – Statics and Dynamics, Umesh Publications
3. Bhavikkatti, S.S., Engineering Mechanics, New Age International Publishers
4. F.P.Beer abd E.R.Johnston (2011), Vector Mechanics for Engineers, Vol.I-Statics, Vol.II-Dynamics, 9th Ed, Tata McGraw Hill
5. Rajasekaran S and Sankarasubramanian G, Engineering Mechanics - Statics and Dynamics, Vikas Publishing House Pvt Ltd.

Course Contents and Lecture Schedule:

Module	Topic	Course outcomes addressed	No. of Hours
1	**Module 1**		**Total: 7**
1.1	Introduction to engineering mechanics – introduction on statics and dynamics - Basic principles of statics – Parellogram law, equilibrium law – Superposition and transmissibility, law of action and reaction (review the topics)	CO1 and CO2	1
1.2	Free body diagrams. Degree of freedom-types of supports and nature of reactions - exercises for free body diagram preparation – composition and resolution of forces, resultant and equilibrium equations (review the topics) - numerical exercises for illustration.	CO1 and CO2	1
1.3	Concurrent coplanar forces - analysis of concurrent forces -methods of projections – illustrative numerical exercise – teacher assisted problem solving.	CO1 and CO2	1
1.4	Analysis of concurrent forces -methods of moment-Varignon's Theorem of Moments - illustrative numerical exercise– teacher assisted problem solving.	CO1 and CO2	1
1.5	Analysis of concurrent force systems – extended problem solving - Session I.	CO3,CO4 and CO5	1
1.6	Analysis of concurrent force systems – extended problem solving - Session II – learning review quiz.	CO3,CO4 and CO5	1
1.7	Analysis of concurrent force systems – extended problem solving - Session III.	CO3,CO4 and CO5	1
2	**Module 2**		**Total: 7**
2.1	Friction – sliding friction - Coulomb's laws of friction – analysis of single bodies –illustrative examples on wedges and ladder-teacher	CO1 and CO2	1

	assisted problem solving tutorials using problems from wedges and ladder.		
2.2	Problems on friction - analysis of connected bodies. illustrative numerical exercise– teacher assisted problem solving.	CO3, CO4 and CO5	1
2.3	Problems on friction-extended problem solving	CO3,C04 and CO5	1
2.4	Parallel coplanar forces – couple - resultant of parallel forces – centre of parallel forces – equilibrium of parallel forces – Simple beam subject to concentrated vertical loads.	CO1 and CO2	1
2.5	General coplanar force system - resultant and equilibrium equations - illustrative examples- teacher assisted problem solving.	CO1 and CO2	1
2.6	General coplanar force system-resultant and equilibrium equations - illustrative examples	CO3, CO4 and CO5	1
2.7	General coplanar force system - Extended problem solving - Quiz to evaluate learning level.	CO3, CO4 and CO5	1
3	**Module 3**		**Total: 7**
3.1	Centroid of simple and regular geometrical shapes – centroid of figures in combination - composite areas- examples for illustration – problems for practice to be done by self.	CO1 and CO2	1
3.2	Moment of inertia- parallel axis theorem –examples for illustration - problems for practice to be done by self.	CO1 and CO2	1
3.3	Moment of inertia - perpendicular axis theorem - example for illustration to be given as hand out and discussion on the solved example.	CO1 and CO2	1
3.4	Solutions to practice problems – problems related to centroid and moment of inertia - problems for practice to be done by self.	CO3, CO4 and CO5	1
3.5	Polar moment of inertia, Radius of gyration. Mass moment of inertia of ring, cylinder and uniform disc. Theorem of Pappus Guldinus - Demonstration	CO1 and CO2	1
3.6	Introduction to forces in space – vectorial representation of forces, moments and couples – simple problems to illustrate vector representations of forces, moments and couples to be done in class.	CO1,and CO2	1
3.7	Solution to practice problems - resultant and equilibrium equations for concurrent forces in space – concurrent forces in space - 2 simple problems to illustrate the application of resultant and equilibrium equations for concurrent forces in space.	CO3,CO4 and CO5	1
4	**Module 4**		**Total: 7**

4.1	Introduction to dynamics – review of rectilinear translation -equations of kinematics – problems to review the concepts – additional problems involving extended application as exercises .	CO1 and CO2	1
4.2	Solutions to exercises with necessary explanation given as hand out – introduction to kinetics – equation of motion – D'Alembert's principle – illustration of the concepts using one numerical exercise from motion on horizontal and inclined surfaces.	CO1 and CO2	1
4.3	Motion of connected bodies - example for illustration to be given as hand out and discussion on the solved example – problems for practice to be done by self.	CO3, CO4 and CO5	1
4.4	Motion of connected bodies-extended problem solving.	CO3, CO4 & CO5	1
4.5	Curvilinear translation - Review of kinematics –projectile motion – simple problems to review the concepts – introduction to kinetics – equation of motion – illustration of the concepts using numerical exercises.	CO3, CO4 & CO5	1
4.6	Extended problem solving – rectilinear and curvilinear translation.	CO3, CO4 & CO5	1
4.7	Concepts on Impulse momentum equation and work energy equation (rectilinear translation – discussions to bring out difference between elastic and inelastic collusions). Concepts on Moment of momentum and work energy equation (curvilinear translation).	CO1 and CO2	1
5	**Module 5**		**Total: 7**
5.1	Rotation – kinematics of rotation- equation of motion for a rigid body rotating about a fixed axis – simple problems for illustration.	CO1 and CO2	1
5.2	Rotation under a constant moment – teacher assisted problem solving.	CO3,CO4 and CO5	1
5.3	Rotation under a constant moment - extended problem solving.	CO3, CO4 and CO5	1
5.4	Plane motion of rigid body- instantaneous centre of rotation (concept only).	CO1 and CO2	1
5.5	Introduction to harmonic oscillation –free vibrations - simple harmonic motion – differential equation and solution. Degree of freedom – examples of single degree of freedom (SDOF) systems – Idealisation of mechanical systems as spring-mass systems (concept only).	CO1 and CO2	1

5.6	SDOF spring mass system –equation of motion – undamped free vibration response - concept of natural frequency. Free vibration response due to initial conditions. Simple problems on determination of natural frequency and free vibration response to test the understanding level.	CO1 and CO2	1
5.7	Free vibration analysis of SDOF spring-mass systems – Problem solving Effect of damping on free vibration response (concept only).	CO1and CO2	1

22EST 205	ENGINEERING GRAPHICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		ESC	2	0	2	3	2019

Preamble: To enable the student to effectively perform technical communication through graphical representation as per global standards.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Draw the projection of points and lines located in different quadrants
CO 2	Prepare multiview orthographic projections of objects by visualizing them in different Positions
CO 3	Draw sectional views and develop surfaces of a given object
CO 4	Prepare pictorial drawings using the principles of isometric and perspective projections to visualize objects in three dimensions.
CO 5	Convert 3D views to orthographic views
CO 6	Obtain multiview projections and solid models of objects using CAD tools

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3											
CO 2	3											
CO 3	3	1										
CO 4	3									1		
CO 5	3									2		
CO 6	3				3					3		

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (100 Marks)
	Test 1 (15 Marks)	Test 2 (15 Marks)	
Remember			
Understand	5		20
Apply	10	10	80
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

CIA for section A carries 25 marks (15 marks for 1 test and Class work 10 marks)

CIA for section B carries 15 marks (10 marks for 1 test and Class work 5 marks)

End Semester Examination Pattern:

ESE will be of 3 hour duration on A4 size answer booklet and will be for 100 marks. The question paper shall contain two questions from each module of Section A only. Student has to answer any one question from each module. Each question carries 20 marks.

Course Level Assessment Questions

(Questions may be framed based on the outline given under each course outcome)

Course Outcome 1 (CO1):

1. Locate points in different quadrants as per given conditions.
2. Problems on lines inclined to both planes .
3. Find True length, Inclinations and Traces of lines.

Course Outcome 2 (CO2)

1. Draw orthographic views of solids and combination solids
2. Draw views of solids inclined to any one reference plane.
3. Draw views of solids inclined to both reference planes.

Course Outcome 3 (CO3):

1. Draw views of solids sectioned by a cutting plane
2. Find location and inclination of cutting plane given true shape of the section
3. Draw development of lateral surface of solids and also its sectioned views

Course Outcome 4 (CO4):

1. Draw Isometric views/projections of soilds
2. Draw Isometric views/projections of combination of soilds
3. Draw Perspective views of Soilds

Course Outcome 5 (CO5):

1. Draw Orthographic views of solids from given three dimensional view

Course Outcome 6 (CO6):

1. Draw the given figure including dimensions using 2D software
2. Create 3D model using modelling software from the given orthographic views or 3D figure or from real 3D objects

Model Question paper

QP CODE: PAGES:3

Reg No:_______________

Name :_______________

Course Code: 22EST 205

ENGINEERING GRAPHICS

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

Instructions: Retain necessary Construction lines
Show necessary dimensions
Answer any ONE question from each module
Each question carries 20 marks

MODULE I

1. The end point A of a line is 20mm above HP and 10mm in front of VP. The other end of the line is 50mm above HP and 15mm behind VP. The distance between the end projectors is 70mm. Draw the projections of the line. Find the true length and true inclinations of the line with the principal planes. Also locate the traces of the line.
2. One end of a line is 20mm from both the principal planes of projection. The other end of the line is 50mm above HP and 40mm in front of VP. The true length of the line is 70mm. Draw the projections of the line. Find its apparent inclinations, elevation length and plan length. Also locate its traces.

MODULE II

3. A pentagonal pyramid of base side 25mm and height 40mm, is resting on the ground on one of its triangular faces. The base edge of that face is inclined 30° to VP. Draw the projections of the solid.

4. A hexagonal prism has side 25mm and height 50mm has a corner of its base on the ground and the long edge containing that corner inclined at 30^o to HP and 45^o to VP. Draw the projections of the solid.

MODULE III

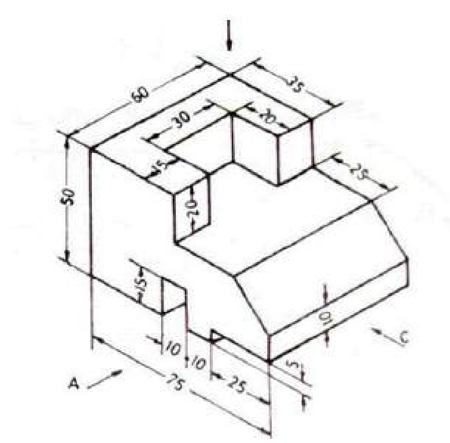
5. A triangular prism of base side 40mm and height 70mm is resting with its base on the ground and having an edge of the base perpendicular to VP. Section the solid such that the true shape of the section is a trapezium of parallel sides 30mm and 10mm. Draw the projections showing the true shape. Find the inclination of the cutting plane with the ground plane.
6. Draw the development of a pentagonal pyramid of base side 30mm and height 50mm. A string is wound from a corner of the base round the pyramid and back to the same point through the shortest distance. Show the position of the string in the elevation and plan.

MODULE IV

7. The frustum of a cone has base diameter 50mm and top diameter 40mm has a height of 60mm. It is paced centrally on top of a rectangular slab of size 80x60mm and of thickness 20mm. Draw the isometric view of the combination.
8. A hexagonal prism has base side 35mm and height 60mm. A sphere of diameter 40mm is placed centrally on top of it. Draw the isometric projection of the combination.

MODULE V

9. Draw the perspective view of a pentagonal prism, 20mm side and 45mm long lying on one of its rectangular faces on the ground and having its axis perpendicular to picture plane. One of its pentagonal faces touches the picture plane and the station point is 50mm in front of PP, 25mm above the ground plane and lies in a central plane, which is 70mm to the left of the center of the prism.
10. Draw three orthographic views with dimensions of the object shown in figure below.



(20X5=100)

Time : 3 hours **22EST205 ENGINEERING GRAPHICS** **Max. Marks: 100**

SCHEME OF VALUATION

1. Locating the points and drawing the projections of the line – 4 marks
   Finding true length by any one method – 6 marks
   Finding true inclination with VP – 2 marks
   Finding true inclination with HP – 2 marks
   Locating horizontal trace – 2 marks
   Locating vertical trace – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks
2. Locating the points and drawing true length of the line – 4 marks
   Finding projections by any method – 6 marks
   Finding length of elevation and plan – 2 marks
   Finding apparent inclinations – 2 marks
   Locating horizontal trace – 2 marks
   Locating vertical trace – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks
3. Drawing initial position plan and elevation – 4 marks
   First inclination views – 4 marks
   Second inclination views -8 marks
   Marking invisible edges – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

   (Any one method or combination of methods for solving can be used.
   If initial position is wrong then maximum 50% marks may be allotted for the answer)

4. Drawing initial position plan and elevation – 4 marks
   First inclination views – 4 marks
   Second inclination views -8 marks
   Marking invisible edges – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

   (Any one method or combination of methods for solving can be used

   If initial position is wrong then maximum 50% marks may be allotted for the answer)

5. Drawing initial position plan and elevation – 4 marks
   Locating section plane as per given condition – 5 marks
   Drawing true shape -5 marks
   Finding inclination of cutting plane – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks
6. Drawing initial position plan and elevation – 4 marks
   Development of the pyramid – 6 marks

Locating string in development -2 marks
Locating string in elevation – 3 marks
Locating string in plan – 3 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

7. Drawing initial positions – 4 marks
   Isometric View of Slab -6 marks
   Isometric View of Frustum – 10 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

   (Initial position is optional, hence redistribute if needed.
   Reduce 4 marks if Isometric scale is taken)

8. Drawing initial positions – 4 marks
   Isometric scale – 4 marks
   Isometric projection of prism -5 marks
   Isometric projection of sphere – 5 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

   (Initial position is optional, hence redistribute if needed.

9. Drawing the planes and locating the station point – 4 marks
   Locating elevation points – 2 marks
   Locating plan points – 2 marks
   Drawing the perspective view – 10 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

10. Drawing the elevation – 8marks
    Drawing the plan – 4 marks
    Drawing the side view – 4 marks
    Marking invisible edges – 2 marks
    Dimensioning and neatness – 2 marks

    Total = 20 marks

SYLLABUS

General Instructions:

- ➢ First angle projection to be followed
- ➢ Section A practice problems to be performed on A4 size sheets
- ➢ Section B classes to be conducted on CAD lab

SECTION A

Module 1

Introduction : Relevance of technical drawing in engineering field. Types of lines, Dimensioning, BIS code of practice for technical drawing.

Orthographic projection of Points and Lines: Projection of points in different quadrants, Projection of straight lines inclined to one plane and inclined to both planes. Trace of line. Inclination of lines with reference planes True length of line inclined to both the reference planes.

Module 2

Orthographic projection of Solids: Projection of Simple solids such as Triangular, Rectangle, Square, Pentagonal and Hexagonal Prisms, Pyramids, Cone and Cylinder. Projection of solids in simple position including profile view. Projection of solids with axis inclined to one of the reference planes and with axis inclined to both reference planes.

Module 3

Sections of Solids: Sections of Prisms, Pyramids, Cone, Cylinder with axis in vertical position and cut by different section planes. True shape of the sections. Also locating the section plane when the true shape of the section is given.

Development of Surfaces: Development of surfaces of the above solids and solids cut by different section planes. Also finding the shortest distance between two points on the surface.

Module 4

Isometric Projection: Isometric View and Projections of Prisms, Pyramids, Cone , Cylinder, Frustum of Pyramid, Frustum of Cone, Sphere, Hemisphere and their combinations.

Module 5

Perspective Projection: Perspective projection of Prisms and Pyramids with axis perpendicular to the ground plane, axis perpendicular to picture plane.

Conversion of Pictorial Views: Conversion of pictorial views into orthographic views.

SECTION B

(To be conducted in CAD Lab)

Introduction to Computer Aided Drawing: Role of CAD in design and development of new products, Advantages of CAD. Creating two dimensional drawing with dimensions using suitable software. (Minimum 2 exercises mandatory)

Introduction to Solid Modelling: Creating 3D models of various components using suitable modelling software. (Minimum 2 exercises mandatory)

Text Books

1. Bhatt, N.D., Engineering Drawing, Charotar Publishing House Pvt. Ltd.
2. John, K.C. Engineering Graphics, Prentice Hall India Publishers.

Reference Books

1. Anilkumar, K.N., Engineering Graphics, Adhyuth narayan Publishers
2. Agrawal, B. And Agrawal, C.M., Engineering Darwing, Tata McGraw Hill Publishers.
3. Benjamin, J., Engineering Graphics, Pentex Publishers- 3rd Edition, 2017
4. Duff, J.M. and Ross, W.A., Engineering Design and Visualisation, Cengage Learning.
5. Kulkarni, D.M., Rastogi, A.P. and Sarkar, A.K., Engineering Graphics with AutoCAD, PHI.
6. Luzaddff, W.J. and Duff, J.M., Fundamentals of Engineering Drawing, PHI.
7. Varghese, P.I., Engineering Graphics, V I P Publishers
8. Venugopal, K., Engineering Drawing and Graphics, New Age International Publishers.

Course Contents and Lecture Schedule

No	**SECTION A**	No. of Hours
1	**MODULE I**	
1.1	Introduction to graphics, types of lines, Dimensioning	1
1.2	Concept of principle planes of projection, different quadrants, locating points on different quadrants	2
1.3	Projection of lines, inclined to one plane. Lines inclined to both planes, trapezoid method of solving problems on lines.	2
1.4	Problems on lines using trapezoid method	2
1.5	Line rotation method of solving, problems on line rotation method	2
2	**MODULE II**	
2.1	Introduction of different solids, Simple position plan and elevation of solids	2
2.2	Problems on views of solids inclined to one plane	2
2.3	Problems on views of solids inclined to both planes	2
2.4	Practice problems on solids inclined to both planes	2

3	**MODULE III**	
3.1	Introduction to section planes. AIP and AVP. Principle of locating cutting points and finding true shape	2
3.2	Problems on sections of different solids	2
3.3	Problems when the true shape is given	2
3.4	Principle of development of solids, sectioned solids	2
4	**MODULE IV**	
4.1	Principle of Isometric View and Projection, Isometric Scale. Problems on simple solids	2
4.2	Isometric problems on Frustum of solids, Sphere and Hemisphere	2
4.3	Problems on combination of different solids	2
5	**MODULE V**	
5.1	Introduction to perspective projection, different planes, station point etc. Perspective problems on pyramids	2
5.2	Perspective problems on prisms	2
5.3	Practice on conversion of pictorial views into orthographic views	2
	SECTION B *(To be conducted in CAD lab)*	
1	Introduction to CAD and software. Familiarising features of 2D software. Practice on making 2D drawings	2
2	Practice session on 2D drafting	2
3	Introduction to solid modelling and software	2
4	Practice session on 3D modelling	2

22EST 206	**BASICS OF CIVIL & MECHANICAL ENGINEERING**	**CATEGORY**	**L**	**T**	**P**	**CREDIT**	**YEAR OF INTRODUCTION**
		ESC	4	0	0	4	2019

Preamble:

Objective of this course is to provide an insight and inculcate the essentials of Civil Engineering discipline to the students of all branches of Engineering and to provide the students an illustration of the significance of the Civil Engineering Profession in satisfying the societal needs.

To introduce the students to the basic principles of mechanical engineering

Prerequisite: NIL

Course Outcomes: After completion of the course, the student will be able to

CO 1	Recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering.
CO 2	Explain different types of buildings, building components, building materials and building construction
CO 3	Describe the importance, objectives and principles of surveying.
CO 4	Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps
CO 5	Discuss the Materials, energy systems, water management and environment for green buildings.
CO 6	Analyse thermodynamic cycles and calculate its efficiency
CO 7	Illustrate the working and features of IC Engines
CO 8	Explain the basic principles of Refrigeration and Air Conditioning
CO 9	Describe the working of hydraulic machines
CO 10	Explain the working of power transmission elements
CO 11	Describe the basic manufacturing, metal joining and machining processes

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	3	2	2	-	-	-	-
CO2	3	2	-	1	3	-	-	3	-	-	-	-
CO3	3	2	-	-	3	-	-	-	2	-	-	-

CO4	3	2	-	-	3	-	-	-	2	-	-	-
CO5	3	2	-	-	3	2	3	-	2	-	-	-
CO6	3	2										
CO7	3	1										
CO8	3	1										
CO9	3	2										
CO10	3	1										
CO11	3											

Assessment Pattern

	Basic Civil Engineering			**Basic Mechanical Engineering**		
Bloom's Category	**Continuous Assessment**		**End Semester Examination (marks)**	**Continuous Assessment**		**End Semester Examination (marks)**
	Test 1 marks	**Test 2 marks**		**Test 1 marks**	**Test 2 marks**	
Remember	5	5	10	7.5	7.5	15
Understand	20	20	40	12.5	12.5	25
Apply				5	5	10
Analyse						
Evaluate						
Create						

Mark distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern:

There will be two parts; Part I – Basic Civil Engineering and Part II – Basic Mechanical Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts -

Part A and Part B. Part A contain 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module out of which one to be answered. Each question carries 10 mark and can have maximum 2 sub-divisions. The pattern for end semester examination for part II is same as that of part I. **However, student should answer both part I and part 2 in separate answer booklets.**

Course Level Assessment Questions:

Course Outcome CO1: *To recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering.*

1.Explain relevance of Civil engineering in the overall infrastructural development of the country.
Course outcome 2 (CO2) (One question from each module and not more than two)

Explain different types of buildings, building components, building materials and building construction

1. Discuss the difference between plinth area and carpet area.

Course outcome 3 (CO3) (One question from each module and not more than two)

Describe the importance, objectives and principles of surveying.

1. Explain the importance of surveying in Civil Engineering

Course outcome 4 (CO4) (One question from each module and not more than two)

Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps

1. Explain the civil engineering aspects of elevators, escalators and ramps in buildings

Course outcome 5 (CO5) (One question from each module and not more than two)

Discuss the Materials, energy systems, water management and environment for green buildings.

1. Discuss the relevance of Green building in society

<u>Section II</u> *Answer any 1 full question from each module. Each full question carries 10 marks*

Course Outcome 1 (CO1) (Two full question from each module and each question can have maximum 2 sub-divisions)

To recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering
<u>CO Questions</u>

1. a List out the types of building as per occupancy. Explain any two, each in about five sentences.
  b. Discuss the components of a building with a neat figure.

2. a. What are the major disciplines of civil engineering and explain their role in the infrastructural framework.

b. Explain the role of NBC, KBR & CRZ norms in building rules and regulations prevailing in our country.

Course Outcome 2 (CO2) & Course Outcome 3 (CO3) (Two full question from each module and each question can have maximum 2 sub-divisions)

Explain different types of buildings, building components, building materials and building construction & Describe the importance, objectives and principles of surveying.

CO Questions

1. **a.** What are the different kinds of cement available and what is their use.
b. List the properties of good building bricks. Explain any five.

2. a. List and explain any five modern construction materials used for construction.
b. Explain the objectives and principles of surveying

Course outcome 4 (CO4) & Course outcome 5 (CO5) (Two full question from each module and each question can have maximum 2 sub-divisions)

Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps & Discuss the Materials, energy systems, water management and environment for green buildings.

CO Questions

1. **a**. Draw the elevation and plan of one brick thick wall with English bond
b. Explain the energy systems and water management in Green buildings

2. **a.** Draw neat sketch of the following foundations: (i) Isolated stepped footing; (ii) Cantilever footing; and (iii) Continuous footing.

b. Discuss the civil engineering aspect of MEP and HVAC in a commercial building

Course Outcome 6 (CO6):

1. In an air standard Otto cycle the compression ratio is 7 and compression begins at 35^oC, 0.1 MPa. The maximum temperature of the cycle is 1100^oC. Find
   i) Heat supplied per kg of air,
   ii) Work done per kg of air,
   iii) Cycle efficiency
   Take Cp = 1.005 kJ/kgK and Cv=0.718 kJ/kgK
2. A Carnot cycle works with adiabatic compression ratio of 5 and isothermal expansion ratio of 2. The volume of air at the beginning of isothermal expansion is 0.3 m^3. If the maximum temperature and pressure is limited to 550K and 21 bar, determine the minimum temperature in the cycle and efficiency of the cycle.
3. In an ideal diesel cycle, the temperature at the beginning and end of compression is 65^oC and 620^oC respectively. The temperature at the beginning and end of the expansion is 1850^oC and 850^oC. Determine the ideal efficiency of the cycle.

4. Explain the concepts of CRDI and MPFI in IC Engines.

Course Outcome 7 (CO7)

1. With the help of a neat sketch explain the working of a 4 stroke SI engine
2. Compare the working of 2 stroke and 4 stroke IC engines
3. Explain the classification of IC Engines.

Course Outcome 8(CO8):

1. Explain the working of vapour compression refrigeration system.
2. With the help of suitable sketch explain the working of a split air conditioner.
3. Define: COP, specific humidity, relative humidity and dew point temperature.

Course Outcome 9 (CO9):

1. Explain the working of a single stage centrifugal pump with sketches.
2. With the help of a neat sketch, explain the working of a reciprocating pump.
3. A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 m^3/s. If the overall efficiency of the turbine is 90%. Determine the power developed by the turbine.

Course Outcome 10 (CO10):

1. Explain the working of belt drive and gear drive with the help of neat sketches
2. Explain a single plate clutch.
3. Sketch different types of gear trains and explain.

Course Outcome 11 (CO11):

1. Describe the operations which can be performed using drilling machine.
2. Explain the functions of runners and risers used in casting.
3. With a neat sketch, explain the working and parts of a lathe.

Model Question Paper

QP CODE: **22EST206** page:3

Reg No:____________________

Name:_______________________________

Course Code:22 EST 206

Course Name: BASICS OF CIVIL AND MECHANICAL ENGINEERING

Max. Marks: 100 Duration: 3 hours

Answer both part I and part 2 in separate answer booklets

PART I: BASIC CIVIL ENGINEERING

PART A

(Answer all questions. Each question carries 4 marks)

1. Explain relevance of Civil engineering in the overall infrastructural development of the country.
2. Discuss the difference between plinth area and carpet area.
3. Explain different types of steel with their properties.
4. What are the different kinds of cement available and what is their use?
5. Define bearing capacity of soil.

(5 x 4 = 20)

Part B

Answer one full question from each module.

MODULE I

6a. List out the types of building as per occupancy. Explain any two, each in about five sentences. (5)

b. Discuss the components of a building with a neat figure. (5)

OR

7a. What are the major disciplines of civil engineering and explain their role in the infrastructural framework. (5)

b. Explain the role of NBC, KBR & CRZ norms in building rules and regulations prevailing in our country. (5)

MODULE II

8a. What are the different kinds of cement available and what is their use. (5)

b. List the properties of good building bricks. Explain any five. (5)

OR

9a. List and explain any five modern construction materials used for construction. (5)

b. Explain the objectives and principles of surveying (5)

MODULE III

10a. Draw the elevation and plan of one brick thick wall with English bond (5)

b. Explain the energy systems and water management in Green buildings (5)

OR

11a. Draw neat sketch of the following foundations: (i) Isolated stepped footing; (ii) Cantilever footing; and (iii) Continuous footing. (5)

b. Discuss the civil engineering aspect of MEP and HVAC in a commercial building (5)

[10 x 3 = 30]

PART II: BASIC MECHANICAL ENGINEERING

PART A

Answer all questions. Each question carries 4 marks

1. Sketch the P-v and T-s diagram of a Carnot cycle and List the processes.
2. Illustrate the working of an epicyclic gear train.
3. Explain cooling and dehumidification processes.
4. Differentiate between soldering and brazing.
5. Explain the principle of Additive manufacturing.

4 x 5 = 20 marks

Part B

Answer one full question from each module.

MODULE I

6. In an air standard Otto cycle the compression ratio is 7 and compression begins at 35^{o}C, 0.1MPa. The maximum temperature of the cycle is 1100^{o}C. Find
   i) Heat supplied per kg of air,
   ii) Work done per kg of air,
   iii)Cycle efficiency

   Take C_p = 1.005 kJ/kgK and C_v=0.718 kJ/kgK — 10 marks

OR

7. a) Explain the working of a 4 stroke SI engine with neat sketches. — 7 marks
   b) Explain the fuel system of a petrol engine. — 3 marks

MODULE II

8. a) Explain the working of a vapour compression system with help of a block diagram. — 7 marks
   b) Define: Specific humidity, relative humidity and dew point temperature. — 3 marks

OR

9. With the help of a neat sketch, explain the working of a centrifugal pump. — 10 marks

MODULE III

10. Explain the two high, three high, four high and cluster rolling mills with neat sketches. — 10 marks

OR

11. a) Describe the arc welding process with a neat sketch. — 6 marks
    b) Differentiate between up-milling and down-milling operations. — 4 marks

SYLLABUS

Module 1

General Introduction to Civil Engineering: Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment. Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.

Introduction to buildings: Types of buildings, selection of site for buildings, components of a residential building and their functions.

Building rules and regulations: Relevance of NBC, KBR & CRZ norms (brief discussion only).

Building area: Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.

Module 2

Surveying: Importance, objectives and principles.

Construction materials, Conventional construction materials**:** types, properties and uses of building materials: bricks, stones, cement, sand and timber

Cement concrete: Constituent materials, properties and types.

Steel: Steel sections and steel reinforcements, types and uses.

Modern construction materials:- Architectural glass, ceramics, Plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials. Modern uses of gypsum, pre-fabricated building components (brief discussion only).

Module 3

Building Construction: Foundations: Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only). Load bearing and framed structures (concept only).

Brick masonry: - Header and stretcher bond, English bond & Flemish bond random rubble masonry.

Roofs and floors: - Functions, types; flooring materials (brief discussion only).

Basic infrastructure services: MEP, HVAC, elevators, escalators and ramps (Civil Engineering aspects only), fire safety for buildings.

Green buildings:- Materials, energy systems, water management and environment for green buildings. (brief discussion only).

Module 4

Analysis of thermodynamic cycles: Carnot, Otto, Diesel cycles, Derivation of efficiency of these cycles, Problems to calculate heat added, heat rejected, net work and efficiency. IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines. Efficiencies of IC Engines(Definitions only), Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines.

Module 5

Refrigeration: Unit of refrigeration, reversed Carnot cycle,COP, vapour compression cycle (only description and no problems); Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners.
Description about working with sketches of: Reciprocating pump, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan turbine. Overall efficiency, Problems on calculation of input and output power of pumps and turbines (No velocity triangles)
Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches.

Module 6

Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications.
Metal Joining Processes: List types of welding, Description with sketches of Arc Welding, Soldering and Brazing and their applications
Basic Machining operations: Turning, Drilling, Milling and Grinding.
Description about working with block diagram of: Lathe, Drilling machine, Milling machine, CNC Machine. Principle of CAD/CAM, Rapid and Additive manufacturing.

Text Books:

1. Rangwala, S. C., Essentials of Civil Engineering, Charotar Publishing House
2. Mckay, W.B. and Mckay, J. K., Building Construction, Volumes 1 to 4, Pearson India Education Services

References Books:

1. Chen W.F and Liew J Y R (Eds), The Civil Engineering Handbook. II Edition CRC Press (Taylor and Francis)
2. Chudley, R and Greeno R, Building construction handbook, Addison Wesley, Longman group, England
3. Chudley, R, Construction Technology, Vol. I to IV, Longman group, England Course Plan
4. Kandya A A, Elements of Civil Engineering, Charotar Publishing house
5. Mamlouk, M. S., and Zaniewski, J. P., Materials for Civil and Construction Engineering, Pearson Publishers
6. Rangwala S.C and Dalal K B Building Construction Charotar Publishing house
7. Clifford, M., Simmons, K. and Shipway, P., An Introduction to Mechanical Engineering Part I - CRC Press
8. Roy and Choudhary, Elements of Mechanical Engineering, Media Promoters &Publishers Pvt. Ltd., Mumbai.
9. Sawhney, G. S., Fundamentals of Mechanical Engineering, PHI
10. G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018
11. Benjamin,J.,Basic Mechanical Engineering,Pentex Books,9th Edition,2018
12. Balachandran, P.Basic Mechanical Engineering,Owl Books

Course Contents and Lecture Schedule:

No	**Topic**	**Course outcomes addressed**	**No. of Lectures**
1	**Module I**		**Total: 7**
1.1	*General Introduction to Civil Engineering*: Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment.	CO1	1
1.2	Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.	CO1	2
1.3	*Introduction to buildings:* Types of buildings, selection of site for buildings, components of a residential building and their functions.	CO2	2
1.4	*Building rules and regulations:* Relevance of NBC, KBR & CRZ norms (brief discussion only)	CO2	1
1.5	*Building area:* Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.	CO2	1
2	**Module 2**		**Total: 7**
2.1	*Surveying:* Importance, objectives and principles.	CO3	1
2.2	Bricks: - Classification, properties of good bricks, and tests on Bricks	CO2	1
2.3	Stones: - *Qualities* of good stones, types of stones and their uses. Cement: - Good qualities of cement, types of cement and their uses.	CO2	1
2.4	Sand: - Classification, qualities of good sand and sieve analysis (basics only). Timber: - Characteristics, properties and uses.	CO2	1
2.5	Cement concrete: - Constituent materials, properties and types, Steel: - Steel sections and steel reinforcements, types and uses.	CO2	1

2.6	Modern construction materials: - Architectural glass, ceramics, plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials, modern uses of gypsum, pre-fabricated building components (brief discussion only)	CO2	2
3	**Module 3**		**Total: 7**
3.1	Foundations: - Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only). Brick masonry: - Header and stretcher bond, English bond & Flemish bond– elevation and plan (one & one and a half brick wall only). Random rubble masonry.	CO2	2
3.2	Roofs: Functions, types; roofing materials (brief discussion only) Floors: Functions, types; flooring materials (brief discussion only)	CO2	2
3.3	*Basic infrastructure services:* MEP, HVAC, Elevators, escalators and ramps (Civil Engineering aspects only) fire safety for buildings	CO4	2
3.4	*Green buildings:*- Materials, energy systems, water management and environment for green buildings. (brief discussion only)	CO5	1
4	**MODULE 4**		
4.1	Analysis of thermodynamic cycles: Carnot, Otto, and Diesel cycle- Derivation of efficiency of these cycles, Problems to calculate heat added, heat rejected, net work and efficiency	4	
4.2	IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines, efficiencies of IC Engines(Description only)	2	
4.3	Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines	2	
5	**MODULE 5**		
5.1	Refrigeration: Unit of refrigeration, reversed Carnot cycle, COP, vapour compression cycle (only description and no problems)	1	
5.2	Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners.	1	

5.3	Description about working with sketches : Reciprocating pump, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan turbine. Overall efficiency, Problems on calculation of input and output power of pumps and turbines (No velocity triangles)	4
5.4	Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches	3
6	**MODULE 6**	
6.1	Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications.	2
6.2	Metal Joining Processes :List types of welding, Description with sketches of Arc Welding, Soldering and Brazing, and their applications	1
6.3	Basic Machining operations: Turning, Drilling, Milling and Grinding Description about working with block diagrams of: Lathe, Drilling machine, Milling machine, CNC Machine	3
6.4	Principle of CAD/CAM, Rapid and Additive manufacturing	1

22EST 207	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	4	0	0	4	2019

Preamble:

This course aims to (1) equip the students with an understanding of the fundamental principles of electrical engineering(2) provide an overview of evolution of electronics, and introduce the working principle and examples of fundamental electronic devices and circuits (3) provide an overview of evolution of communication systems, and introduce the basic concepts in radio communication.

Prerequisite: Physics and Mathematics (Pre-university level)

Course Outcomes: After the completion of the course the student will be able to

CO 1	Apply fundamental concepts and circuit laws to solve simple DC electric circuits
CO 2	Develop and solve models of magnetic circuits
CO 3	Apply the fundamental laws of electrical engineering to solve simple ac circuits in steady State
CO 4	Describe working of a voltage amplifier
CO 5	Outline the principle of an electronic instrumentation system
CO 6	Explain the principle of radio and cellular communication

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	-	-	-	-	-	-	-	-	-	2
CO 2	3	1	-	-	-	-	-	-	-	-	-	2
CO 3	3	1	-	-	-	-	-	-	-	-	-	2
CO 4	2	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	2
CO 6	2	-	-	-	-	-	-	-	-	-	-	2

Assessment Pattern

	Basic Electrical Engineering			Basic Electronics Engineering		
Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (Marks)**	**Continuous Assessment Tests**		**End Semester Examination (Marks)**
	Test 1 (Marks)	**Test 2 (Marks)**		**Test 1 (Marks)**	**Test 2 (Marks)**	
Remember	0	0	10	10	10	20
Understand	12.5	12.5	20	15	15	30
Apply	12.5	12.5	20			
Analyse						
Evaluate						
Create						

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part I – Basic Electrical Engineering and Part II – Basic Electronics Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts - Part A and Part B. Part A contain 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module out of which one to be answered. Each question carries 10 mark and can have maximum 2 sub-divisions. The pattern for end semester examination for part II is same as that of part I. **However, student should answer both part I and part 2 in separate answer booklets.**

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Solve problems based on current division rule.

2. Solve problems with Mesh/node analysis.

3. Solve problems on Wye-Delta Transformation.

Course Outcome 2 (CO2):

1. Problems on series magnetic circuits

2. Problems on parallel magnetic circuits

3. Problems on composite magnetic ciruits

4. Course Outcome 3 (CO3):

1. problems on self inductance, mutual inductance and coefficient of coupling

2. problems on rms and average values of periodic waveforms

3. problems on series ac circuits

4. Compare star and Delta connected 3 phase AC systems.

Course Outcome 4 (CO4): Describe working of a voltage amplifier

1.What is the need of voltage divider biasing in an RC coupled amplifier?

2. Define operating point in the context of a BJT amplifier.

3. Why is it required to have a voltage amplifier in a public address system?

Course Outcome 5 (CO5): Outline the principle of an electronic instrumentation system

1. Draw the block diagram of an electronic instrumentation system.

2. What is a transducer?

3. Explain the working principle of operation of digital multimeter.

Course Outcome 6 (CO6): Explain the principle of radio and cellular communication

1. What is the working principle of an antenna when used in a radio transmitter?

2. What is the need of two separate sections RF section and IF section in a super heterodyne receiver?

3. What is meant by a cell in a cellular communication?

Model Question Paper

QP CODE: Pages: 3

Reg No.:________________

Name:__________________

Course Code: 22EST 207

Course Name: BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

Max. Marks: 100 Duration: 3 hours

Answer both part I and part 2 in separate answer booklets

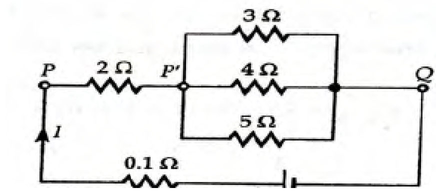
PART I

BASIC ELECTRICAL ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Calculate the current through the 4□ resistor in the circuit shown, applying current division rule:



2. Calculate the RMS and average values of a purely sinusoidal current having peak value 15A.

3. An alternating voltage of (80+j60)V is applied to an RX circuit and the current flowing through the circuit is (-4+j10)A. Calculate the impedance of the circuit in rectangular and polar forms. Also determine if X is inductive or capacitive.

4. Derive the relation between line and phase values of voltage in a three phase star connected system.

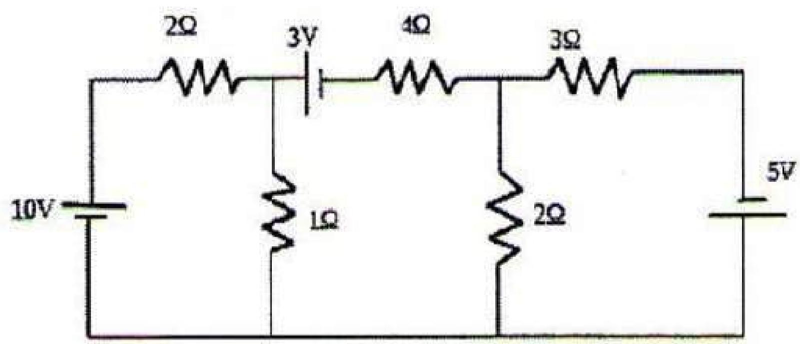
5. Compare electric and magnetic circuits. *(5x4=20)*

PART B

Answer one question from each module; each question carries 10 marks.

Module 1

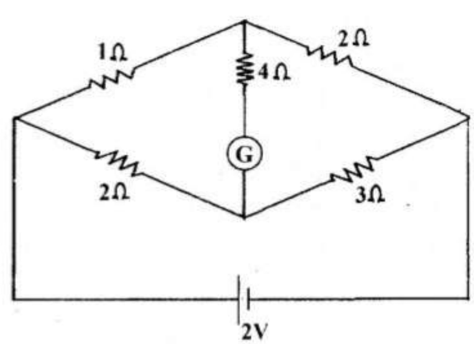
6. . Calculate the node voltages in the circuit shown, applying node analysis:



(6 marks)

7. (a) State and explain Kirchhoff's laws. (4 marks)

(b) Calculate the current through the galvanometer (G) in the circuit shown:



Module 2

8. (a) State and explain Faraday's laws of electromagnetic induction with examples. (4 marks)

(b) Differentiate between statically and dynamically induced emf. A conductor of length 0.5m moves in a uniform magnetic field of flux density 1.1T at a velocity of 30m/s.Calculate the emf induced in the conductor if the direction of motion of the conductor is inclined at 60^0 to the direction of field. (6 marks)

9. (a) Derive the amplitude factor and form factor of a purely sinusoidal waveform. (5 marks)

(b) A current wave is made up of two components-a 5A dc component and a 50Hz ac component, which is a sinusoidal wave with a peak value of 5A. Sketch the resultant waveform and determine its RMS and average values. (5 marks)

Module 3

10. Draw the power triangle and define active, reactive and apparent powers in ac circuits. Two coils A and B are connected in series across a 240V, 50Hz supply. The resistance of A is 5 □ and the inductance of B is 0.015H. If the input from the supply is 3kW and 2kVAR, find the inductance of A and the resistance of B. Also calculate the voltage across each coil.

11. A balanced three phase load consists of three coils each having resistance of 4Ω and inductance 0.02H. It is connected to a 415V, 50Hz, 3-phase ac supply. Determine the phase voltage, phase current, power factor and active power when the loads are connectedin (i) star (ii) delta.

(3x10=30)

PART II

BASIC ELECTRONICS ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Give the specifications of a resistor. The colour bands marked on a resistor are Blue, Grey, Yellow and Gold. What are the minimum and maximum resistance values expected from that resistance?
2. What is meant by avalanche breakdown?
3. Explain the working of a full-wave bridge rectifier.
4. Discuss the role of coupling and bypass capacitors in a single stage RC coupled amplifier.
5. Differentiate AM and FM communication systems.

(5x4=20)

PART B

Answer one question from each module; each question carries 10 marks.

Module 4

6. a) Explain with diagram the principle of operation of an NPN transistor. (5)
   b) Sketch and explain the typical input-output characteristics of a BJT when connected in common emitter configuration. (5)

OR

7. a) Explain the formation of a potential barrier in a P-N junction diode. (5)
   b) What do you understand by Avalanche breakdown? Draw and explain the V-I characteristics of a P-N junction and Zener diode. (5)

Module 5

8. a) With a neat circuit diagram, explain the working of an RC coupled amplifier. (6)
   b) Draw the frequency response characteristics of an RC coupled amplifier and state the reasons for the reduction of gain at lower and higher frequencies. (4)

OR

9. a) With the help of block diagram, explain how an electronic instrumentation system. (6)
   b) Explain the principle of an antenna. (4)

Module 6

10. a) With the help of a block diagram, explain the working of Super hetrodyne receiver. (6)
    b) Explain the importance of antenna in a communication system. (4)

OR

11. a) With neat sketches explain a cellular communication system. (5)
    b) Explain GSM communication with the help of a block diagram. (5)

(3x10=30)

SYLLABUS

MODULE 1: Elementary Concepts of Electric Circuits

Elementary concepts of DC electric circuits: Basic Terminology including voltage, current, power, resistance, emf; Resistances in series and parallel; Current and Voltage Division Rules; Capacitors & Inductors: V-I relations and energy stored. Ohms Law and Kirchhoff's laws-Problems; Star-delta conversion (resistive networks only-derivation not required)-problems.

Analysis of DC electric circuits: Mesh current method - Matrix representation - Solution of network equations. Node voltage methods-matrix representation-solution of network equations by matrix methods. Numerical problems.

MODULE 2: Elementary Concepts of Magnetic circuits, Electromagnetic Induction and AC fundamentals

Magnetic Circuits: Basic Terminology: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits- Series and parallel magnetic circuits with composite materials, numerical problems.

Electromagnetic Induction: Faraday's laws, problems, Lenz's law- statically induced and dynamically induced emfs - Self-inductance and mutual inductance, coefficient of coupling

Alternating Current fundamentals: Generation of alternating voltages-Representation of sinusoidal waveforms: frequency, period, Average, RMS values and form factor of waveforms-Numerical Problems.

MODULE 3: AC Circuits

AC Circuits: Phasor representation of sinusoidal quantities. Trignometric, Rectangular, Polar and complex forms. Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power Power factor. Analysis of RL, RC and RLC series circuits-active, reactive and apparent power. Simple numerical problems.

Three phase AC systems: Generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- Numerical problems

MODULE 4

Introduction to Semiconductor devices: Evolution of electronics – Vacuum tubes to nano electronics. Resistors, Capacitors and Inductors (constructional features not required): types, specifications. Standard values, color coding. PN Junction diode: Principle of operation, V-I characteristics, principle of avalanche breakdown. Bipolar Junction Transistors: PNP and NPN structures, Principle of operation, relation between current gains in CE, CB and CC, input and output characteristics of common emitter configuration.

MODULE 5

Basic electronic circuits and instrumentation: Rectifiers and power supplies: Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

MODULE 6

Introduction to Communication Systems: Evolution of communication systems – Telegraphy to 5G. Radio communication: principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver, Principle of antenna – radiation from accelerated charge. Mobile communication: basic principles of cellular communications, principle and block diagram of GSM.

Text Books

1. D P Kothari and I J Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. D C Kulshreshtha, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
3. ChinmoySaha, Arindham Halder and Debarati Ganguly, Basic Electronics - Principles and Applications, Cambridge University Press, 2018.
4. M.S.Sukhija and T.K.Nagsarkar, Basic Electrical and Electronics Engineering, Oxford University Press, 2012.
5. Wayne Tomasi and Neil Storey, A Textbook On Basic Communication and Information Engineering, Pearson, 2010.

Reference Books

1. Del Toro V, “Electrical Engineering Fundamentals”, Pearson Education.
2. T. K. Nagsarkar, M. S. Sukhija, “Basic Electrical Engineering”, Oxford Higher Education.
3. Hayt W H, Kemmerly J E, and Durbin S M, “Engineering Circuit Analysis”, Tata McGraw-Hill
4. Hughes, “Electrical and Electronic Technology”, Pearson Education.
5. V. N. Mittle and Arvind Mittal, “Basic Electrical Engineering,” Second Edition, McGraw Hill.
6. Parker and Smith, “Problems in Electrical Engineering”, CBS Publishers and Distributors.
7. S. B. Lal Seksena and Kaustuv Dasgupta, “Fundamentals of Electrical Engineering”, Cambridge University Press.
8. Anant Agarwal, Jeffrey Lang, Foundations of Analog and Digital Electronic Circuits, Morgan Kaufmann Publishers, 2005.
9. Bernard Grob, Ba sic Electronics, McGraw Hill.
10. A. Bruce Carlson, Paul B. Crilly, Communication Systems: An Introduction to Signals and Noise in Electrical Communication, Tata McGraw Hill, 5th Edition.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lectures
1	***Elementary Concepts of Electric Circuits***	
1.1	**Elementary concepts of DC electric circuits:** Basic Terminology including voltage, current, power, resistance, emf; Resistances in series and parallel; Current and Voltage Division Rules; Capacitors & Inductors: V-I relations and energy stored. Ohms Law and Kirchhoff's laws-Problems; Star-delta conversion (resistive networks only-derivation not required)-problems.	1 2 1
1.2	**Analysis of DC electric circuits:** Mesh current method - Matrix representation - Solution of network equations. Node voltage methods-matrix representation-solution of network equations by matrix methods. Numerical problems.	1 1 2
2	**Elementary Concepts of Magnetic circuits, Electromagnetic Induction and AC fundamentals**	
2.1	**Magnetic Circuits:** Basic Terminology: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits- Series and parallel magnetic circuits with composite materials, numerical problems.	1 2
2.2	**Electromagnetic Induction:** Faraday's laws, problems, Lenz's law-statically induced and dynamically induced emfs - Self-inductance and mutual inductance, coefficient of coupling	1 2
2.3	**Alternating Current fundamentals:** Generation of alternating voltages-Representation of sinusoidal waveforms: frequency, period, Average, RMS values and form factor of waveforms-Numerical Problems.	2
3	**AC Circuits**	

3.1	**AC Circuits:** Phasor representation of sinusoidal quantities. Trigonometric, Rectangular, Polar and complex forms. Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power, Power factor. Analysis of RL, RC and RLC series circuits-active, reactive and apparent power. Simple numerical problems.	1 2 1 2
3.2	**Three phase AC systems:** Generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- Numerical problems.	2
4	**Introduction to Semiconductor devices**	
4.1	Evolution of electronics – Vacuum tubes to nano electronics (In evolutional perspective only)	1
4.2	Resistors, Capacitors and Inductors: types, specifications. Standard values, color coding (No constructional features)	2
4.3	**PN Junction diode**: Principle of operation, V-I characteristics, principle of avalanche breakdown	2
4.4	**Bipolar Junction Transistors:** PNP and NPN structures, Principle of operation, relation between current gains in CE, CB and CC, input and output characteristics of common emitter configuration	3
5	**Basic electronic circuits and instrumentation**	
5.1	**Rectifiers and power supplies:** Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator	3
5.2	**Amplifiers:** Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing	4
5.3	**Electronic Instrumentation:** Block diagram of an electronic instrumentation system	2
6	**Introduction to Communication Systems**	
6.1	Evolution of communication systems – Telegraphy to 5G	1

6.2	**Radio communication:** principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver, Principle of antenna – radiation from accelerated charge	4
6.3	**Mobile communication:** basic principles of cellular communications, principle and block diagram of GSM.	2

Suggested Simulation Assignments for Basic Electronics Engineering

1. Plot V-I characteristics of Si and Ge diodes on a simulator
2. Plot Input and Output characteristics of BJT on a simulator
3. Implementation of half wave and full wave rectifiers
4. Simulation of RC coupled amplifier with the design supplied
5. Generation of AM signal

Note: The simulations can be done on open tools such as QUCS, KiCad, GNURadio or similar software to augment the understanding.

22HUT 208	PROFESSIONAL COMMUNICATION	CATEGORY	L	T	P	CREDIT
		MNC	2	0	2	--

Preamble: Clear, precise, and effective communication has become a *sine qua non* in today's information-driven world given its interdependencies and seamless connectivity. Any aspiring professional cannot but master the key elements of such communication. The objective of this course is to equip students with the necessary skills to listen, read, write, and speak so as to comprehend and successfully convey any idea, technical or otherwise, as well as give them the necessary polish to become persuasive communicators.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to

CO 1	Develop vocabulary and language skills relevant to engineering as a profession
CO 2	Analyze, interpret and effectively summarize a variety of textual content
CO 3	Create effective technical presentations
CO 4	Discuss a given technical/non-technical topic in a group setting and arrive at generalizations/consensus
CO 5	Identify drawbacks in listening patterns and apply listening techniques for specific needs
CO 6	Create professional and technical documents that are clear and adhering to all the necessary conventions

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1										3		2
CO 2										1		3
CO 3						1			1	3		
CO 4										3		1
CO 5		1							2	3		
CO 6	1					1			1	3		

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	50	50	2 hours

Continuous Internal Evaluation

Total Marks: 50

Attendance	: 10 marks
Regular assessment	: 25 marks
Series test (one test only, should include verbal aptitude for placement and higher studies, this test will be conducted for 50 marks and reduced to 15)	: 15 marks

Regular assessment

Project report presentation and Technical presentation through PPT	: 7.5 marks
Listening Test	: 5 marks
Group discussion/mock job interview	: 7.5 marks
Resume submission	: 5 marks

End Semester Examination

Total Marks: 50, Time: 2 hrs.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. List down the ways in which gestures affect verbal communication.
2. Match the words and meanings

Ambiguous	promotion
Bona fide	referring to whole
Holistic	not clear
Exaltation	genuine

3. Expand the following Compound Nouns - a. Water supply. b. Object recognition. c. Steam turbine

Course Outcome 2 (CO2)

1. Read the passage below and prepare notes:

Mathematics, rightly viewed, possesses not only truth, but supreme beauty—a beauty cold and austere, like that of sculpture, without appeal to any part of our weaker nature, without the gorgeous trappings of painting or music, yet sublimely pure, and capable of a stern perfection such as only the greatest art can show. The true spirit of delight, the exaltation, the sense of being more than man, which is the touchstone of the highest excellence, is to be found in mathematics as surelyas in poetry. What is best in mathematics deserves not merely to be learnt as a task, but to be assimilated as a part of daily thought, and brought again and again before the mind with ever- renewed encouragement. Real life is, to most men, a long second-best, a perpetual compromise between the ideal and the possible; but the world of pure reason knows no compromise, nopractical limitations, no barrier to the creative activity embodying in splendid edifices the passionateaspiration after the perfect from which all great work springs. Remote from human passions, remoteeven from the pitiful facts of nature, the generations have gradually created an ordered cosmos, where pure thought can dwell as in its natural home, and where one, at least, of our nobler impulsescan escape from the dreary exile of the actual world.

So little, however, have mathematicians aimed at beauty, that hardly anything in their work has had this conscious purpose. Much, owing to irrepressible instincts, which were better than avowed *beliefs, has been moulded by an unconscious taste; but much also has been spoilt by false notions of what was fitting. The characteristic excellence of mathematics is only to be found where the reasoning is rigidly logical: the rules of logic are to mathematics what those of structure are to architecture. In the most beautiful work, a chain of argument is presented in which every link is important on its own account, in which there is an air of ease and lucidity throughout, and the premises achieve more than would have been thought possible, by means which appear natural and inevitable. Literature embodies what is general in particular circumstances whose universal significance shines through their individual dress; but mathematics endeavours to present whatever is most general in its purity, without any irrelevant trappings.*

How should the teaching of mathematics be conducted so as to communicate to the learner as much as possible of this high ideal? Here experience must, in a great measure, be our guide; but some maxims may result from our consideration of the ultimate purpose to be achieved.

- From "On the teaching of mathematics" – Bertrand Russell

2. Enumerate the advantages and disadvantages of speed reading. Discuss how it can impact comprehension.

Course Outcome 3(CO3):

1. What are the key elements of a successful presentation?
2. Elucidate the importance of non-verbal communication in making a presentation
3. List out the key components in a technical presentation.

Course Outcome 4 (CO4):

1. Discuss: 'In today's world, being a good listener is more important than being a good Speaker.'
2. Listen to a video/live group discussion on a particular topic, and prepare a brief summary of the proceedings.
3. List the do's and don'ts in a group discussion.

Course Outcome 5 (CO5):

1. Watch a movie clip and write the subtitles for the dialogue.
2. What do you mean by barriers to effective listening? List ways to overcome each of these.
3. What are the different types of interviews? How are listening skills particularly important in Skype/telephonic interviews?

Course Outcome 6 (CO6):

1. Explain the basic structure of a technical report.
2. You have been offered an internship in a much sought-after aerospace company and are very excited about it. However, the dates clash with your series tests. Write a letter to the Manager – University Relations of the company asking them if they can change the dates to coincide with your vacation.
3. You work in a well-reputed aerospace company as Manager – University Relations. You are in charge of offering internships. A student has sent you a letter requesting you to change the dates allotted to him since he has series exams at that time. But there are no vacancies available during the period he has requested for. Compose an e-mail informing him of this and suggest that he try to arrange the matter with his college.

Syllabus

Module 1

Use of language in communication: Significance of technical communication Vocabulary Development: technical vocabulary, vocabulary used in formal letters/emails and reports, sequence words, misspelled words, compound words, finding suitable synonyms, paraphrasing, verbal analogies. Language Development: subject-verb agreement, personal passive voice, numerical adjectives, embedded sentences, clauses, conditionals, reported speech, active/passive voice.

Technology-based communication: Effective email messages, slide presentations, editing skills using software. Modern day research and study skills: search engines, repositories, forums such as Git Hub, Stack Exchange, OSS communities (MOOC, SWAYAM, NPTEL), and Quora; Plagiarism

Module 2

Reading, Comprehension, and Summarizing: Reading styles, speed, valuation, critical reading, reading and comprehending shorter and longer technical articles from journals, newspapers, identifying the various transitions in a text, SQ3R method, PQRST method, speed reading. Comprehension: techniques, understanding textbooks, marking and underlining, Note-taking: recognizing non-verbal cues.

Module 3

Oral Presentation: Voice modulation, tone, describing a process, Presentation Skills: Oral presentation and public speaking skills, business presentations, Preparation: organizing the material, self-Introduction, introducing the topic, answering questions, individual presentation practice, presenting visuals effectively.

Debate and Group Discussions: introduction to Group Discussion (GD), differences between GD and debate; participating GD, understanding GD, brainstorming the topic, questioning and clarifying, GD strategies, activities to improve GD skills

Module 4

Listening and Interview Skills Listening: Active and Passive listening, listening: for general content, to fill up information, intensive listening, for specific information, to answer, and to understand. Developing effective listening skills, barriers to effective listening, listening to longer technical talks, listening to classroom lectures, talks on engineering /technology, listening to documentaries and making notes, TED talks.

Interview Skills: types of interviews, successful interviews, interview etiquette, dress code, body language, telephone/online (skype) interviews, one-to-one interview & panel interview, FAQs related to job interviews

Module 5

Formal writing: Technical Writing: differences between technical and literary style. Letter Writing (formal, informal and semi formal), Job applications, Minute preparation, CV preparation (differences between Bio-Data, CV and Resume), and Reports. Elements of style, Common Errors in Writing: describing a process, use of sequence words, Statements of Purpose, Instructions, Checklists.

Analytical and issue-based Essays and Report Writing: basics of report writing; Referencing Style (IEEE Format), structure of a report; types of reports, references, bibliography.

Lab Activities

Written: Letter writing, CV writing, Attending a meeting and Minute Preparation, Vocabulary Building

Spoken: Phonetics, MMFS (Multimedia Feedback System), Mirroring, Elevator Pitch, telephone etiquette, qualities of a good presentation with emphasis on body language and use of visual aids.

Listening: Exercises based on audio materials like radio and podcasts. Listening to Song. practice and exercises.

Reading: Speed Reading, Reading with the help of Audio Visual Aids, Reading Comprehension Skills

Mock interview and Debate/Group Discussion: concepts, types, Do’s and don’ts- intensive practice

Reference Books

1. English for Engineers and Technologists (Combined edition, Vol. 1 and 2), Orient Blackswan 2010.
2. Meenakshi Raman and Sangeetha Sharma,”Technical Communication: Principles and Practice”, 2nd Edition, Oxford University Press, 2011
3. Stephen E. Lucas, "The Art of Public Speaking", 10th Edition; McGraw Hill Education, 2012.
4. Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw Hill Education, 2017.
5. William Strunk Jr. & E.B. White, "The Elements of Style", 4th Edition, Pearson, 1999.
6. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004.
7. Goodheart-Willcox, "Professional Communication", First Edition , 2017.
8. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India, 6 edition, 2015.
9. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1 edition, 2013.
10. Anand Ganguly, “Success in Interview”, RPH, 5th Edition, 2016.
11. Raman Sharma, “Technical Communications”, Oxford Publication, London, 2004.

22EST209	PROGRAMING IN C	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	2	1	2	4	2019

Preamble: The syllabus is prepared with the view of preparing the Engineering Graduates capable of writing readable C programs to solve computational problems that they may have to solve in their professional life. The course content is decided to cover the essential programming fundamentals which can be taught within the given slots in the curriculum. This course has got 2 Hours per week for practicing programming in C. A list showing 24 mandatory programming problems are given at the end. The instructor is supposed to give homework/assignments to write the listed programs in the rough record as and when the required theory part is covered in the class. The students are expected to come prepared with the required program written in the rough record for the lab classes.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Analyze a computational problem and develop an algorithm/flowchart to find its solution
CO 2	Develop readable* C programs with branching and looping statements, which uses Arithmetic, Logical, Relational or Bitwise operators.
CO 3	Write readable C programs with arrays, structure or union for storing the data to be processed
CO 4	Divide a given computational problem into a number of modules and develop a readable multi-function C program by using recursion if required, to find the solution to the computational problem
CO 5	Write readable C programs which use pointers for array processing and parameter passing
CO 6	Develop readable C programs with files for reading input and storing output

readable* - readability of a program means the following:

1. Logic used is easy to follow
2. Standards to be followed for indentation and formatting
3. Meaningful names are given to variables
4. Concise comments are provided wherever needed

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓		✓				✓	✓	✓
CO2	✓	✓	✓	✓	✓					✓		✓
CO3	✓	✓	✓	✓	✓					✓		✓
CO4	✓	✓	✓	✓	✓					✓	✓	✓
CO5	✓	✓			✓					✓		✓
CO6	✓	✓			✓					✓		✓

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks**
	Test 1 (Marks)	**Test 2 (Marks)**	
Remember	15	10	25
Understand	10	15	25
Apply	20	20	40
Analyse	5	5	10
Evaluate			
Create			

Mark distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test 1 (for theory, for 2 hrs)	: 20 marks
Continuous Assessment Test 2 (for lab, internal examination, for 2 hrs)	: 20 marks

Internal Examination Pattern: There will be two parts; Part A and Part B. Part A contains 5 questions with 2 questions from each module (2.5 modules x 2 = 5), having 3 marks for each question. Students should answer all questions. Part B also contains 5 questions with 2 questions from each module (2.5 modules x 2 = 5), of which a student should answer any one. The questions should not have sub-divisions and each one carries 7 marks.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1): Write an algorithm to check whether largest of 3 natural numbers is prime or not. Also, draw a flowchart for solving the same problem.

Course Outcome 2 (CO2): Write an easy to read C program to process a set of n natural numbers and to find the largest even number and smallest odd number from the given set of numbers. The program should not use division and modulus operators.

Course Outcome 3(CO3): Write an easy to read C program to process the marks obtained by n students of a class and prepare their rank list based on the sum of the marks obtained. There are 3 subjects for which examinations are conducted and the third subject is an elective where a student is allowed to take any one of the two courses offered.

Course Outcome 4 (CO4): Write an easy to read C program to find the value of a mathematical function f which is defined as follows. f(n) = n! / (sum of factors of n), if n is not prime and f(n) = n! / (sum of digits of n), if n is prime.

Course Outcome 5 (CO5): Write an easy to read C program to sort a set of n integers and to find the number of unique numbers and the number of repeated numbers in the given set of numbers. Use a function which takes an integer array of n elements, sorts the array using the Bubble Sorting Technique and returns the number of unique numbers and the number of repeated numbers in the given array.

Course Outcome 6 (CO6): Write an easy to read C program to process a text file and to print the Palindrome words into an output file.

Model Question paper

QP CODE: PAGES:3

Reg No:_______________

Name :_______________

***Course Code: 22*EST 209**

Course Name: Programming in C (Common to all programs)

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Write short note on processor and memory in a computer.
2. What are the differences between compiled and interpreted languages? Give example for each.
3. Write a C program to read a Natural Number through keyboard and to display the reverse of the given number. For example, if "3214567" is given as input, the output to be shown is "7654123".
4. Is it advisable to use *goto* statements in a C program? Justify your answer.
5. Explain the different ways in which you can *declare & initialize* a single dimensional array.
6. Write a C program to read a sentence through keyboard and to display the count of white spaces in the given sentence.
7. What are the advantages of using functions in a program?
8. With a simple example program, explain *scope* and *life time* of variables in C.
9. Write a function in C which takes the address of a single dimensional array (containing a finite sequence of numbers) and the number of numbers stored in the array as arguments and stores the numbers in the same array in reverse order. Use pointers to access the elements of the array.
10. With an example, explain the different modes of opening a file. (10x3=30)

Part B

Answer any one Question from each module. Each question carries 14 Marks

11. (a) Draw a flow chart to find the position of an element in a given sequence, using linear searching technique. With an example explain how the flowchart finds the position of a given element. **(10)**

(b) Write a pseudo code representing the flowchart for linear searching. **(4)**

OR

12. (a) With the help of a flow chart, explain the bubble sort operation. Illustrate with an example. **(10)**

(b) Write an algorithm representing the flowchart for bubble sort. **(4)**

13. (a) Write a C program to read an English Alphabet through keyboard and display whether the given Alphabet is in upper case or lower case. **(6)**

(b) Explain how one can use the builtin function in C, *scanf*to read values of different data types. Also explain using examples how one can use the builtin function in C, *printf*for text formatting. **(8)**

OR

14. (a) With suitable examples, explain various operators in C. (10)

(b) Explain how characters are stored and processed in C. **(4)**

15. (a) Write a function in C which takes a 2-Dimensional array storing a matrix of numbers and the order of the matrix (number of rows and columns) as arguments and displays the sum of the elements stored in each row. **(6)**

(b) Write a C program to check whether a given matrix is a diagonal matrix. **(8)**

OR

16. (a) Without using any builtin string processing function like *strlen*, *strcat* etc., write a program to concatenate two strings. **(8)**

(b) Write a C program to perform bubble sort. **(6)**

17. (a) Write a function namely *myFact* in C to find the factorial of a given number. Also, write another function in C namely*nCr* which accepts two positive integer parameters *n* and *r* and returns the value of the mathematical function*C(n,r)*(n! / (r! x (n - r)!)). The function *nCr* is expected to make use of the factorial function *myFact.* *(10)*

(b) What is recursion? Give an example. **(4)**

OR

18. (a) With a suitable example, explain the differences between a structure and a union in C. **(6)**

(b) Declare a structure namely *Student* to store the details (*roll number, name, mark_for_C*) of a student. Then, write a program in C to find the average mark obtained by the students in a class for the subject *Programming in C* (using the field *mark_for_C*). Use array of structures to store the required data **(8)**

19. (a) With a suitable example, explain the concept of pass by reference. **(6)**

(b) With a suitable example, explain how pointers can help in changing the content of a single dimensionally array passed as an argument to a function in C. **(8)**

OR

20. (a) Differentiate between sequential files and random access files? **(4)**

(b) Using the prototypes explain the functionality provided by the following functions. (10)

rewind()

i. fseek()

ii. ftell()

iii. fread()

iv.** fwrite()* ***(14X5=70)

SYLLABUS

Programming in C (Common to all disciplines)

Module 1

Basics of Computer Hardware and Software

Basics of Computer Architecture: processor, Memory, Input& Output devices
Application Software & System software: Compilers, interpreters, High level and low level languages
Introduction to structured approach to programming, Flow chart Algorithms, Pseudo code (*bubble sort, linear search - algorithms and pseudocode*)

Module 2

Program Basics

Basic structure of C program: Character set, Tokens, Identifiers in C, Variables and Data Types , Constants, Console IO Operations, printf and scanf
Operators and Expressions: Expressions and Arithmetic Operators, Relational and Logical Operators, Conditional operator, size of operator, Assignment operators and Bitwise Operators. Operators Precedence
Control Flow Statements: If Statement, Switch Statement, Unconditional Branching using goto statement, While Loop, Do While Loop, For Loop, Break and Continue statements.(Simple programs covering control flow)

Module 3

Arrays and strings

Arrays Declaration and Initialization, 1-Dimensional Array, 2-Dimensional Array
String processing: In built String handling functions (strlen, strcpy, strcat and strcmp, puts, gets)
Linear search program, bubble sort program, simple programs covering arrays and strings

Module 4

Working with functions

Introduction to modular programming, writing functions, formal parameters, actual parameters Pass by Value, Recursion, Arrays as Function Parameters structure, union, Storage Classes, Scope and life time of variables, *simple programs using functions*

Module 5

Pointers and Files

Basics of Pointer: declaring pointers, accessing data though pointers, NULL pointer,array access using pointers, pass by reference effect

File Operations: open, close, read, write, append

Sequential access and random access to files: In built file handlingfunctions (*rewind() ,fseek(), ftell(), feof(), fread(), fwrite()*), *simple programs covering pointers and files.*

Text Books

1. Schaum Series, Gottfried B.S.,Tata McGraw Hill,Programming with C
2. E. Balagurusamy, Mcgraw Hill,Programming in ANSI C
3. Asok N Kamthane, Pearson,Programming in C
4. Anita Goel, Pearson, Computer Fundamentals

Reference Books

1. Anita Goel and Ajay Mittal, Pearson, Computer fundamentals and Programming in C
2. Brian W. Kernighan and Dennis M. Ritchie, Pearson, C Programming Language
3. Rajaraman V, PHI, Computer Basics and Programming in C
4. Yashavant P, Kanetkar, BPB Publications, Let us C

Course Contents and Lecture Schedule

Module 1: Basics of Computer Hardware and Software		**(7 hours)**
1.1	**Basics of Computer Architecture:** Processor, Memory, Input& Output devices	**2 hours**
1.2	**Application Software & System software:** Compilers, interpreters, High level and low level languages	**2 hours**
1.3	Introduction to structured approach to programming, Flow chart	**1 hours**
1.4	Algorithms, Pseudo code (*bubble sort, linear search - algorithms and pseudocode*)	**2 hours**
Module 2: Program Basics		**(8 hours)**
2.1	**Basic structure of C program:** Character set, Tokens, Identifiers in C, Variables and Data Types , Constants, Console IO Operations, printf and scanf	**2 hours**
2.2	**Operators and Expressions:** Expressions and Arithmetic Operators, Relational and Logical Operators, Conditional operator, sizeof operator, Assignment operators and Bitwise Operators. Operators Precedence	**2 hours**

2.3	**Control Flow Statements:** If Statement, Switch Statement, Unconditional Branching using goto statement, While Loop, Do While Loop, For Loop, Break and Continue statements.*(Simple programs covering control flow)*	**4 hours**
Module 3: Arrays and strings:		**(6 hours)**
3.1	Arrays Declaration and Initialization, 1-Dimensional Array, 2-Dimensional Array	**2 hours**
3.2	**String processing:** In built String handling functions(*strlen, strcpy, strcat and strcmp, puts, gets*)	**2 hours**
3.3	Linear search program, bubble sort program, *simple programs covering arrays and strings*	**3 hours**
Module 4: Working with functions		**(7 hours)**
4.1	Introduction to modular programming, writing functions, formal parameters, actual parameters	**2 hours**
4.2	Pass by Value, Recursion, Arrays as Function Parameters	**2 hours**
4.3	structure, union, Storage Classes,Scope and life time of variables, *simple programs using functions*	**3 hours**
Module 5: Pointers and Files		**(7 hours)**
5.1	**Basics of Pointer**: declaring pointers, accessing data though pointers, NULL pointer,array access using pointers, pass by reference effect	**3 hours**
5.2	**File Operations**: open, close, read, write, append	1 **hours**
5.3	**Sequential access and random access to files:** In built file handlingfunctions (*rewind() ,fseek(), ftell(), feof(), fread(), fwrite()*)**,** *simple programs covering pointers and files.*	**2 hours**

C PROGRAMMING LAB (Practical part of EST 102, Programming in C)

Assessment Method: The Academic Assessment for the Programming lab should be done internally by the College. The assessment shall be made on 50 marks and the mark is divided as follows: Practical Records/Outputs - 20 marks (internal by the College), Regular Lab Viva - 5 marks (internal by the College), Final Practical Exam – 25 marks (internal by the College).

The mark obtained out of 50 will be converted into equivalent proportion out of 20 for CIE computation.

LIST OF LAB EXPERIMENTS

1. Familiarization of Hardware Components of a Computer

2. Familiarization of Linux environment – How to do Programming in C with Linux

3. Familiarization of console I/O and operators in C

i) Display "Hello World"

ii) Read two numbers, add them and display theirsum

iii) Read the radius of a circle, calculate its area and display it

iv)Evaluate the arithmetic expression ((a -b / c * d + e) * (f +g)) and display its solution.Read the values of the variables from the user through console.

4. Read 3 integer values and find the largest amoung them.

5. Read a Natural Number and check whether the number is prime or not

6. Read a Natural Number and check whether the number is Armstrong or not

7. Read n integers, store them in an array and find their sum and average

8. Read n integers, store them in an array and search for an element in the array using an algorithm for Linear Search

9. Read n integers, store them in an array and sort the elements in the array using Bubble Sort algorithm

10. Read a string (word), store it in an array and check whether it is a palindrome word or not.

11. Read two strings (each one ending with a $ symbol), store them in arrays and concatenate them without using library functions.

12. Read a string (ending with a $ symbol), store it in an array and count the number of vowels, consonants and spaces in it.

13. Read two input each representing the distances between two points in the Euclidean space, store these in structure variables and add the two distance values.

14. Using structure, read and print data of n employees (*Name, Employee Id and Salary*)

15. Declare a union containing 5 string variables (*Name, House Name, City Name, State and Pin code*) each with a length of C_SIZE (user defined constant). Then, read and display the address of a person using a variable of the union.

16. Find the factorial of a given Natural Number n usingrecursive and non recursive functions

17. **R**ead a string (word), store it in an array and obtain its reverse by using a user defined function.

18. Write a menu driven program for performing matrix addition, multiplication and finding the transpose. Use functions to (i) read a matrix, (ii) find the sum of two matrices, (iii) find the product of two matrices, (i) find the transpose of a matrix and (v) display a matrix.

19. Do the following using pointers

i) add two numbers

ii) swap two numbers using a user defined function

20. Input and Print the elements of an array using pointers

21. Compute sum of the elements stored in an array using pointers and user defined function.

22. Create a file and perform the following

iii) Write data to the file

iv) Read the data in a given file & display the file content on console

v) append new data and display on console

23. Open a text input file and count number of characters, words and lines in it; and store the results in an output file.

22PHL 210	ENGINEERING PHYSICS LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	0	0	2	1	2019

Preamble: The aim of this course is to make the students gain practical knowledge to co-relate with the theoretical studies and to develop practical applications of engineering materials and use the principle in the right way to implement the modern technology.

Prerequisite: Higher secondary level Physics

Course Outcomes: After the completion of the course the student will be able to

CO 1	Develop analytical/experimental skills and impart prerequisite hands on experience for engineering laboratories
CO 2	Understand the need for precise measurement practices for data recording
CO 3	Understand the principle, concept, working and applications of relevant technologies and comparison of results with theoretical calculations
CO 4	Analyze the techniques and skills associated with modern scientific tools such as lasers and fiber optics
CO 5	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3				3			1	2			1
CO 2	3				3			1	2			1
CO 3	3				3			1	2			1
CO 4	3				3			1	2			1
CO 5	3				3			1	2			1

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment /Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

LIST OF EXPERIMENTS

(Minimum 8 experiments should be completed)

1. CRO-Measurement of frequency and amplitude of wave forms
2. Measurement of strain using strain gauge and wheatstone bridge
3. LCR Circuit – Forced and damped harmonic oscillations
4. Melde's string apparatus- Measurement of frequency in the transverse and longitudinal mode
5. Wave length measurement of a monochromatic source of light using Newton's Rings method.
6. Determination of diameter of a thin wire or thickness of a thin strip of paper using air wedge method.
7. To measure the wavelength using a millimeter scale as a grating.
8. Measurement of wavelength of a source of light using grating.
9. Determination of dispersive power and resolving power of a plane transmission grating
10. Determination of the particle size of lycopodium powder
11. Determination of the wavelength of He-Ne laser or any standard laser using diffraction grating
12. Calculate the numerical aperture and study the losses that occur in optical fiber cable.
13. I-V characteristics of solar cell.
14. LED Characteristics.
15. Ultrasonic Diffractometer- Wavelength and velocity measurement of ultrasonic waves in a liquid
16. Deflection magnetometer-Moment of a magnet- Tan A position.

Reference books

1. S.L.Gupta and Dr.V.Kumar, "Practical physics with viva voice", Pragati PrakashanPublishers, Revised Edition, 2009
2. M.N.Avadhanulu, A.A.Dani and Pokely P.M, "Experiments in Engineering Physics", S.Chand&Co,2008
3. S. K. Gupta, "Engineering physics practicals", Krishna Prakashan Pvt. Ltd., 2014
4. P. R. Sasikumar "Practical Physics", PHI Ltd., 2011.

22CYL 211	ENGINEERING CHEMISTRY LAB	CATEGORY	L	T	P	CREDIT
		BSC	0	0	2	1

Preamble: To impart scientific approach and to familiarize with the experiments in chemistry relevant for research projects in higher semesters

Prerequisite: Experiments in chemistry introduced at the plus two levels in schools

Course outcomes: After the completion of the course the students will be able to

CO 1	Understand and practice different techniques of quantitative chemical analysis to generate experimental skills and apply these skills to various analyses
CO 2	Develop skills relevant to synthesize organic polymers and acquire the practical skill to use TLC for the identification of drugs
CO 3	Develop the ability to understand and explain the use of modern spectroscopic techniques for analysing and interpreting the IR spectra and NMR spectra of some organic compounds
CO 4	Acquire the ability to understand, explain and use instrumental techniques for chemical analysis
CO 5	Learn to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments
CO 6	Function as a member of a team, communicate effectively and engage in further learning. Also understand how chemistry addresses social, economical and environmental problems and why it is an integral part of curriculum

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3				2							3
CO 2	3				3							3
CO 3	3				3							3
CO 4	3				3							3
CO 5	3				1							3
CO 6	3				1							3

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment /Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

LIST OF EXPERIMENTS (MINIMUM 8 MANDATORY)

1. Estimation of total hardness of water-EDTA method
2. Potentiometric titration
3. Determination of cell constant and conductance of solutions.
4. Calibration of pH meter and determination of pH of a solution
5. Estimation of chloride in water
6. Identification of drugs using TLC
7. Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} in solution
8. Determination of molar absorptivity of a compound ($KMnO_4$ or any water soluble food colorant)
9. Synthesis of polymers (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin
10. Estimation of iron in iron ore
11. Estimation of copper in brass
12. Estimation of dissolved oxygen by Winkler's method
13. (a) Analysis of IR spectra (minimum 3 spectra) (b) Analysis of ^1H NMR spectra (minimum 3 spectra)
14. Flame photometric estimation of Na^+ to find out the salinity in sand
15. Determination of acid value of a vegetable oil
16. Determination of saponification of a vegetable oil

Reference Books

1. G. Svehla, B. Sivasankar, "Vogel's Qualitative Inorganic Analysis", Pearson, 2012.
2. R. K. Mohapatra, "Engineering Chemistry with Laboratory Experiments", PHI Learning, 2017.
3. Muhammed Arif, "Engineering Chemistry Lab Manual", Owl publishers, 2019.
4. Ahad J., "Engineering Chemistry Lab manual", Jai Publications, 2019.
5. Roy K Varghese, "Engineering Chemistry Laboratory Manual", Crownplus Publishers, 2019.
6. Soney C George, Rino Laly Jose, "Lab Manual of Engineering Chemistry", S. Chand & Company Pvt Ltd, New Delhi, 2019.

22ESL 212	CIVIL & MECHANICAL WORKSHOP	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
			0	0	2	1	2019

Preamble: The course is designed to train the students to identify and manage the tools, materials and methods required to execute an engineering project. Students will be introduced to a team working environment where they develop the necessary skills for planning, preparing and executing an engineering project.

To enable the student to familiarize various tools, measuring devices, practices and different methods of manufacturing processes employed in industry for fabricating components.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to:

Course Outcome	Course Outcome Description
CO 1	Name different devices and tools used for civil engineering measurements
CO 2	Explain the use of various tools and devices for various field measurements
CO 3	Demonstrate the steps involved in basic civil engineering activities like plot measurement, setting out operation, evaluating the natural profile of land, plumbing and undertaking simple construction work.
CO 4	Choose materials and methods required for basic civil engineering activities like field measurements, masonry work and plumbing.
CO 5	Compare different techniques and devices used in civil engineering measurements
CO 6	Identify Basic Mechanical workshop operations in accordance with the material and objects
CO 7	Apply appropriate Tools and Instruments with respect to the mechanical workshop trades
CO 8	Apply appropriate safety measures with respect to the mechanical workshop trades

Mapping of course outcomes with program outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	-	-	-	1	1	-	-	2	2	-	-
CO 2	1	-	-	-	1	1	-	-	2	2	-	-
CO 3	1	-	-	-	1	1	-	2	2	2	1	-
CO 4	1	-	-	-	1	1	-	2	2	2	1	1
CO 5	1	-	-	-	1	1	-	-	2	2		1
CO 6	2											

CO 7	2											
CO 8	2											

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	70	30	1 hour

Assessment Procedure: Total marks allotted for the course is 100 marks. CIE shall be conducted for 70 marks and ESE for 30 marks. CIE should be done for the work done by the student and also viva voce based on the work done on each practical session. ESE shall be evaluated by written examination of one hour duration conducted internally by the institute.

Continuous Internal Evaluation Pattern:

Attendance : 20 marks
Class work/ Assessment /Viva-voce : 50 marks
End semester examination (Internally by college) : 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

PART 1

CIVIL WORKSHOP

Exercise 1. Calculate the area of a built-up space and a small parcel of land- Use standard measuring tape and digital distance measuring devices

Exercise 2. (a) Use screw gauge and vernier calliper to measure the diameter of a steel rod and thickness of a flat bar

(b) Transfer the level from one point to another using a water level

(c) Set out a one room building with a given plan and measuring tape

Exercise 3. Find the level difference between any two points using dumpy level

Exercise 4. (a) Construct a $1\frac{1}{2}$ thick brick wall of 50 cm height and 60 cm length using English bond. Use spirit level to assess the tilt of walls.

(b) Estimate the number of different types of building blocks to construct this wall.

Exercise 5. (a) Introduce the students to plumbing tools, different types of pipes, type of connections, traps, valves ,fixtures and sanitary fittings.

(b) Install a small rainwater harvesting installation in the campus

Reference Books:

1. Khanna P.N, “Indian Practical Civil Engineering Handbook”, Engineers Publishers.
2. Bhavikatti. S, "Surveying and Levelling (Volume 1)", I.K. International Publishing House
3. Arora S.P and Bindra S.P, " Building Construction", Dhanpat Rai Publications
4. S. C. Rangwala, “Engineering Materials,” Charotar Publishing House.

PART II

MECHANICAL WORKSHOP

LIST OF EXERCISES

(Minimum EIGHT units mandatory and FIVE models from Units 2 to 8 mandatory)

UNIT 1:- General : Introduction to workshop practice, Safety precautions, Shop floor ethics, Basic First Aid knowledge.

Study of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc and accessories (b) bearings, seals, O-rings, circlips, keys etc.

UNIT 2:- Carpentry : Understanding of carpentry tools

Minimum any one model

1. T –Lap joint 2. Cross lap joint 3. Dovetail joint 4. Mortise joints

UNIT 3:- Foundry : Understanding of foundry tools

Minimum any one model

1. Bench Molding 2. Floor Molding 3. Core making 4. Pattern making

UNIT 4: - Sheet Metal : Understanding of sheet metal working tools

Minimum any one model

1. Cylindrical shape
2. Conical shape
3. Prismatic shaped job from sheet metal

UNIT 5: - Fitting : Understanding of tools used for fitting

Minimum any one model

1. Square Joint
2. V- Joint
3. Male and female fitting

UNIT 6: - Plumbing : Understanding of plumbing tools, pipe joints

Any one exercise on joining of pipes making use of minimum three types of pipe joints

UNIT 7: - Smithy: Understanding of tools used for smithy.

Demonstrating the forge-ability of different materials (MS, Al, alloy steel and cast steels) in cold and hot states.

Observing the qualitative difference in the hardness of these materials

Minimum any one exercise on smithy

1. Square prism
2. Hexagonal headed bolt
3. Hexagonal prism
4. Octagonal prism

UNIT 8: -Welding: Understanding of welding equipments

Minimum any one welding practice

Making Joints using electric arc welding. bead formation in horizontal, vertical and over head positions

UNIT 9: - Assembly: Demonstration only

Dissembling and assembling of

1. Cylinder and piston assembly
2. Tail stock assembly
3. Bicycle
4. Pump or any other machine

UNIT 10: - Machines: Demonstration and applications of the following machines

Shaping and slotting machine; Milling machine; Grinding Machine; Lathe; Drilling Machine.

UNIT 11: - Modern manufacturing methods: Power tools, CNC machine tools, 3D printing, Glass cutting.

Course Contents and Lecture Schedule:

No	Topic	No of Sessions
1	**INTRODUCTION**	
1.1	Workshop practice, shop floor precautions, ethics and First Aid knowledge. Studies of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc and accessories (b) bearings, seals, O-rings, circlips, keys etc	1
2	**CARPENTRY**	
2.1	Understanding of carpentry tools and making minimum one model	2

3	**FOUNDRY**	
3.1	Understanding of foundry tools and making minimum one model	2
4	**SHEET METAL**	
4.1	Understanding of sheet metal working tools and making minimum one model	2
5	**FITTING**	
5.1	Understanding of fitting tools and making minimum one model	2
6	**PLUMBING**	
6.1	Understanding of pipe joints and plumbing tools and making minimum one model	2
7	**SMITHY**	
7.1	Understanding of smithy tools and making minimum one model	2
8	**WELDING**	
8.1	Understanding of welding equipments and making minimum one model	2
9	**ASSEMBLY**	
9.1	Demonstration of assembly and dissembling of multiple parts components	1
10	**MACHINES**	
10.1	Demonstration of various machines	1
11	**MODERN MANUFACTURING METHODS**	
11.1	Demonstrations of: power tools, CNC Machine tools, 3D printing, Glass cutting	1

22ESL 213	ELECTRICAL & ELECTRONICS WORKSHOP	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	0	0	2	1	2019

Preamble: Electrical Workshop is intended to impart skills to plan and carry out simple electrical wiring. It is essential for the practicing engineers to identify the basic practices and safety measures in electrical wiring.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Demonstrate safety measures against electric shocks.
CO 2	Identify the tools used for electrical wiring, electrical accessories, wires, cables, batteries and standard symbols
CO 3	Develop the connection diagram, identify the suitable accessories and materials necessary for wiring simple lighting circuits for domestic buildings
CO 4	Identify and test various electronic components
CO 5	Draw circuit schematics with EDA tools
CO 6	Assemble and test electronic circuits on boards
CO 7	Work in a team with good interpersonal skills

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	3	-	-	-	-	-	1
CO 2	2	-	-	-	-	-	-	-	-	1	-	-
CO 3	2	-	-	1	-	1	-	1	2	2	-	2
CO 4	3	-	-	-	-	-	-	-	-	-	-	2
CO 5	3	-	-	-	2	-	-	-	-	-	-	2
CO 6	3	-	-	-	2	-	-	-	-	-	-	1
CO 7	-	-	-	-	-	-	-	-	3	2	-	2

Mark distribution

Total Marks	CIE	ESE	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment /Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

Syllabus

PART 1

ELECTRICAL

List of Exercises / Experiments

1. a) Demonstrate the precautionary steps adopted in case of Electrical shocks.

   b)Identify different types of cables, wires, switches, fuses, fuse carriers, MCB, ELCB and MCCB with ratings.
2. Wiring of simple light circuit for controlling light/ fan point (PVC conduit wiring)
3. Wiring of light/fan circuit using Two way switches . (Staircase wiring)
4. Wiring of Fluorescent lamps and light sockets (6A) with a power circuit for controlling power device. (16A socket)
5. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and Energy meter.
6. a)Identify different types of batteries with their specifications.

   b)Demonstrate the Pipe and Plate Earthing Schemes using Charts/Site Visit.

PART II

ELECTRONICS

List of Exercises / Experiments (Minimum of 7 mandatory)

1. Familiarization/Identification of electronic components with specification (Functionality, type, size, colour coding, package, symbol, cost etc. [Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals, Displays, Fasteners, Heat sink etc.)

2. Drawing of electronic circuit diagrams using BIS/IEEE symbols and introduction to EDA tools (such as Dia or XCircuit), Interpret data sheets of discrete components and IC's, Estimation and costing.

3. Familiarization/Application of testing instruments and commonly used tools. [Multimeter, Function generator, Power supply, DSO etc.] [Soldering iron, De- soldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers, Crimping tool, Hot air soldering and de- soldering station etc.]

4. Testing of electronic components [Resistor, Capacitor, Diode, Transistor and JFET using multimeter.]

5. Inter-connection methods and soldering practice. [Bread board, Wrapping, Crimping, Soldering - types - selection of materials and safety precautions, soldering practice in connectors and general purpose PCB, Crimping.]

6. Printed circuit boards (PCB) [Types, Single sided, Double sided, PTH, Processing methods, Design and fabrication of a single sided PCB for a simple circuit with manual etching (Ferric chloride) and drilling.]

7. Assembling of electronic circuits using SMT (Surface Mount Technology) stations.

8. Assembling of electronic circuit/system on general purpose PCB, test and show the functioning (**Any Two circuits).**

   1. Fixed voltage power supply with transformer, rectifier diode, capacitor filter, zener/IC regulator.

   2. Square wave generation using IC 555 timer in IC base.

   3. Sine wave generation using IC 741 OP-AMP in IC base.

   4. RC coupled amplifier with transistor BC107.

SEMESTER 3

SEMESTER III

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	22MAT 301	PARTIAL DIFFERENTIAL EQUATION AND COMPLEX ANALYSIS	3-1-0	4	4
B	22CET 302	MECHANICS OF SOLIDS	3-1-0	4	4
C	22CET 303	FLUIDMECHANICS & HYDRAULICS	3-1-0	4	4
D	22CET 304	SURVEYING & GEOMATICS	4-0-0	4	4
E	22EST 305	DESIGN & ENGINEERING	2-0-0	2	2
1/2	22HUT306	PROFESSIONAL ETHICS	2-0-0	2	2
F	22MNC307	SUSTAINABLEENGINEERING	2-0-0	2	--
S	22CEL308	CIVIL ENGINEERING PLANNING & DRAFTING LAB	0-0-3	3	2
T	22CEL309	SURVEY LAB	0-0-3	3	2
R/M	22CEMR310.1/2/3	Remedial/Minorcourse	3-1-0	4 *	4
TOTAL				**26/30**	**22/26**

MINOR

SEMESTER	BASKET I				BASKET II				BASKET III			
	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT
S3	22CEMR310.1	BUILDING CONSTRUCTION & STRUCTURAL SYSTEMS	4	4	22CEMR310.2	INTRODUCTION TO GEOTECHNICAL ENGINEERING	4	4	22CEMR310.3	INFORMATICS FOR INFRASTRUCTURE MANAGEMENT	4	4

CODE 22MAT 301	PARTIAL DIFFERENTIAL EQUATIONS AND COMPLEX ANALYSIS	CATEGORY	L	T	P	CREDIT
		BASIC SCIENCE COURSE	3	1	0	4

Preamble: This course introduces basic ideas of partial differential equations which are widely used in the modelling and analysis of a wide range of physical phenomena and has got application across all branches of engineering. To understand the basic theory of functions of a complex variable, residue integration and conformal transformation.

Prerequisite: A basic course in partial differentiation and complex numbers**.**

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the concept and the solution of partial differential equation.
CO 2	Analyse and solve one dimensional wave equation and heat equation.
CO 3	Understand complex functions, its continuity differentiability with the use of Cauchy-Riemann equations.
CO 4	Evaluate complex integrals using Cauchy's integral theorem and Cauchy's integral formula, understand the series expansion of analytic function
CO 5	Understand the series expansion of complex function about a singularity and Apply residue theorem to compute several kinds of real integrals.

PO's	Broad area
PO 1	Engineering Knowledge
PO 2	Problem Analysis
PO 3	Design/Development of solutions
PO 4	Conduct investigations of complex problems
PO 5	Modern tool usage
PO 6	The Engineer and Society
PO 7	Environment and Sustainability
PO 8	Ethics
PO 9	Individual and team work

PO 10	Communication
PO 11	Project Management and Finance
PO 12	Life long learning

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	2	1				2		2
CO 2	3	3	3	3	2	1				2		2
CO 3	3	3	3	3	2	1				2		2
CO 4	3	3	3	3	2	1				2		2
CO 5	3	3	3	3	2	1				2		2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests(%)		End Semester Examination(%)
	1	2	
Remember	10	10	10
Understand	30	30	30
Apply	30	30	30
Analyse	20	20	20
Evaluate	10	10	10
Create			

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of whichstudent should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions.

Course Outcome 1 (CO1):

1. Form the partial differential equation given $z = xf(x) + ye^2$
2. What is the difference between complete integral and singular integral of a partial differential equation
3. Solve $3z = xp + yq$
4. Solve $(p^2 + q^2) = qz$
5. Solve $u_x - 2u_t = u$ by the method of separation of variables

Course Outcome 2 (CO2):

1. Write any three assumptions in deriving one dimensional wave equations
2. Derive one Dimensional heat equation
3. Obtain a general solution for the one dimensional heat equation $\frac{6u}{6t} = c^2 \frac{6^2u}{6t^2}$
4. A tightly stretched flexible string has it's ends fixed at $x = 0$and $x = l$. At $t = 0$, the string is given a shape defined by $f(x) = \mu x(l - x)$ where μ is a constant
5. Find the temperature $u(x, t)$ in a bar which is perfectly insulated laterally whose ends are kept at $0°C$ and whose initial temperature (in degree Celsius) is $f(x) = (10 - x)$ given that it's length is 10 cm and specific heat is 0.056cal/gram deg

Course Outcome 3(CO3):

1. Separate the real and imaginary parts of $f(z) = \frac{1}{1+z}$
2. Check whether the function $f(z) = \frac{Re(z^2)}{|z|}$is continuous at $z = 0$ given $f(0) = 0$
3. Determine a and b so that function $u = e^{-\pi x}cosay$ is harmonic. Find it's harmonic conjugate.
4. Find the fixed points of $w = \frac{i}{2z-1}$
5. Find the image of $|z| \le \frac{1}{2}, -\frac{\pi}{8}< argz < \frac{\pi}{}$under $w = z^2$

Course Outcome 4(CO4):

1. Find the value of $\int_C exp(z^2)dz$ where C is $|z| = 1$
2. Integrate the function $\int \frac{sinz}{\_\_\_\_} dz$ where C is $|z - 4 - 2i| = 6.5$
3. Evaluate $\int_C \frac{e^{z+4iz}}{(z-\frac{\pi}{4})^3} dz$ where C is $|z| = 1$
4. Find the Maclaurin series expansion of $f(z) = \frac{i}{1-z}$ and state the region of convergence.
5. Find the image of $|z| = 2$ under the mapping $w = z + \frac{1}{z}$

Course Outcome 5 (CO5):

1. Determine the singularity of $exp\left(\frac{1}{z}\right)$
2. Find the Laurent series of $\frac{1}{z^2(z-i)}$ about $z = i$
3. Find the residues of $f(z) = \frac{50z}{z^3+2z^2-7z+4}$
4. Evaluate $\int_C tan2\pi z\, dz$ where C is $|z - 0.2| = 0.2$
5. Evaluate $\int_0^{2\pi} \frac{d\theta}{\sqrt{2}-cos\,\theta}$

Syllabus

Module 1 (Partial Differential Equations) (8 hours)

(Text 1-Relevant portions of sections 17.1, 17.2, 17.3, 17.4, 17.5, 17.7, 18.1, 18.2)

Partial differential equations, Formation of partial differential equations –elimination of arbitrary constants-elimination of arbitrary functions, Solutions of a partial differential equations, Equations solvable by direct integration, Linear equations of the first order-Lagrange's linear equation, Non-linear equations of the first order -Charpit's method, Solution of equation by method of separation of variables.

Module 2 (Applications of Partial Differential Equations) (10 hours)

(Text 1-Relevant portions of sections 18.3,18.4, 18.5)

One dimensional wave equation- vibrations of a stretched string, derivation, solution of the wave equation using method of separation of variables, D'Alembert's solution of the wave equation, One dimensional heat equation, derivation, solution of the heat equation

Module 3 (Complex Variable – Differentiation) (9 hours)

(Text 2: Relevant portions of sections13.3, 13.4, 17.1, 17.2 , 17.4)

Complex function, limit, continuity, derivative, analytic functions, Cauchy-Riemann equations, harmonic functions, finding harmonic conjugate, Conformal mappings- mappings $w = z^2$,, $w = e^z$,. Linear fractional transformation $w = \frac{1}{z}$, fixed points, Transformation $w = sinz$

(From sections 17.1, 17.2 and 17.4 only mappings $w = z^2, , w = e^z, w = \frac{1}{z}, w = sinz$ and problems based on these transformation need to be discussed)

Module 4 (Complex Variable – Integration) (9 hours)

(Text 2- Relevant topics from sections14.1, 14.2, 14.3, 14.4,15.4**)**

Complex integration, Line integrals in the complex plane, Basic properties, First evaluation method-indefinite integration and substitution of limit, second evaluation method-use of a representation of a path, Contour integrals, Cauchy integral theorem (without proof) on simply connected domain,Cauchy integral theorem (without proof) on multiply connected domain Cauchy Integral formula (without proof), Cauchy Integral formula for derivatives of an analytic function, Taylor's series and Maclaurin series.,

Module 5 (Complex Variable – Residue Integration) (**9 hours**)

(Text 2- Relevant topics from sections16.1, 16.2, 16.3, 16.4 **)**

Laurent's series(without proof), zeros of analytic functions, singularities, poles, removable singularities, essential singularities, Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral using residue theorem, Residue integration of real integrals – integrals of rational functions of $cos\theta$ and $sin\theta$, integrals of improper integrals of the form $\int_{-\infty}^{\infty} f(x)\, dx$ with no poles on the real axis. ($\int_A^B f(x)\, dx$ whose integrand become infinite at a point in the interval of integration is excluded from the syllabus),

Textbooks:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2018.

2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2016.

References:

1. Peter V. O'Neil, Advanced Engineering Mathematics, Cengage, 7th Edition, 2012

Assignments

Assignment: Assignment must include applications of the above theory in the concerned engineering branches

Course Contents and Lecture Schedule

No	Topic	No. of Lectures

1	**Partial Differential Equations**	
1.1	Partial differential equations, Formation of partial differential equations –elimination of arbitrary constants-elimination of arbitrary functions, Solutions of a partial differential equations, Equations solvable by direct integration,	3
1.2	Linear equations of the first order- Lagrange's linear equation, Non-linear equations of the first order - Charpit's method	3
1.3	Boundary value problems, Method of separation of variables.	2
2	**Applications of Partial Differential Equations**	
2.1	One dimensional wave equation- vibrations of a stretched string, derivation,	1
2.2	solution of the wave equation using method of separation of variables, D'Alembert's solution of the wave equation	4
2.3	One dimensional heat equation, derivation,	1
2.4	solution of the heat equation, (excluding problems in steady state conditions)	4
3	**Complex Variable – Differentiation**	
3.1	Complex function, limit, continuity, derivative, analytic functions, Cauchy-Riemann equations,	4
3.2	harmonic functions, finding harmonic conjugate,	2
3.3	Conformal mappings- mappingsof $w = z^2,, w = e^z, w = \frac{1}{z}, w = sinz$.	3
4	**Complex Variable – Integration**	
4.1	Complex integration, Line integrals in the complex plane, Basic properties, First evaluation method, second evaluation method, use of representation of a path	4
4.2	Contour integrals, Cauchy integral theorem (**without proof**) on simply connected domain, on multiply connected domain(**without proof**) .Cauchy Integral formula (**without proof**),	2
4.3	Cauchy Integral formula for derivatives of an analytic function,	2
4.3	Taylor's series and Maclaurin series.	1
5	**Complex Variable – Residue Integration**	

5.1	Laurent's series(**without proof**)	2
5.2	zeros of analytic functions, singularities, poles, removable singularities, essential singularities, Residues,	2
5.3	Cauchy Residue theorem (**without proof**), Evaluation of definite integral using residue theorem	2
5.4	Residue integration of real integrals – integrals of rational functions of $cos\theta$and $sin\theta$, integrals of improper integrals of the form $\int_{-\infty}^{\infty} f(x)dx$with no poles on the real axis. ($\int_{A}^{B} f(x)dx$**whose integrand become infinite at a point in the interval of integration is excluded from the syllabus**),	3

Model Question Paper

(For all branches except Computer Science and Information Technology)

(2019 Scheme)

Reg No: Name:

THIRD SEMESTER B.TECH. DEGREE EXAMINATION

(MONTH & YEAR)

Course Code:

Course Name: PARTIAL DIFFERENTIAL EQUATIONS AND COMPLEX ANALYSIS

MAX.MARKS: 100 DURATION: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1. Derive a partial differential equation from the relation $z = f(x + at) + g(x - at)$
2. Solve $\frac{\partial^2 z}{\partial x \partial y} = x^2 y$
3. State any three assumptions in deriving the one dimensional wave equation
4. What are the possible solutions of one-dimensional heat equation?
5. If $f(z) = u + iv$ is analytic, then show that u and v are harmonic functions.
6. Check whether $f(z) = \bar{z}$ is analytic or not.
7. Evaluate $\int_c \tan z \, dz$ where c is the unit circle.
8. Find the Taylor's series of $f(z) = \frac{1}{z}$ about $z = 2$.
9. What type of singularity have the function $f(z) = \frac{1}{\cos z - \sin z}$
10. Find the residue of $\frac{e^z}{z^3}$ at its pole.

PART B

Answer any one full question from each module, each question carries 14 marks.

Module-I

11. (a) Solve $x(y - z)p + y(z - x)q = z(x - y)$
    (b) Use Charpit's methods to solve $q + xp = p^2$
12. (a) Find the differential equation of all spheres of fixed radius having their centers in the xy-plane.

(b) Using the method of separation of variables, solve $\frac{\partial u}{\partial x} = 2\frac{\partial u}{\partial t} + u$, where $(x, 0) = 6e^{-3x}$.

Module – II

13. (a) Derive the solution of one dimensional wave equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$ with zero boundary conditions and with initial conditions $u(x, 0) = f(x)$ and $\left(\frac{\partial u}{\partial t}\right)_{t=0} = 0$.

(b) A homogeneous rod of conducting material of length 100 cm has its ends kept at zero temperature and the temperature initially is $u(x, 0) = \begin{cases} x, 0 \le x \le 50 \\ 100 - x, 50 \le x \le 100 \end{cases}$. Find the temperature $u(x, t)$ at any time.

14. (a) A tightly stretched string of length l with fixed ends is initially in equilibrium position. It is set vibrating by giving each point a velocity $v_0 \sin^3(\pi x/l)$. Find the displacement of the string at any time.

(b) An insulated rod of length l has its ends A and B are maintained at $0^0 c$ and $100^0 C$ respectively under steady state condition prevails. If the temperature at B is suddenly reduced to $0^0 c$ and maintained at $0^0 c$, Find the temperature at a distance x from A at time t.

Module-III

15. (a) Show that $f(z) = e^z$ is analytic for all z. Find its derivative.
(b) Find the image of $|z - 2i| = 2$ under the transformation $w = \frac{1}{z}$

16. (a) Prove that the function $(x, y) = x^3 - 3xy^2 - 5y$ is harmonic everywhere. Find its harmonic conjugate.
(b) Find the image of the infinite stripe $0 \le y \le \pi$ under the transformation $w = e^z$

Module-IV

17. (a) Evaluate $\int_0^{2+i} (\bar{z})^2 \, dz$, along the real axis to 2 and then vertically to $2 + i$
(b) Using Cauchy's integral formula evaluate $\int_c \frac{5z+7}{z^2+2z-3} d$, where c is $|z - 2| = 2$

18. (a) Evaluate $\int_c \frac{\sin^2 z}{\left(z-\frac{\pi}{6}\right)^3} dz$, where C is $|z| = 1$.

(b) Expand $\frac{1}{(z-1)(z-2)}$ in the region $|z| < 1$

Module- V

19. (a) Expand $f(z) = \frac{z^2-1}{z^2-5z+6}$ in $2 < |z| < 3$ as a Laurent's series.

(b) Using contour integration evaluate $\int_0^{2\pi} \frac{d\theta}{2+\cos\theta}$

20. (a) Use residue theorem to evaluate $\int \frac{\cos h\pi z}{^2+4} dz$ where are C is $|z| = 3$.

(b) Apply calculus of residues to evaluate $\int_{-\infty}^{\infty} \frac{1}{(x^2+1)^3} dx$.

22CET 302	MECHANICS OF SOLIDS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PCC	3	1	0	4	2019

Preamble:

Mechanics of solids is one of the foundation courses in the study of structural systems. The course provides the fundamental concepts of mechanics of deformable bodies and helps students to develop their analytical and problem solving skills. The course introduces students to the various internal effects induced in structural members as well as their deformations due to different types of loading. After this course students will be able to determine the stress, strain and deformation of loaded structural elements.

Prerequisite: EST 100 Engineering Mechanics

Course Outcomes: After the completion of the course the student will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Recall the fundamental terms and theorems associated with mechanics of linear elastic deformable bodies.	Remembering
CO2	Explain the behavior and response of various structural elements under various loading conditions.	Understanding
CO3	Apply the principles of solid mechanics to calculate internal stresses/strains, stress resultants and strain energies in structural elements subjected to axial/transverse loadsand bending/twisting moments.	Applying
CO4	Choose appropriate principles or formula to find the elastic constants of materials making use of the informationavailable.	Applying
CO5	Perform stress transformations, identify principal planes/ stresses and maximum shear stress at a point in a structural member.	Applying
CO6	Analyse the given structural member to calculate the safe load or proportion the cross section to carry the load safely.	Analysing

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-
CO6	3	3	1	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	15
Understand	10	10	15
Apply	30	20	60
Analyse		10	10
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Course Level Assessment (Sample) Questions

CO1: Recall the fundamental terms and theorems associated with mechanics of linear elastic deformable bodies.

1. What is proportionality limit? What is its significance?
2. Sketch the stress-strain curve of mild steel and mark the salient points
3. What is Poisson's ratio?
4. What is Bulk modulus of Elasticity? Write the relationship between Bulk modulus of elasticity and Young's modulus of elasticity.
5. What is pure bending? Give an example.
6. What is point of contraflexure?
7. What are the limitations of Euler's formula to calculate the buckling load of slender columns.
8. What is strain energy?
9. What is complementary shear stress?
10. What are principal stresses and principal planes?

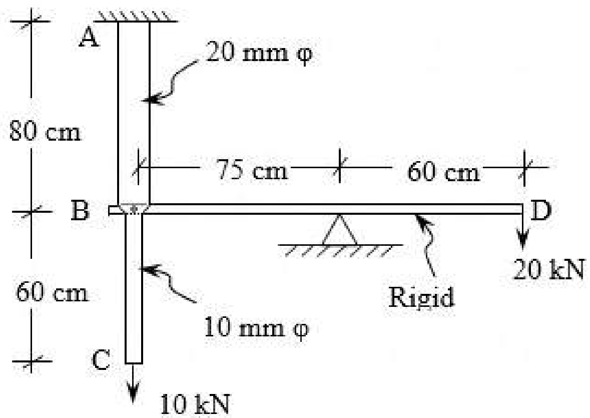
CO2: Explain the behavior and response of various structural elements under various loading conditions.

1. Explain how the deformation of an axially loaded bar with uniformly varying cross section is calculated?
2. Explain the behavior of mild steel under gradually increasing tensile load.
3. Explain the effect of temperature change on a composite bar made of two materials.
4. How do you compute the maximum stress induced in a bar due to impact load?
5. Explain the concept of BM and SF in beams, with the help of a cantilever beam subjected to uniformly distributed load over the whole span.
6. List three important assumptions used in the theory of pure bending and explain their significance.
7. Explain the behavior of slender columns under axial compressive load.
8. Distinguish between short and long columns with reference to their behavior under axial compression.
9. Explain how the limitation of Euler's formula to calculate buckling load of columns is addressed in Rankine's formula.

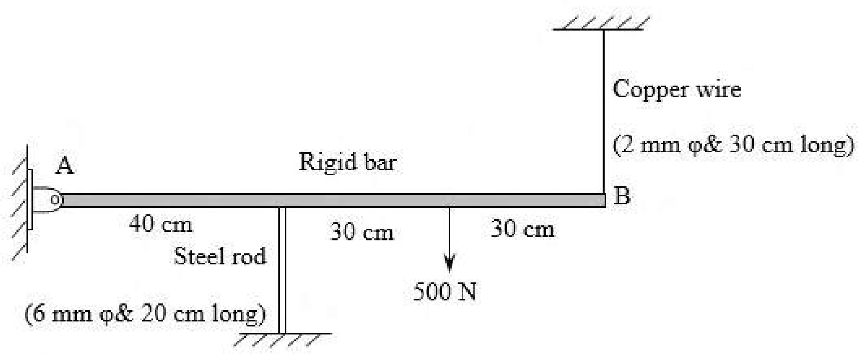
CO3: Apply the principles of solid mechanics to calculate internal stresses/strains, stress resultants and strain energies in structural elements subjected to axial/transverse loads and bending/twisting moments.

1. A steel flat of cross section 25 mm × 6 mm carries a tensile load of 12 kN. Find the stress induced in the cross section. If a circular hole of diameter 12 mm is made (normal to the flat surface), find the maximum stress induced in the cross section.

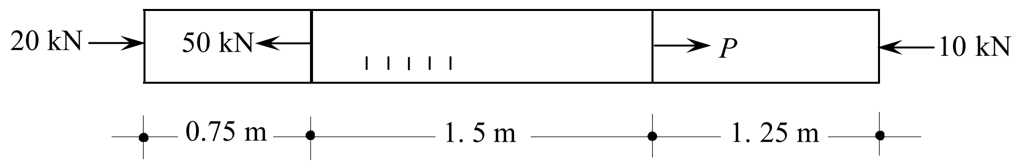
2. The bar ABC shown in figure is made of steel and has circular cross section. The bar BD is rigid. Find the stresses in portions AB and BC and the vertical deflection at C. Take E = 210 GPa.



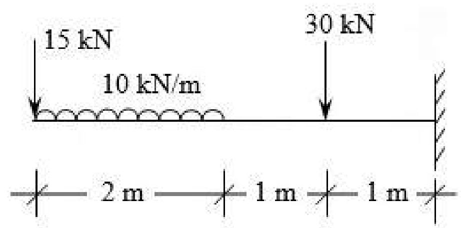
3. A rigid bar AB of length 100 cm, hinged at one end is supported by a steel rod and a copper wire as shown. Find the stresses induced in the rod and wire due to a downward load acting at 70 cm from the hinged end of the bar. Calculate the vertical deflection at B also. Modulus of elasticity of steel and copper are 200 GPa and 80 GPa respectively. Neglect the weight of the rigid bar.



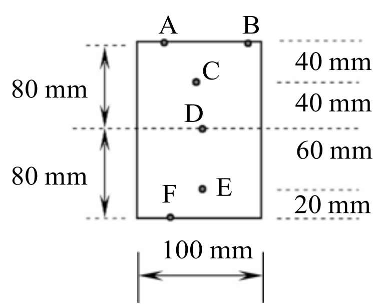
4. A 32 mm diameter steel bar is subjected to forces as shown in figure. Find thevalue of *P* necessary for equilibrium and stresses in different segments. Also calculate the final length of the bar. Take E = 200 GPa.



5. A cylindrical bar with two sections of lengths 50 cm and 25 cm, and diameters 20 mm and 15 mm respectively is subjected to an axial pull such that the maximum stress is $150MN/m^2$. Calculate the strain energy stored in the bar. $E=200GN/m^2$
6. Draw the SFD and BMD of the beam shown.



7. Figure shows the cross section of a beam. Find the stresses (both magnitude and nature) at points A,B,C,D,E and F, if the section carries a BM of 12 kNm. Draw the variation of stress across the cross section. Also calculate the shear stress at these points if the cross section carries a SF of 50 kN.



CO4: Choose appropriate principles or formula to find the elastic constants of materials making use of the information available.

1. A concrete cylinder of diameter 150 mm and height 300 mm is tested under compression. It was found that the diameter was increased by 0.0102 mm and the height was decreased by 0.165 mm under the action of a compressive load of 200kN. Calculate the modulus of elasticity, Poisson's ratio, bulk modulus and shear modulus of concrete.

2. A tension test is carried out on a mild steel bar of 10 mm diameter. The bar yields under a load of 20 kN, it reaches a maximum load of 40 kN and breaks at 25 kN.The diameter of the bar at breaking was found to be 7 mm. The increase in length of the bar over a gauge length of 50 mm was found to be 0.029 mm under a load of 10 kN. Estimate (a) Young's modulus, (b) yield strength, (c) ultimate strength and (d) actual breaking strength

CO5: Perform stress transformations, identify principal planes/stresses and maximum shear stress at a point in a structural member.

1. A bar of 12 mm diameter carries an axial pull of 15 kN. Find the normal and shear stress on a plane inclined at 60° with the axis of the bar. What is the maximum shear stress induced in the bar and the inclination of the corresponding plane?
2. At a certain point in a strained material, the stresses on two planes at right angles to each other are 50 MPa (tensile) and 80 MPa (compressive). They are accompanied by a shear stress of magnitude 20 MPa. Find the principal stresses and locate their planes. Also find the maximum shear stress and resultant stresson the plane of maximum shear stress.

CO6: Analyse the given structural member to calculate the safe load or proportion the cross section to carry the load safely.

1. A timber beam 150 mm × 200 mm is used as a simply supported beam of span 3 m. Find the maximum uniformly distributed load that can be applied in addition to a concentrated load of 5 kN acting at the mid span, if the maximum bending stress in the beam is not to exceed 8 N/mm^2. Neglect self weight of beam.
2. A 3 m long cantilever beam of rectangular section is required to carry a udl of 10 kN/m over the whole span. If the maximum bending stress is limited to 12 N/mm^2, find the dimensions of the cross section assuming depth to width ratio as2.
3. A cast iron test beam 25 mm square in section and 700 mm long is simply supported at ends. It fails under a central load of 2300 N. What load at the freeend will break a cantilever of the same material 50 mm wide × 100 mm deep and 1500 mm long?
4. A solid circular shaft transmits 80 kW power at 190 rpm. Calculate the diameter of the shaft if the twist in the shaft is not to exceed 1° in 2 m length of shaft and shear stress is limited to 60 MPa. Take G = 100 GPa.

SYLLABUS

Module – 1

Review of statics, Concept of stress and strain – types, Stress – strain relation - Hooke's law, Young's modulus of elasticity.
Stress-strain diagram of mild steel.
Factor of safety, working stress.
Axially loaded bars with uniform cross section–stress, strain and deformation.
Deformation of axially loaded bars with varying cross section and bars with varying axial loads.
Statically indeterminate systems (number of unknowns restricted to two).

Module – 2

Temperature effects, temperature stress in composite bars.
Shear stress and shear strain, Modulus of rigidity, simple shear, punching shear.
Lateral strain, Poisson's ratio,volumetric strain.
Bulk modulus of elasticity, relationships between elastic constants.
Strain energy – concept.Strain energy due to normal stress.
Strain energy in bars carrying axial loads.
Instantaneous stress in bars due to gradual, sudden and impact loads.Strain energy due to shear stress.
Stresses in thin cylinders and spheres due to internal pressure.

Module – 3

Beams – different types. Types of loading on beams. Concept of bending moment and shear force.
Relationship between intensity of load, shear force and bending moment.
Shear force and bending moment diagrams of cantilever beams, simply supported beams and overhanging beams for different type of loads. Point of contraflexure.

Module – 4

Theory of simple bending, assumptions and limitations.
Calculation of normal stress in beams, moment of resistance
Shear stress in beams.
Beams of uniform strength.
Strain energy due to bending – calculation of strain energy in beams.
Differential equation for calculating the deflection of beams. (Introduction and demonstration only. Students are not expected to solve deflection problems.)

Module – 5

Stresses on inclined sections for uniaxial and biaxial stress fields.
Principal stresses and principal planes in 2D problems, maximum shear stress.
Strains along principal directions.
Mohr's circle of stress for 2D problems.
Short columns – direct and bending stress. Kern of a section.
Slender columns – Euler's buckling load, slenderness ratio, limitation of Euler's formula.
Rankines formula.
Torsion of circular and hollow circular shafts, Power transmitted by circular shafts and hollow circular shafts.Strain energy due to torsion.

Text Books:

1. H. J. Shah andS. B. Junnarkar, Mechanics of Structures Vol - I, Charotar Publishing House.
2. R. K. Bansal, A Text book of Strength of Materials, Laxmi Publications (P) Ltd, New Delhi.
3. B. C. Punmia, Ashok K. Jain, Arun Kumar Jain, Mechanics of Materials, Laxmi Publications (P) Ltd, New Delhi.

References:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall International Series.
2. James M Gere, S.P. Timoshenko, Mechanics of Materials, CBS Publishers and Distributors, New Delhi.
3. R.C. Hibbeler, Mechanics of Materials (edn.10), Pearson
4. S. Ramamrutham and R. Narayanan, Strength of Materials, Dhanpat Rai Publishing Co (P) Ltd.
5. Rattan, Strength of Materials, McGraw Hill Education India.

Lecture Plan –Mechanics of Solids

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module I : Total lecture hours : 8**		
1.1	Review of statics – equilibrium conditions, free body diagrams, centroid, moment of inertia.	-	1
1.2	Concept of stress, types of stresses. Concept of strain ,types of strains. Stress – strain relation - Hooke's law, Young's modulus of elasticity.	CO1, CO2, CO4	1
1.3	Stress-strain ($\sigma - \varepsilon$) diagram of mild steel – proportional limit, yield point, ultimate stress, fracture. True and engineering $\sigma - \varepsilon$ curve, idealized $\sigma - \varepsilon$ curves. Factor of safety, working stress.	CO1, CO2	1
1.4	Axially loaded bars with uniform cross section– calculation of stress, strain and deformation.	CO2, CO3	1
1.5	Deformation of axially loaded bars with varying cross section. Stepped bars, bars with tapering cross section	CO3	1
1.6	Deformation of axially loaded bars with varying axial loads – elongation of bars under self weight, elongation/contraction of uniform/stepped bars.	CO3	1
1.7	Statically indeterminate systems – analysis of axially loaded composite bars (with maximum two materials)	CO3, CO6	1
1.8	Analysis of indeterminate systems with axial load carrying members (number of unknowns restricted to two). (Example: Assessment Level Question 3 of CO3)	CO3, CO6	1

2	**Module II : Total lecture hours : 8**		
2.1	Temperature effects, temperature stress in composite bars.	CO2, CO3	1
2.2	Shear stress and shear strain, Modulus of rigidity, simple shear, punching shear.	CO1, CO2, CO3, CO4	1
2.3	Lateral strain, Poisson's ratio, volumetric strain. Volumetric strain of rectangular bar, circular bar and sphere. Volumetric strain expressed in terms of strains along three mutually perpendicular directions.	CO2, CO3	1
2.4	Bulk modulus of elasticity, relationships between elastic constants.	CO1, CO4	1
2.5	Strain energy – concept. Resilience, modulus of resilience and proof resilience. Strain energy due to normal stress.Calculation of total strain energy in bars carrying axial loads. Strain energy due to shear stress.	CO1,CO2, CO3	2
2.6	Instantaneous stress in bars due to gradual, sudden and impact loads.	CO1,CO2, CO3	1
2.7	Stresses in thin cylinders and spheres due to internal pressure	CO1, CO2, CO3	1
3	**Module III : Total lecture hours : 8**		
3.1	Beams – different types. Types of loading on beams. Concept of bending moment and shear force. Shear force and bending moment diagrams.	CO1, CO2	1
3.2	Relationship between load, shear force and bending moment. Demonstration using simple examples.	CO1	1
3.3	Shear force and bending moment diagrams of cantilever beams subjected to point load, concentrated moments, uniformly distributed and uniformly varying loads.	CO2	2
3.4	Shear force and bending moment diagrams of simply supported beams subjected to point load, concentrated moment, uniformly distributed and uniformly varying loads.	CO2	2
3.5	Shear force and bending moment diagrams of overhanging beams subjected to point load, concentrated moment and uniformly distributed loads. Point of contraflexure.	CO1, CO2	2
4	**Module IV : Total lecture hours : 9**		
4.1	Theory of simple bending – derivation of equation, assumptions and limitations.	CO1, CO2	1
4.2	Variation of bending stress across the cross section. Maximum bending stress, section modulus, moment of resistance.	CO1, CO2	1
4.3	Calculation of normal stress in beams. Problems involving bending stress	CO3	1

4.4	Shear stress in beams – derivation of equation. Variation of shear stress across the cross section. (Derivation required for rectangular, circular and triangular sections only)	CO1, CO2	1
4.5	Calculation of shear stress- problems involving shear stress.	CO3	1
4.6	Calculation of allowable loads in beams based on bending stress and shear stress criteria.	CO6	1
4.7	Proportioning beam sections to carry given load without exceeding the allowable bending stress and/ shear stress. Beams of uniform strength.	CO6	1
4.8	Strain energy due to bending – calculation of strain energy in beams. (Cantilever and simply supported beams subjected to point load and uniformly distributed load)	CO1, CO2, CO3	1
4.9	Moment-curvature relation. Basic differential equation for calculating the deflection of beams. Simple example to calculate deflection of beams (such as cantilever beam with point load at free end) for demonstration purpose.	CO1	1
5	**Module V : Total lecture hours : 12**		
5.1	Stresses on inclined planes for uniaxial and biaxial stress fields. Element subjected to pure shear.	CO3	2
5.2	Principal stresses and principal planes in 2D problems, maximum shear stress. Strains along principal directions.	CO1, CO3, CO5	2
5.3	Mohr's circle of stress for 2D problems.	CO3, CO5	1
5.4	Short columns – direct and bending stress. Kern of a section (concept only).	CO1,CO2, CO3	1
5.5	Slender columns –Buckling, Euler's buckling load for columns with pinned ends. Eulers' buckling load for columns with different end conditions (no derivation required). Effective length of columns with different end conditions.	CO1,CO2, CO3	2
5.6	Slenderness ratio, limitation of Euler's formula. Rankine's formula. Safe load calculation using Rankine's formula (demonstration only).	CO1,CO2, CO3	1
5.7	Torsion of circular and hollow circular shafts, assumptions, derivation of torsion equation. Variation of stress across the cross section.Polar modulus.	CO1,CO2, CO3	1
5.8	Power transmitted by circular shafts and hollow circular shafts. Proportioning the shafts to transmit a given power based on shear stress and angle of twist considerations Strain energy due to torsion.	CO3, CO6	2

MODEL QUESTION PAPER

Reg.No.:_______________ Name:___________________________

THIRD SEMESTER B.TECH DEGREE EXAMINATION

Course Code:22CET302

Course Name: MECHANICS OF SOLIDS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions; each question carries 3 marks.

1. a) Define the terms (i) proportionality limit, (ii) ultimate stress (ii) working stress.
   b) Explain, how the deformation of an axially loaded bar with uniformly varying cross section is calculated?
   c) Explain the effect of temperature change on a composite bar made of two materials.
   d) What is Bulk modulus of Elasticity? Write the relationship between Bulk modulus of elasticity and Young's modulus of elasticity.
   e) What is the relationship between intensity of load, SF and BM?
   f) Explain the concept of BM and SF in beams, with the help of a cantilever beam subjected to uniformly distributed load over the whole span.
   g) What is pure bending? Give an example.
   h) List three important assumptions used in the theory of pure bending and their significance.
   i) What are principal stresses and principal planes?
   j) Distinguish between short and long columns with reference to their behavior under axial compression.

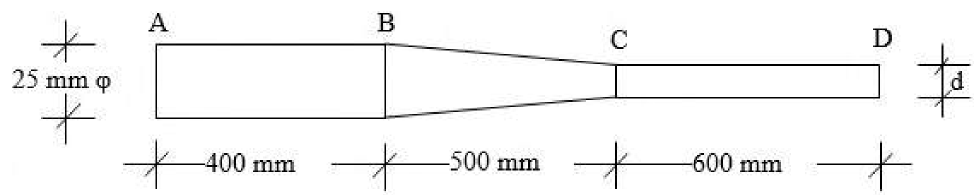
(10×3 marks = 30 marks)

PART B

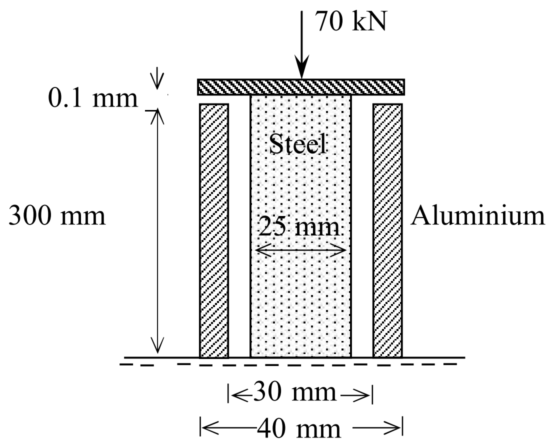
Answer one full question from each module; each full question carries 14 marks.

Module I

2. A bar of circular cross section has three segments as shown in figure. The portion AB has a constant diameter of 25 mm. The portion BC has diameter 25 mm at B and tapers uniformly to diameter 'd ' at C. The portion CD has a constant diameter of 'd '. The bar was found to elongate by 0.539 mm under an axial tension of 20 kN. Find the value of 'd '. Take Young's modulus of elasticity of the material as 200 GPa.



3. A steel rod of 25 mm diameter is placed in a hollow aluminium cylinder with internal diameter 30 mm and external diameter 40 mm. The steel rod projects 0.1 mm as shown. The bar carries a compressive force of 70 kN through a rigid bearing plate. Find the stresses in steel and aluminium bars. E_s = 200 GPa and E_{al} = 120 GPa



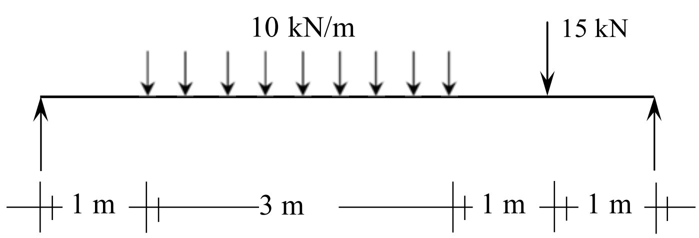
Module II

4. A concrete cylinder of diameter 150 mm and height 300 mm is tested under axial compression. It was found that the diameter was increased by 0.0102 mm and the heightwas decreased by 0.165 mm under the action of a compressive load of 200 kN. Calculate the modulus of elasticity, Poisson's ratio, bulk modulus and shear modulus of concrete.

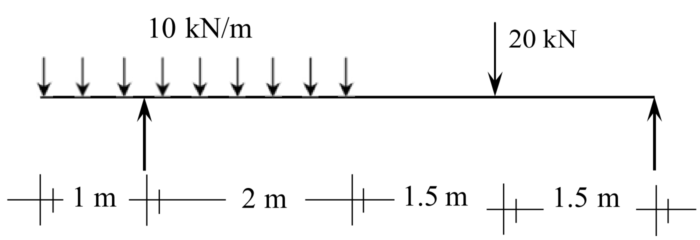
5. A compound bar is made of a central steel plate 60 mm wide and 10 mm thick to which copper plates 40 mm wide and 5mm thick are rigidly connected on each side. The length of the bar at normal temperature is 1 m. If the temperature is raised by 80°C, determine the stress in each metal and the change in length. Es = 2×10^5 N/mm^2 ,α_S = 12×10^{-6} /°C, Ec = 1.05×10^5 N/mm^2 and α_C = 17.5×10^{-6} /°C.

Module III

6. Draw the SFD and BMD of the beam loaded as shown in figure. Find the maximum BM and locate the point of maximum BM also.



7. An overhanging beam is loaded as shown. Draw SFD and BMD. Locate the point of contraflexure also.



Module IV

8. a) A simply supported beam of triangular cross section, having width 160 mm and height 210 mm, carries a udl of 2 kN/m over a span of 4m. Find the maximum tensile and compressive stresses induced. Draw the variation of stress across the cross section.

(10 marks)

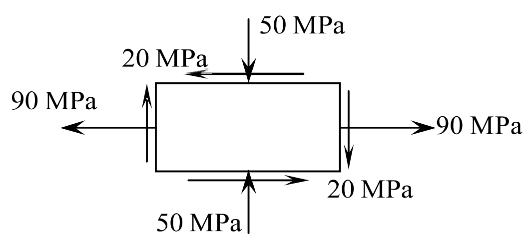
b) Calculate the total strain energy due to bending in a cantilever beam of span *L* carrying a point load *W* at its free end. (4 marks)

9. a) A timber beam 150 mm × 200 mm (width = 150 mm) is used as a simply supported beam of span 3 m. Find the maximum uniformly distributed load that can be applied in addition to a concentrated load of 5 kN acting at the mid span, if the maximum bending stress and shear stress in the beam are not to exceed 15 N/mm^2 and 2 N/mm^2 respectively. Neglect self weight of beam. (10 marks)

b) What is beam of uniform strength? Give an example. (4 marks)

Module V

10. A point in a strained body is subjected to stresses as shown in figure. Find the principal stresses and maximum shear stress. Also locate the principal planes and planes of maximum shear stress, with respect to the vertical plane. Calculate the strains along the direction of the principal stresses also. Take E = 200 GPa and = 0.25.



11. A solid circular shaft transmits 80 kW power at 190 rpm. Calculate the diameter of the shaft if the twist in the shaft is not to exceed 1° in 2 m length of shaft and shear stress is limited to 60 MPa. Take G = 100 GPa.

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22CET 303	Fluid Mechanics and Hydraulics	Category	L	T	P	Credit	Year of Introduction
		PCC	3	1	0	4	2019

Preamble: Goal of this course is to expose the students to the fundamental concepts of fluid mechanics, hydraulics of pipes and open channels and to enhance the problem solving skills. The concepts learned will help in applying them for the design of hydraulic structures and to real world fluid flow problems.

Pre-requisite: Elementary mathematics, concepts in engineering mechanics

Course outcome

After the course, the student will able to:

CO1	Recall the relevant principles of hydrostatics and hydraulics of pipes and open channels
CO2	Identify or describe the type, characteristics or properties of fluid flow
CO3	Estimate the fluid pressure, perform the stability check of bodies under hydrostatic condition
CO4	Compute discharge through pipes or estimate the forces on pipe bends by applying hydraulic principles of continuity, energy and/or momentum
CO5	Analyze or compute the flow through open channels, perform the design of prismatic channels

CET 203 Fluid Mechanics and Hydraulics		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	2	2										
	CO2	2	2										
	CO3	3	3				1						
	CO4	3	3				1						
	CO5	3	3	2									

Assessment pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	5	5	15
Understand	10	10	15
Apply	20	20	40
Analyze	15	15	30

Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks
Total : 50 marks

End semester examination pattern – There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Qn No	**Question**	**Marks**	**Course outcome (CO) Assessed**
	Part A **(Answer ALL Questions)**		
1	Explain the method of estimation of hydrostatic force on curved surfaces	3	CO1
2	Compare the use of piezometer and manometer for pressure measurement	3	CO1
3	Explain the experimental method of determination of metacentric height	3	CO1
4	Define streamline, streakine and pathline	3	CO2
5	Explain the use and principle of Pitot tube	3	CO1
6	Obtain the discharge equation of a large rectangular Orifice	3	CO2
7	Explain conveyance and section factor for uniform flow and their practical applications	3	CO1
8	Obtain the condition for maximum velocity through	3	CO1

	circular channels		
9	State the assumptions involved in the derivation of dynamic equation of gradually varied low	3	CO1
10	Explain the classification of hydraulic jumps based on Froude's Number	3	CO1
	Part B **(Answer ANY ONE FULL question from each module)**		
	Module I		
11(a)	Differentiate gauge pressure, atmospheric pressure and absolute pressure	4	CO1
11(b)	A U-tube manometer is used to measure the pressure of water in a pipeline which is in excess of atmospheric. The left limb is connected to the pipeline and right limbis open to atmosphere. The free surface of mercury in theright limb is in level with the centre line of the pipe and the level difference of mercury in the limbs of the manometer is 20 cm. Compute the water pressure in the pipeline. If the pressure of water is increased by 50 %, compute the manometric reading.	10	CO3
12(a)	Obtain the expression for centre of pressure of a lamina placed in fluid in vertical position	4	CO1
12(b)	An inclined rectangular sluice gate AB 1.2m by 5m as shown in fig is installed to control the discharge of water. The end A is hinged. Determine the force normal to gate applied at B to open it.	10	CO3
	Module II		
13(a)	Find the acceleration at (1, 2, 3) after 1 sec for a 3D flow given by $u=yz+t$, $v=xz-t$, $w=xy$	6	CO2
13(b)	Derive continuity equation in 3D Cartesian coordinates	8	CO1

14(a)	A solid cylinder 2 m in diameter and 2 m in length floats in water with its axis vertical. If the specific gravity of the material of the cylinder is 0.65, find the metacentric height and comment on the stability of the body	6	CO3
14(b)	Explain the stability conditions of floating bodies and submerged bodies	8	CO1
	Module III		
15	Gasoline (specific gravity 0.82) flows at a rate of 215 l/s in upward direction through an inclined venturimeter fitted to a 300 mm diameter pipe. The venturimeter is inclined at 60^o to vertical and its 150 mm diameter throat is 1.2 m from the entrance along its length. Pressure gauges inserted at the inlet and throat show pressures of 0.141 N/mm^2 and 0.077 N/mm^2 respectively. Compute the coefficient of discharge of the venturimeter. If instead of pressure gauges, the entrance and throat are connected to two limbs of a mercury u-tube manometer, determine the manometric reading.	14	CO4
16	A pipeline of 600 m diameter is 1.5 km long. To increase the discharge, another pipe of same diameter is introduced in parallel to the first pipe, for the second halfof length. If *f*=0.04, and head at inlet is 300 mm, calculate the increase in discharge. Neglect minor losses.	14	CO4
	Module IV		
17(a)	Explain the characteristics of velocity distribution in open channels	4	CO2
17(b)	A lined canal n=0.014 is of trapezoidal section with one side vertical and other with a slope of 1.5H:1 V. If the channel is to deliver 9 m^3/sec when laid on a slope of 0.0002, calculate the dimensions of the efficient section that requires minimum lining.	10	CO5
18(a)	Obtain the discharge equation of a Cipoletti weir	4	CO2
18(b)	A 40 m long weir is divided into 12 equal bays byvertical posts, each 0.6 m wide. Using Francis formula, calculate the discharge over the weir if the head over the crest is 1.2 m and velocity of approach is 2 m/sec	10	CO5
	Module V		
19 (a)	State the characteristics of M type profiles	4	CO2

19 (b)	A very wide rectangular channel carries a discharge of 8 cumecs per m width. The channel has a bed slope of 0.004 and Manning's roughness coefficient 0.015. Find the distance to a section were water depth is 0.9 m using single step method	10	CO5
20 (a)	Show that minimum specific force for a given discharge indicate the critical flow in open channels	4	CO2
20 (b)	The energy loss and Froude number after the jump in a horizontal rectangular channel are 9.00 and 0.12 respectively. Determine the depth before the jump will be and the power lost per m width of the channel	10	CO5

Model Question Paper

Reg No.:...................... **QP CODE:...................**

Name:..

THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CET303

Fluid Mechanics and Hydraulics

Max. Marks: 100 **Duration: 3 hours**

Part A

(Answer all questions; each question carries 3 marks)

1. Explain the method of estimation of hydrostatic force on curved surfaces
2. Compare the use of piezometer and manometer for pressure measurement
3. Explain the experimental method of determination of metacentric height
4. Define streamline, streakline and pathline
5. Explain the use and principle of Pitot tube
6. Obtain the discharge equation of a large rectangular orifice
7. Explain conveyance and section factor for uniform flow and their practical applications
8. Obtain the condition for maximum velocity through circular channels
9. State the assumptions involved in the derivation of dynamic equation of gradually varied low

10. Explain the classification of hydraulic jumps based on Froude's Number

(3 Marks x 10 = 30 Marks)

Part B

(Answer one full question from each module, each question carries 14 marks)

Module I

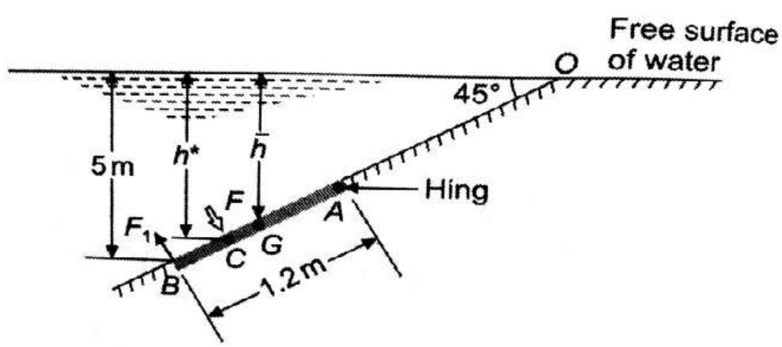
11. (a) Differentiate gauge pressure, atmospheric pressure and absolute pressure (4 Marks)

(b) A U-tube manometer is used to measure the pressure of water in a pipeline which is in excess of atmospheric. The left limb is connected to the pipeline and right limb is open to atmosphere. The free surface of mercury in the right limb is in level with the centre line of the pipe and the level difference of mercury in the limbs of the manometer is 20 cm. Compute the water pressure in the pipeline. If the pressure of water is increased by 50 %, compute the manometric reading. (10 Marks)

OR

12.(a) Obtain the expression for centre of pressure of a lamina placed in fluid in vertical position (4 Marks)

(b) An inclined rectangular sluice gate AB 1.2m by 5m as shown in fig is installed to control the discharge of water. The end A is hinged. Determine the force normal to gate applied at B to open it. (10 Marks)



Module II

13.(a) Find the acceleration at (1, 2, 3) after 1 sec for a 3D flow given by $u=yz+t$, $v=xz-t$, $w=xy$

(6 Marks)

(b) Derive continuity equation in 3D Cartesian coordinates (8 Marks)

OR

14. (a) A solid cylinder 2 m in diameter and 2 m in length floats in water with its axis vertical. If the specific gravity of the material of the cylinder is 0.65, find the metacentric height and comment on the stability of the body. (6 Marks)

(b) Explain the stability conditions of floating and submerged bodies (8 Marks)

Module III

15. Gasoline (specific gravity 0.82) flows at a rate of 215 l/s in upward direction through an inclined venturimeter fitted to a 300 mm diameter pipe. The venturimeter is inclined at 60° to vertical and its 150 mm diameter throat is 1.2 m from the entrance along its length.Pressure gauges inserted at the inlet and throat show pressures of 0.141 N/mm^{2}and 0.077 N/mm^2 respectively. Compute the coefficient of discharge of the venturimeter. If instead of pressure gauges, the entrance and throat are connected to two limbs of a mercury u-tube manometer, determine the manometric reading. (14 Marks)

OR

16. A pipeline of 600 m diameter is 1.5 km long. To increase the discharge, another pipe of same diameter is introduced in parallel to the first pipe, for the second half of length. If *f*=0.04, and head at inlet is 300 mm, calculate the increase in discharge. Neglect minor losses. (14 Marks)

Module IV

17 (a) Explain the characteristics of velocity distribution in open channels (4 Marks)

(b) A lined canal n=0.014 is of trapezoidal section with one side vertical and other with a slope of 1.5H:1 V. If the channel is to deliver 9 m^3/sec when laid on a slope of 0.0002, calculate the dimensions of the efficient section that requires minimum lining. (10 Marks)

OR

18 (a) Obtain the discharge equation of a Cipoletti weir (4 Marks)

(b) A 40 m long weir is divided into 12 equal bays by vertical posts, each 0.6 m wide. Using Francis formula, calculate the discharge over the weir if the head over the crest is 1.2 m and velocity of approach is 2 m/sec (10 Marks)

Module V

19 (a) State the characteristics of M type profiles (4 Marks)

(b) A very wide rectangular channel carries a discharge of 8 cumecs per m width. The channel has a bed slope of 0.004 and Manning's roughness coefficient 0.015. Find the distance to a section were water depth is 0.9 m using single step method. (10 Marks)

OR

20.(a) Show that minimum specific force for a given discharge indicate the critical flow in open channels. (4 Marks)

(b) The energy loss and Froude number after the jump in a horizontal rectangular channel are 9.00 and 0.12 respectively. Determine the depth before the jump will be and the power lost per m width of the channel. (10 Marks)

Course Code: 22CET303

Fluid Mechanics and Hydraulics

Syllabus

Module I

Introduction to the subject-Fluid properties (mass density, specific weight, viscosity, specific gravity), Classification of Fluids (prerequisite no questions from this section) Fluid statics-variation of pressure in a fluid, measurement of fluid pressure using piezometers and manometers, U-tube manometers, Forces on immersed plane placed vertical and inclined positions. Hydrostatic force on curved surfaces – Practical application of total pressure on spillway gates.

Module II

Buoyancy and Floatation: Buoyant force, Principle of floatation, stability of floating and submerged bodies, metacentre and metacentric height, analytical and experimental determinationof metacentric height
Hydrodynamics- Methods of describing fluid motion, Lagrangian and Eulerian methods, velocityand acceleration, types of fluid flow, description of fluid flow-streamline, pathline and streakline; continuity equation in one, two and three dimensions

Module III

Fluid kinetics-forces considered in describing fluid motion, Derivation of Bernoulli's equation by integration of Euler's equation along a streamline, kinetic energy correction factor, Applications of Bernoulli's equation- Venturimeter, Pitot tube and Orificemeter; Hydraulic coefficients of orifices and their experimental determination, Discharge through small orifice and large rectangular orifices

Pipe flow- computation of major and minor losses in pipes, hydraulic gradient line and total energy line, pipes in series-equivalent pipe, flow through parallel pipes.

Module IV

Open channel flow – comparison between pipe flow and open channel flow, velocity distribution in open channels, types of channels, type of flow, geometric elements of channel section,uniform flow computations (Chezy's equation, Kutter's and Manning's formula); Most economical sections – rectangular, triangular and trapezoidal channels, condition for maximum discharge and maximum velocity through circular channels, conveyance and section factor
Flow measurement in channels – notches and weirs – Discharge computations using weirs-velocity of approach and end contraction, discharge equations of rectangular weir, triangular weir, trapezoidal and Cipoletti weir, submerged weir, broad crested weir.

Module V

Specific energy- specific energy diagram and discharge diagram, Critical flow and its computation.
Gradually varied flow- Dynamic equation of gradually varied flow-different forms, types and characteristics of water surface profiles in rectangular prismatic channels. Computation of length of water surface profiles by direct step method
Specific force, Rapidly varied flow-Hydraulic jump-conjugate or sequent depths, expression for sequent depths and energy loss for a hydraulic jump in horizontal rectangular channels, types uses and characteristics of hydraulic jump

Text Books

1. Modi P. N. and S. M. Seth, Hydraulics & Fluid Mechanics, S.B.H Publishers, New Delhi, 2002.
2. Subramanya K., Theory and Applications of Fluid Mechanics, Tata McGraw-Hill, 1993.
3. Subramanya K., Flow in Open channels, Tata McGraw-Hill, 2009.

References

1. Streeter.V.L. Fluid Mechanics, Mc Graw Hill Publishers.
2. Bruce R Munson, Donald F Young . Fundamentals of Fluid Mechanics, John Wiley & sons, 2011.
3. Jain A. K., Fluid Mechanics, Khanna Publishers, Delhi, 1996.
4. Joseph Katz, Introductory Fluid Mechanics, Cambridge University Press, 2015
5. Arora.K.R. Fluid Mechanics, Hydraulics and Hydraulic Machines, Standard Publishers, 2005.

6. Narasimhan S., A First Course in Fluid Mechanics, University Press (India) Pvt. Ltd., 2006.
7. Frank.M.White, Fluid Mechanics, Mc Graw Hill, 2013.
8. Mohanty.A.K. Fluid Mechanics, Prentice Hall, New Delhi, 2011
9. Narayana Pillai,N. Principles of Fluid Mechanics and Fluid Machines, University Press, 2011.
10. Kumar.D.N. Fluid Mechanics and Fluid power Engineering, S.K.Kataria & sons, 2013.

Course Code: 22CET303

Fluid Mechanics and Hydraulics

Course content and Schedule of lecture (sample)

Module	Topic	Course outcome addressed	No of Hours
Module I (9 Hours)			
1.1	Introduction to the subject-Fluid properties (mass density, specific weight, viscosity, specific gravity) Classification of Fluids	CO1	1
1.2	Fluid statics-fluid pressure and variation of pressure in a fluid, Pressure head	CO1	1
1.3	Measurement of pressure using piezometers and manometers	CO3	1
1.4	Problems on pressure measurement	CO3	1
1.5	Tutorial	CO3	1
1.6	Pressure head on immersed plane- vertical and inclined cases	CO3	1
1.7	Problems on estimation of pressure	CO3	1
1.8	Estimation of pressure force acting on curved surfaces	CO1	1
1.9	Tutorial	CO3	1
Module II (9 Hours)			
2.1	Buoyancy, buoyant force, principle of floatation, stability of submerged bodies	CO1	1
2.2	Stability of floating bodies, metacentre and metacentric height-analytical determination	CO1	1
2.3	Metacentric height- experimental determination, problems	CO3	1
2.4	Problems on buoyancy and floatation	CO3	1

2.5	Kinematics of fluids: Methods of describing fluid motion, Lagrangian and Eulerian methods, Types of fluid flow; Description of fluid motion-streamline, streakline and pathline	CO2	1
2.6	Velocity & Acceleration of fluid particle, convective and local acceleration	CO2	1
2.7	Problems on flow properties	CO2	1
2.8	Conservation of mass, Equation of continuity in 1D,2D and 3D	CO2	1
2.9	Tutorial	CO2	1
Module III (9 Hours)			
3.1	Introduction to fluid kinetics – forces acting; Euler's equation of motion and integration of Euler's equation of motion along a streamline- Bernoulli's Equation, Energy correction factor	CO1	1
3.2	Applications of Bernoulli's equation, Venturimeter and orifice meter, Problems	CO4	1
3.3	Problems	CO4	1
3.4	Flow through orifices: types of orifices, Experimental determination of Hydraulic coefficients	CO2	1
3.5	Flow over a sharp edged orifice, Flow through large rectangular orifice and submerged orifices	CO2	1
3.6	Pipe flow: Equations for determination of major and minor energy Losses	CO1	1
3.7	Hydraulic gradient and total energy line; pipes in series and parallel	CO1	1
3.8,	Problems on discharge computation	CO4	1
3.9	Tutorial	CO4	1
Module IV (9 Hours)			
4.1	Introduction-difference between pipe flow and open channel flow-types of channels and flow, velocity distribution in open channels	CO1	1
4.2	Geometric elements of channels-computation for simple sections-Uniform flow; Derivation of Chezy's equation	CO1	1
4.3	Manning's and Kutter's Equation, Concept of Conveyance and Section factor, problems	CO5	1
4.4	Problems		1
4.5	Most economical sections-conditions for rectangular, triangular and trapezoidal channels	CO5	1
4.6	Most economical circular channels, Problems	CO5	1
4.7	Flow measurement in channels- Types of weirs flow over rectangular and triangular sharp crested weir; Effect of end contraction and velocity of approach	CO5	1

4.8	Flow over a trapezoidal weir, Cipolletti weir, broad crested weir, submerged weirs	CO5	1
4.9	Tutorial	CO5	1
Module V (9 Hours)			
5.1	Specific energy, Specific energy diagram computation of critical depth	CO5	1
5.2	Problems	CO5	1
5.3	Gradually varied flow-Concept, Forms of GVF equations,	CO5	1
5.4	Types and Characteristics of water surface profiles	CO5	1
5.5	Problems	CO5	1
5.6	Computation of length of water surface profiles by direct step method, Problems	CO5	1
5.7	Specific force, Conjugate depths, Hydraulic jump- Derivation of sequent depth relation in rectangular channels	CO5	1
5.8	Characteristics, types and uses of hydraulic jump, Problems	CO5	1
5.9	Tutorial	CO5	1

22CET304	SURVEYING & GEOMATICS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	4	0	0	4	2019

Preamble:
Objective of the course is to impart an awareness on the principles of surveying, various methods and instruments of surveying, errors associated with field measurements and advanced surveying techniques.

Prerequisite: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Apply surveying techniques and principles of leveling for the preparation of contour maps, computation of area-volume and sketching mass diagram
CO 2	Apply the principles of surveying for triangulation
CO 3	Apply different methods of traverse surveying and traverse balancing
CO 4	Identify the possible errors in surveying and apply the corrections in field Measurements
CO 5	Apply the basic knowledge of setting out of different types of curves
CO 6	Employ surveying techniques using advanced surveying equipments

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3		2	2							
CO 2	3	3		2								
CO 3	3	3						1	2			
CO 4	3	2										
CO 5	3	2	1	1				1	2			
CO 6	3			2	2			1				2

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (marks)
	Test 1 Marks	Test 2 Marks	
Remember	**7.5**	**7.5**	**30**
Understand	**7.5**	**7.5**	**30**
Apply	**10**	**10**	**40**
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern:

The question consists of two parts- Part A and Part B. Part A consists of 10 questions with 3 marks for each (two questions from each module). Part B consists of two questions from each module, out of which one has to be answered. Each question carries 14 marks and can have maximum 2 subdivisions.

Sample Course Level Assessment Questions:

Course Outcome 1 (CO1): The following perpendicular offsets were taken at 10m intervals from a survey line AB to an irregular boundary line: 2.50, 3.80, 4.33, 6.76, 5.30, 7.25, 8.95, 8.25 and 5.50.Calculate the area in sqm, enclosed between the survey line, the irregular boundary ,the first and the last offsets by i) Simpsons rule ii) Trapezoidal rule.

Course Outcome 2 (CO2): What is meant by satellite station and reduction to centre. From an eccentric station S, 13 metres to the west of the main station B, the following angles were measured. Angle BSC= 75°25'32", Angle CSA = 55°32'20''. The stations S and C are to the opposite sides of the line AB. Calculate the correct angle ABC if the lengths AB and BC are 5288m and 4940m respectively

Course Outcome 3 (CO3): How do you balance a closed traverse with closing error using the graphical method of Bowdich's rule?

Course Outcome 4 (CO4): How is the most probable value in direct observations of equal weights determined?

Course Outcome 5 (CO5): How do you set out a simple curve by Rankine's method of tangential angles. Calculate the necessary data for setting out a curve of 300 m radius. Assume any other data, if required.

Course Outcome 6 (CO6): What are spectral signature curves? Discuss the spectral reflectance of soil, water and vegetation.

Syllabus

Module 1

Introduction to Surveying- Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines,Local attraction, Declination, Methods of orientation (by compass and by backsighting)

Levelling: Principles of levelling- Dumpy level, booking and reducing levels, Methods- simple, differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in leveling

Contouring: Characteristics, methods, uses.

Module 2

Area and Volume: computation of area by offsets to base line, by dividing area into number of triangles; volume of level section by prismoidal and trapezoidal formulae.

Mass diagram: Construction, Characteristics and uses

Theodolite survey: Instruments, Measurement of horizontal and vertical angle, principles of stadia and tangential tacheometry (introduction only)

Triangulation: Triangulation figures, Triangulation stations, Inter visibility of stations, Satellite Stations and reduction to centre.

Module 3

Traverse Surveying - Methods of traversing, Checks in closed traverse, Traverse computations, Balancing the traverse- Bowditch's rule, Transit rule, graphical method based on Bowditch's rule, omitted measurements (a line and an angle only)

Theory of Errors – Types, theory of least squares, Weighting of observations, Most probable value, Computation of indirectly observed quantities - method of normal equations.

Module 4

C**urve Surveying** – Elements of simple and compound curves – Methods of setting out (Angular methods only)– Elements of Reverse curve (Introduction only)– Transition curve – length of curve – Elements of transition curve - Vertical curve (Introduction only)

Total Station – concept of EDM, principles and working, advantages and applications

Module 5

Global Positioning Systems-Components and principles, satellite ranging-calculating position, signal structure, application of GPS, GPS Surveying methods-Static, Rapid static, Kinematic methods – DGPS

Remote Sensing : Definition- Electromagnetic spectrum-Energy interactions with atmosphere and earth surface features-spectral reflectance of vegetation, soil and water- Classification of sensors-Active and Passive, Resolution-spatial, spectral radiometric and Temporal resolution, Multi spectral scanning-Along track and across track scanning

Geographical Information System-components of GIS, GIS operations, Map projections-methods, Coordinate systems-Geographic and Projected coordinate systems, Data Types- Spatial and attribute data, Raster and vector data representation

Text Books :

1. Dr. B.C. Punmia , Ashok Kumar Jain &Arun Kumar Jain - Surveying , Laxmi publications (P) Ltd , 2005
2. Chang,K , “Introduction to Geographic Information Systems”, Tata McGraw-Hill Publishing Co. Ltd, 2008
3. George Joseph, “Fundamentals of Remote Sensing”, University Press, 2003

References :

1. C. Venkatramaiah, Textbook of Surveying, Universities Press (India) Private Limited 2011
2. James M Andersen, Edward M Mikhail, Surveying Theory and Practice, McGraw Hill Education
4. Prof. T.P.Kenetkar&Prof.S.V.Kulkarni - Surveying and Levelling , Pune VidyarthiGriha Prakashan,2004
5. N NBasak, Surveying and Levelling, McGrawHill Education
6. R.Agor - A Text book of Surveying and Levelling, Khanna Publishers, 2005
3. S.K.Duggal - Surveying Vol. I, Tata McGraw Hill Ltd ,Reprint 2015.
7. S.K. Duggal - Surveying Vol. II, Tata McGraw Hill Ltd ,Reprint 2015
4. Burrough P , Principles of Geographical Information systems, Oxford University Press, 1998
5. Iliffe, C.J., Datums and Map Projections for Remote Sensing, GIS and Surveying, Whittles Publishing, 2006
6. James M Andersen, Edward M Mikhail, Surveying Theory and Practice, McGraw Hill education, 7e, 1998
7. Kang-tsung Chang, „Introduction to GIS‟ , Tata McGraw-Hill Publishing Co. Ltd, 8e, 2016
8. Lillesand M and Kiefer W, “Remote Sensing and Image Interpretation”. John Wiley and Sons,Inc., 2000

Course Content and lecture Schedule:

No.	Topic	Course Outcome	No. of Hrs
1	**Module 1**		Total: 9
1.1	**Introduction to Surveying**- Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines,Local attraction, Declination, Methods of orientation	CO1	4
1.2	**Levelling**: Principles of levelling- Dumpy level, booking and reducing levels, Methods- simple, differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in leveling	CO1	4
1.3	**Contouring**: Characteristics, methods, uses.	CO1	1
2	**Module 2**		Total: 9
2.1	**Area and Volume**: computation of area by offsets to base line, by dividing area into number of triangles; volume of level section by prismoidal and trapezoidal formulae.	CO1	3
2.2	**Mass diagram**: Construction, Characteristics and uses	CO1	1
2.3	**Theodolite survey**: Instruments, Measurement of horizontal and vertical angle, principles of stadia and tangential tacheometry (introduction only)	CO2	2
2.4	**Triangulation:** Triangulation figures, Triangulation stations, Inter visibility of stations, Satellite Stations and reduction to centre.	CO2	3
3	**Module 3**		Total: 9
3.1	**Traverse Surveying** - Methods of traversing, Checks in closed traverse, Traverse computations, Balancing the traverse- Bowditch's rule, Transit rule, graphical method based on Bowditch's rule, Gales Traverse table, omitted measurements (a line and an angle only)	CO3	5
3.2	**Theory of Errors** – Types, theory of least squares, Weighting of observations, Most probable value, Computation of indirectly observed quantities - method of normal equations.	CO4	4
4	**Module 4**		Total: 9
4.1	C**urve Surveying** – Elements of simple and compound curves – Methods of setting out (Angular methods only)– Elements of Reverse curve (Introduction only)– Transition curve – length of curve – Elements of transition curve - Vertical curve (introduction only)	CO5	6
4.2	**Total Station** – concept of EDM, principles and working, advantages and applications	CO6	3
5	**Module 5**		Total: 9
5.1	**Global Positioning Systems**-Components and Principles, Satellite ranging-calculating position, signal structure,	CO6	3

	application of GPS, GPS Surveying methods-Static, Rapid static , Kinematic methods – DGPS		
5.2	**Remote Sensing** : Definition- Electromagnetic spectrum-Energy interactions with atmosphere and earth surface features-spectral reflectance of vegetation, soil and water- Classification of sensors- Active and Passive, Resolution-spatial, spectral radiometric and Temporal resolution, Multi spectral scanning-Along track and across track scanning	CO6	3
5.3	**Geographical Information System**-components of GIS, GIS operations, Map projections- methods, Coordinate systems-Geographic and Projected coordinate systems, Data Types-Spatial and attribute data, Raster and vector data representation	CO6	3

THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code:**22CET 304**

Course Name: **SURVEYING & GEOMATICS**
Model Question Paper

Marks:100 Duration: 3 hrs

PART A
(Answer all Questions: Each question carries 3 marks)

1. What are the general principles of surveying?
2. Define back sight, foresight and intermediate sight.
3. How do you determine the intervisibilty of triangulation stations?
4. What is the principle of stadia tacheometry?
5. How will you determine probable error of computed quantities?
6. What are the checks in closed traverse?
7. What are the elements of a compound curve?
8. Explain the two theodolite method of setting out of simple curve.
9. What is multi spectral scanning? Differentiate along track and across track scanning.
10. What is meant by satellite ranging?

PART B
(Answer one full question from each module)

11. a. Define contour. What are the characteristics of contour? (4)

b. The following readings were taken in a running closed compass traverse.
Line FB BB
AB 49 °55’ 230 °00’
BC 177 °45’ 356 °00’
CD 104 °15’ 284 °55’
DE 165 °15’ 345 °15’
EA 259 °30’ 79 °90’
i) State the stations which were affected by local attraction.
ii) Determine the corrected bearings
iii) Calculate the true bearings if the declination was 1° 30’ W. (10)

OR

12. a. What are the different methods of orientation in plane table surveying? (4)

b. The following readings were taken with a dumpy level and a 4 m levelling staff on a continuously sloping ground at 30m intervals. 0.685, 1.455, 1.850, 2.330, 2.885 ,3.380, 1.055, 1.860, 2.265, 3.540, 0.835, 0.945, 1.530 and 2.250. The reduced level of the first point is 80.750. Rule out a page of a level book and enter the above readings. Determine RLs of all points using height of instrument method. Determine the gradient of the line joining the first and last point. (10)

13. a. The following perpendicular offsets were taken at 10m intervals from a survey line AB to an irregular boundary line: 2.50, 3.80, 4.33, 6.76, 5.30, 7.25, 8.95, 8.25 and 5.50.Calculate the area in sqm, enclosed between the survey line, the irregular boundary ,the first and the last offsets by i) Simpsons rule ii) Trapezoidal rule. (10)

b. Explain Mass diagram and its characteristics features. (4)

OR

14. a. Explain the method of observing the horizontal angle by the method of repetition and reiteration in triangulation survey. (4)

b. What is meant by satellite station and reduction to centre. From an eccentric station S, 13 metres to the west of the main station B, the following angles were measured. Angle BSC= 75°25’32”, Angle CSA = 55°32’20’’. The stations S and C are to the opposite sides of the line AB. Calculate the correct angle ABC if the lengths AB and BC are 5288m and 4940m respectively. (10)

15. a. The following are the mean values observed in the measurement of three angles
A, B, C at one station
A =86°42’46.2’’ with weight 4
A+B =134°36°33.6’’ with weight 3
A+B+C =262°18’10.4’’ with weight 1
B+C =185°35’24.8’’ with weight 2
Calculate the most probable value of A, B and C. (10)

b. Distinguish between a) closed traverse and open traverse b) loose needle method and fast needle method of traverse surveying (4)

OR

16. a. State the fundamental principle of method of least squares. How is the most probable value in direct observations of equal weights determined? (7)

b. Describe the procedures for balancing a closed traverse by graphical method. (7)

17. a. Two tangents intersect at chainage 1000 m, the deflection angle being $60^0 20$’.Calculate the necessary data for setting out a curve of 200 m radius to connect two tangents if it is intended to set out the curve by Rankine’s method of tangential angles. Take peg interval equal to 20 m. (10)

b. What are the advantages and applications of Total Station survey?(4)

OR

18. a. What is transition curve? What are its functions? What are the methods to find out the length of transition curve? (10)
19. b. Explain the principle behind electromagnetic distance measurement. (4)

20. a. What are the components of GPS? Illustrate with figure. Explain the functions of each of them in detail. (10)

b. What are the applications of GIS? (4)

OR

21. a. How does electromagnetic radiation interact with atmosphere? (7)

b. What are the various types of map projections based on the projection surface? (7)

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
			2	0	0	2
22EST 305	DESIGN AND ENGINEERING					

Preamble:

The purpose of this course is to

i) introduce the undergraduate engineering students the fundamental principles ofdesign engineering,

ii) make them understand the steps involved in the design process and

iii) familiarize them with the basic tools used and approaches in design.

Students are expected to apply design thinking in learning as well as while practicing engineering, which is very important and relevant for today. Case studies from various practical situations will help the students realize that design is not only concerned about the function but also many other factors like customer requirements, economics, reliability, etc. along with a variety of life cycle issues.

The course will help students to consider aesthetics, ergonomics and sustainability factors in designs and also to practice professional ethics while designing.

Prerequisite:

Nil. The course will be generic to all engineering disciplines and will not require specialized preparation or prerequisites in any of the individual engineering disciplines.

Course Outcomes:

After the completion of the course the student will be able to

CO 1	Explain the different concepts and principles involved in design engineering.
CO 2	Apply design thinking while learning and practicing engineering.
CO 3	Develop innovative, reliable, sustainable and economically viable designs incorporating knowledge in engineering.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1					1			1		
CO 2		2				1		1				2
CO 3			2			1	1		2	2		1

Assessment Pattern

Continuous Internal Evaluation (CIE) Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination (ESE) Pattern: There will be two parts; Part A and Part B.
Part A : 30 marks
part B : 70 marks
Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions.
Part B contains 2 case study questions from each module of which student should answer any one. Each question carry 14 marks and can have maximum 2 sub questions.

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	5	5	10
Understand	10	10	20
Apply	35	35	70
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Course Level Assessment Questions

Course Outcome 1 (CO1): Appreciate the different concepts and principles involved in design engineering.

1. State how engineering design is different from other kinds of design

2. List the different stages in a design process.

3. Describedesign thinking.

4. State the function of prototyping and proofing in engineering design.

5. Write notes on the following concepts in connection with design engineering 1) Modular Design, 2) Life Cycle Design , 3) Value Engineering, 4) Concurrent Engineering, and 5) Reverse Engineering

6. State design rights.

Course Outcome 2 (CO2) Apply design thinking while learning and practicing engineering.

1. Construct the iterative process for design thinking in developing simple products like a pen, umbrella, bag, etc.

2. Show with an example how divergent-convergent thinking helps in generating alternative designs and then how to narrow down to the best design.

3. Describe how a problem-based learning helps in creating better design engineering solutions.

4. Discuss as an engineer, how ethics play a decisive role in your designs

Course Outcome 3(CO3): Develop innovative, reliable, sustainable and economically viable designs incorporating different segments of knowledge in engineering.

1. Illustratethe development of any simple product by passing through the different stages of design process

2. Show thegraphical design communication with the help of detailed 2D or 3D drawings for any simple product.

3. Describe how to develop new designs for simple products through bio-mimicry.

TKM COLLEGE OF ENGINEERING, KOLLAM (GOVT. AIDED AUTONOMOUS)

Model Question paper

Reg No.:_______________Name:___________________________

THIRD/FOURTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: 22EST 305

Course Name: DESIGN AND ENGINEERING

Max. Marks: 100Duration: 3 Hours

PART A

Answer all questions, each question carries 3 marks
Use only hand sketches

(1) Write aboutthe basic design process.

(2) Describe how to finalize the design objectives.

(3) State the role of divergent-convergent questioning in design thinking.

(4) Discuss how to perform design thinking in a team managing the conflicts.

(5) Show how engineering sketches and drawings convey designs.

(6) Explain the role of mathematics and physics in design engineering process.

(7) Distinguish between project-based learning and problem-based learning in design engineering.

(8) Describe how concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?

(9) Show how designs are varied based on the aspects of production methods, life span, reliability and environment?

(10) Explain how economics influence the engineering designs?

(10x3 marks =30 marks)

Part B

Answer any ONE question from each module. Each question carry 14 marks

Module 1

(11) Show the designing of a wrist watch going through the various stages of the design process. Use hand sketches to illustrate the processes.

or

(12) Find the customer requirements for designing a new car showroom. Show how the design objectives were finalized considering the design constraints?

Module 2

(13) Illustrate the design thinking approach for designing a bag for college students within a limited budget. Describe each stage of the process and the iterative procedure involved. Use hand sketches to support your arguments.

or

(14) Construct a number of possible designs and then refine them to narrow down to the best design for a drug trolley used in hospitals. Show how the divergent-convergent thinking helps in the process. Provide your rationale for each step by using hand sketches only.

Module 3

(15) Graphically communicate the design of a thermo flask used to keep hot coffee. Draw the detailed 2D drawings of the same with design detailing, material selection, scale drawings, dimensions, tolerances, etc. Use only hand sketches.

or

(16) Describe the role of mathematical modelling in design engineering. Show how mathematics and physics play a role in designing a lifting mechanism to raise 100 kg of weight to a floor at a height of 10 meters in a construction site.

Module 4

(17) Show the development of a nature inspired design for a solar poweredbus waiting shed beside a highway. Relate between natural and man-made designs. Use hand sketches to support your arguments.

or

(18) Show the design of a simple sofa and then depict how the design changes when considering 1) aesthetics and 2) ergonomics into consideration. Give hand sketches and explanations to justify the changes in designs.

Module 5

(19) Examine the changes in the design of a foot wear with constraints of 1) production methods, 2) life span requirement, 3) reliability issues and 4) environmental factors. Use hand sketches and give proper rationalization for the changes in design.

or

(20) Describe the how to estimate the cost of a particular design using ANY of the following: i) a website, ii) the layout of a plant, iii) the elevation of a building, iv) anelectrical or electronic system or device and v) a car.

Show how economics will influence the engineering designs. Use hand sketches to support your arguments.

(5x14 marks =70 marks)

Syllabus

Module 1

Design Process:- Introduction to Design and Engineering Design, Defining a Design Process-:Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.

Module 2

Design Thinking Approach:-Introduction to Design Thinking, Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Design Thinking as Divergent-Convergent Questioning. Design Thinking in a Team Environment.

Module 3

Design Communication (Languages of Engineering Design):-Communicating Designs Graphically, Communicating Designs Orally and in Writing. Mathematical Modeling In Design, Prototyping and Proofing the Design.

Module 4

Design Engineering Concepts:-Project-based Learning and Problem-based Learning in Design.Modular Design and Life Cycle Design Approaches. Application of Bio-mimicry,Aesthetics and Ergonomics in Design. Value Engineering, Concurrent Engineering, and Reverse Engineering in Design.

Module 5

Expediency, Economics and Environment in Design Engineering:-Design for Production, Use, and Sustainability. Engineering Economics in Design. Design Rights. Ethics in Design

Text Books

1) YousefHaik, SangarappillaiSivaloganathan, Tamer M. Shahin, Engineering Design Process, Cengage Learning 2003, Third Edition, ISBN-10: 9781305253285,

2) Voland, G., Engineering by Design, Pearson India 2014, Second Edition, ISBN 9332535051

Reference Books

1. Philip Kosky, Robert Balmer, William Keat, George Wise, Exploring Engineering, Fourth Edition: An Introduction to Engineering and Design, Academic Press 2015, 4th Edition,ISBN: 9780128012420.
2. Clive L. Dym, Engineering Design: A Project-Based Introduction, John Wiley & Sons, New York 2009, Fourth Edition, ISBN: 978-1-118-32458-5
3. Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Berg Publishers 2011, First Edition, ISBN: 978-1847886361
4. Pahl, G., Beitz, W., Feldhusen, J., Grote, K.-H., Engineering Design: A Systematic Approach, Springer 2007, Third Edition, ISBN 978-1-84628-319-2

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1: Design Process**	
1.1	Introduction to Design and Engineering Design. *What does it mean to design something? How Is engineering design different from other kinds of design? Where and when do engineers design? What are the basic vocabularyin engineering design? How to learn and do engineering design.*	1
1.2	*Defining a Design Process*-: Detailing Customer Requirements. *How to do engineering design? Illustrate the process with an example. How to identify the customer requirements of design?*	1
1.3	*Defining a Design Process*-: Setting Design Objectives, Identifying Constraints, Establishing Functions. *How to finalize the design objectives? How to identify the design constraints? How to express the functions a design in engineering terms?*	1
1.4	*Defining a Design Process*-: Generating Design Alternatives and Choosing a Design. *How to generate or create feasible design alternatives? How to identify the "best possible design"?*	1
1.5	Case Studies:- Stages of Design Process. *Conduct exercises for designing simple products going through the different stages of design process.*	1
2	**Module 2: Design Thinking Approach**	
2.1	Introduction to Design Thinking *How does the design thinking approach help engineers in creating innovative and efficient designs?*	1
2.2	Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. *How can the engineers arrive at better designs utilizing the iterative design thinking process (in which knowledge acquired in the later stages can be applied back to the earlier stages)?*	1
2.3	Design Thinking as Divergent-Convergent Questioning. *Describe how to create a number of possible designs and then how to refine and narrow down to the 'best design'.*	1
2.4	Design Thinking in a Team Environment. *How to perform design thinking as a team managing the conflicts ?*	1
2.5	Case Studies: Design Thinking Approach. *Conduct exercises using the design thinking approach for*	1

	designing any simple products within a limited time and budget	
3	**Module 3: Design Communication (Languages of Engineering Design)**	
3.1	Communicating Designs Graphically. *How do engineering sketches and drawings convey designs?*	1
3.2	Communicating Designs Orally and in Writing. *How can a design be communicated through oral presentation or technical reports efficiently?*	1
	First Series Examination	
3.3	Mathematical Modelling in Design. *How do mathematics and physics become a part of the design process?*	1
3.4	Prototyping and Proofing the Design. *How to predict whether the design will function well or not?*	1
3.5	Case Studies: Communicating Designs Graphically. *Conduct exercises for design communication through detailed 2D or 3D drawings of simple products with design detailing, material selection, scale drawings, dimensions, tolerances, etc.*	1
4	**Module 4: Design Engineering Concepts**	
4.1	Project-based Learning and Problem-based Learning in Design. *How engineering students can learn design engineering through projects?* *How students can take up problems to learn design engineering?*	1
4.2	Modular Design and Life Cycle Design Approaches. *What is modular approach in design engineering? How it helps?* *How the life cycle design approach influences design decisions?*	1
4.3	Application of Bio-mimicry, Aesthetics and Ergonomics in Design. *How do aesthetics and ergonomics change engineering designs?* *How do the intelligence in nature inspire engineering designs? What are the common examples of bio-mimicry in engineering?*	1
4.4	Value Engineering, Concurrent Engineering, and Reverse Engineering in Design. *How do concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?*	1
4.5	Case Studies: Bio-mimicry based Designs. *Conduct exercises to develop new designs for simple*	1

	products using bio-mimicry and train students to bring out new nature inspired designs.	
5	**Module 5: Expediency, Economics and Environment in Design Engineering**	
5.1	Design for Production, Use, and Sustainability. *How designs are finalized based on the aspects of production methods, life span, reliability and environment?*	1
5.2	Engineering Economics in Design. *How to estimate the cost of a particular design and how will economics influence the engineering designs?*	1
5.3	Design Rights. *What are design rights and how can an engineer put it into practice?*	1
5.4	Ethics in Design. *How do ethics play a decisive role in engineering design?*	1
5.5	Case Studies: Design for Production, Use, and Sustainability. *Conduct exercises using simple products to show how designs change with constraints of production methods, life span requirement, reliability issues and environmental factors.*	1
Second Series Examination		

Code.	Course Name	L	T	P	Hrs	Credit
22HUT 306	**Professional Ethics**	2	0	0	2	2

Preamble: To enable students to create awareness on ethics and human values.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the core values that shape the ethical behaviour of a professional.
CO 2	Adopt a good character and follow an ethical life.
CO 3	Explain the role and responsibility in technological development by keeping personal ethics and legal ethics.
CO 4	Solve moral and ethical problems through exploration and assessment by established experiments.
CO 5	Apply the knowledge of human values and social values to contemporary ethical values and global issues.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1								2			2	
CO 2								2			2	
CO 3								3			2	
CO 4								3			2	
CO 5								3			2	

Assessment Pattern

Bloom's category	Continuous Assessment Tests		End Semester Exam
	1	2	
Remember	15	15	30
Understood	20	20	40
Apply	15	15	30

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment Tests (2 Nos)	:	25 marks
Assignments/Quiz	:	15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

<u>Course Level Assessment Questions</u>

Course Outcome 1 (CO1):
1. Define integrity and point out ethical values.
2. Describe the qualities required to live a peaceful life.
3. Explain the role of engineers in modern society.

Course Outcome 2 (CO2)
1. Derive the codes of ethics.
2. Differentiate consensus and controversy.
3. Discuss in detail about character and confidence.

Course Outcome 3(CO3):
1. Explain the role of professional’s ethics in technological development.
2. Distinguish between self interest and conflicts of interest.
3. Review on industrial standards and legal ethics.

Course Outcome 4 (CO4):
1. Illustrate the role of engineers as experimenters.
2. Interpret the terms safety and risk.
3. Show how the occupational crimes are resolved by keeping the rights of employees.

Course Outcome 5 (CO5):
1. Exemplify the engineers as managers.
2. Investigate the causes and effects of acid rain with a case study.
3. Explorate the need of environmental ethics in technological development.

Model Question paper

QP CODE: **Reg No:_____________**

PAGES: **Name :_____________**

THIRD/FOURTH SEMESTERB.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 2 2 HUT 306

Course Name: PROFESSIONAL ETHICS

Max. Marks: 100 **Duration: 3 Hours**

(2019-Scheme)

PART A

(Answer all questions, each question carries 3 marks)

1. Define empathy and honesty.

2. Briefly explain about morals, values and ethics.

3. Interpret the two forms of self-respect.

4. List out the models of professional roles.

5. Indicate the advantages of using standards.

6. Point out the conditions required to define a valid consent?

7. Identify the conflicts of interests with an example?

8. Recall confidentiality.

9. Conclude the features of biometric ethics.

10. Name any three professional societies and their role relevant to engineers.

(10x3 = 30 marks)

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Classify the relationship between ethical values and law?

b) Compare between caring and sharing. (10+4 = 14 marks)

Or

12. a) Exemplify a comprehensive review about integrity and respect for others.

b) Discuss about co-operation and commitment. (8+6 = 14 marks)

MODULE II

13.a) Explain the three main levels of moral developments, deviced by Kohlberg.

b) Differentiate moral codes and optimal codes. (10+4 = 14 marks)

Or

14. a) Extrapolate the duty ethics and right ethics.

b) Discuss in detail the three types of inquiries in engineering ethics (8+6 = 14 marks)

MODULE III

15.a) Summarize the following features of morally responsible engineers.

(i) Moral autonomy **(ii)** Accountability

b)Explain the rights of employees (8+6 = 14 marks)

Or

16. a) Explain the reasons for Chernobyl mishap ?

b) Describe the methods to improve collegiality and loyalty. (8+6 = 14 marks)

MODULE IV

17.a) Execute collegiality with respect to commitment, respect and connectedness.

b) Identify conflicts of interests with an example. (8+6 = 14 marks)

Or

18. a) Explain in detail about professional rights and employee rights.

b) Exemplify engineers as managers.

MODULE V

19.a) Evaluate the technology transfer and appropriate technology.

b) Explain about computer and internet ethics. (8+6 = 14 marks)

Or

20. a) Investigate the causes and effects of acid rain with a case study.

b) Conclude the features of ecocentric and biocentric ethics. (8+6 = 14 marks)

Syllabus

Module 1 – Human Values.

Morals, values and Ethics – Integrity- Academic integrity-Work Ethics- Service Learning- Civic Virtue- Respect for others- Living peacefully- Caring and Sharing- Honestly- courage-Cooperation commitment- Empathy-Self Confidence -Social Expectations.

Module 2 - Engineering Ethics & Professionalism.

Senses of Engineering Ethics - Variety of moral issues- Types of inquiry- Moral dilemmas –Moral Autonomy – Kohlberg's theory- Gilligan's theory- Consensus and Controversy-Profession and Professionalism- Models of professional roles-Theories about right action –Self interest-Customs and Religion- Uses of Ethical Theories.

Module 3- Engineering as social Experimentation.

Engineering as Experimentation – Engineers as responsible Experimenters- Codes of Ethics- Plagiarism- A balanced outlook on law - Challenges case study- Bhopal gas tragedy.

Module 4- Responsibilities and Rights.

Collegiality and loyalty – Managing conflict- Respect for authority- Collective bargaining- Confidentiality- Role of confidentiality in moral integrity-Conflicts of interest- Occupational crime- Professional rights- Employee right- IPR Discrimination.

Module 5- Global Ethical Issues.

Multinational Corporations- Environmental Ethics- Business Ethics- Computer Ethics -Role in Technological Development-Engineers as Managers- Consulting Engineers- Engineers as Expert witnesses and advisors-Moral leadership.

Text Book

1. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012.

2. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited ,New Delhi,2006.

Reference Books

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi,2014.
2. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
3. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics- Concepts and cases, Wadsworth Thompson Learning, United states,2005.
4. http://www.slideword.org/slidestag.aspx/human-values-and-Professional-ethics.

Course Contents and Lecture Schedule

SL.No	Topic	No. of Lectures 25
1	**Module 1 – Human Values.**	
1.1	Morals, values and Ethics, Integrity, Academic Integrity,Work Ethics	1
1.2	Service Learning, Civic Virtue, Respect for others, Living peacefully	1
1.3	Caring and Sharing, Honesty, Courage, Co-operation commitment	2
1.4	Empathy, Self Confidence, Social Expectations	1
2	**Module 2- Engineering Ethics & Professionalism.**	
2.1	Senses of Engineering Ethics, Variety of moral issues, Types of inquiry	1
2.2	Moral dilemmas, Moral Autonomy, Kohlberg's theory	1
2.3	Gilligan's theory, Consensus and Controversy,Profession& Professionalism, Models of professional roles, Theories about right action	2
2.4	Self interest-Customs and Religion, Uses of Ethical Theories	1
3	**Module 3- Engineering as social Experimentation.**	
3.1	Engineering as Experimentation, Engineers as responsible Experimenters	1
3.2	Codes of Ethics,Plagiarism, A balanced outlook on law	2
3.3	Challenger case study, Bhopal gas tragedy	2
4	**Module 4- Responsibilities and Rights.**	
4.1	Collegiality and loyalty, Managing conflict, Respect for authority	1
4.2	Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Conflicts of interest	2
4.3	Occupational crime, Professional rights, Employee right, IPR Discrimination	2
5	**Module 5- Global Ethical Issues.**	
5.1	Multinational Corporations, Environmental Ethics, Business Ethics, Computer Ethics	2
5.2	Role in Technological Development, Moral leadership	1
5.3	Engineers as Managers, Consulting Engineers, Engineers as Expert witnesses and advisors	2

CODE 22MCN 307	SUSTAINABLE ENGINEERING	CATEGORY	L	T	P	CREDIT
			2	0	0	NIL

Preamble: Objective of this course is to inculcate in students an awareness of environmental issues and the global initiatives towards attaining sustainability. The student should realize the potential of technology in bringing in sustainable practices.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the relevance and the concept of sustainability and the global initiatives in this direction
CO 2	Explain the different types of environmental pollution problems and their sustainable solutions
CO 3	Discuss the environmental regulations and standards
CO 4	Outline the concepts related to conventional and non-conventional energy
CO 5	Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2	3					2
CO 2						2	3					2
CO 3						2	3					2
CO 4						2	3					2
CO 5						2	3					2

Assessment Pattern

Mark distribution

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Course Level Assessment Questions

Course Outcome 1 (CO1): Understand the relevance and the concept of sustainability and the global initiatives in this direction

1. Explain with an example a technology that has contributed positively to sustainable development.
2. Write a note on Millennium Development Goals.

Course Outcome 2 (CO2): Explain the different types of environmental pollution problems and their sustainable solutions

1. Explain the 3R concept in solid waste management?
2. Write a note on any one environmental pollution problem and suggest a sustainable solution.
3. In the absence of green house effect the surface temperature of earth would not have been suitable for survival of life on earth. Comment on this statement.

Course Outcome 3(CO3): Discuss the environmental regulations and standards

1. Illustrate Life Cycle Analysis with an example of your choice.
2. "Nature is the most successful designer and the most brilliant engineer that has ever evolved". Discuss.

Course Outcome 4 (CO4): Outline the concepts related to conventional and non-conventional energy

1. Suggest a sustainable system to generate hot water in a residential building in tropical climate.
2. Enumerate the impacts of biomass energy on the environment.

Course Outcome 5 (CO5): Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles

1. Suggest suitable measures to make the conveyance facilities used by your institution sustainable.

Model Question paper

Part A

(Answer all questions. Each question carries 3 marks each)

1. Define sustainable development.
2. Write a short note on Millennium Development Goals.
3. Describe carbon credit.
4. Give an account of climate change and its effect on environment.
5. Describe biomimicry? Give two examples.
6. Explain the basic concept of Life Cycle Assessment.

7. Name three renewable energy sources.

8. Mention some of the disadvantages of wind energy.

9. Enlist some of the features of sustainable habitat.

10. Explain green engineering.

Part B

(Answer one question from each module. Each question carries 14 marks)

11. Discuss the evolution of the concept of sustainability. Comment on its relevance in the modern world.

OR

12. Explain Clean Development Mechanism.

13. Explain the common sources of water pollution and its harmful effects.

OR

14. Give an account of solid waste management in cities.

15. Explain the different steps involved in the conduct of Environmental Impact Assessment.

OR

16. Suggest some methods to create public awareness on environmental issues.

17. Comment on the statement, “Almost all energy that man uses comes from the Sun”.

OR

18. Write notes on:
    a. Land degradation due to water logging.
    b. Over exploitation of water.

19. Discuss the elements related to sustainable urbanisation.

OR

20. Discuss any three methods by which you can increase energy efficiency in buildings.

Syllabus

Sustainability- need and concept, technology and sustainable development-Natural resources and their pollution, Carbon credits, Zero waste concept. Life Cycle Analysis, Environmental Impact Assessment studies, Sustainable habitat, Green buildings, green materials, Energy, Conventional and renewable sources, Sustainable urbanization, Industrial Ecology.

Module 1

Sustainability: Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Clean Development Mechanism (CDM).

Module 2

Environmental Pollution: Air Pollution and its effects, Water pollution and its sources, Zero waste concept and 3 R concepts in solid waste management; Greenhouse effect, Global warming, Climate change, Ozone layer depletion, Carbon credits, carbon trading and carbon foot print, legal provisions for environmental protection.

Module 3

Environmental management standards: ISO 14001:2015 frame work and benefits, Scope and goal of Life Cycle Analysis (LCA), Circular economy, Bio-mimicking, Environment Impact Assessment (EIA), Industrial ecology and industrial symbiosis.

Module 4

Resources and its utilisation: Basic concepts of Conventional and non-conventional energy, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans and Geothermal energy.

Module 5

Sustainability practices: Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanisation, Sustainable cities, Sustainable transport.

Reference Books

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
3. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
4. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
5. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
6. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
7. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
8. Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios Publication

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Sustainability	
1.1	Introduction, concept, evolution of the concept	1
1.2	Social, environmental and economic sustainability concepts	1
1.3	Sustainable development, Nexus between Technology and Sustainable Development	1
1.4	Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs)	1
1.5	Clean Development Mechanism (CDM)	1
2	Environmental Pollution	
2.1	Air Pollution and its effects	1
2.2	Water pollution and its sources	1
2.3	Zero waste concept and 3 R concepts in solid waste management	1
2.4	Greenhouse effect, Global warming, Climate change, Ozone layer depletion	1
2.5	Carbon credits, carbon trading and carbon foot print.	1
2.6	Legal provisions for environmental protection.	1
3	Environmental management standards	
3.1	Environmental management standards	1
3.2	ISO 14001:2015 frame work and benefits	1
3.3	Scope and Goal of Life Cycle Analysis (LCA)	1
3.4	Circular economy, Bio-mimicking	1
3.5	Environment Impact Assessment (EIA)	1
3.6	Industrial Ecology, Industrial Symbiosis	1
4	Resources and its utilization	
4.1	Basic concepts of Conventional and non-conventional energy	1
4.2	General idea about solar energy, Fuel cells	1
4.3	Wind energy, Small hydro plants, bio-fuels	1
4.4	Energy derived from oceans and Geothermal energy	1
5	Sustainability Practices	
5.1	Basic concept of sustainable habitat	1
5.2	Methods for increasing energy efficiency of buildings	1
5.3	Green Engineering	1
5.4	Sustainable Urbanisation, Sustainable cities, Sustainable transport	1

22C EL 308	CIVIL ENGINEERING PLANNING &DRAFTING LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	0	0	3	2	2019

Preamble: The course is designed tointroduce the fundamentals of Civil Engineering drawingand understand the principles of planning. The students will be able to learn the drafting of buildings manually and using drafting software such as AutoCAD.
.

Prerequisite: ENGINEERING GRAPHICS

Course Outcomes and their assessment: After the completion of the course, the student will be able to:

Course Outcome (CO)	Course Outcome Description	CO assessment strategy
CO 1	Illustrate ability to organise civil engineering drawings systematically and professionally	Assessment of the overall organisation of the drawing, labels and templates used.
CO 2	Prepare building drawings as per the specified guidelines.	Application of guidelines for functional planning of building unit.
CO3	Assess a complete building drawing to include all necessary information	Level of incorporation of Guidelines specified by NBC, meeting the requirement of building rules specified by local bodies of administration.
CO 4	Create a digital formof the building plan using any drafting software	Evaluation of the printouts of prepared building plan

Mapping of course outcomes (COs) with program outcomes (POs)

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	-	-	-	2	3	3	-	-
CO 2	3	-	-	-	-	-	-	2	3	3	-	-
CO 3	3	-	-	-	-	-	-	2	3	3	-	-
CO 4	3	-	-	-	-	-	-	2	2	3	-	-

List of Experiments (Any 12 experiments out of 15 need to be performed mandatorily.Manual drafting and drafting using computer aided drafting software is mandatory for the experiments)

1. Draw sectional details and elevation of paneled doors
2. Draw sectional details and elevation of glazedwindows and ventilators in wood.
3. Draw sectional details , detailing on fixing arrangement and elevation of steel windows.
4. Draw elevation, section and detailing of connection between members, arrangement for fixing at the support for steel roof truss.
5. Draw plan, section and elevation of dog legged staircase.
6. Draw sectional details of a load bearing wall over strip footing, RCC Column over isolated footing and pile footing with pile cap.
7. Draw plan, section and elevation of single storied residential buildings with flat roof.
8. Draw plan, section and elevation of two storied residential building.
9. Draw plan , section and elevation of a community hallhavingcorrugated GI sheetroof.
10. Prepare a site plan and service planas per latest buildingrules (KPBR or KMBR)
11. Prepare detailed drawing on building services (for single and two storied buildings only)and on-site wastewater disposal systems like septic tank and soak pit.
12. Draw plan, section and elevation of multi-storied framed buildings.
13. Draw plan, section and elevation of a public buildings–office complex, public health centre, post office, bank etc
14. Draw plan, section and elevation of a industrial building withcorrugated GI steel roof and PEB based walling elements.
15. Create 3D model of a two storied residential building and render the model.

References

1. National Building Code of India
2. Kerala panchayat building rules, 2019
3. Kerala Municipality building rules, 2019
4. Dr. Balagopal T.S. Prabhu, Building Drawing and Detailing, Spades Publishers, Calicut
5. AutoCAD Essentials, Autodesk official Press, John Wiley & Sons, USA
6. Shah, M.G., Kale, C. M. and Patki, S.Y. Building Drawing With An Intergrated Approach to Built Environment, Tata McGraw Hill Publishing Company Limited, New Delhi

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Marks for 12 exercises using manual draftingin A4 Paper :**50 marks**

Marks for 12 exercises using computer aided drafting software in A3/A4 paper**: 25 marks**

COs	Assessment Strategy	Marking Criteria	Marks
CO 1	Assessment of the overall organisation of the drawing, labels and templates used.	Marks to be awarded based on the initial preparations displayed in manual drawing	**10**
CO 2	Application of guidelines for functional planning of building unit.	Marks to be awarded based on the prepared plan of the building	**20**
CO 3	Level of incorporation of Guidelines specified by NBC, meeting the requirement of building rules specified by local bodies of administration.	Marks to be awarded based on the checklists of assessment for the prepared plan of the building	**20**
CO 4	Evaluation of the printouts of prepared building plan	Marks to be awarded based on the printout of the final plan of the building	**25**

End Semester Examination Pattern: ESE will be of **2.5 hours** duration on A2 size answer booklet and will be for 75 marks. (only manual drafting for ESE)

22CEL 309	SURVEY LAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble:
Objective of the course is to impart practical experience to students by exposing them to various techniques of field surveying. The course is designed to make student familiar with conventional and advanced surveying instruments.

Prerequisite: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Use conventional surveying tools such as chain/tape and compass for plotting and area determination.
CO 2	Apply levelling principles in field
CO 3	Solve triangulation problems using theodolite
CO 4	Employ total station for field surveying
CO 5	Demonstrate the use of distomat and handheld GPS

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3							1	2			
CO 2	3			1				1	2			
CO 3	3			1				1	2			
CO 4	3			1	3			1	2			2
CO 5	3				3			1				2

Course Level Assessment Questions

Course Outcome 1 (CO1): Plot the given area using chain/tape and compass and compute its area.

Course Outcome 2 (CO2): Determine the reduced levels of the given points in the filed with respect to the Bench Mark of RL=100.00

Course Outcome 3 (CO3): Find out the distance between two inaccessible points A and B. Baseline measurement is allowed.

Course Outcome 4 (CO4): Compute the area of a given plot using total station.

Course Outcome 5 (CO5): Explain the parts of a handheld GPS with neat sketch.

Assessment Pattern

Bloom's Category	Continuous Assessment	End Semester Examination (marks)
Remember	**10**	**15**
Understand	**10**	**15**
Apply	**40**	**40**
Analyse		
Evaluate		
Create		

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation (CIE) Pattern

Attendance : 15 marks
Continuous Assessment : 30 marks
Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination (ESE) Pattern:

Practical examination shall include problems on leveling/theodolite and total station with equal mark distribution. The following guidelines should be followed regarding award of marks
(a) Preliminary work : 15 Marks
(b) Implementing the work/Conducting the experiment : 10 Marks
(c) Performance, result and inference (usage of equipments and trouble shooting) : 25 Marks
(d) Viva voce : 20 marks
(e) Record : 5 Marks

General instructions:
Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Syllabus

List of Exercises/ Experiments:

1. Introduction to conventional surveying - 1 session
2. Levelling - 4sessions
3. Theodolite surveying - 5sessions
4. Total Station survey - 4sessions
5. Study of instruments - 1 session
   - Automatic level
   - digital level
   - Handheld GPS

Course Content and Practical Schedule (Any twelve experiments are mandatory):

Expt. No.	List of exercises/experiments	Course Outcome	No. of Hrs
1	**Introduction to conventional surveying** a. Chain surveying b. Compass surveying	CO1	3
	Levelling	CO2	
2	Simple leveling		3
3	Differential levelling		3
4	Fly levelling		3
5	Contouring		3
	Theodolite surveying	CO3	
6	Distance between accessible points (horizontal angle)		3
7	Distance between inaccessible points (horizontal angle)		3
8	Level difference between points (vertical angle)		3
9	Tangential tacheometry (vertical angle)		3
10	Height of building (vertical angle)		3
	Total station survey	CO4	
11	Heights and distances		3
12	Area computation		3
13	Contouring		3
14	Downloading		3
15	**Study of instruments** a. Automatic level b. Digital level c. Handheld GPS	CO5	3

Reference Books

1. Dr. B.C. Punmia , Ashok Kumar Jain &Arun Kumar Jain - Surveying , Laxmi publications (P) Ltd , 2005
2. C. Venkatramaiah, Textbook of Surveying, Universities Press (India) Private Limited 2011

3. Prof. T.P.Kenetkar&Prof.S.V.Kulkarni - Surveying and Levelling , Pune VidyarthiGriha Prakashan,2004
4. R.Agor - A Text book of Surveying and Levelling, Khanna Publishers, 2005
5. S.K.Duggal - Surveying Vol. I, Tata McGraw Hill Ltd ,Reprint 2015.
6. S.K. Duggal - Surveying Vol. II, Tata McGraw Hill Ltd ,Reprint 2015

22CEMR 310.1	BUILDING CONSTRUCTION AND STRUCTURAL SYSTEMS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		VAC	4	0	0	4	2019

Preamble:

This course provides the essential aspects of building construction such as components of buildings, materials of construction and structural systems to the students of other branches of Engineering.

Pre requisite: Nil

Course Outcomes: After the completion of the course the student will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Explain the properties and testing methods of different materials used for building construction.	Understanding
CO2	Explain the construction details of different components of buildings.	Understanding
CO3	Explain construction practices such as prefabricated, cost effective and sustainable technologies	Understanding
CO4	Explain the details and behavior of structural systems and structural elements used in buildings.	Understanding

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		-	-	-	-	-	-	-	-	-	-
CO2	2		-	-	-	-	-	-	-	-	-	-
CO3	2		-	-	-	-	-	-	-	-	-	-
CO4	2		-	-	-	-	-	-	-	-	-	-

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

<u>Course Level Assessment Questions</u>

CO1 Explain the properties and testing methods of different materials used for building construction.

1. What is blended cement? What are its advantages?
2. Explain any one test performed on coarse aggregate.
3. Discuss the role of admixtures in concrete
4. Explain any one test performed in fresh concrete.
5. Explain any one test performed on hardened concrete.

CO2 Explain the construction details of different components of buildings.

1. What is a lintel? Why is it required?
2. Explain the different types of shallow foundations.
3. Explain the different types of deep foundations.
4. Explain the procedure adopted for laying marble flooring.

CO3 Explain construction practices such as prefabricated, cost effective and sustainable technologies

1. What is prefabrication? What are the advantages and disadvantages of prefabricated construction?
2. Explain the construction details of rat-trap bond masonry.
3. Explain the principles of filler slab.

CO4 Explain the details and behavior of structural systems and structural elements used in buildings.

1. What are the different forms of reinforcement used in columns? Explain the functions of each.
2. Distinguish between load bearing wall construction and moment resisting frame construction.
3. Sketch any two types of steel roof truss.
4. Sketch the reinforcement details of a simply supported beam.

SYLLABUS

Module -1

Cement – Types, Composition, manufacturing process, properties, tests. Aggregates – properties, tests. Mortar – types, properties, uses. Chemical admixtures – types, uses.

Module -2

Concrete – PCC, RCC. Properties of fresh concrete, Workability – tests. Properties of hardened concrete – tests for strength, Nominal mix and design mix.

Module - 3

Flooring and roofing materials, Lintels and arches, Types and construction details of doors, windows and ventilators. Finishing works, Timber products, Formwork

Module -4

Foundations – shallow and deep, Cost effective construction, Sustainable building technologies, Non destructive testing of concrete, Prefabricated construction.

Module -5

Structural elements - beams, columns and slabs. Principles of reinforced concrete, types of reinforcements, Reinforcement details of structural elements, Structural systems, Concrete floor systems.

Text Books

1. Punmia B. C, Building Construction, Laxmi Publications
2. Arora and Bindra, Building Construction, Dhanpath Rai and Sons.
3. Shetty M.S., Concrete Technology, S. Chand & company.

References

1. Madan Mehta, Walter Scarborough and Diane Armpriest, Building Construction – Principles, Materials and Systems, Pearson.
2. Daniel Schodek and Martin Bechthold, Structures, Pearson.
3. V. SankaraSubramaniyan, Construction Technology, Lakshmi Publications, Chennai.
4. S. S. Bhavikatti, Construction Technology, Chess Educational Publishers, Chennai.
5. Rangwala S C., Engineering Materials, Charotar Publishers.

6. P. C. Varghese, Building Materials, PHI Learning Pvt Ltd., Delhi.
7. Mehta and Monteiro, Concrete - Micro structure, Properties and Materials, McGraw Hill Professional.
8. Neville A. M. and Brooks J. J., Concrete Technology, Pearson Education.
9. R. Santhakumar, Concrete Technology, Oxford Publications.

Lecture Plan - Building Construction and Structural Systems

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module I : Total lecture hours : 9**		
1.1	Cement – Types of cements, chemical composition. Blended cements	CO1	1
1.2	Manufacturing of cement	CO1	1
1.3	Properties and tests on cement, Hydration of cement	CO1	2
1.4	Aggregates – types, role of aggregates.	CO1	1
1.5	Properties of aggregates and tests. Grading requirements. Natural and synthetic aggregates	CO1	2
1.6	Mortar – types, Sand – properties, uses	CO1	1
1.7	Water quality for construction. Chemical admixtures – types and uses.	CO1	1
2	**Module II : Total lecture hours : 10**		
2.1	Concrete – PCC, RCC and Prestressed concrete (brief descriptions only)	CO1	1
2.2	Making of concrete – batching, mixing, transporting, placing, compacting, finishing and curing	CO1	2
2.3	Properties of fresh concrete – workability, segregation and bleeding.	CO1	1
2.4	Factors affecting workability and strength – tests on workability, demonstration of slump test.	CO1	2
2.5	Effects of aggregates on properties of concrete	CO1	1
2.6	Properties of hardened concrete – tests for strength of concrete in compression, tension and flexure.	CO1	2
2.7	Nominal mixes and design mixes, mix designations, ready mixed concrete	CO1	1
3	**Module III : Total lecture hours : 8**		
3.1	Flooring and roofing materials	CO2	1
3.2	Lintels and arches – types.	CO2	1
3.3	Doors, Windows and ventilators – types and construction	CO2	2

	Details		
3.4	Finishing works. Paint – types	CO1	1
3.5	Timber – seasoning	CO1	1
3.6	Timber products – properties and uses of plywood, fibre board and particle board	CO1	1
3.7	Formwork, Construction and expansion joints	CO2	1
4	**Module IV : Total lecture hours : 10**		
4.1	Types of shallow foundations.	CO2	1
4.2	Types of deep foundations.	CO2	1
4.3	Foundation failure – causes	CO2	1
4.4	Introduction to cost effective construction – principles of filler slab and rat-trap bond masonry.	CO3	2
4.5	Sustainable building technologies.	CO3	2
4.6	Non destructive testing of concrete – rebound hammer test and ultrasonic pulse velocity test.(with demonstrations)	CO1	2
4.7	Introduction to prefabricated construction- advantages, slip form construction	CO3	1
5	**Module V : Total lecture hours : 8**		
5.1	Introduction to structural systems – functions, Primary structural elements – beams, columns and slabs.	CO4	1
5.2	Principles of reinforced concrete, types of reinforcements – tension reinforcements, compression reinforcements and stirrups.	CO4	2
5.3	Reinforcement details of beams, columns and slabs.	CO4	2
5.4	Structural systems – load bearing walls, moment resisting frames	CO4	1
5.5	Structural systems – trusses, cables and membranes	CO4	1
5.6	Elevated concrete floor systems, beams supported concrete floors – one way and two way slabs, flat slabs.	CO4	1

MODEL QUESTION PAPER

Reg.No.:______________ Name:__________________________

THIRD SEMESTER B.TECH DEGREE EXAMINATION

Course Code: 22CEMR310.1

Course Name: BUILDING CONSTRUCTION AND STRUCTURAL SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions; each question carries 3 marks.

1. a) What is hydration of cement?
   b) What is mortar? What are its uses?
   c) What are the advantages of prestressed concrete over conventional reinforced concrete?
   d) Distinguish between nominal mix and design mix.
   e) Name different types of paints and mention their use.
   f) List different types of timber products used in building construction.
   g) What is a raft foundation?
   h) Explain any one non destructive test used to assess the quality of concrete.
   i) What is a truss? How does a truss resist external loads?
   j) Why is reinforcement essential in concrete beams?

(10×3 marks = 30 marks)

PART B

Answer one full question from each module; each full question carries 14 marks.

Module I

2.	a)	What is mean by grading of aggregates?	(5)
	b)	Explain the process of manufacturing cement.	(9)
3.	a)	Explain the role of admixtures in concrete	(5)
	b)	Explain the various tests used to assess properties of cement.	(9)

Module II

4.	a)	What is curing of concrete? Why is it important?	(5)
	b)	What is meant by workability of concrete? Discuss the factors influencing workability of concrete.	(9)
5.	a)	Distinguish between segregation and bleeding.	(5)

b) Explain the various tests performed on hardened concrete. (9)

Module III

6. a) Sketch a typical arch and mark its parts. (5)
   b) What is seasoning of timber? Explain different methods of seasoning. (9)
7. a) What is a lintel? Why it is required? (5)
   b) Explain different types of scaffoldings. (9)

Module IV

8. a) Explain with neat sketches any three types of foundations. (6)
   b) Describe the causes of foundation failure. (8)
9. a) What is a slip form? Where are they used? (6)
   b) Explain the construction of filler slabs. (8)

Module V

10. a) What are the functions of a structural system? (5)
    b) With the help of neat sketches, explain the different forms of reinforcement used in beams? Also explain the functions of each. (9)

11. a) Distinguish between one way and two way slab systems. (5)
    b) Compare load bearing wall construction and moment resisting frame construction. (9)

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22CEMR 310.2	INTRODUCTION TO GEOTECHNICAL ENGINEERING	CATEGORY	L	T	P	CREDIT	Year of Introduction
		VAC	4	0	0	4	2019

Preamble: Goal of this course is to expose the students to the fundamental concepts of soil mechanics and foundation engineering. After this course, students will be able to identify and classify the soil and to recognize practical problems in real-world situations and respond accordingly.

Prerequisite : Nil

Course Outcomes: After completion of the course the student will be able to:

CO 1	Explain the basic concepts, theories and methods of analysis in soil mechanics and foundation engineering
CO 2	Solve the basic properties of soil by applying functional relationships
CO 3	Determine the engineering properties of soil by applying the laboratory test results and the fundamental concepts
CO 4	Estimate the design parameters of footings and retaining walls

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	3	-	-	-	-	-	-	-	-	-	-
CO 3	2	3	-	-	-	-	-	-	-	-	-	-
CO 4	2	3	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	10	10	20
Apply	25	25	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation (CIE) Pattern :

Attendance : 10 Marks

Continuous Assessment Test (2 numbers) : 25 Marks

Assignment/Quiz/Course project : 15 Marks

End Semester Examination (ESE) Pattern : There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

Course Outcome 1 (CO1):

1. The fundamental concepts of basic properties and index properties of soil
2. The fundamental concepts of engineering properties of soils related to Permeability, shear strength, consolidation & compaction
3. Concepts of Total, neutral and effective stress; and vertical stress below loaded areas
4. Basic theories of Earth pressure, Bearing Capacity and Settlement of footings

Course Outcome 2 (CO2):

1. Solve the basic properties of soil by applying functional relationships

Course Outcome 3 (CO3):

1. Calculate the engineering properties of soil related to Permeability, consolidation, compaction & shear strength by applying the laboratory test results
2. Calculate the engineering properties of soil by applying the concepts of soil mechanics related to total , neutral and effective stress; and vertical stress below loaded areas

Course Outcome 4 (CO4):

1. Estimate the earth pressure acting on the retaining walls
2. Estimate the bearing capacity of footings
3. Estimate the immediate and consolidation settlement of footings

Model Question Paper

QP CODE:

Reg No.:_______________ **Name:___________________________**

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEMR 310.2

Course Name : INTRODUCTION TO GEOTECHNICAL ENGINEERING

Max. Marks: 100 Duration: 3 hours

Part A

(***Answer all questions; each question carries 3 marks***)

1. Draw a three phase block diagram and define (i) Void Ratio, (ii) Water Content and (iii) Degree of saturation
2. Explain different types of soil structures.
3. Define (i) Well graded, (ii) Poorly graded and (iii) Gap graded soils
4. Define (i) Liquid Limit, (ii) Plastic Limit and (iii) Shrinkage Limit
5. Explain Mohr Coulomb shear strength theory.
6. Explain different types of earth pressures.
7. Explain the situations in which combined footings are provided.
8. List the assumptions of Terzaghi's theory of bearing capacity.
9. Define (i) pre consolidation pressure, (ii) Compression Index and (iii) Recompression Index.
10. Differentiate between Consolidation and Compaction.

PART B

(Answer one full question from each module, each question carries 14 marks)

Module – 1

11. (a) Derive the relation between bulk unit weight, specific gravity, void ratio and degree of saturation from the fundamentals. (5 Marks)

 (b) A sample of wet silty clay soil weighs 1.26 kN. The following data were found from lab tests on the sample. Density □ = 21 kN/m3, Water content w = 15%, Specific Gravity G = 2.7. Determine (i) Dry density, (ii) Void Ratio, (iii) Porosity (iv) Degree of Saturation, (v) Saturated unit weight (vi) Submerged unit weight and (vii) Volume of soil. (9 Marks)

12. (a) Explain the procedures to determine the field density of soil. (5 Marks)

 (b) 1000 cm3 core cutter weighing 9.46 N was used to find out the in-situ unit weight of soil in an embankment. The weight of core cutter with in-situ soil was noted to be 27.7 N. Laboratory tests on the sample indicated water content of 10% and specific gravity of solids of 2.63. Determine the bulk unit weight, dry unit weight, void ratio and degree of saturation. Also calculate the saturated unit weight and the corresponding water content if the embankment is saturated during rain without change in volume. (9 Marks)

Module – 2

13. (a) Explain the factors affecting permeability of soil. (5 Marks)

(b) A soil sample of height 6 cm and area of cross section 100 cm^2 was subjected to constant head permeability test with head of 36 cm and 90 cc of water passes through the specimen during a test interval of 5 min. Compute the coefficient of permeability of the soil sample.
If the same sample is subjected to falling head permeability test and found that head drops from 60 cm to 20 cm in 4 min. Determine the cross sectional area of the stand pipe. (9 Marks)

14. (a) A concentrated load of 500 kN is applied at ground surface. Compute the vertical pressure (i) at a depth of 5m below the load, (ii) at a distance of 3m at the same depth. Use Boussinesq's theory. (5 Marks)

(b) A sand deposit of 8 m thick was loaded with a uniform surcharge of 10 kN/m^2. Water table (WT) is at 3 m below GL. Density of sand is 18 kN/m^3 above WT and 19 kN/m^3 below WT. Draw Total, Neutral and Effective Stress Diagrams up to 8 m below GL. Take γ_w = 10 kN/m^3.

(9 Marks)

Module – 3

15. (a) List the advantages and disadvantages of Direct Shear Test. (7 Marks)

(b) A cylindrical specimen of soil fails under axial vertical stress of 150 kN/m^2, when it is laterally unconfined. Failure plane makes an angle of 53° with the horizontal. Determine shear strength parameters c & ϕ. (7 Marks)

16. (a) Explain critical depth of an unsupported cut in a cohesive soil. (5 Marks)

(b) A retaining wall 8m high with a smooth vertical back retains a sandy backfill (ϕ =340 , Density of soil above water table is 18 kN/m3 and below water table is 19 kN/m3). Water table is at 3 m below ground level. Find the total active pressure per metre length of the wall and its point of application above the base by Rankine's theory. (9 Marks)

Module – 4

17. Explain different types of shallow foundations and list the advantages and disadvantages of each type of footings. (14 Marks)

18. (a) Explain various factors that affect ultimate bearing capacity of a shallow footing? (5 Marks)

(b) A square footing of 2 m x 2 m is to be founded at a depth of 1.5 m in a soil with following data:

γ = 19 kN/m^3 ;	C = 30 kN/m^2 ;	ϕ = 40^0
N_c = 95.7 ;	N_q = 81.3 ;	N_γ = 100.4

Determine the net safe bearing capacity with a factor of safety of 3, when Water table is at
(i) 0.75 m from ground level. (ii) 2.5 m from ground level. (9 Marks)

Module – 5

19. (a) What is meant by Immediate Settlement? How to determine this. (5 Marks)

(b) A 3m square footing at a depth of 2m from ground level carries a net load intensity of 150 kN/m^2. If a compressible clay layer 3m thick exists at a depth of 5m below the footing, determine the settlement of the footing due to consolidation of clay layer. Assume the water table at a depth of 3m below GL. For sand, density = 18 kN/m^3 above water table and

19 kN/m^3 below water table. For clay layer, LL = 65%, w_n = 40% and G = 2.7. Take γ_w = 10 kN/m^3. (9 Marks)

20. (a) What is meant by Allowable settlement? (5 Marks)

(b) The following are results of a standards proctor compaction test performed on a sample of soil

Water Content %	6	8	10	12	14	16
Bulk Density (kN/m^3)	17.7	19.8	21	21.3	20.9	20.2

Plot the water content – dry density curve and obtain Moisture content and Maximum dry density. Also plot the zero air voids curve. Take G = 2.65. (9 Marks)

SYLLABUS

Module	Contents
1	Introduction to soil mechanics - Soil types -Major soil deposits of India - 3 phase system - Basic soil properties: Void ratio, porosity, degree of saturation, air content, water content, specific gravity, unit weight - Relationship between basic soil properties - numerical problems. Laboratory Determination of Water content by oven drying; Specific gravity using pycnometer & specific gravity bottle and Field density by sand replacement method – Field density by Core Cutter method - Soil Structure: single grained, honey combed, flocculated and dispersed structure and their effects on the basic soil properties – Sensitivity and Thixotropy.
2	Index properties - Sieve analysis – Well graded, poorly graded and gap graded soils - Consistency - Atterberg Limits and Plasticity Index – Plasticity Chart –I.S. classification. Permeability of soils - Darcy’s law – Numerical Problems - Factors affecting permeability Principle of effective stress - Total, neutral and effective stress – Pressure diagrams - numerical problems Stress distribution - Boussinesq’s equations for vertical pressure due to point loads – Approximate methods for Vertical Pressure beneath rectangular shape: 2:1 Distribution Method - numerical problems -Isobars- Pressure bulbs
3	Shear strength of soils- Practical Applications - Mohr-Coulomb failure criterion – Mohr circle method for determination of principal planes and stresses– relationship between shear parameters and principal stresses [no derivation required] – Numerical Problems - Brief discussion of Direct shear test & UCC Lateral earth pressure – At-rest, active and passive earth pressures – Rankine’s theories [no derivation required] - Influence of surcharge, layered backfill and water table on earth pressure- numerical problems
4	Foundation - general consideration : Functions of foundations - Definition of shallow and deep foundations - Different types of foundations : Strip Footings; Isolated Footings; Combined Footings – Rectangular and Trapezoidal; Raft Foundations and Pile Foundations - Selection of type of foundation - Advantages and limitations of various types of foundations Bearing capacity of shallow foundations – Ultimate, safe and allowable bearing capacity. - Failure mechanism, assumptions and equation of Terzaghi’s bearing capacity theory for strip footing [no derivation required] – Bearing capacity factors and charts - Terzaghi’s formulae for circular and square footings - numerical problems - Local and general shear failure - Factors affecting bearing capacity – Effect of water table on bearing capacity - numerical problems -
5	Settlement analysis: Introduction - causes of settlement – immediate, consolidation and total settlement –Estimation of immediate settlement – Numerical Problems – Consolidation - Definition – Spring analogy for primary consolidation - Void ratio versus pressure relationship - Coefficient of compressibility and volume compressibility – Pre consolidation Pressure - Compression index-Estimation of magnitude of settlement of normally consolidated clays - Numerical problems Allowable settlement - Total and differential settlements as per Indian standard Compaction of soils - Difference between consolidation and compaction - IS Light & Heavy Compaction Tests – OMC and MDD

Text Books:

1. Ranjan G. and A. S. R. Rao, Basic and Applied Soil Mechanics, New Age International, 2002.
2. Arora K. R., Geotechnical Engineering, Standard Publishers, 2006.

References:

1. Das B. M., Principles of Geotechnical Engineering, Cengage India Pvt. Ltd., 2010.
2. Venkatramaiah, Geotechnical Engg, Universities Press, 2000.
3. Terzaghi K. and R. B. Peck, Soil Mechanics in Engineering Practice, John Wiley, 1967.
4. A V Narasimha Rao and C Venkatramaiah, Numerical Problems, Examples and Objective questions in Geotechnical Engineering, Universities Press (India) Ltd., 2000
5. Purushothamaraj P., Soil Mechanics and Foundation Engineering, Dorling Indersley (India) Pvt. Ltd., 2013
6. Taylor D.W., Fundamentals of Soil Mechanics, Asia Publishing House, 1948.

Course Contents and Lecture Schedule:

Module	Contents	Outcomes Addressed	Hours
1	**Module 1**		9
1.1	Nature of soil and functional relationships : Introduction to soil mechanics – Soil types – Major soil deposits of India	CO 1	1
1.2	3 phase system – Basic soil properties : Void ratio, porosity, degree of saturation, air content, water content, specific gravity, unit weight	CO 1	1
1.3	Relationship between basic soil properties	CO 1	1
1.4	Numerical problems	CO 2	2
1.5	Determination of Water content by oven drying, Specific gravity using pycnometer & specific gravity bottle	CO 1	1
1.6	Determination of Field density by sand replacement method & Core Cutter method	CO 1	1
1.7	Numerical problems	CO 2	1
1.8	Soil Structure and their effects on the basic soil properties – Sensitivity and Thixotropy	CO 1	1
2	**Module 2**		9
2.1	Index properties - Sieve analysis – Well graded, poorly graded and gap graded soils	CO 1	1
2.2	Consistency - Atterberg Limits and Plasticity Index	CO 1	1
2.3	Plasticity Chart –I.S. classification	CO 1	1
2.4	Permeability of soils - Darcy's law – Factors affecting permeability	CO 1	1
2.5	Principle of effective stress - Total, neutral and effective stress – Pressure diagrams	CO 1	1
2.6	Numerical problems	CO 3	1
2.7	Stress distribution - Introduction - Boussinesq's equations for vertical pressure due to point loads – Numerical problems	CO 1 & CO 3	1
2.8	Approximate methods for Vertical Pressure beneath rectangular shape: 2:1 Distribution Method - numerical problems	CO 1 & CO 3	1
2.9	Isobars- Pressure bulbs	CO 4	1
3	**Module 3**		9
3.1	Shear strength of soils- Practical Applications - Mohr-Coulomb failure criterion	CO 1	1
3.2	Mohr circle method for determination of principal planes and stresses– relationship between shear parameters and principal stresses [no derivation required]	CO 1	1
3.3	Numerical Problems	CO 3	
3.4	Brief discussion of Direct shear test & UCC	CO 1	1

3.5	Lateral earth pressure – At-rest, active and passive earth pressure	CO 1	1
3.6	Rankine's theories [no derivation required]	CO 1	1
3.7	Influence of surcharge and water table on earth pressure	CO 1	1
3.8	Numerical problems	CO 4	1
3.9	Earth pressure on retaining walls with layered backfill – Numerical Problems	CO 1 & CO 4	1
4	**Module 4**		**9**
4.1	Foundations : Functions of foundations - Definition of shallow and deep foundations	CO 1	1
4.2	Different types of foundations : Strip Footings; Isolated Footings; Combined Footings – Rectangular & Trapezoidal; Raft Foundations and Pile Foundations	CO 1	1
4.3	Selection of type of foundation - Advantages and limitations of various types of foundations	CO 1	1
4.4	Bearing capacity of shallow foundations – Ultimate, safe and allowable bearing capacity.	CO 1	1
4.5	Failure mechanism, assumptions and equation of Terzaghi's bearing capacity theory for strip footing [no derivation required]	CO 1	1
4.6	Bearing capacity factors and charts - Terzaghi's formulae for circular and square footings -	CO 1	1
4.7	Numerical problems	CO 4	1
4.8	Effect of water table on bearing capacity - numerical problems	CO 1 & CO 4	1
4.9	Local and general shear failure - Factors affecting bearing capacity	CO 1	1
5	**Module 5**		**9**
5.1	Settlement analysis: Introduction - causes of settlement – immediate, consolidation and total settlement	CO 1	1
5.2	Estimation of immediate settlement – Numerical Problems	CO 1 & CO 4	1
5.3	Consolidation - Definition – Spring analogy for primary consolidation	CO 1	1
5.4	Void ratio versus pressure relationship - Coefficient of compressibility and volume compressibility – Pre consolidation Pressure - Compression index	CO 1	1
5.5	Estimation of magnitude of settlement of normally consolidated clays - Numerical problems	CO 4	1
5.6	Allowable settlement - Total and differential settlements as per Indian standard	CO 1	1
5.7	Compaction of soils - Difference between consolidation and compaction	CO 1	1
5.8	IS Light & Heavy Compaction Tests – OMC and MDD	CO 1	1
5.9	Numerical Problems	CO 3	1

CODE: 22CEMR 310.3	Course Name INFORMATICS FOR INFRASTRUCTURE MANAGEMENT	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: This course is aimed at exposing the students to the scope of Informatics and Internet of Things (IoT) in Civil Engineering. It introduces students to the fundamentals of data analytics, informatics &IoT as it is applicable to civil engineering field.After this course, students will be in a position to appreciate the use of informatics &IoTin civil engineering projects and follow the future developments in this sector.

Prerequisite: NIL

Course Outcomes:

Course Outcome	Description of Course Outcome	Prescribed learning level
CO 1	To understand the fundamental concepts of data science, informatics & internet of things	Remembering, Understanding
CO 2	To learn the use of geomaticsin planning and site selection of infrastructure projects	Applying & Analysing
CO 3	To apply building informatics in construction, monitoring and project management	Applying& Analysing
CO4	To learn the role of IoT technology in infrastructure management	Applying& Analysing

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	-	-	-	2	-	-	-	-	-	-	2
CO 3	2	-	-	-	2	-	-	-	-	-	-	2
CO4	2	-	-	-	2	-	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	15
Understand	10	10	15
Apply	15	15	35
Analyse	15	15	35
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

Course Outcome 1 (CO1):*To understand the fundamental concepts of data science, informatics & internet of things.*

1. ExplainDIKW pyramid.
2. Explain the data mining techniques
3. Discuss different data models
4. Discuss the vector data analysis techniques
5. Explain COBie standard
6. List IoT protocols
7. What are the elements of BIM?

Course Outcome 2 (CO2): *To learn the use of geomatics for planning and site selection of infrastructure projects.*

1. Discuss how geomatics help in site selection of a solid waste management facility
2. Discuss how terrain modeling is an important geographic information for project planning

Course Outcome 3 (CO3): *To apply building informatics in construction, monitoring and project management.*

1. How BIM helps inreducing the cost of construction?
2. Discuss the steps in developing a BIM for an infrastructure project.

Course Outcome 4 (CO4): *To learn the role of IoT technology in infrastructure management.*

1. How a water supply system could benefit by IoT technology?
2. Monitoring infrastructure projects could leverage from IoT technologies! Discuss.

Syllabus

Module 1 Data to Information

History of informatics, DIKW pyramid, data management- data types, Meta data, database management systems; Data analysis techniques-spatial and non-spatial data, trends and patterns; Data mining techniques, data processing for information

Module 2 Geoinformatics

Fundamental concepts in Geo-informatics- Components, Spatial data and attributes, vector and raster data models, Methods of data input, Spatial data editing; Vector data analysis- buffering, overlay; Raster data analysis- local operations, neighborhood operations, zonal operations ; GIS output: cartographic and non-cartographic output

Module 3 Planning and Site selection

Site suitability analysis for Residential area, Industrial area, Recreational Area, Solid Waste Disposal, Water treatment plant, reservoirs;
Land use/ Land cover mapping, Ground Water Potential Zonation Mapping, Hazard Zonation Mapping, Terrain modelling
Network Analysis- Water supply line, Sewer line, Power line, Telecommunication, Road network

Module 4 Building Informatics

Building Information Modelling- Definition, Elements of BIM, steps in BIM development, COBie standard, potential and applications of BIM, Case studies

Module 5 Internet of Things (IoT) in Civil Infrastructure

IoT Standards& Protocols, Concept of IoT in civil engineering- Applications in construction, product monitoring and project Management
Smart Buildings- sensors & devices, selection criteria, data integration
Management Applications- Traffic Regulation, Water Supply, Pollution control, HVAC, Energy use

Text Books

1. J. Campbell, Essentials of Geographic Information Systems, Saylor Foundation, 2011.
2. RamezElmasri, ShamkantB.Navathe, "Fundamental of Database Systems", Pearson Addison Wesley, 2003.
3. BIM Handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers, Publisher: John Wiley & Sons; 2nd edition (1 July 2011), Language: English, ISBN-10: 9780470541371

Reference Books

1. Raja R. A. Issa and Svetlana Olbina,Building Information Modeling: Applications and Practices, ASCE, 2015.

2. Samuel Greengard, The internet of things, The MIT Press Essential Knowledge Series, 2015, ISBN: 978-0-262-52773-6.
3. ShashiShekhar and Sanjay Chawla,"Spatial Databases:A Tour", Prentice Hall, 2003.
4. Building Information Modeling: BIM in Current and Future Practice, Publisher: John Wiley & Sons; 1 edition (15 August 2014), Language: English, ISBN-10: 9781118766309

Lecture Plan – Informatics for Infrastructure Management

Module	*Topic*	*Course outcomes addressed*	*No. of Lectures*
1	**Module I : Total lecture hours : 9**		
1.1	History of informatics	CO1	Lecture 1
1.2	DIKW pyramid& Meta data	CO1	Lecture 2
1.3	Data management	CO1	Lecture 3
1.4	Data types & Meta data	CO1	Lecture 4
1.5	Database management systems	CO1	Lecture 5
1.6	Data analysis techniques	CO1	Lecture 6
1.7	Trends & Patterns in data analysis	CO1	Lecture 7
1.8	Data mining techniques	CO1	Lecture 8
1.9	Data processing for information	CO1	Lecture 9
2	**Module II : Total lecture hours : 9**		
2.1	Fundamental concepts in Geo-informatics-	CO1	Lecture 1
2.2	Components of GIS	CO1	Lecture 2
2.3	Spatial data and attributes	CO1	Lecture 3
2.4	Data models- vector & raster	CO1	Lecture 4
2.5	Methods of data input	CO1	Lecture 5
2.6	Spatial data editing	CO1	Lecture 6
2.7	Vector data analysis	CO1	Lecture 7
2.8	Raster data analysis- local & neighbourhood analysis	CO1	Lecture 8
2.9	Raster data analysis- zonal analysis& GIS output	CO1	Lecture 9

3	**Module III : Total lecture hours : 9**		
3.1	Site suitability analysis for Residential area,& Industrial area	CO2	Lecture 1
3.2	Site suitability analysis for recreational area & solid waste disposal	CO2	Lecture 2
3.3	Site suitability analysis for water treatment plant & reservoir	CO2	Lecture 3
3.4	Land use&land cover mapping	CO2	Lecture 4
3.5	Ground water potential zonation& Hazard zonation mapping	CO2	Lecture 5
3.6	Terrain modelling	CO2	Lecture 6
3.7	Network analysis for water supply & sewer lines	CO2	Lecture 7
3.8	Network analysis for power line & telecommunication	CO2	Lecture 8
3.9	Network analysis for road network	CO2	Lecture 9
4	**Module IV : Total lecture hours : 9**		
4.1	Building Information Modelling- Definition	CO3	Lecture 1
4.2	Elements of BIM	CO3	Lecture 2& 3
4.3	Steps in BIM development	CO3	Lecture 4 & 5
4.4	COBie standard	CO3	Lecture 6
4.5	Potential & applications of BIM	CO3	Lecture 7
4.6	Case studies of BIM	CO3	Lecture 8& 9
5	**Module V : Total lecture hours : 9**		
5.1	IoT Standards & Protocols, Concept of IoT in civil engineering	CO4	Lecture 1
5.2	Application of IoT in construction, product monitoring & project management	CO4	Lecture 2,3 & 4
5.3	Smart buildings	CO4	Lecture 5
5.5	Selection criteria of sensors & devices, Data integration	CO4	Lecture 6
5.7	Management applications of IoT- Traffic, water supply, pollution control, HVAC & energy use	CO4	Lecture7,8 & 9

Model Question Paper

TKM COLLEGE OF ENGINEERING, KOLLAM (GOVT. AIDED AUTONOMOUS)

QP CODE:

Reg No.:________________ **Name:___________________________**

THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code:22CEMR310.3
Course Name: INFORMATICS FOR INFRASTRUCTURE MANAGEMENT

Max. Marks: 100 Duration: 3 hours

Part A
(***Answer all questions; each question carries 3 marks***)

1. Explain different data types.
2. Explain DIKW pyramid.
3. Compare vector & raster model.
4. What are the components of GIS?
5. Explain network analysis.
6. What is the importance of terrain modeling?
7. Define BIM.
8. What is COBie standard?
9. List the IoT protocols.
10. Explain the concept of smart buildings.

PART B
(Answer one full question from each module, each question carries 14 marks)

11. (a) Discuss data analysis techniques for spatial data. (5 Marks)

    (b) Explain the steps in processing data into information. (9 Marks)

OR

12. (a) Briefly describe the history of informatics (5 Marks)

    (b) Explain various data mining techniques. (9 Marks)

13. (a) Discuss various data inputting methods for GIS (5 Marks)

    (b) Explain various vector analysis techniques. (9 Marks)

OR

14. (a) Explain buffering analysis. What is its application? (5 Marks)

    (b) Explain various raster data analysis techniques. (9 Marks)

15. (a) How the site suitability analysis is carried out for a solid waste management facility? (7 Marks)

(b) Explain how geomatics is useful for mapping hazard zones. (7 Marks)

OR

16. (a) Explain the methodology for road network analysis. (7 Marks)

(b) Explain the process of converting data to information for a reservoir site selection. (7 Marks)

17. (a) What are the applications of BIM? (5 Marks)

(b) Discuss the steps in developing a BIM for an infrastructure project.(9 marks)

OR

18. (a) Explain the elements of BIM. (5 Marks)

(b) How BIM helps in reducing the cost of construction? (9 Marks)

19. (a) What sensors & devices would help in monitoring water distribution network. (5 Marks)

(b) Infrastructuremanagement could leverage from IoT technologies! Discuss. (9 Marks)

OR

20. (a) What are the selection criteria for sensors & devices used in IoT technologies. (7 Marks)

(b) Discuss how IoT technologies could help in pollution control. (7 Marks)

SEMESTER 4

SEMESTER IV

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	22MAT401	PROBABILITY, STATISTICS AND NUMERICAL METHODS	3-1-0	4	4
B	22CET 402	ENGINEERING GEOLOGY	3-0-1	4	4
C	22CET 403	GEOTECHNICAL ENGINEERING – I	4-0-0	4	4
D	22CET 404	TRANSPORTATION ENGINEERING	4-0-0	4	4
E 1/2	22EST 405	DESIGN & ENGINEERING	2-0-0	2	2
	22HUT406	PROFESSIONAL ETHICS	2-0-0	2	2
F	22MNC407	CONSTITUTION OF INDIA	2-0-0	2	--
S	22CEL 408	MATERIAL TESTING LAB– I	0-0-3	3	2
T	22CEL 409	FLUID MECHANICS LAB	0-0-3	3	2
R/M/H	22CEMR410.1/2/3 22CEHR411.1/2/3	Remedial/Minor/Honours course	3-1-0	4*	4
TOTAL				26/30	22/26

MINOR

SEMESTER	BASKET I				BASKET II				BASKET III			
	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT
S4	22CEMR410.1	BUILDING DRAWING	4	4	22CEMR410.2	INTRODUCTION TO TRANSPORTATION ENGINEERING	4	4	22CEMR410.3	CLIMATE CHANGE & HAZARD MITIGATION	4	4

HONOURS

SEMESTER	GROUP I				GROUP II				GROUP III			
	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT
S 4	22CEHR411.1	ADVANCED MECHANICS OF SOLIDS	4	4	22CEHR411.2	PAVEMENT CONSTRUCTION AND MANAGEMENT	4	4	22CEHR411.3	GEOGRAPHICAL INFORMATION SYSTEMS	4	4

22MAT 401	COURSE NAME	CATEGORY	L	T	P	CREDIT
	PROBABILITY,STATISTICS AND NUMERICAL METHODS	BASIC SCIENCE COURSE	3	1	0	4

Preamble: This course introduces students to the modern theory of probability and statistics, covering important models of random variables and techniques of parameter estimation and hypothesis testing. A brief course in numerical methods familiarizes students with some basic numerical techniques for finding roots of equations, evaluation definite integrals solving systems of linear equations, and solving ordinary differential equations which are especially useful when analytical solutions are hard to find.

Prerequisite: A basic course in one-variable and multi-variable calculus**.**

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the concept, properties and important models of discrete random variables and, using them, analyze suitable random phenomena.
CO 2	Understand the concept, properties and important models of continuous random variables and,using them, analyse suitable random phenomena.
CO 3	Perform statistical inferences concerning characteristics of a population based on attributes of samples drawn from the population
CO 4	Compute roots of equations, evaluate definite integrals and perform interpolation on given numerical data using standard numerical techniques
CO 5	Apply standard numerical techniques for solving systems of equations, fitting curves on given numerical data and solving ordinary differential equations.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	2	2					2		1
CO 2	3	2	2	2	2					2		1
CO 3	3	2	2	2	2					2		1
CO 4	3	2	2	2	2					2		1
CO 5	3	2	2	2	2					2		1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests(%)		End Semester Examination(%)
	1	2	
Remember	10	10	10
Understand	30	30	30
Apply	30	30	30
Analyse	20	20	20
Evaluate	10	10	10
Create			

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Let X denote the number that shows up when an unfair die is tossed. Faces 1 to 5 of the die are equally likely, while face 6 is twice as likely as any other. Find the probability distribution, mean and variance of X.

2. An equipment consists of 5 componets each of which may fail independently with probability 0.15. If the equipment is able to function properly when at least 3 of the componets are operational, what is the probability that it functions properly?

3. X is a binomial random variable $(n, p)$with $n = 100$and $p = 0.1$. How would you approximate it by a Poisson random variable?

4. Three balls are drawn at random without replacement from a box containing 2 white, 3 red and 4 black balls. If X denotes the number of white balls drawn and Y denotes the number of red balls drawn, find the joint probability distribution of (X,Y)

Course Outcome 2 (CO2)

1. What can you say about $P(X = a)$ for any real number $a$when Xis a (i) discrete random variable? (ii) continuous random variable?
2. A string, 1 meter long, is cut into two pieces at a random point between its ends. What is the probability that the length of one piece is at least twice the length of the other?
3. A random variable has a normal distribution with standard deviation 10. If the probability that it will take on a value less than 82.5 is 0.82, what is the probability that it will take on a value more than 58.3?
4. X and Y are independent random variables with X following an exponential distribution with parameter μ and Y following and exponential distribution with parameter λ. Find $P(X+Y \leqslant 1)$

Course Outcome 3(CO3):

1. In a random sample of 500 people selected from the population of a city 60 were found to be left-handed. Find a 95% confidence interval for the proportion of left-handed people in the city population.

2. What are the types of errors involved in statistical hypothesis testing. Explain the level of risks associated with each type of error.

3. A soft drink maker claims that a majority of adults prefer its leading beverage over that of its main competitor's. To test this claim 500 randomly selected people were given the two beverages in random order to taste. Among them, 270 preferred the soft drink maker's brand, 211 preferred the competitor's brand, and 19 could not make up their minds. Determine whether there is sufficient evidence, at the 5% level of significance, to support the soft drink maker's claim against the default that the population is evenly split in its preference.

4. A nutritionist is interested in whether two proposed diets, *diet A* and *diet B* work equally well in providing weight-loss for customers. In order to assess a difference between the two diets, she puts 50 customers on diet A and 60 other customers on diet B for two weeks. Those on the former had weight losses with an average of 11 pounds and a standard deviation of 3 pounds, while those on the latter lost an average of 8 pounds with a standard deviation of 2 pounds. Do the diets differ in terms of their weight loss?

Course Outcome 4(CO4):

1. Use Newton-Raphson method to find a real root of the equation $f(x) = e^{2x} - x - 6$correct to 4 decimal places.
2. Compare Newton's divided difference method and Langrange's method of interpolation
3. Use Newton's forward interpolation formula to compute the approximate values of the function $f$at $x = 0.25$from the following table of values of $x$and $f(x)$

x	0	0.5	1	1.5	2
f(x)	1.0000	1.0513	1.1052	1.1618	1.2214

4. Find a polynomial of degree 3 or less the graph of which passes thorugh the points (-1,3), (0,-4), (1,5) and (2,-6)

Course Outcome 5 (CO5):

1. Apply Gauss-Seidel method to solve the following system of equations

$$4x_1 - x_2 - x_3 = 3$$
$$-2x_1 + 6x_2 + x_3 = 9$$
$$-x_1 + x_2 + 7x_3 = -6$$

2. Using the method of least squares fit a straight line of the form $y = ax + b$to the following set of ordered pairs (x, y) :
(2,4), (3,5), (5,7), (7,10), (9,15)

3. Write the normal equations for fitting a curve of the form $y = a_0 + a_1x^2$to a given set

of pairs of data points.

4. Use Runge-Kutta method of fourth order to compute $y(0.25)$and $y(0.5)$, given the initial value problem

$$y' = x + xy + y, (0) = 1$$

SYLLABUS

Module 1 (Discrete probability distributions) **9 hours**

(Text-1: *Relevant topics* from sections-3.1-3.4, 3.6, 5.1)

Discrete random variables and their probability distributions, Expectation, mean and variance, Binomial distribution, Poisson distribution, Poisson approximation to the binomial distribution, Discrete bivariate distributions, marginal distributions, Independent random variables, Expectation -multiple random variables.

Module 2 (Continuous probability distributions) **9 hours**

(Text-1:*Relevant topics* from sections-4.1-4.4, 3.6, 5.1)

Continuous random variables and their probability distributions, Expectation, mean and variance, Uniform, exponential and normal distributions, Continuous bivariate distributions, marginal distributions, Independent random variables, Expectation-multiple random variables, i.i.d random variables and Central limit theorem (**without proof**).

Module 3 (Statistical inference) **9 hours**

(Text-1:*Relevant topics* from sections-5.4,, 3.6, 5.1,7.2, 8.1, 8.3, 9.1-9.2,9.4)

Population and samples, Sampling distribution of the mean and proportion (for large samples only), Confidence interval for single mean and single proportions(for large samples only). Test of hypotheses: Large sample test for single mean and single proportion, equality of means and equality of proportions of two populations, small sample t-tests for single mean of normal population, equality of means (**only pooled t-test, for independent samples from two normal populations with equal variance**)

Module 4 (Numerical methods -I) **9 hours**

(Text 2- *Relevant topics* from sections 19.1, 19.2, 19.3, 19.5)

Errors in numerical computation-round-off, truncation and relative error, Solution of equations – Newton-Raphson method and Regula-Falsi method. Interpolation-finite differences, Newton's forward and backward difference method, Newton's divided difference method and Lagrange's method. Numerical integration-Trapezoidal rule and Simpson's 1/3rd rule (**Proof or derivation of the formulae not required for any of the methods in this module**)

Module 5 (Numerical methods -II) **9 hours**

(Text 2- *Relevant topics* from sections 20.3, 20.5, 21.1)

Solution of linear systems-Gauss-Siedal and Jacobi iteration methods. Curve fitting-method of least squares, fitting staright lines and parabolas. Solution of ordinary differential equations-Euler and Classical Runge-Kutta method of second and fourth order, Adams-Moulton predictor-correction method (**Proof or derivation of the formulae not required for any of the methods in this module**)

Text Books

1. (Text-1) Jay L. Devore, *Probability and Statistics for Engineering and the Sciences*, 8th edition, Cengage, 2012
2. (Text-2) Erwin Kreyszig, *Advanced Engineering Mathematics*, 10 th Edition, John Wiley & Sons, 2016.

Reference Books

1. Hossein Pishro-Nik, *Introduction to Probability, Statistics and Random Processes*, Kappa Research, 2014 (Also available online at www.probabilitycourse.com)
2. Sheldon M. Ross, *Introduction to probability and statistics for engineers and scientists*, 4th edition, Elsevier, 2009.
3. T. Veera Rajan, *Probability, Statistics and Random processes*, Tata McGraw-Hill, 2008
4. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 36 Edition, 2010.

Assignments

Assignments should include specific problems highlighting the applications of the methods introduced in this course in physical sciences and engineering.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Discrete Probability distributions**	**9 hours**
1.1	Discrete random variables and probability distributions, expected value, mean and variance (discrete)	3
1.2	Binomial distribution-mean, variance, Poisson distribution-mean, variance, Poisson approximation to binomial	3
1.3	Discrete bivariate distributions, marginal distributions, Independence of random variables (discrete), Expected values	3
2	**Continuous Probability distributions**	**9 hours**
2.1	Continuous random variables and probability distributions, expected value, mean and variance (continuous)	2

2.2	Uniform, exponential and normal distributions, mean and variance of these distributions	4
2.3	Continuous bivariate distributions, marginal distributions, Independent random variables, Expected values, Central limit theorem.	3
3	**Statistical inference**	**9 hours**
3.1	Population and samples, Sampling distribution of single mean andsingle proportion(large samples)	1
3.2	Confidence interval for single mean and single proportions (large samples)	2
3.3	Hypothesis testing basics, large sample test for single proportion, single proportion	2
3.4	Large sample test for equality of means and equality of proportions of two populations	2
3.5	t-distribution and small sample t-test for single mean and pooled t-test for equality of means	2
4	**Numerical methods-I**	**9 hours**
4.1	Roots of equations- Newton-Raphson, regulafalsi methods	2
4.2	Interpolation-finite differences, Newton's forward and backwardformula,	3
4.3	Newton's divided difference method, Lagrange's method	2
4.4	Numerical integration-trapezoidal rule and Simpson's 1/3-rd rule	2
5	**Numerical methods-II**	**9 hours**
5.1	Solution of linear systems-Gauss-Siedal method, Jacobi iteration method	2
5.2	Curve-fitting-fitting straight lines and parabolas to pairs of data points using method of least squares	2
5.3	Solution of ODE-Euler and Classical Runge-Kutta methods of second and fourth order	4
5.4	Adams-Moulton predictor-corrector methods	1

22CET 402	Engineering Geology	Category	L	T	P	Credits	Year of Introduction
		PCC	3	0	1	4	2020

Preamble: Goal of this course is to introduce to the students the basics of earth processes, materials, groundwater and the geological characteristics of such processes and materials which are relevant to the Civil Engineering applications.

Prerequisites: Nil

Course Outcomes: After completion of the course the student will be able to:

CO1	Recall the fundamental concepts of surface processes, subsurface process, minerals, rocks, groundwater and geological factors in civil engineering constructions.
CO2	Identify and describe the surface processes, subsurface process, earth materials, groundwater and geological factors in civil engineering constructions.
CO3	Apply the basic concepts of surface and subsurface processes, minerals, rocks, groundwater and geological characteristics in civil engineering constructions.
CO4	Analyze and classify geological processes, earth materials and groundwater.
CO5	Evaluation of geological factors in civil engineering constructions.

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2					1	2					
CO2	3											
CO3	3											
CO4	3	2										
CO5	3	1	3			3	3	2				2

Assessment pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	9 (3 marks for each question in which one question from third module)	6	15
Understand	6	9 (3 marks for each question in which one question from third module)	15
Apply	14 +14 + 7 (Question for 7 marks is from third module)	14 +14 + 7 (Question for 7 marks is from third module)	70
Analyse			

Evaluate			

Mark distribution

Total Marks	CIE marks	ESE marks	Test 1 &2 Duration	ESE Duration
150	50	100	1.5 hours	3 hours

Continuous Internal Evaluation Pattern:

Attendance: 10marks

Continuous Assessment Test (2 numbers): 25 marks

Assignment/Quiz/Courseproject: 15 marks

End Semester ExaminationPattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14marks.

Course Level Assessment Questions:

Part A

Course Outcome 1 (CO1): (One question from each module to meet the course objective 1: To recall the fundamental concepts of surface processes, subsurface process, minerals, rocks, ground water and geological factors in civil engineering constructions).

1. Define weathering of rocks

Course Outcome 2 (CO2) (One question from each module to meet the course objective 2: To identify and describe the surface processes, subsurface process, earth materials, groundwater and geological factors in civil engineering constructions.)

1. Explain the classification of soil

Part B

All the questions under this section shall assess the learning levels corresponding to the course outcomes 3, 4 and5.

1. **a)** Classify weathering and discuss the engineering classification of weathered rock masses (7 marks)

   b) Write your comments on the relevance of geology in civil engineering constructions (7 marks)

Model Question Paper

QP CODE:

RegNo.:_______________

Name:________________________

B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CET 402

ENGINEERING GEOLOGY

Max.Marks: 100 Duration: 3hours

Part A

(Answer all questions; each question carries 3 marks)

1. Define weathering of rocks

2. Explain soil erosion and classification of soils

3. Describe earthquakes and write notes on seismograph and seismogram

4. Illustrate the elastic rebound theory with a diagram

5. Define Ghyben Herzberg relation in sea water intrusion

6. Explain Darcy's Law with a neat diagram

7. Write down the physical properties and chemical composition of given minerals

a. Calcite

b. Gypsum

8. Describe the different types of igneous rocks based on theirorigin

9. Illustrate the major parts of the fold with a neat diagram

10. Distinguish between clinometer compass and Brunton compass

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11. a) Discuss the relevance of geology in civil engineering constructions (7marks)

b) Give an account on classification of weathering with suitable diagrams and examples (7 marks)

12. Describe the geological work of rivers. Discuss different landform features produced by weathering and river action with suitable diagrams. (14 marks)

Module -2

13. Comment on the relation of earthquakes with plate tectonics. Give an account on different plates with earthquake prone area (14 marks)

14. Discuss the various types of seismic waves and their relevance in the study of internal structure of earth. (14marks)

Module -3

15. Discuss the vertical distribution of groundwater. Give an account of the water bearing properties of rocks and hydrological cycle with neat diagrams. (14marks)

16. a) Elucidate application of electrical resistivity survey in ground water exploration. (8 marks)

b) Give a brief account on different ground water recharge methods (6 marks)

Module -4

17. Distinguish between metamorphic and sedimentary rocks with respect to their structure with diagrams (14marks)

18. a) Elucidate various physical properties of minerals for their identification. (9marks)

b) Give an account on hardness of minerals with Moh's hardness scale (5 marks)

Module -5

19. a) Enumerate the geological factors to be considered for selecting a dam site (9 marks)

b) Discuss the geological conditions suitable and unsuitable for construction of tunnels (5marks)

20. Distinguish between folds and faults. Give an account on classification of folds with neat diagrams (14 marks)

ENGINEERING GEOLOGY

Syllabus

Module	Contents	Hours
Module 1 External Earth Processes	Relevance of Geology in Civil Engineering, **Surface Processes of the earth-** a) Weathering of rocks-Types of weathering, Processes of Origin of Products of weathering like sand, clay, laterite and soil, soil profile, Soil erosion and soil conservation measures. Engineering significance of weathering. b) Geological processes by rivers. c) Landslides-types, causes and controlling measures, Coastal Processes-Geological work by waves and currents and coastal protection measures	9
Module 2 Internal Earth Processes	**Internal Processes of the earth-** a) Earthquakes- Plate Tectonics, Origin of earthquakes, Seismic waves, Rating of earthquakes, types of earthquakes, Seismic zones of India. Basics of seismic safety factor, Interior of the earth as revealed by propagation of seismic waves.	9
Module 3 Groundwater	**Hydrogeology**-Occurrence of groundwater, aquifers and types of aquifers, confining beds, porosity and vertical distribution of groundwater. Darcy's Law. Permeability/hydraulic conductivity. Problems created by groundwater to civil engineering structures, Methods to control groundwater problems, Electrical resistivity survey for groundwater exploration. Seawater intrusion in Coastal area. Herzberg relation.	9
Module 4 Earth Materials	**Mineralogy-**Physical properties of minerals, physical properties and chemical composition of minerals like quartz, orthoclase, plagioclase, biotite, muscovite, hornblende, augite, hypersthene, calcite, gypsum. **Petrology-**Igneous, sedimentary and metamorphic rocks, Igneous rocks-Chemical and mineralogical classification and structure. Sedimentary rocks-types based on mode of formation and structures Metamorphic rocks-structures only. Megascopic study of granite, dolerite, basalt, sandstone, limestone, shale, gneiss, marble and charnockite. Rock types of Kerala. Rock cycle	9
Module 5 Secondary Structures of Rocks	**Structural Geology–** Attitude of rocks – Dip and Strike. Terminology, brief classification and engineering significance of folds, faults and joints. Geological part of site investigation for the construction of dams, reservoirs and tunnels. Topo sheet. Structural mapping. Clinometer compass and Brunton compass.	9

Textbooks

1. Duggal S.K, Pandey H.K and Rawat N (2014) Engineering Geology, Mcgraw Hill Education NewDelhi
2. Gokhale KVGK (2015) Principles of Engineering Geology, BS Publications, Hyderabad

3. Singh P (2014) Engineering and General Geology, SK Kataria and sons, NewDelhi
4. SubinoyGangopadhyay (2017) Engineering Geology, OxfordUniversity

References

1. David K Todd & Larry W Mays (2011) Groundwater Hydrogeology, Wiley India Pvt Ltd.
2. Gokhale N.W. (2015) Manual of Geological Maps, CBS Publishers, NewDelhi
3. Gribble CD (2005) Rutleys Elements of Mineralogy,Springer
4. Marland P Billings (2016), Structural Geology, Pearson education

Course Contents and Lecture Schedule:

Module	Topic	No. of hours
Module 1	Weathering of rocks-Types of weathering, Processes of Origin of Products of weathering like sand, clay, laterite and soil	3
	Soil profile, Soil erosion and soil conservation measures. Engineering significance of weathering.	2
	Geological processes by rivers. Landslides-types, causes and controlling measures	2
	Coastal Processes-Geological work by waves and currents and coastal protection measures	2
Module 2	Earthquakes- Plate Tectonics, Origin of earthquakes, Seismic waves, Rating of earthquakes, types of earthquakes	4
	Seismic zones of India. Basics of seismic safety factor	2
	Interior of the earth as revealed by propagation of seismic waves.	3
Module 3	Occurrence of groundwater, aquifers and types of aquifers, confining beds, porosity and vertical distribution of groundwater.	2
	Darcy's Law.Permeability/hydraulic conductivity. Problems created by groundwater to civil engineering structures	3
	Methods to control groundwater problems	1
	Electrical resistivity survey for groundwater exploration.	2
	Seawater intrusion in Coastal area. Ghyben Herzberg relation.	1
Module 4	Physical properties of minerals, physical properties and chemical composition of minerals like quartz, orthoclase, plagioclase, biotite, muscovite, hornblende, augite, hypersthene, calcite, gypsum	4

	Igneous, sedimentary and metamorphic rocks, Igneous rocks-Chemical and mineralogical classification and structure. Sedimentary rocks-types based on mode of formation and structures Metamorphic rocks-structures only. Megascopic study of granite, dolerite, basalt, sandstone, limestone, shale, gneiss, marble and charnockite. Rock types of Kerala. Rock cycle	**5**
Module 5	Attitude of rocks – Dip and Strike. Terminology	**1**
	Brief classification and engineering significance of folds, faults and joints	**3**
	Geological part of site investigation for the construction of dams, reservoirs and tunnels	**3**
	Toposheet, Structural mapping. Clinometer compass and Brunton compass	**2**

<table>
<tr><td rowspan="2">22CET 403</td><td rowspan="2">GEOTECHNICAL ENGINEERING - I</td><td>CATEGORY</td><td>L</td><td>T</td><td>P</td><td>CREDIT</td><td>Year of Introduction</td></tr>
<tr><td>PCC</td><td>4</td><td>0</td><td>0</td><td>4</td><td>2019</td></tr>
</table>

Preamble: Goal of this course is to expose the students to the fundamental concepts of soil mechanics and laboratory tests to determine the basic, index and engineering properties of soils. After this course, students will be able to identify and classify the soil and to recognize practical problems in real-world situations and respond accordingly.

Prerequisite : Nil

Course Outcomes: After completion of the course the student will be able to:

CO 1	Explain the fundamental concepts of basic and engineering properties of soil
CO 2	Describe the laboratory testing methods for determining soil parameters
CO 3	Solve the basic properties of soil by applying functional relationships
CO 4	Calculate the engineering properties of soil by applying the laboratory test results and the fundamental concepts of soil mechanics
CO 5	Analyze the soil properties to identify and classify the soil

<u>Mapping of course outcomes with program outcomes (Minimum requirement)</u>

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	3	-	-	-	-	-	-	-	-	-	-
CO 4	2	3	-	-	-	-	-	-	-	-	-	-
CO 5	2	3	-	-	-	-	-	-	-	-	-	-

<u>Assessment Pattern</u>

<table>
<tr><th rowspan="2">Bloom’s Category</th><th colspan="2">Continuous Assessment Tests</th><th rowspan="2">End Semester Examination (Marks)</th></tr>
<tr><th>Test 1 (Marks)</th><th>Test 2 (Marks)</th></tr>
<tr><td>Remember</td><td>10</td><td>10</td><td>20</td></tr>
<tr><td>Understand</td><td>10</td><td>15</td><td>20</td></tr>
<tr><td>Apply</td><td>25</td><td>25</td><td>50</td></tr>
<tr><td>Analyse</td><td>5</td><td></td><td>10</td></tr>
<tr><td>Evaluate</td><td></td><td></td><td></td></tr>
<tr><td>Create</td><td></td><td></td><td></td></tr>
</table>

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation (CIE) Pattern :

Attendance : 10 Marks

Continuous Assessment Test (2 numbers) : 25 Marks

Assignment/Quiz/Course project : 15 Marks

End Semester Examination (ESE) Pattern : There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

Course Outcome 1 (CO1):

1. The fundamental concepts of basic properties and index properties of soil
2. The fundamental concepts of engineering properties of soils related to Permeability, consolidation, compaction & shear strength
3. Concepts of Total, neutral and effective stress; and vertical stress below loaded areas
4. Concepts of Slope stability

Course Outcome 2 (CO2):

1. The laboratory testing methods for determining basic and index soil properties
2. The laboratory testing methods for determining engineering properties related to Permeability, consolidation, compaction & shear strength

Course Outcome 3 (CO3):

1. Solve the basic properties of soil by applying functional relationships

Course Outcome 4 (CO4):

1. Calculate the engineering properties of soil related to Permeability, consolidation, compaction & shear strength by applying the laboratory test results
2. Calculate the settlement of footings due to consolidation and application of time rate of consolidation settlement
3. Calculate the engineering properties of soil by applying the concepts of soil mechanics related to total , neutral and effective stress; and vertical stress below loaded areas
4. Calculate the stability of slopes

Course Outcome 5 (CO5):

1. Identify and classify the soil by analysing the basic and index properties of soil

TKM COLLEGE OF ENGINEERING, KOLLAM (GOVT. AIDED AUTONOMOUS)

Model Question Paper

QP CODE:

Reg No.:_______________ **Name:___________________________**

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CET 403
Course Name : GEOTECHNICAL ENGINEERING - I

Max. Marks: 100 Duration: 3 hours

Part A
(***Answer all questions; each question carries 3 marks***)

1. Draw a three phase block diagram and define (i) Void Ratio, (ii) Water Content and (iii) Degree of saturation
2. Explain the procedure for Specific Gravity test using Pycnometer.
3. Define (i) Liquid Limit, (ii) Plastic Limit & (iii) Shrinkage Limit
4. Differentiate between Coefficient of Permeability and Coefficient of Percolation.
5. Explain Total Stress, Neutral Stress and Effective Stress.
6. List the assumptions of Boussinesq's theory.
7. Define pre consolidation pressure. Explain the method for the estimation of pre consolidation pressure.
8. Differentiate between Consolidation and Compaction.
9. Explain Mohr Coulomb shear strength theory.
10. What are the different types of slope failures?

PART B
(Answer one full question from each module, each question carries 14 marks)

Module – 1

11. (a) Derive the relation between bulk unit weight, specific gravity, void ratio and degree of saturation from the fundamentals. (5 Marks)

    (b) A sample of wet silty clay soil weighs 1.26 kN. The following data were found from lab tests on the sample. Density γ = 21 kN/m3, Water content w = 15%, Specific Gravity G = 2.7. Determine (i) Dry density, (ii) Void Ratio, (iii) Porosity (iv) Degree of Saturation, (v) Saturated unit weight (vi) Submerged unit weight and (vii) Volume of soil. (9 Marks)

12. (a) Explain different types of soil structures. (5 Marks)

(b) 1000 cm3 core cutter weighing 9.46 N was used to find out the in-situ unit weight of soil in an embankment. The weight of core cutter with in-situ soil was noted to be 27.7 N. Laboratory tests on the sample indicated water content of 10% and specific gravity of solids of 2.63. Determine the bulk unit weight, dry unit weight, void ratio and degree of saturation. Also calculate the saturated unit weight and the corresponding water content if the embankment is saturated during rain without change in volume. (9 Marks)

Module – 2

13. (a) What is the use of particle size distribution curve? With the help of particle size distribution curve define the following terms (i) well graded soil (ii) poorly graded soil and (iii) gap graded soil. (5 Marks)

(b) Tests on a fined grained soil sample indicated the following properties:

Liquid Limit = 52%, Plastic Limit = 32% and Shrinkage Limit = 17%. Classify the soil as per IS Code. If the specimen of this soil shrinks from a volume of 10 cm^3 at Liquid Limit to 6 cm^3 at the shrinkage limit, calculate the specific gravity of solids. (9 Marks)

14. (a) Explain the factors affecting permeability of soil. (5 Marks)

(b) A soil sample of height 6 cm and area of cross section 100 cm^2 was subjected to constant head permeability test with head of 36 cm and 90 cc of water passes through the specimen during a test interval of 5 min. Compute the coefficient of permeability of the soil sample.
If the same sample is subjected to falling head permeability test and found that head drops from 60 cm to 20 cm in 4 min. Determine the cross sectional area of the stand pipe. (9 Marks)

Module – 3

15. (a) Explain Quick Sand Condition and Critical Hydraulic Gradient. (5 Marks)

(b) A sand deposit of 8 m thick was loaded with a uniform surcharge of 10 kN/m^2. Water table (WT) is at 3 m below GL. Density of sand is 18 kN/m^3 above WT and 19 kN/m^3 below WT. Draw Total, Neutral and Effective Stress Diagrams up to 8 m below GL. Take γ_w = 10 kN/m^3. (9 Marks)

16. (a) A concentrated load of 500 kN is applied at ground surface. Compute the vertical pressure (i) at a depth of 5m below the load, (ii) at a distance of 3m at the same depth. Use Boussinesq's theory. (7 Marks)

(b) A water tank is founded on a circular ring type of foundation. The ring is of 2.5m width and its external diameter is 10m. Compute the vertical stress at 4m depth beneath the centre of the foundation, if pressure on the foundation is 100kPa. (7 Marks)

Module – 4

17. (a) A 8 m thick clay layer with double drainage settles by 120 mm in 2 years. Cv = 1.5 x 10^{-3} cm^2/sec. Calculate the likely ultimate consolidation settlement and find out how long it will take to undergo 90% of this settlement. (5 Marks)

(b) A 3m square footing at a depth of 2m from ground level carries a net load intensity of 150 kN/m^2. If a compressible clay layer 3m thick exists at a depth of 5m below the footing, determine the settlement of the footing due to consolidation of clay layer. Assume the water table at a depth of 3m below GL. For sand, density = 18 kN/m^3 above water table and

19 kN/m^3 below water table. For clay layer, LL = 65%, w_n = 40% and G = 2.7. Take γ_w = 10 kN/m^3. (9 Marks)

18. (a) Explain the field compaction methods. (5 Marks)

(b) The following are results of a standards proctor compaction test performed on a sample of soil

Water Content %	6	8	10	12	14	16
Bulk Density (kN/m^3)	17.7	19.8	21	21.3	20.9	20.2

Plot the water content – dry density curve and obtain Moisture content and Maximum dry density. Also plot the zero air voids curve. Take G = 2.65. (9 Marks)

Module – 5

19. (a) A cylindrical specimen of soil fails under axial vertical stress of 150 kN/m^2, when it is laterally unconfined. Failure plane makes an angle of 53° with the horizontal. Determine shear strength parameters c & ϕ. (5 Marks)

(b) Determine the shear strength parameters using the following data using graphical method:

Sample	Confining Pressure σ_c (kN/m^2)	Deviator Stress σ_d (kN/m^2)
1	100	600
2	200	750
3	300	900

(9 Marks)

20. (a) Explain the Swedish circle method for the analysis of slopes for a c-ϕ soil. (5 Marks)

(b) Determine factor of safety of vertical foundation trench 5m deep if c = 50 kN/m^2, ϕ = 25°, γ = 17 kN/m^3. Assume Taylor's stability no. Sn = 0.166. (9 Marks)

SYLLABUS

Module 1

Nature of soil and functional relationships : Introduction to soil mechanics – Soil types – Major soil deposits of India - 3 phase system – Basic soil properties : Void ratio, porosity, degree of saturation, air content, water content, specific gravity, unit weight - Relationship between basic soil properties - Numerical problems

Determination of Water content by oven drying, Specific gravity using pycnometer & specific gravity bottle - Determination of Field density by sand replacement method & Core Cutter method - Numerical problems

Soil Structure and their effects on the basic soil properties – Sensitivity and Thixotropy

Module 2

Index properties : Sieve analysis – Well graded, poorly graded and gap graded soils - Stoke's law – Hydrometer analysis [no derivation required for percentage finer and diameter] – Relative Density - Numerical problems - Consistency – Atterberg Limits and indices – Plasticity charts - laboratory tests for Liquid Limit, Plastic Limit & Shrinkage Limit - Numerical problems

IS classification of soil - Numerical problems

Permeability of soils : Darcy's law – Factors affecting permeability – Laboratory tests: Constant head and falling head permeability tests - Numerical problems - Average permeability of stratified deposits - numerical problems

Module 3

Principle of effective stress - Total, neutral and effective stress – Pressure diagrams - Numerical problems - Pressure diagrams in soils saturated by capillary action – Quick sand condition – Critical hydraulic gradient

Stress distribution : Introduction - Boussinesq's equations for vertical pressure due to point loads and line loads – Assumptions and Limitations - Numerical problems - Vertical pressure due to uniformly distributed loads beneath strip, circular and rectangular shapes [no derivation required] - Numerical problems

Approximate methods for vertical stress-distribution of contact pressure beneath footings : Equivalent Point Load method & 2:1 Distribution Method - Numerical problems - Pressure Isobars - Pressure bulbs – Newmark's charts (Construction procedure not required) and their use.

Module 4

Consolidation - Definition – Concepts of Coefficient of compressibility and volume compressibility - e-log p curve - Compression index, Recompression index and Pre consolidation Pressure - Normally consolidated, over consolidated and under consolidated soils - Estimation of magnitude of settlement of normally consolidated clays - Numerical problems

Terzaghi's theory of one-dimensional consolidation (no derivation required) - average degree of consolidation – Time factor - Coefficient of consolidation - Numerical problems - Laboratory consolidation test – Determination of Coefficient of Consolidation - Practical Applications

Compaction of soils - Difference between consolidation and compaction - IS Light & Heavy Compaction Tests – OMC and MDD - Zero Air voids line - Numerical problems - Control of compaction - Field compaction methods - Proctor needle for field control

Module 5

Shear strength of soils- Practical Applications - Mohr-Coulomb failure criterion - Mohr circle method for determination of principal planes and stresses– relationship between shear parameters and principal stresses - Numerical problems

Brief discussion of Laboratory tests - Triaxial compression test - UU, CU and CD tests - Total and effective stress strength parameters - Unconfined compression test, Direct shear test and vane shear test – Applicability - Numerical problems

Stability of finite slopes - Toe failure, base failure, slip failure - Swedish Circle Method : $\phi=0$ analysis and c-ϕ analysis - Friction circle method - Taylor's Stability number - Stability charts - Numerical Problems

Text Books:

1. Ranjan G. and A. S. R. Rao, Basic and Applied Soil Mechanics, New Age International, 2002.
2. Arora K. R., Geotechnical Engineering, Standard Publishers, 2006.

References:

1. Das B. M., Principles of Geotechnical Engineering, Cengage India Pvt. Ltd., 2010.
2. Venkatramaiah, Geotechnical Engg, Universities Press, 2000.
3. Terzaghi K. and R. B. Peck, Soil Mechanics in Engineering Practice, John Wiley, 1967.
4. A V Narasimha Rao and C Venkatramaiah, Numerical Problems, Examples and Objective questions in Geotechnical Engineering, Universities Press (India) Ltd., 2000
5. Purushothamaraj P., Soil Mechanics and Foundation Engineering, Dorling Indersley (India) Pvt. Ltd., 2013
6. Taylor D.W., Fundamentals of Soil Mechanics, Asia Publishing House, 1948.

Course Contents and Lecture Schedule:

Module	Contents	Outcomes Addressed	Hours
1	**Module 1**		**9**
1.1	**Nature of soil and functional relationships** : Introduction to soil mechanics – Soil types – Major soil deposits of India	CO 1	1
1.2	3 phase system – Basic soil properties : Void ratio, porosity, degree of saturation, air content, water content, specific gravity, unit weight	CO 1	1
1.3	Relationship between basic soil properties	CO 1 & CO 3	1
1.4	Numerical problems	CO 3	2
1.5	Determination of Water content by oven drying, Specific gravity using pycnometer & specific gravity bottle	CO 2	1
1.6	Determination of Field density by sand replacement method & Core Cutter method	CO 2	1
1.7	Numerical problems	CO 3 & CO 4	1
1.8	Soil Structure and their effects on the basic soil properties – Sensitivity and Thixotropy	CO 1 & CO 5	1
2	**Module 2**		**9**
2.1	**Index properties** : Sieve analysis – Well graded, poorly graded and gap graded soils	CO 1 & CO 2	1
2.2	Stoke's law – Hydrometer analysis [no derivation required for percentage finer and diameter] – Relative Density	CO 1 & CO 2	1
2.3	Numerical problems	CO 4	1
2.4	Consistency – Atterberg Limits and indices – Plasticity charts - laboratory tests for Liquid Limit, Plastic Limit & Shrinkage Limit	CO 1 & CO 2	1
2.5	Numerical problems	CO 4	1
2.6	IS classification of soil - Numerical problems	CO 1 & CO 5	1
2.7	**Permeability of soils** : Darcy's law – Factors affecting permeability – Laboratory tests: Constant head and falling head permeability tests	CO 1 & CO 4	1
2.8	Numerical problems	CO 4	1
2.9	Average permeability of stratified deposits - numerical problems	CO 1 & CO 4	1
3	**Module 3**		**9**
3.1	**Principle of effective stress -** Total, neutral and effective stress – Pressure diagrams	CO 1	1
3.2	Numerical problems	CO 4	1
3.3	Pressure diagrams in soils saturated by capillary action – Quick sand condition – Critical hydraulic gradient	CO 1	1
3.4	**Stress distribution** : Introduction - Boussinesq's equations for vertical pressure due to point loads and line loads – Assumptions and Limitations	CO 1	1

3.5	Numerical problems	CO 4	1
3.6	Vertical pressure due to uniformly distributed loads beneath strip, circular and rectangular shapes [no derivation required]	CO 1	1
3.7	Numerical problems	CO 4	1
3.8	Approximate methods for vertical stress-distribution of contact pressure beneath footings : Equivalent Point Load method & 2:1 Distribution Method - Numerical problems	CO 1 & CO 4	1
3.9	Pressure Isobars - Pressure bulbs – Newmark's charts (Construction procedure not required) and their use.	CO 1	1
4	**Module 4**		**9**
4.1	**Consolidation** - Definition – Concepts of Coefficient of compressibility and volume compressibility - e-log p curve - Compression index, Recompression index and Pre consolidation Pressure	CO 1	1
4.2	Normally consolidated, over consolidated and under consolidated soils - Estimation of magnitude of settlement of normally consolidated clays	CO 1 & CO 4	1
4.3	Numerical problems	CO 4	1
4.4	Terzaghi's theory of one-dimensional consolidation (no derivation required) - average degree of consolidation – Time factor - Coefficient of consolidation	CO 1 & CO 4	1
4.5	Numerical problems	CO 4	1
4.6	Laboratory consolidation test – Determination of Coefficient of Consolidation - Practical Applications	CO 2 & CO 4	1
4.7	**Compaction of soils** - Difference between consolidation and compaction - IS Light & Heavy Compaction Tests – OMC and MDD - Zero Air voids line	CO 1, CO2 & CO 4	1
4.8	Numerical problems	CO 4	1
4.9	Control of compaction - Field compaction methods - Proctor needle for field control	CO 1	1
5	**Module 5**		**9**
5.1	**Shear strength of soils**- Practical Applications - Mohr-Coulomb failure criterion	CO 1	1
5.2	Mohr circle method for determination of principal planes and stresses– relationship between shear parameters and principal stresses	CO 1 & CO 4	1
5.3	Numerical problems	CO 4	1
5.4	Brief discussion of Laboratory tests - Triaxial compression test - UU, CU and CD tests - Total and effective stress strength parameters	CO 2 & CO 4	1
5.5	Unconfined compression test, Direct shear test and vane shear test – Applicability	CO 2 & CO 4	1
5.6	Numerical problems	CO 4	1
5.7	**Stability of finite slopes** - Toe failure, base failure, slip failure	CO 1	1
5.8	Swedish Circle Method : ϕ=0 analysis and c-ϕ analysis - Friction circle method	CO 1 & CO 4	1
5.9	Taylor's Stability number - Stability charts - Numerical Problems	CO 1 & CO 4	1

22CET 404	TRANSPORTATION ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	4	0	0	4	2019

Preamble

Objective of the course is to introduce the principles and practice of Highway, Railway, Harbour and dock, Tunnel and Airport Engineering.

Prerequisite: Nil

Course Outcomes:

	Description
CO No.	At the end of the course, students will be able to:
CO 1	Apply the basic principles of Highway planning and design highway geometric elements
CO 2	Apply standard code specifications in judging the quality of highway materials; designing of flexible pavements
CO 3	Explain phenomena in road traffic by collection, analysis and interpretation of traffic data through surveys; creative design of traffic control facilities
CO 4	Understand about railway systems, tunnel, harbour and docks
CO 5	Express basics of airport engineering and design airport elements

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	1		1	3	1		2		1
CO 2	3	1	3	1		1	1	1		1		1
CO 3	3	2	2	1					1	2		2
CO 4	2						2	1				2
CO 5	3	3	3			3		2				

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (marks)
	Test 1 Marks	Test 2 Marks	
Remember	**7.5**	**7.5**	**30**
Understand	**7.5**	**7.5**	**30**
Apply	**5**	**5**	**20**
Analyse	**5**	**5**	**20**
Evaluate			
Create			

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:
Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern:

The question consists of two parts- Part A and Part B. Part A consists of 10 questions with 3 marks for each (two questions from each module). Part B consists of two questions from each module, out of which one has to be answered. Each question carries 14 marks and can have maximum 2 subdivisions.

Sample Course Level Assessment Questions:

1 **Course Outcome 1 (CO1):** While aligning a highway in a built up area, it was necessary to provide a horizontal curve of radius 300 m for a design speed 65Km/hr, length of wheel base-6m and pavement width 10.5m. Assume rate of introduction of super elevation as 1 in 100 and super elevation is provided by rotating about centre line. Design super elevation, extra widening of pavement and length of transition curve.

2 **Course Outcome 2 (CO2):** Design a flexible pavement for two lane single carriage way for present traffic 1200 commercial vehicles per day, period of construction= 3 yrs, annual traffic growth = 7.5%, Design CBR = 7%, Design life = 15 yrs. Use IRC method.

3 **Course Outcome 3 (CO3):** Traffic in a congested multilane highway lane is observed to have an average spacing of 200 ft,and an average headway of 3.8s. Estimate the rate of flow, density and speed of traffic in this lane.

4 Course Outcome 4 (CO4):
Sketch the component parts of a permanent way and mark the salient points

5 **Course Outcome 5 (CO5):** The total length of a runway is 1000 m. The elevation at distance 0,200 m, 400 m, 600 m, 800 m and 1000 m are 100.0 m, 99.2 m, 101.0 m, 101.8 m, 101.4 m and 101.0 m respectively. What will be the effective gradient of runway?

Syllabus

Module	Contents	Hours
1	Introduction to Transportation Engineering, Classification of roads, Typical cross sections of roads in urban and rural area, Requirements and factors controlling alignment of roads Introduction to geometric design of highways, Design controls and criteria, Design of highway cross section elements, Design of horizontal alignment - Stopping sight distance, Overtaking sight distance, super elevation, transition curve, length and shift of transition curve, extra widening. Vertical alignment (introduction only)	10
2	Introduction to highway materials, Desirable properties and testing of road aggregates, bituminous materials and sub grade soil. Introduction of flexible and rigid pavements, Factors influencing the design of flexible pavements, Design of flexible pavements by CBR method and IRC 37: 2018. Construction of bituminous pavements	9
3	Introduction to traffic engineering, Traffic characteristics, Capacity and Level of Service, Design Speed, Traffic surveys, Types of road intersections, Traffic control devices (introduction only), Design of isolated signals by Webster's method.	7
4	Railway Engineering - Component parts of a railway track - functions, concept of Gauges, coning of wheels, cant deficiency, compensation of gradients Tunnel Engineering: Tunnel – sections, tunnel surveying - alignment, transferring centre grade into tunnel. Harbours – classification, features, requirements. Break waters - necessity and functions, classification. Docks – Functions and types - dry docks, wet docks (Introduction only)	8
5	Introduction to Airport Engineering, Components of airport, selection of site for airport. Runway orientation, basic runway length and corrections required, Taxiways and aprons.	8

Text Books

1. Khanna, S.K. and Justo C.E.G., Highway Engineering, Nem Chand & Bros., 2015
2. Kadiyali, L. R. and N.B Lal, Principles and Practices of Highway Engineering, Khanna Publishers, 2013
3. Khanna, S. K. and Arora. M. G., Airport Planning and Design, Nemchand& Bros
4. Mundrey J. S, Railway Track Engineering, Tata McGraw Hill, 2009

5. Rangawala, S.C. , Railway Engineering, Charotor Publishing House
6. Rao G. V, Principles of Transportation and Highway Engineering, Tata McGrawHill, 1996
7. Srinivasan,R., Harbour, Dock & Tunnel Engineering, Charotor Publishing House, 28e, 2016

References

1. Horonjeff R. and McKelvy, F., Planning and Design of Airports, McGraw Hill, 5e, 2010
2. IRC: 37-2018, Guidelines for the Design of Flexible Pavements, IRC 2018, New Delhi
3. O' Flaherty, C.A (Ed.)., Transport Planning and Traffic Engineering, Elsevier, 1997
4. Rangwala, S. C., Airport Engg. Charotar Publishing Co., 16e, 2016
5. Yoder, E. J and Witczak, M. W, Principles of Pavement Design, John Wiley & Sons, 1991
6. Bindra, S.P., A course in Docks and Harbour Engineering, Dhanpat Rai& Sons
7. Chandra, S. and Agarwal, M.M., Railway Engineering, Oxford University Press, New Delhi, 2008
8. Saxena, S. C and Arora, S. P, Railway Engineering, Dhanpat Rai& Sons, 7e, 2010
9. Subhash C. Saxena, Railway Engineering, Dhanpat Rai& Sons

Course Content and lecture Schedule:

No.	Topic	Course Outcome	No. of Hrs
1	**Module 1**		Total: 10
1.1	Introduction to Transportation Engineering, Classification of roads, Typical cross sections of roads in urban and rural area, Requirements and factors controlling alignment of roads.	CO1	2
1.2	Introduction to geometric design of highways, Design controls and criteria, Design of highway cross section elements	CO1	2
1.3	Design of horizontal alignment - Stopping sight distance, Overtaking sight distance, super elevation, transition curve, length and shift of transition curve, extra widening. Vertical alignment (introduction only)	CO1	6
2	**Module 2**		Total: 9
2.1	Introduction to highway materials, Desirable properties and testing of road aggregates, bituminous materials and sub grade soil.	CO2	3
2.2	Introduction of flexible and rigid pavements, Factors influencing the design of flexible pavements, Design of flexible pavements by CBR method and IRC 37 : 2018	CO2	3
2.3	Construction of bituminous pavements	CO2	3
3	**Module 3**		Total: 7
3.1	Introduction to traffic engineering, Traffic characteristics, Capacity and Level of Service, Design Speed, Traffic surveys, Types of road intersections,	CO3	4
3.2	Traffic control devices (introduction only), Design of isolated signals by Webster's method.	CO3	3
4	**Module 4**		Total: 8
4.1	Railway Engineering - Component parts of a railway track - functions, concept of Gauges, coning of wheels, cant deficiency, compensation of gradients	CO4	4
4.2	Tunnel Engineering: Tunnel – sections, tunnel surveying - alignment, transferring centre grade into tunnel.	CO4	2
4.3	Harbours – classification, features, requirements. Break waters - necessity and functions, classification. Docks – Functions and types - dry docks, wet docks (Introduction only)	CO4	2
5	**Module 5**		Total: 8
5.1	Introduction to Airport Engineering, Components of airport, selection of site for airport.	CO5	3
5.2	Runway orientation, basic runway length and corrections required, Taxiways and aprons.	CO5	5

THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CET 404
Course Name: **TRANSPORTATION ENGINEERING**
Model Question Paper

Marks: 100 Duration: 3 hrs

PART A
(Answer all questions. Each question carry three marks)

1. With a sketch, explain typical cross sectional layout of a two lane road in urban areas.
2. What is meant by reaction time? What is its role in Geometric design of highways?
3. Outline the IRC 37- 2018 recommendations for determining the thickness of Flexible pavements.
4. Differentiate flexible and rigid pavements
5. How would you draw the fundamental diagram of traffic flow
6. Explain grade separated intersections and discuss the advantages and limitations
7. Analyse the concept of cant deficiency with suitable explanations
8. Write short note on Littoral Drift
9. Enumerate the various factors which would be kept in view while selecting suitable site for an airport.
10. What are taxiways?

PART B
(Answer one full question from each module)

11. a) Enumerate the factors governing the width of carriage way. State the IRC specifications for width of carriage way for various classes of roads. (10)
b) Write a brief note on classification of highways in India. (4)

OR

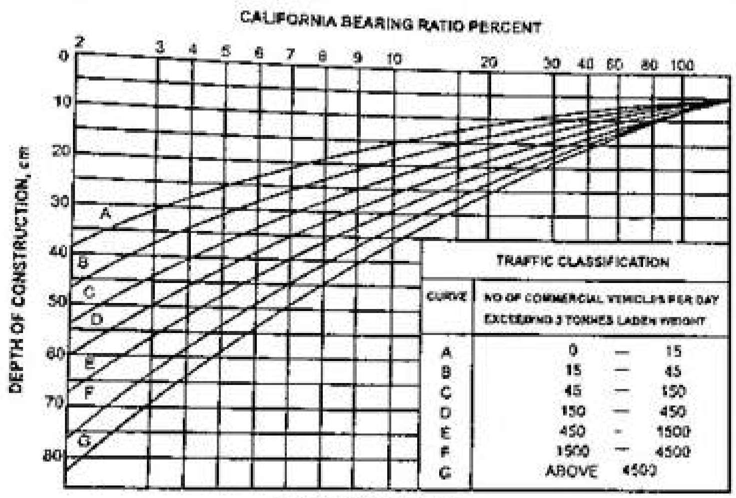
12. a) Calculate the stopping sight distance on a highway for a design speed of 100 kmph. (6)
b) What is super elevation? Explain the design steps of super elevation. (8)

13a) Explain the construction practices of the following bituminous base courses.

1) Bituminous macadam
2) Penetration macadam (6)

b) The soil subgrade sample was obtained from the project site and the CBR tests conducted at field density gave the following readings. Draw the load penetration curve and determine the CBR value and find the total thickness of the pavement by CBR method as recommended by IRC for commercial vehicles 1500 per day, with 7% growth rate. The pavement construction is to be completed in three years after last traffic count. (Use the standard design chart provided) (8)

Penetration (mm)	Load (kg)	Penetration (mm)	Load (kg)
0.0	0.0	3.0	60.0
0.5	6.0	4.0	70.0
1.0	17.0	5.0	77.0
1.5	30.0	7.5	89.0
2.0	42.0	10.0	100.0
2.5	55.0	12.5	115.0



C B R DESIGN CHART

OR

14 a) Explain in detail the various factors that influencing the design of flexible pavements? (10)

b) List out the desirable properties of aggregates to be used in pavement construction. Also specify various tests for judging the suitability of aggregates. (4)

15 a) What are the advantages and disadvantages of traffic signals? (8)

b) What is (i) Saturation flow, (ii) Lost time, and (iii) Phase in a signal design? (6)

OR

16 a) Define the basic terms basic capacity, possible capacity and practical capacity and analyze its importance in traffic engineering. (6)

b) Evaluate the factors affecting level of service of a multilane highway. (8)

17 a) Analyse various types of gradient used on railway track. What is grade compensation and why is it necessary? (6)

b) State the natural and meteorological phenomena a harbour engineer has to study and briefly mention the effects of these phenomena (8)

OR

18 a) Explain the functions of rails, sleepers and ballast. (8)

b) What are the classifications of tunneling? (6)

19 a) Explain in detail about the functions of taxiways and aprons. (6)

b) What are the factors to be considered in the orientation of runway? (8)

OR

20 a) What are the factors affecting selection of site for airport? (4)

b) The length of a runway under standard conditions is 1500m. The airport is to be provided at an elevation of 110m above mean sea level. The airport reference temperature is 320C. Following data refers to the proposed longitudinal section of runway. Determine the corrected length of runway. (10)

End to end of runway (m)	Grade (%)	End to end of runway (m)	Grade (%)
0 to 300	+1	1500 to 1800	+1
300 to 900	-0.2	1800 to 2100	-0.3
900 to 1500	+0.5		

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
22EST405	DESIGN AND ENGINEERING		2	0	0	2

Preamble:

The purpose of this course is to

i) introduce the undergraduate engineering studentsthe fundamental principles of design engineering,

ii) make them understand the steps involved in the design process and

iii) familiarize them with the basic tools used and approaches in design.

Students are expected to apply design thinking in learning as well as while practicing engineering, which is very important and relevant for today. Case studies from various practical situations will help the students realize that design is not only concerned about the function but also many other factors like customer requirements, economics, reliability, etc. along with a variety of life cycle issues.

The course will help students to consider aesthetics, ergonomics and sustainability factors in designs and also to practice professional ethics while designing.

Prerequisite:

Nil. The course will be generic to all engineering disciplines and will not require specialized preparation or prerequisites in any of the individual engineering disciplines.

Course Outcomes:

After the completion of the course the student will be able to

CO 1	Explain the different concepts and principles involved in design engineering.
CO 2	Apply design thinking while learning and practicing engineering.
CO 3	Develop innovative, reliable, sustainable and economically viable designs incorporating knowledge in engineering.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1					1			1		
CO 2		2				1		1				2
CO 3			2			1	1		2	2		1

Assessment Pattern

Continuous Internal Evaluation (CIE) Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination (ESE) Pattern: There will be two parts; Part A and Part B.
Part A : 30 marks
part B : 70 marks
Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions.
Part B contains 2 case study questions from each module of which student should answer any one. Each question carry 14 marks and can have maximum 2 sub questions.

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	5	5	10
Understand	10	10	20
Apply	35	35	70
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Course Level Assessment Questions

Course Outcome 1 (CO1): Appreciate the different concepts and principles involved in design engineering.

1. State how engineering design is different from other kinds of design

2. List the different stages in a design process.

3. Describe design thinking.

4. State the function of prototyping and proofing in engineering design.

5. Write notes on the following concepts in connection with design engineering 1) Modular Design, 2) Life Cycle Design , 3) Value Engineering, 4) Concurrent Engineering, and 5) Reverse Engineering

6. State design rights.

Course Outcome 2 (CO2) : Apply design thinking while learning and practicing engineering.

1. Construct the iterative process for design thinking in developing simple products like a pen, umbrella, bag, etc.

2. Show with an example how divergent-convergent thinking helps in generating alternative designs and then how to narrow down to the best design.

3. Describe how a problem-based learning helps in creating better design engineering solutions.

4. Discuss as an engineer, how ethics play a decisive role in your designs

Course Outcome 3(CO3): Develop innovative, reliable, sustainable and economically viable designs incorporating different segments of knowledge in engineering.

1. Illustrate the development of any simple product by passing through the different stages of designprocess

2. Show the graphical design communication with the help of detailed 2D or 3D drawings for anysimple product.

3. Describe how to develop new designs for simple products through bio-mimicry.

TKM COLLEGE OF ENGINEERING, KOLLAM (GOVT. AIDED AUTONOMOUS)

Model Question paper

Reg No.:_______________Name:____________________________

THIRD/FOURTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: 22EST405

Course Name: DESIGN AND ENGINEERING

Max. Marks: 100Duration: 3 Hours

PART A

Answer all questions, each question carries 3 marks
Use only hand sketches

(1) Write aboutthe basic design process.

(2) Describe how to finalize the design objectives.

(3) State the role of divergent-convergent questioning in design thinking.

(4) Discuss how to perform design thinking in a team managing the conflicts.

(5) Show how engineering sketches and drawings convey designs.

(6) Explain the role of mathematics and physics in design engineering process.

(7) Distinguish between project-based learning and problem-based learning in design engineering.

(8) Describe how concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?

(9) Show how designs are varied based on the aspects of production methods, life span, reliability and environment?

(10) Explain how economics influence the engineering designs?

(10x3 marks =30 marks)

Part B

Answer any ONE question from each module. Each question carry 14 marks

Module 1

(11) Show the designing of a wrist watch going through the various stages of the design process. Use hand sketches to illustrate the processes.

or

(12) Find the customer requirements for designing a new car showroom. Show how the design objectives were finalized considering the design constraints?

Module 2

(13) Illustrate the design thinking approach for designing a bag for college students within a limited budget. Describe each stage of the process and the iterative procedure involved. Use hand sketches to support your arguments.

or

(14) Construct a number of possible designs and then refine them to narrow down to the best design for a drug trolley used in hospitals. Show how the divergent-convergent thinking helps in the process. Provide your rationale for each step by using hand sketches only.

Module 3

(15) Graphically communicate the design of a thermo flask used to keep hot coffee. Draw the detailed 2D drawings of the same with design detailing, material selection, scale drawings, dimensions, tolerances, etc. Use only hand sketches.

or

(16) Describe the role of mathematical modelling in design engineering. Show how mathematics and physics play a role in designing a lifting mechanism to raise 100 kg of weight to a floor at a height of 10 meters in a construction site.

Module 4

(17) Show the development of a nature inspired design for a solar poweredbus waiting shed beside a highway. Relate between natural and man-made designs. Use hand sketches to support your arguments.

or

(18) Show the design of a simple sofa and then depict how the design changes when considering 1) aesthetics and 2) ergonomics into consideration. Give hand sketches and explanations to justify the changes in designs.

Module 5

(19) Examine the changes in the design of a foot wear with constraints of 1) production methods, 2) life span requirement, 3) reliability issues and 4) environmental factors. Use hand sketches and give proper rationalization for the changes in design.

or

(20) Describe the how to estimate the cost of a particular design using ANY of the following: i) a website, ii) the layout of a plant, iii) the elevation of a building, iv) anelectrical or electronic system or device and v) a car.

Show how economics will influence the engineering designs. Use hand sketches to support your arguments.

(5x14 marks =70 marks)

SYLLABUS

Module 1

Design Process:- Introduction to Design and Engineering Design, Defining a Design Process-:Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.

Module 2

Design Thinking Approach:-Introduction to Design Thinking, Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Design Thinking as Divergent-Convergent Questioning. Design Thinking in a Team Environment.

Module 3

Design Communication (Languages of Engineering Design):-Communicating Designs Graphically, Communicating Designs Orally and in Writing. Mathematical Modeling In Design, Prototyping and Proofing the Design.

Module 4

Design Engineering Concepts:-Project-based Learning and Problem-based Learning in Design.Modular Design and Life Cycle Design Approaches. Application of Bio-mimicry,Aesthetics and Ergonomics in Design. Value Engineering, Concurrent Engineering, and Reverse Engineering in Design.

Module 5

Expediency, Economics and Environment in Design Engineering:-Design for Production, Use, and Sustainability. Engineering Economics in Design. Design Rights. Ethics in Design

Text Books

1) YousefHaik, SangarappillaiSivaloganathan, Tamer M. Shahin, Engineering Design Process, Cengage Learning 2003, Third Edition, ISBN-10: 9781305253285,

2) Voland, G., Engineering by Design, Pearson India 2014, Second Edition, ISBN 9332535051

Reference Books

1. Philip Kosky, Robert Balmer, William Keat, George Wise, Exploring Engineering, Fourth Edition: An Introduction to Engineering and Design, Academic Press 2015, 4th Edition, ISBN: 9780128012420.
2. Clive L. Dym, Engineering Design: A Project-Based Introduction, John Wiley & Sons, New York 2009, Fourth Edition, ISBN: 978-1-118-32458-5
3. Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Berg Publishers 2011, First Edition, ISBN: 978-1847886361
4. Pahl, G., Beitz, W., Feldhusen, J., Grote, K.-H., Engineering Design: A Systematic Approach, Springer 2007, Third Edition, ISBN 978-1-84628-319-2

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1: Design Process**	
1.1	Introduction to Design and Engineering Design. *What does it mean to design something? How Is engineering design different from other kinds of design? Where and when do engineers design? What are the basic vocabularyin engineering design? How to learn and do engineering design.*	1
1.2	*Defining a Design Process-*: Detailing Customer Requirements. *How to do engineering design? Illustrate the process with an example. How to identify the customer requirements of design?*	1
1.3	*Defining a Design Process-*: Setting Design Objectives, Identifying Constraints, Establishing Functions. *How to finalize the design objectives? How to identify the design constraints? How to express the functions a design in engineering terms?*	1
1.4	*Defining a Design Process-*: Generating Design Alternatives and Choosing a Design. *How to generate or create feasible design alternatives? How to identify the "best possible design"?*	1
1.5	Case Studies:- Stages of Design Process. *Conduct exercises for designing simple products going through the different stages of design process.*	1
2	**Module 2: Design Thinking Approach**	
2.1	Introduction to Design Thinking *How does the design thinking approach help engineers in creating innovative and efficient designs?*	1
2.2	Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. *How can the engineers arrive at better designs utilizing the iterative design thinking process (in which knowledge acquired in the later stages can be applied back to the earlier stages)?*	1
2.3	Design Thinking as Divergent-Convergent Questioning. *Describe how to create a number of possible designs and then how to refine and narrow down to the 'best design'.*	1
2.4	Design Thinking in a Team Environment. *How to perform design thinking as a team managing the conflicts ?*	1
2.5	Case Studies: Design Thinking Approach. *Conduct exercises using the design thinking approach for*	1

	designing any simple products within a limited time and budget	
3	**<u>Module 3: Design Communication</u> (Languages of Engineering Design)**	
3.1	Communicating Designs Graphically. *How do engineering sketches and drawings convey designs?*	1
3.2	Communicating Designs Orally and in Writing. *How can a design be communicated through oral presentation or technical reports efficiently?*	1
	First Series Examination	
3.3	Mathematical Modelling in Design. *How do mathematics and physics become a part of the design process?*	1
3.4	Prototyping and Proofing the Design. *How to predict whether the design will function well or not?*	1
3.5	Case Studies: Communicating Designs Graphically. *Conduct exercises for design communication through detailed 2D or 3D drawings of simple products with design detailing, material selection, scale drawings, dimensions, tolerances, etc.*	1
4	**<u>Module 4: Design Engineering Concepts</u>**	
4.1	Project-based Learning and Problem-based Learning in Design. *How engineering students can learn design engineering through projects?* *How students can take up problems to learn design engineering?*	1
4.2	Modular Design and Life Cycle Design Approaches. *What is modular approach in design engineering? How it helps?* *How the life cycle design approach influences design decisions?*	1
4.3	Application of Bio-mimicry, Aesthetics and Ergonomics in Design. *How do aesthetics and ergonomics change engineering designs?* *How do the intelligence in nature inspire engineering designs? What are the common examples of bio-mimicry in engineering?*	1
4.4	Value Engineering, Concurrent Engineering, and Reverse Engineering in Design. *How do concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?*	1
4.5	Case Studies: Bio-mimicry based Designs. *Conduct exercises to develop new designs for simple*	1

	products using bio-mimicry and train students to bring out new nature inspired designs.	
5	**Module 5: Expediency, Economics and Environment in Design Engineering**	
5.1	Design for Production, Use, and Sustainability. *How designs are finalized based on the aspects of production methods, life span, reliability and environment?*	1
5.2	Engineering Economics in Design. *How to estimate the cost of a particular design and how will economics influence the engineering designs?*	1
5.3	Design Rights. *What are design rights and how can an engineer put it into practice?*	1
5.4	Ethics in Design. *How do ethics play a decisive role in engineering design?*	1
5.5	Case Studies: Design for Production, Use, and Sustainability. *Conduct exercises using simple products to show how designs change with constraints of production methods, life span requirement, reliability issues and environmental factors.*	1
Second Series Examination		

Code.	Course Name	L	T	P	Hrs	Credit
22HUT406	**Professional Ethics**	2	0	0	2	2

Preamble: To enable students to create awareness on ethics and human values.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the core values that shape the ethical behaviour of a professional.
CO 2	Adopt a good character and follow an ethical life.
CO 3	Explain the role and responsibility in technological development by keeping personal ethics and legal ethics.
CO 4	Solve moral and ethical problems through exploration and assessment by established experiments.
CO 5	Apply the knowledge of human values and social values to contemporary ethical values and global issues.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1								2			2	
CO 2								2			2	
CO 3								3			2	
CO 4								3			2	
CO 5								3			2	

Assessment Pattern

Bloom's category	Continuous Assessment Tests		End Semester Exam
	1	2	
Remember	15	15	30
Understood	20	20	40
Apply	15	15	30

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment Tests (2 Nos)	:	25 marks
Assignments/Quiz	:	15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):
1. Define integrity and point out ethical values.
2. Describe the qualities required to live a peaceful life.
3. Explain the role of engineers in modern society.

Course Outcome 2 (CO2)
1. Derive the codes of ethics.
2. Differentiate consensus and controversy.
3. Discuss in detail about character and confidence.

Course Outcome 3(CO3):
1. Explain the role of professional's ethics in technological development.
2. Distinguish between self interest and conflicts of interest.
3. Review on industrial standards and legal ethics.

Course Outcome 4 (CO4):
1. Illustrate the role of engineers as experimenters.
2. Interpret the terms safety and risk.
3. Show how the occupational crimes are resolved by keeping the rights of employees.

Course Outcome 5 (CO5):
1. Exemplify the engineers as managers.
2. Investigate the causes and effects of acid rain with a case study.
3. Explorate the need of environmental ethics in technological development.

Model Question paper

QP CODE: **Reg No:_______________**

PAGES: 3 **Name :_______________**

THIRD/FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22HUT406
Course Name: PROFESSIONAL ETHICS

Max. Marks: 100 **Duration: 3 Hours**

(2019-Scheme)

PART A

(Answer all questions, each question carries 3 marks)

1. Define empathy and honesty.

2. Briefly explain about morals, values and ethics.

3. Interpret the two forms of self-respect.

4. List out the models of professional roles.

5. Indicate the advantages of using standards.

6. Point out the conditions required to define a valid consent?

7. Identify the conflicts of interests with an example?

8. Recall confidentiality.

9. Conclude the features of biometric ethics.

10. Name any three professional societies and their role relevant to engineers.

(10x3 = 30 marks)

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Classify the relationship between ethical values and law?

b) Compare between caring and sharing. (10+4 = 14 marks)

Or

12. a) Exemplify a comprehensive review about integrity and respect for others.

b) Discuss about co-operation and commitment. (8+6 = 14 marks)

MODULE II

13.a) Explain the three main levels of moral developments, deviced by Kohlberg.

b) Differentiate moral codes and optimal codes. (10+4 = 14 marks)

Or

14. a) Extrapolate the duty ethics and right ethics.

b) Discuss in detail the three types of inquiries in engineering ethics (8+6 = 14 marks)

MODULE III

15.a) Summarize the following features of morally responsible engineers.

(i) Moral autonomy **(ii)** Accountability

b)Explain the rights of employees (8+6 = 14 marks)

Or

16. a) Explain the reasons for Chernobyl mishap ?

b) Describe the methods to improve collegiality and loyalty. (8+6 = 14 marks)

MODULE IV

17.a) Execute collegiality with respect to commitment, respect and connectedness.

b) Identify conflicts of interests with an example. (8+6 = 14 marks)

Or

18. a) Explain in detail about professional rights and employee rights.

b) Exemplify engineers as managers.

MODULE V

19.a) Evaluate the technology transfer and appropriate technology.

b) Explain about computer and internet ethics. (8+6 = 14 marks)

Or

20. a) Investigate the causes and effects of acid rain with a case study.

b) Conclude the features of ecocentric and biocentric ethics. (8+6 = 14 marks)

SYLLABUS

Module 1 – Human Values.

Morals, values and Ethics – Integrity- Academic integrity-Work Ethics- Service Learning- Civic Virtue-Respect for others- Living peacefully- Caring and Sharing- Honestly- courage-Cooperation commitment-Empathy-Self Confidence -Social Expectations.

Module 2 - Engineering Ethics & Professionalism.

Senses of Engineering Ethics - Variety of moral issues- Types of inquiry- Moral dilemmas –Moral Autonomy – Kohlberg's theory- Gilligan's theory- Consensus and Controversy-Profession and Professionalism- Models of professional roles-Theories about right action –Self interest-Customs and Religion- Uses of Ethical Theories.

Module 3- Engineering as social Experimentation.

Engineering as Experimentation – Engineers as responsible Experimenters- Codes of Ethics- Plagiarism-A balanced outlook on law - Challenges case study- Bhopal gas tragedy.

Module 4- Responsibilities and Rights.

Collegiality and loyalty – Managing conflict- Respect for authority- Collective bargaining- Confidentiality-Role of confidentiality in moral integrity-Conflicts of interest- Occupational crime- Professional rights-Employee right- IPR Discrimination.

Module 5- Global Ethical Issues.

Multinational Corporations- Environmental Ethics- Business Ethics- Computer Ethics -Role in Technological Development-Engineers as Managers- Consulting Engineers- Engineers as Expert witnesses and advisors-Moral leadership.

Text Book

1. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012.
2. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited ,New Delhi,2006.

Reference Books

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi,2014.
2. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
3. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics- Concepts and cases, Wadsworth Thompson Learning, United states,2005.
4. http://www.slideword.org/slidestag.aspx/human-values-and-Professional-ethics.

Course Contents and Lecture Schedule

SL.No	Topic	No. of Lectures 25
1	**Module 1 – Human Values.**	
1.1	Morals, values and Ethics, Integrity, Academic Integrity,Work Ethics	1
1.2	Service Learning, Civic Virtue, Respect for others, Living peacefully	1
1.3	Caring and Sharing, Honesty, Courage, Co-operation commitment	2
1.4	Empathy, Self Confidence, Social Expectations	1
2	**Module 2- Engineering Ethics & Professionalism.**	
2.1	Senses of Engineering Ethics, Variety of moral issues, Types of inquiry	1
2.2	Moral dilemmas, Moral Autonomy, Kohlberg's theory	1
2.3	Gilligan's theory, Consensus and Controversy,Profession& Professionalism, Models of professional roles, Theories about right action	2
2.4	Self interest-Customs and Religion, Uses of Ethical Theories	1
3	**Module 3- Engineering as social Experimentation.**	
3.1	Engineering as Experimentation, Engineers as responsible Experimenters	1
3.2	Codes of Ethics,Plagiarism, A balanced outlook on law	2
3.3	Challenger case study, Bhopal gas tragedy	2
4	**Module 4- Responsibilities and Rights.**	
4.1	Collegiality and loyalty, Managing conflict, Respect for authority	1
4.2	Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Conflicts of interest	2
4.3	Occupational crime, Professional rights, Employee right, IPR Discrimination	2
5	**Module 5- Global Ethical Issues.**	
5.1	Multinational Corporations, Environmental Ethics, Business Ethics, Computer Ethics	2
5.2	Role in Technological Development, Moral leadership	1
5.3	Engineers as Managers, Consulting Engineers, Engineers as Expert witnesses and advisors	2

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
22MNC407	CONSTITUTION OF INDIA		2	0	0	NIL

Preamble:

The study of their own country constitution and studying the importance environment as well as understanding their own human rights help the students to concentrate on their day to day discipline. It also gives the knowledge and strength to face the society and people.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Explain the background of the present constitution of India and features.
CO 2	Utilize the fundamental rights and duties.
CO 3	Understand the working of the union executive, parliament and judiciary.
CO 4	Understand the working of the state executive, legislature and judiciary.
CO 5	Utilize the special provisions and statutory institutions.
CO 6	Show national and patriotic spirit as responsible citizens of the country

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2	2	2		2		
CO 2						3	3	3		3		
CO 3						3	2	3		3		
CO 4						3	2	3		3		
CO 5						3	2	3		3		
CO 6						3	3	3		2		

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			

Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1 Discuss the historical background of the Indian constitution.

2 Explain the salient features of the Indian constitution.

3 Discuss the importance of preamble in the implementation of constitution.

Course Outcome 2 (CO2)

1 What are fundamental rights ? Examine each of them.

2 Examine the scope of freedom of speech and expression underlying the constitution.

3 The thumb impression of an accused is taken by the police against his will. He contends that this is a violation of his rights under Art 20(3) of the constitution. Decide.

Course Outcome 3(CO3):

1 Explain the powers of the President to suspend the fundamental rights during emergency.

2 Explain the salient features of appeal by special leave.

3. List the constitutional powers of President.

Course Outcome 4 (CO4):

1 Discuss the constitutional powers of Governor.

2 Examine the writ jurisdiction of High court.

3 Discuss the qualification and disqualification of membership of state legislature.

Course Outcome 5 (CO5):

1 Discuss the duties and powers of comptroller of auditor general.

2 Discuss the proclamation of emergency.

3 A state levies tax on motor vehicles used in the state, for the purpose of maintaining roads in the state. X challenges the levy of the tax on the ground that it violates the freedom of interstate commerce guaranteed under Art 301. Decide.

Course Outcome 6 (CO6):

1 Explain the advantages of citizenship.

2 List the important principles contained in the directive principles of state policy.

3 Discuss the various aspects contained in the preamble of the constitution

Model Question paper

PART A

(Answer all questions. Each question carries 3 marks)

1 Define and explain the term constitution.

2 Explain the need and importance of Preamble.

3 What is directive principle of state policy?

4 Define the State.
5 List the functions of Attorney general of India.
6 Explain the review power of Supreme court.
7 List the qualifications of Governor.
8 Explain the term and removal of Judges in High court.

9 Explain the powers of public service commission.

10 List three types of emergency under Indian constitution.

(10X3=30marks)

PART B

(Answer on question from each module. Each question carries 14 marks)

Module 1

11. Discuss the various methods of acquiring Indian citizenship. 12 Examine the salient features of the Indian constitution

Module 2

13 A high court passes a judgement against X. X desires to file a writ petition in the supreme court under Art32, on the ground that the judgement violates his fundamental rights. Advise him whether he can do so.

14 What is meant by directive principles of State policy? List the directives.

Module3

15 Describe the procedure of election and removal of the President of India.

16 Supreme court may in its discretion grant special leave to appeal. Examine the situation.

Module 4

17 Discuss the powers of Governor.

18 X filed a writ petition under Art 226 which was dismissed. Subsequently, he filed a writ petition under Art 32 of the constitution, seeking the same remedy. The Government argued that the writ petition should be dismissed, on the ground of res judicata. Decide.

Module 5

13 Examine the scope of the financial relations between the union and the states.

14 Discuss the effects of proclamation of emergency.

(14X5=70marks)

Syllabus

Module 1 Definition, historical back ground, features, preamble, territory, citizenship.

Module 2 State, fundamental rights, directive principles, duties.

Module 3 The machinery of the union government.

Module 4 Government machinery in the states

Module 5 The federal system, Statutory Institutions, miscellaneous provisions

Text Books

1 D D Basu, Introduction to the constitution of India, Lexis Nexis, New Delhi, 24e, 2019

2 PM Bhakshi, The constitution of India, Universal Law, 14e, 2017

Reference Books

1 Ministry of law and justice, The constitution of India, Govt of India, New Delhi, 2019.

2 JN Pandey, The constitutional law of India, Central Law agency, Allahabad, 51e, 2019

3 MV Pylee, India's Constitution, S Chand and company, New Delhi, 16e, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1**	
1.1	Definition of constitution, historical back ground, salient features of the constitution.	1
1.2	Preamble of the constitution, union and its territory.	1
1.3	Meaning of citizenship, types, termination of citizenship.	2
2	**Module 2**	
2.1	Definition of state, fundamental rights, general nature, classification, right to equality ,right to freedom , right against exploitation	2
2.2	Right to freedom of religion, cultural and educational rights, right to constitutional remedies. Protection in respect of conviction for offences.	2

2.3	Directive principles of state policy, classification of directives, fundamental duties.	2
3	**Module 3**	
3.1	The Union executive, the President, the vice President, the council of ministers, the Prime minister, Attorney-General, functions.	2
3.2	The parliament, composition, Rajya sabha, Lok sabha, qualification and disqualification of membership, functions of parliament.	2
3.3	Union judiciary, the supreme court, jurisdiction, appeal by special leave.	1
4	**Module 4**	
4.1	The State executive, the Governor, the council of ministers, the Chief minister, advocate general, union Territories.	2
4.2	The State Legislature, composition, qualification and disqualification of membership, functions.	2
4.3	The state judiciary, the high court, jurisdiction, writs jurisdiction.	1
5	**Module 5**	
5.1	Relations between the Union and the States, legislative relation, administrative relation, financial Relations, Inter State council, finance commission.	1
5.2	Emergency provision, freedom of trade commerce and inter course, comptroller and auditor general of India, public Services, public service commission, administrative Tribunals.	2
5.3	Official language, elections, special provisions relating to certain classes, amendment of the Constitution.	2

22CEL 408	MATERIAL TESTING LAB - I	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	0	0	3	2	2019

Preamble: The course aims to enrich the understanding of the fundamental concepts of mechanics of deformable bodies through systematic experimental techniques for the estimation of various mechanical properties of engineering materials.

Prerequisite: Engineering Physics, Mechanics of Materials. Knowledge in use of Vernier caliper and micrometer screw gauge expected.

General Instructions to Faculty:

1. Any 12experimentsout of 15 need to be performed mandatorily. Virtual Lab facility [11] cannot be used to substitute the conduct of these mandatory experiments.
2. The laboratory should have possession of modern testing equipment such as strain gauges, LVDTs, load cells and data acquisition systems at least for demonstration purposes
3. Periodic maintenance and calibration of various testing instruments needs to be made.
4. Use of data visualization packages needs to promoted for making various plots.

Course Outcomes: After the completion of the course, the student will be able to:

Course Outcome	Course Outcome Description
CO 1	To understand the behaviour of engineering materials under various forms and stages of loading.
CO 2	Characterize the elastic properties of various materials.
CO3	Evaluate the strength and stiffness properties of engineering materials under various loading conditions.

Mapping of course outcomes with program outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	**3**	**2**	**2**	**2**	**1**	**3**	**-**	**-**	**2**	**2**	**-**	**2**
CO 2	**3**	**2**	**2**	**2**	**1**	**3**	**-**	**-**	**2**	**2**	**-**	**2**
CO 3	**3**	**2**	**2**	**2**	**1**	**3**	**-**	**-**	**2**	**2**	**-**	**2**

Course Level Assessment Questions

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks
Continuous Assessment : 30 marks
Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks
(b) Implementing the work/Conducting the experiment : 10 Marks
(c) Performance, result and inference (usage of equipment and trouble shooting) : 25 Marks
(d) Viva voce : 20 marks
(e) Record : 5 Marks

General instructions:
Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

References

1. S.P. Timoshenko, *History of Strength of Materials,* Dover publications, 1953
2. Egor P. Popov, Engineering Mechanics of Solids, Pearson, 1998.
3. IS 1608 (2005): Metallic Materials – Tensile testing at Ambient temperature, 3rd Revision, July 2008
4. IS 1598 (1977): Method for Izod Impact test of Metals, 2nd reprint, September 1986.
5. IS 1499 (1977) : Method for Charpy Impact test (U-Notch) for metals, 3rd reprint, March 1992.

6. IS 5242 (1979) Method of Test for determining Shear Strength of Metals, 1st revision, 2006.
7. IS 1500 (2005): Method for Brinell Hardness Test for Metallic Materials, 3rd revision, 2005.
8. IS 1501 (2002) : Method for Vickers hardness Test for Metallic Materials.
9. IS 1717 (2012): Metallic Materials – Wire – Simple Torsion Test, 3rd revision, 2012.
10. IS 883 (1994): Design of Structural Timber in Building- Code of Practice, Reaffirmed 2005)
11. www.vlab.co.in

SYLLABUS

Exercise 1. Study on stress-strain characteristics of mild steel and by conducting uniaxial tension test on rod specimens

Exercise 2. Study on stress-strain characteristics of tor steel by conducting uniaxial tension test on rod specimens

Exercise 3. Study on estimation of shear capacity of mild steel specimen by conducting a double shear test on rod specimen.

Exercise 4. Study on flexural behaviour of steel by conduction of test on RSJ (I cross section)

Exercise 5. Study on torsional behaviour and estimation of modulus of rigidity of steel by conducting torsion test on rod specimens

Exercise 6. Study on estimation of modulus of rigidity of steel and brass / copper materials utilizing the principles of torsional vibrations.

Exercise 7. Study on estimation of toughness properties of steel specimens by conducting (a) Izod &(b) Charpy impact tests.

Exercise 8. Study on estimation of hardness properties of engineering materials such as brass, aluminium, copper, steel etc.by performing Brinell hardness test

Exercise 9. Study on estimation of Hardness properties of engineering materials such as brass, aluminium, copper, steel etc.by performing

9.1 Rockwell hardness test
9.2 Vicker's hardness test

Exercise 10. Study on estimation of modulus of rigidity of steel by performing tension tests on spring specimens.

Exercise 11. Study on estimation of modulus of rigidity of steel by performing compression tests on spring specimens

Exercise 12. Study on flexural behaviour of timber material by performing tests on beam specimens.

Exercise 13. Study on estimation of compression strength of timber specimen.

Exercise 14. Experiment on verification of Maxwell's reciprocal theorem

Exercise 15. Bend &rebend test on mild steel specimen

Optional Exercises:

Study/ demonstration of :

- Fatigue test on steel rod specimen
- Strain gauges and Load cells
- Elastic buckling modes of column under different boundary conditions

22CE L 409	FLUID MECHANICS LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	0	0	3	2	2019

Preamble: The course is designed to train the students to familiarize and understand the different flow measurement equipment's and their procedures. Students will be introduced to a team working environment where they develop the necessary skills of experimentation techniques for the study of flow phenomena in channels/pipes.

Prerequisite: Fluid Mechanics and Hydraulics

Course Outcomes: After the completion of the course, the student will be able to:

Course Outcome (CO)	Course Outcome Description
CO 1	Apply fundamental knowledge of Fluid Mechanics to corresponding experiments
CO 2	Apply theoretical concepts in Fluid Mechanics to respective experiments
CO 3	Analyse experimental data and interpret the results
CO 4	Document the experimentation in prescribed manner

Mapping of course outcomes (COs) with program outcomes (POs)

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	-	-	-	-	-	2	3	-	-	-
CO 2	2	2	-	-	-	-	-	2	3	-	-	-
CO 3	3	3	-	2	-	-	-	2	3	3	-	-
CO 4	1	-	-	-	-	-	-	2	2	3	-	-

Course Level Assessment Questions

Assessment Pattern

Mark distribution

Total Marks	Continuous Internal Evaluation (CIE)	End Semester Examination (ESE)	End Semester Examination (ESE) Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance	: 15 marks
Continuous Assessment	: 30 marks
Internal Test (Immediately before the second series test)	: 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks.

a) Preliminary work	: 15 marks
b) Implementing the work/ Conducting the experiment	: 10 marks
c) Performance, result and inference (usage of equipments and trouble shooting)	: 25 marks
d) Viva voce	: 20 marks
e) Record	: 5 marks

General Instructions:

Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Reference Books:

1. Modi P. N. and S. M. Seth, Hydraulics & Fluid Mechanics, S.B.H Publishers, New Delhi, 2002.
2. Subramanya K., Theory and Applications of Fluid Mechanics, Tata McGraw-Hill, 1993.
3. Subramanya K., Flow in Open channels, Tata McGraw-Hill, 2009.

List of Exercises/ Experiments (Any 12 experiments out of 15 need to be performed mandatorily. Lab experiments may be given considering 12 sessions of 3 hours each)

1. Study of taps, valves, pipe fittings, gauges, Pitot tubes, water meters and current meters.
2. Calibration of Pressure gauges
3. Determination of metacentric height and radius of gyration of floating bodies.
4. Verification of Bernoulli's theorem
5. Hydraulic coefficients of orifices and mouth pieces under constant head method and time of emptying method.
6. Calibration of Venturimeter

7. Calibration of Orifice meter
8. Calibration of water meter.
9. Calibration of rectangular rectangular notch
10. Calibration of triangular notch.
11. Time of Emptying through orifice
12. Plotting Specific Energy Curves in Open Channel flow
13. Study of Parameters of Hydraulic Jump in Open channel Flow.
14. Determination of friction co-efficient in pipes
15. Determination of loss co-efficient for pipe fittings

22CEMR 410.1	COURSE NAME **BUILDING DRAWING**	CATEGORY	L	T	P	CREDIT
		VAC	2	2	0	4

Preamble: Objective of the course is to give exposure to building rules, impart training in visualisation and planning of various types of buildings and their components.

Prerequisite: Engineering Graphics

Course Outcomes: After the completion of the course the student will be able to

CO 1	The student will be able to understand building drawing, scales and methods of dimensioning
CO 2	The student will be able draw the details of panelled door, glazed windows, joint details of roof truss
CO 3	The student will be able to draw plan and sectional elevation of reinforced concrete staircase
CO 4	Understand the basic concepts and methods of building drawing using AutoCAD Software
CO 5	The student will be able to prepare site plan, service plan, Septic tank and soak pit - detailed drawing

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	-	-	2	-	-	-	-	-	-	-
CO 2	3	3	-	-	3	-	-	-	-	-	-	-
CO 3	3	3	-	-	3	-	-	-	-	-	-	-
CO 4	3	3	-	-	3	-	-	-	-	-	-	-
CO 5	3	3	-	-	3	-	-	-	-	-	-	-

Mark distribution

Total marks	CIE Marks	ESE Marks	ESE duration
150	50	100	3 hours

Continuous internal evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern: ESE will be of **3 hour** duration on A2 size answer booklet and will be for 100 marks. (only manual drafting for ESE). 5 descriptive type questions of 2 marks each, one from each module. 2 drawing questions of 45 marks each, with choice from 4, from any 4 modules.

SYLLABUS

Module 1

General – Study of IS Codes of practice on building drawing – Scales- method of dimensioning.

Sectional plan, sectional elevation, front view and joint details of Panelled door and Glazed windows.

Module 2

Types of Roof- Roofing- Elevation and joint details-Roof truss in steel sections.

Types of Stairs- Plan and sectional elevation of reinforced concrete staircase.

Module 3

Building rules- Two storied and multi-storeyed building- Plan, section and elevation.

Public buildings like offices, bank, dispensary etc.

Module 4

Building rules -Industrial building- Plan, section and elevation.

Preparation of site plan and service plan.

Module 5

Preparation of Septic tank and soak pit -detailed drawing.

Course Content and lecturer Schedule:

No.	**Course Plan**	**Course Outcome**	**No. ofHrs**
	Module 1:		
1.1	General – Study of IS Codes of practice on building drawing	CO1	2
1.2	Scales- method of dimensioning		2
1.3	Sectional plan, sectional elevation, front view and joint details of	CO2	
1.4	(a)Panelled doors		2
1.5	(b)Glazed windows		2
	Module 2:		
2.1	Types of Roofs	CO2	2
2.2	Roof truss in steel sections		2
2.3	Types of Stairs	CO3	2
2.4	Reinforced concrete staircase		2
	Module 3:		
3.1	Building rules	CO4	2
	Plan, section and elevation of		
3.2	(a) Two storied building		2
3.3	(b) multi-storeyed building		2
3.4	(c) Public building		2

4.1 4.2	**Module 4:** Building rules and type of Industrial building Plan elevation and section of industrial building	CO4	2 2
4.3 4.4	Preparation of site plan service plan	CO5	2 2
5.1	**Module 5:** Preparation of Septic tank and soak pit -detailed drawing	CO5	2

Reference Books

1. National Building Code of India.

2. Kerala Municipal Building Rules.

3. Dr. Balagopal T.S. Prabhu, Building Drawing and Detailing, Spades Publishers, Calicut.

Model Question Paper

QP CODE: Reg No:-----------

Name:...............

FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code**: 22CEMR410.1**

BUILDING DRAWING

Max. Marks: 100 Duration: 3 hours

Part A
(Answer all questions; each question carries 2 marks)

1. Draw neat sketches for following lines; (a) Section line (b) Hidden line (c) Dimension line (d) Extension line
2. What are the major components of a steel truss?
3. What is the difference between waist slab and folded slab stair?
4. What is FAR and FSI?
5. State the importance of site plan and openings schedule in civil engineering drawing.

PART B
(Answer Two full question, each question carries 45 marks)

6. (a) Draw the elevation and sectional view of a double leaf and six paneled door of size 2000x1200 mm

OR

(b) Plan a RCC stair case for a room dimension 450 cm x 300 cm. Draw plan view and sectional view. Take floor height =3m.

7. (a) a single stored residential house with the following requirements & draw plan, elevation and section.

(i) Verandah (ii) Bed room (3 no's), one with attached toilet (iii) living hall (iv) kitchen (v) work area (vi) common toilet

OR

(b) Draw the plan and elevation of a small hospital for the following requirements;

(i) Doctor's room (2)	(ii) causality
(iii) Dressing area	(iv) Pharmacy
(v) Laboratory	(vi) Store room
(vii) Toilets	(vii) ward (5 bed)

22CEMR 410.2	INTRODUCTION TO TRANSPORTATION ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		VAC	4	0	0	4	2019

Preamble

Objective of the course is to introduce the principles and practice of Highway,Traffic Engineering and Transportation Planning.

Prerequisite: Nil

Course Outcomes:

	Description
CO No.	At the end of the course, students will be able to:
1	**Discuss** the basic characteristics of Highways and basics of geometric design.
2	**Analyse** the features of highway materials , various types of pavements, and construction techniques
3	**Interpret** the basics of traffic characteristics, describe how to conduct traffic surveys and interpret data, understand the various traffic control devices
4	**Establish** the basics of different modes of transportation and their characteristics including rail, water and air.
5	**Appraise** Travel Demand Estimation process and the sustainable transportation measures and its application through promoting public transportation modes.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	1	2			1	1	1		1		1
2	3	1				1	1	1		1		1
3	3	1	1			1	1	1	1	1		1
4	2	1				1	1	1		1	1	1
5	3	3				2	3	1	1	1	1	1

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (marks)
	Test 1 Marks	Test 2 Marks	
Remember	**10**	**10**	**30**
Understand	**10**	**10**	**30**
Apply	**5**	**5**	**40**
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern:
The question consists of two parts- Part A and Part B. Part A consists of 5 questions with 5 marks for each (one questions from each module). Part B consists of two questions from each module, out of which one has to be answered. Each question carries 15 marks and can have maximum 3 subdivisions.

Course Level Assessment Questions:

Course Outcome 1 (CO1): What are the basic requirements for an ideal highway alignment? Describe thefactors considered in finalising the alignment.

Course Outcome 2 (CO2): Describe the specifications of materials and construction steps of bituminous concrete pavements.

Course Outcome 3 (CO3): Explain the effect of various vehicular characteristics on traffic stream behaviour.

Course Outcome 4 (CO4): Sketch the typical layout of an airport showing the location of taxiways, runways, apron and terminal building for a two open parallel runways.

Course Outcome 5 (CO5): What are the options available in present day society to make transportation sustainable? What are the steps to be adopted by the stakeholders to implement it in India?

SYLLABUS

Mod	Contents	Hrs
1	Introduction to Transportation Engineering, Role of transportation in the development of a society, Classification of roads, Typical cross sections of roads in urban and rural area, Introduction to geometric design of highways, highway cross section elements	9
2	Introduction of flexible and rigid pavements. Introduction to highway materials, Desirable properties and testing of road aggregates, bituminous materials and sub grade soil. Construction of bituminous pavements and rigid pavements (Basics only)	9
3	Introduction to traffic engineering, Traffic characteristics, Capacity and Level of Service, Design Speed, Traffic signals and markings, Types of road intersections, Traffic control devices (introduction only)	8
4	Railway Engineering - Component parts of a railway track - functions, concept of Gauges, coning of wheels Harbours – classification, features, requirements. Break waters - necessity and functions, classification. Docks – Functions and types - dry docks, wet docks (Introduction only) Airport Engineering:- Components of airport and airport layout, Runway orientation, Taxiways, aprons. and Terminal Building (Introduction only)	12
5	Transportation Planning:-Need for Transportation planning, Transport- land use interaction, Travel Demand Estimation –(Introduction only) Sustainable urban transport; issues and challenges, Emerging concepts in sustainable transportation: green vehicles and green roads, green and alternate fuels;	7

Text Books

1. Khanna, S.K. & Justo E.G., Highway Engineering, Nem Chand & Bros., 2000
2. Kadiyali, L. R., Traffic Engineering& Transportation Planning, Khanna Publishers, 2017
3. Khanna, S. K. and Arora. M. G., Airport Planning and Design, Nemchand& Bros
4. Rangawala, S.C. , Railway Engineering, Charotar Publishing House
5. Rao G. V, Principles of Transportation and Highway Engineering, Tata McGrawHill, 1996
6. Srinivasan,R., Harbour, Dock & Tunnel Engineering, Charotar Publishing House, 28e, 2016

References

1. Partho Chakraborty and Animesh Das, Principles of Transportation Engineering,
2. IRC: 37-2001, Guidelines for the Design of Flexible Pavements, IRC 2001, New Delhi
3. IRC:37-2012, Tentative Guidelines for the Design of Flexible Pavements , PHI, 2017
4. O' Flaherty, C.A (Ed.)., Transport Planning and Traffic Engineering, Elsevier, 1997
5. C S Papacostas and P D Prevedouros, Transportation Engineering and Planning, 2007
6. Yoder, E. J &Witezak, M. W, Principles of Pavement Design, John Wiley & Sons, 1991
7. Sustainable Urban Transport Shanghai Manual – A Guide for Sustainable Urban Development in the 21st Century

Course Content and lecture Schedule:			
No.	**Topic**	**Course Outcome**	**No. of Hrs**
1	**Module 1**		Total: 9
1.1	Introduction to Transportation Engineering, Role of transportation in the development of a society, Various fields of Transportation Engineering	CO1	2
1.2	Classification of roads, Typical cross sections of roads in urban and rural area,	CO1	3
1.3	Introduction to geometric design of highways, highway cross section elements, Horizontal alignment and Vertical alignment (introduction only)	CO1	4
2	**Module 2**		Total:9
2.1	Introduction of flexible and rigid pavements	CO2	2
2.2	Introduction to highway materials, Desirable properties and testing of road aggregates	CO2	4
2.3	Construction of bituminous pavement sand rigid pavements (Basics only)	CO2	3
3	**Module 3**		Total: 8
3.1	Introduction to traffic engineering, Traffic characteristics	CO3	2
3.2	Capacity and Level of Service, Design Speed	CO3	2
3.3	Traffic signals and markings	CO3	2
3.4	Types of road intersections, Traffic control devices (introduction only)	CO3	2
4	**Module 4**		Total: 12
4.1	Railway Engineering - Component parts of a railway track functions, concept of Gauges, coning of wheels	CO4	4
4.2	Harbours – classification, features, requirements. Break waters - necessity and functions, classification. Docks – Functions and types - dry docks, wet docks (Introduction only)	CO4	4
4.3	Introduction to Airport Engineering, Components of airport, Runway orientation, Taxiways and aprons and Terminal Building	CO4	4
5	**Module 5**		Total: 7
5.1	Need for Transportation planning, Transport- land use interaction	CO5	1
5.2	Travel Demand Estimation - Steps in 4 stage planning process	CO5	2
5.3	Sustainable urban transport; issues and challenges	CO5	1
5.4	Policy options for urban transport- Push and pull approach, NMT planning, Transit oriented development	CO5	2
5.5	Emerging concepts in sustainable transportation: green vehicles and green roads, green and alternate fuels;	CO5	1

FOURTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: **22CEMR410.2**

Course Name: **INTRODUCTION TO TRANSPORTATION ENGINEERING**

Model Question Paper

Marks:100 Duration: 3 hrs

PART A

(Answer all Questions: Each question carries 3 marks)

1 What is the role of roads in Indian economy?
2 Explain briefly the classification of highways in India.
3 Differentiate flexible and rigid pavement
4 Differentiate tack coat and prime coat. What are the objectives of application of each?
5 Distinguish between traffic capacity, basic capacity and practical capacity.
6 Discuss about the requirements of traffic control devices.
7 List and define the component parts of a railway track.
8 What are the detrimental forces acting on break water?
9 List the role of transportation planning to society
10 What are the advantages of green fuel?

(3 x 10=30 marks)

PART B

(Answer one full question from each module)

11	a.	What are the factors controlling the alignment of highways? Explain the influence each of them in detail?	7
	b.	Discuss about the various cross section elements to be considered in the geometric design of highways?	7
		OR	
12	a.	Design the rate of super elevation for a horizontal highway curve of radius 500 m and speed 100 kmph	7
	b.	What is overtaking sight distance? Derive the equation for OSD.	7
13	a.	Differentiate flexible and rigid pavements. Sketch a typical section for each.	7
	b.	Discuss the desirable properties of aggregates used for road construction.	7
		OR	
14	a.	Discuss any three properties of bitumen and their effect on the performance ofbituminous mixes in pavements.	7
	b.	What are the factors to be considered in design of flexible pavements and indicate their significance?	7

15	a.	Explain the effect of various vehicular characteristics on traffic stream behaviour.	7
	b.	Draw a typical Speed-flow diagram and indicate the Levels of service as per IRC.	7
		OR	
16	a.	What are the advantages and disadvantages of traffic signals?	7
	b.	Enumerate the basic types of intersections and basic principles involved.	7
17	a.	Explain with neat sketches the concept of coning of wheels.	7
	b.	How are harbours classified? Explain with sketches any two types.	7
		OR	
18	a	Distinguish between wet docks and dry docks? What are its functions?	7
	b.	Enumerate the factors that are to be considered for site selection of an airport?	7
19	a.	Enumerate how land use and transportation planning are inter related.	7
	b.	Briefly explain the various stages in travel demand estimation	7
		OR	
20	a.	What are the ways to overcome the issues and challenges in transportation?	7
	b.	How can green vehicles and green roads contribute to sustainable transportation?	7

22CEMR 410.3	Climate Change and Hazard Mitigation	Category	L	T	P	Credit	Year of Introduction
		VAC	4	0	0	4	2019

Preamble: The course is designed to build climate literacy among students, encourages them to adapt to climate change related issues. It helps learners to understand the fundamentals of climate, climate change and climate models, evaluate the impacts of climate change on ecosystems, and empower learners to take appropriate actions to adopt various hazard mitigation measures.

Pre-requisite: Nil

Course outcome

After the course, the student will able to:

CO1	Explain the basic physical principles of the global climate system.
CO2	Describe the large-scale climatic changes which has influenced the ecosystem.
CO3	List actions in key sectors to mitigate hazards due to climate change.
CO4	Identify international initiatives which support countries to address the climate change challenges.
CO5	Analyse the impact of climate change on ecosystem.

CET 256	Climate Change and Hazard Mitigation		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
		CO1	3					2	1							1	
		CO2	3					2	1								
		CO3	3					2	1								
		CO4	3					2									
		CO5	3					2	1								

Assessment pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	20	20	40
Apply			
Analyze	15	15	30
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment Test (2 numbers)	:	25 marks
Assignment/Quiz/Course project	:	15 marks
Total	**:**	**50 marks**

End semester examination pattern – There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment

Qn No	Question	Marks	Course outcome (CO) Assessed
	Part A		
1	Define climate system.	3	CO1
2	How does Albedo affect climate of a place?	3	CO1
3	Briefly explain El Nino and its effects.	3	CO2

4	What is carbon cycling?	3	CO2
5	Describe about General Circulation Models.	3	CO5
6	Comment on Ocean Acidification.	3	CO5
7	Discuss the mission of Intergovernmental Panel on Climate Change.	3	CO4
8	What is Montreal Protocol?	3	CO4
9	Briefly explain Carbon dioxide Capture and Storage.	3	CO3
10	Discuss the importance of bio energy crops.	3	CO3
	Part B **(Answer ANY ONE FULL question from each module)**		
	Module I		
11(a)	What is the general circulation of the atmosphere?	7	CO1
11(b)	How does the general circulation affect the earth's climate?	7	CO1
12(a)	What is the composition and structure of the atmosphere?	7	CO1
12(b)	Explain the significance of water in the atmosphere on climate of earth.	7	CO1
	Module II		
13(a)	State and explain Global Warming Potential.	7	CO2
13(b)	Briefly explain Gandhian ideas on Global warming.	7	CO2
14(a)	Describe the importance of Greenhouse effect on global climate system.	7	CO2

14(b)	Discuss the role of carbon dioxide in Greenhouse effect	7	CO2
	Module III		
15	Briefly explain the impact of climate change on surface temperature and precipitation.	14	CO5
16	Describe the different uncertainties inherent in the projection of climate. .	14	CO5
	Module IV		
17	Enumerate the international initiatives to address climate change challenges and explain any two.	14	CO4
18(a)	Outline the structure of the Intergovernmental Panel on Climate Change.	4	CO4
18(b)	Explain the comprehensive Assessment Reports of IPCC.	10	CO4
	Module V		
19 (a)	Explain hazards due to climate change and describe the possible mitigation measures to it.	14	CO3
20 (a)	Discuss the concept of energy efficiency in buildings in response to climate change.	5	CO3
20 (b)	Discuss the impact of climate change on Ecosystem and its adaptation measures.	9	CO3

Model Question Paper

Reg No.:………………….. **QP CODE:………………..**

Name:………………………

THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEMR410.3

Climate Change and Hazard Mitigation

Max. Marks: 100 **Duration: 3 hours**

Part A

(Answer all questions; each question carries 3 marks)

1. Define climate system.
2. How does Albedo affect climate?
3. Briefly explain El Nino and its effects.
4. What is carbon cycling?
5. Describe about General Circulation Models.
6. Comment on Ocean Acidification.
7. Discuss the mission of Intergovernmental Panel on Climate Change.
8. What is Montreal Protocol?
9. Briefly explain Carbon dioxide Capture and Storage.
10. Discuss the importance of bio energy crops.

Part B

(Answer one full question from each module; each question carries 14 marks)

Module I

11. a) What is the general circulation of the atmosphere? (7 Marks)

    b) How does the general circulation affect the earths climate? (7 Marks)

OR

12. a) What is the composition and structure of the atmosphere? (7 Marks)

b) Explain the significance of water in the atmosphere on climate of earth. (7 Marks)

Module II

13. (a) State and explain Global Warming Potential. (7 Marks)

(b) Briefly explain Gandhian ideas on Global warming. (7 Marks)

OR

14. (a) Describe the importance of Greenhouse effect on global climate system. (7 Marks)

(b) Discuss the role of carbon dioxide in Greenhouse effect. (7 Marks)

Module III

15. Explain the impact of climate change on surface temperature and precipitation. (14 Marks)

OR

16. Describe the different uncertainties inherent in the projection of climate. (14 Marks)

Module IV

17. Enumerate the international initiatives to address climate change challenges and explain any two. (14 Marks)

OR

18. a) Outline the structure of the Intergovernmental Panel on Climate Change. (4 Marks)

b) Explain the comprehensive Assessment Reports of IPCC. (10 Marks)

Module V

19. Explain hazards due to climate change and describe the possible mitigation measures to it. (14 Marks)

OR

20. (a) Discuss the concept of energy efficiency in buildings in response to climate change. (5 Marks)

(b) Discuss the impact of climate change on Ecosystem and its adaptation measures. (9 Marks)

Course Code: 22CEMR410.3
Climate Change and Hazard Mitigation

Module I

Introduction to Earth's Climate System: Basic concepts- Radiation, Albedo, Emissivity, scales of motion, large-scale motion, general circulation, troposphere-stratosphere transport. Atmospheric structure and thermodynamics: pressure, density, composition, temperature structure, water in the atmosphere. Atmospheric photochemistry and chemical kinetics

Module II

Hurricanes and Global warming: Global Ocean Circulation - El Nino and its effects - Paleo- indicators of climate -The Nature of Storms—cyclones, tornadoes and hurricanes. Greenhouse effect-greenhouse gases-sources of emission - The Role of Carbon Dioxide, The Earth's Carbon Reservoirs, Carbon Cycling-Climate and Weather Global warming potential - Effects of Global warming- Gandhian ideas on global warming.

Module III

Climate data and Models: Equations of atmospheric fluid mechanics, energy equation, turbulence, mixing length models, Atmospheric chemical transport and general circulation models. Analyses of climate data. Climate projections and their uncertainties. Impacts of climate change on Surface temperature, Precipitation, Ocean pH, Sea-level and Arctic sea-ice extent.

Module IV

International initiatives to address the climate change challenges: History of Earth's climate – 1970s (IIASA, DOE), 1980s, Startup of the U.N IPCC, Mission of the IPCC, The Framework Convention on Climate Change, The Kyoto Protocol to the Framework Convention, Earth Summit, Montreal Protocol. Policy Analyses, Internationally Adopted Emissions Restrictions.

Module V

Climate Change Adaptation & Mitigation Measures: Adaptation to climate change in the fields of Ecosystems and biodiversity - Agriculture and food security, land use, forestry, human health, water supply, sanitation and infrastructure. Hazards due to climate change and Mitigation Measures: Extreme weather events. Mitigation measures in sectors vital to humanity (food, water, health): Brief explanation of - Carbon dioxide capture and storage (CCS), Bio-energy crops, Energy efficiency in buildings.

Text Books

- Mark Masli, Climate Change: A Very Short Introduction, Oxford University Press, 2014.
- Jan C van Dam, Impacts of Climate Change and Climate Variability on Hydrological Regimes, Cambridge University Press, UK, 2003.
- Trenberth, K.E. (Editor), 1992: *Climate System Modeling*, Cambridge University Press, Cambridge, U.K.

References

- IPCC second assessment report - Working Group I Report, The Science of climate change, 1995.
- IPCC fourth assessment report - The AR4 synthesis report, 2007
- IPCC fourth assessment report - Working Group I Report, The physical Science Basis, 2007.
- IPCC fourth assessment report - Working Group II Report, Impacts, Adaptation and Vulnerability, 2007.
- IPCC fourth assessment report - Working Group III Report Mitigation of Climate change, 2007
- IPCC fifth assessment report - The AR5 synthesis report, 2014

Course Code: 22CEMR410.3

Climate Change and Hazard Mitigation

Course content and Schedule of Lecture (sample)

Module	Topic	Course outcome addressed	No of Hours
Module I (9 Hours)			
1.1	Introduction to Earth's Climate System: Basic concepts	CO1	1
1.2	Radiation, Albedo, Emissivity,	CO1	1
1.3	Scales of motion, large-scale motion	CO1	1
1.4	General circulation, troposphere-stratosphere transport	CO1	1
1.5	Atmospheric structure and thermodynamics	CO1	1
1.6	Pressure, density, composition	CO1	1

1.7	Temperature structure, water in the atmosphere	CO1	1
1.8	Atmospheric photochemistry	CO1	1
1.9	Chemical kinetics	CO1	1
Module II (9 Hours)			
2.1	Hurricanes and Global warming: Global Ocean Circulation	CO2	1
2.2	El Nino and its effects - Paleo- indicators of climate	CO2	1
2.3	The Nature of Storms—cyclones, tornadoes and hurricanes	CO2	1
2.4	Greenhouse effect-greenhouse gases-sources of emission	CO2	1
2.5	The Role of Carbon Dioxide, The Earth’s Carbon Reservoirs	CO2	1
2.6	Carbon Cycling-Climate and Weather Global warming potential	CO2	1
2.7	Effects of Global warming	CO2	1
2.8	Effects of Global warming	CO2	1
2.9	Gandhian ideas on global warming.	CO2	1

Module III (9 Hours)			
3.1	Climate data and Models; Equations of atmospheric fluid mechanics, energy equation, turbulence	CO5	1
3.2	Mixing length models	CO5	1
3.3	Atmospheric chemical transport	CO5	1
3.4	General circulation models	CO5	1
3.5	Analyses of climate data	CO5	1
3.6	Climate projections and their uncertainties	CO5	1
3.7	Impacts of climate change on Surface temperature, Precipitation	CO5	1
3.8	Impacts of climate change on Ocean pH, Sea-level and Arctic sea-ice extent	CO5	1

3.9	Impacts of climate change on Ocean pH, Sea-level and Arctic sea-ice extent	CO5	1
Module IV (9 Hours)			
4.1	International initiatives to address the climate change challenges	CO4	1
4.2	History of Earth's climate – 1970s (IIASA, DOE), 1980s	CO4	1
4.3	Startup of the U.N IPCC, Mission of the IPCC	CO4	1
4.4	The Framework Convention on Climate Change	CO4	1
4.5	The Kyoto Protocol to the Framework Convention	CO4	1
4.6	Earth Summit	CO4	1
4.7	Montreal Protocol	CO4	1
4.8	Policy Analyses	CO4	1
4.9	Internationally Adopted Emissions Restrictions	CO4	1

Module V (9 Hours)			
5.1	Climate Change Adaptation & Mitigation Measures	CO3	1
5.2	Adaptation to climate change in the fields of Ecosystems and biodiversity	CO3	1
5.3	Agriculture and food security, land use, forestry, human health	CO3	1
5.4	Water supply, sanitation and infrastructure	CO3	1
5.5	Hazards due to climate change and Mitigation Measures: Extreme weather events	CO3	1
5.6	Mitigation measures in sectors vital to humanity (food, water, health)	CO3	1
5.7	Carbon dioxide capture and storage (CCS)	CO3	1
5.8	Bio-energy crops, Energy efficiency in buildings.	CO3	1
5.9	Energy efficiency in buildings.	CO3	1

22CEHR 411.1	COURSE NAME ADVANCED MECHANICS OF SOLIDS	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: Objective of this course is to expose the students to the advanced concepts of mechanics of materials and enhance their problem-solving skills. The course aims to understand the stresses and strains in 2D and 3D solid bodies. It introduces students to the elements of theories of elasticity, failure and failure criteria. Students will be able to understand concepts, principles and governing equations in dealing with elastic solids. After this course students will be in a position to find mechanical behaviour of elastic materials by determining the stress, strains produced by the application of load.

Prerequisite: Mechanics of Solids

Course Outcomes:

Course Outcome	Description of Course Outcome	Prescribed learning level
CO 1	To explain the material properties of solids and the state of stress and strain developed in solids due to applied loads.	Remembering, Understanding& Applying
CO 2	To illustrate the different failure theories and apply the apt failure criteria to find out the Factor of Safety against structural failure.	Applying& Analysing
CO 3	To predict the structuralresponse of standard cross sections of isotropic materials due to applied torsion.	Applying& Analysing

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-
CO 3	3	3	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	15
Understand	10	10	15
Apply	15	15	35
Analyse	15	15	35
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25
marks Assignment/Quiz/Course project : 15
marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Course Level Assessment

Questions Part A

Course Outcome 1 (CO1): (Two questions each from module 1 to module 3 to meet the course objective 1:*To understand the material properties of solids and the state of stress and strain developed in solids due to applied loads.*)

1. Explain stress invariants
2. Explain Stress space
3. Explain the transformation of strain
4. Explain transformation of stress
5. List the differential equations of equilibrium for three dimensional stress state.
6. State the assumptions in classical linear elasticity
7. Differentiate between principal stress and principal strain
8. List the six compatibility equations for a three dimensional system.
9. Distinguish between rectangular strain rosette and equiangular strain rosette.
10. Differentiate between stress tensor and strain tensor
12.Explain octahedral stresses & strain

Course Outcome 2 (CO2) (Two questions from module4 to meet the course objective 2: *To understand the different failure theories and apply the apt failure criteria to find the Factorof Safety.***)**

1. Discuss the failure criteria for ductile materials
2. Discuss the failure criteria for brittle materials
3. Explain Palm miner rule
4.Discuss the failure due to stress reversal
5.Explain SN Curve
6. Explain stress concentration factor

Course Outcome 3 (CO3) (Two questions from module 5 to meet the course objective 3: *To predict the structural response of standard cross sections of isotropic materials due to applied torsion.***)**

1. Discuss the use of St Venants semi inverse method
2. Explain Prandtl's membrane analogy

Part B

All the questions under this section shall assess the learning levels corresponding to the course outcomes listed below.

CO 1	To understand the material properties of solids and the state of stress and strain developed in solids due to applied loads.
CO 2	To learn the different failure theories and apply the apt failure criteria to find the Factor of Safety against structural failure.
CO 3	To predict the structural response of standard cross sections of isotropic materials due to applied torsion.

1. The state of strain at a point in an isotropic material is given by strain tensor.

$$\begin{bmatrix} 0.002 & 0 & -0.002 \\ 0 & -0.004 & 0.0006 \\ -0.002 & 0.0006 & 0 \end{bmatrix}$$

Determine stress tensor at this point. Take E = 200 GPa. Poisson's ratio = 0.3.

Course outcome identifier	**Description of course outcome**	**Learning level assessed**	**Marks allocated**
CO 1	To explain the material properties of solids and the state of stress and strain developed in solids due to applied loads.	Remembering – (Relation between Lame's Constants and E & poisons ratio) (D matrix for Isotropic Material)	4
		Understanding- (Constitutive Stress – strain Relationship)	2
		Analysing-(Computation of stress from strain with application of Constitutive stress strain relationship)	6
		Applying- (Formation of Stress tensor from stress components)	2
Total			14

2. A low carbon steel shaft is designed to have a diameter of 25 mm. It is to be subjected to an axial load P= 20 kN , a moment M = 130 N m, and a torque T = 220 Nm. If the yield point for the steel is 260 MPa, determine the factor of safety used in the design of the shaft based on the a) Tresca criterion of failure b)Von mises criterion of failure assuming that failure occurs at initiation of yielding.

Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 1	To explain the material properties of solids and the state of stress and strain developed in solids due to applied loads.	Analysing – (Computation of state of stress from loading situation)	6
CO 2	To illustrate the different failure theories and apply the apt failure criteria to find the Factor of Safety against structural failure.	Remembering – (Formulae for the Tresca & Von mises Criteria)	4
		Applying – Computation of Factor of Safety	4
Total			14

3. A square shaft has 42.0 mm sides and has the same cross sectional area as shafts having circular and equilateral triangular cross sections. If each shaft is subjected to a torque of 1kNm, Determine the maximum shearing stress for each of the three shafts.

Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To predict the structural response of standard cross sections of isotropic materials due to applied torsion.	Understanding – (Knowledge regarding Saint Venant's Semi Inverse Method)	4
		Applying-(Use of Stress Function)	2
		Remembering- (Relation between maximum shear stress with applied Torsion and the geometric parameters	4
		Applying- (Use of appropriate Equation)	4
Total			14

Model Question Paper
22CEHR411.1 - Advanced Mechanics of Solids

Qn No	Questions	Marks	Course Outcome (CO) Assessed
Part A (Answer all questions; each question carry 3 marks)			
1	Explain transformation of stress	3	1
2	Differentiate between spherical and Deviatorial stress tensor	3	1
3	Explain strain invariants	3	1
4	Distinguish between rectangular strain rosette and equiangular strain rosette	3	1
5	List the six compatibility equations for a three dimensional system	3	1
6	List out the differential equations of equilibrium for three dimensional stress state.	3	1
7	Discuss the failure criteria for ductile materials	3	2
8	Explain stress concentration factor	3	2
9	Discuss the use of St Venants semi inverse method	3	3
10	Explain Prandtl's membrane analogy	3	3
Part B (Answer one full question from each module, each question carry 14 marks)			
Module I			
11(a)	Derive the expression for the stress on arbitrarily plane whose unit normal vector is defined by $li+mj+nk$ for a rectangular coordinate system with x,y and z as reference axes.	6	1
11 (b)	Find the expression for the Normal stress and Shearing stress on a new coordinate system with X,Y and Z as the reference axes.X axis is defined by $l_1i +m_1j+n_1k$, Y axis is defined by $l_2i +m_2j+n_2k$ andZ axis is defined by $l_3i +m_3j+n_3k$	8	1
OR			
12 (a)	A rectangular bar of metal of cross section 20 mm x 35 mm is subjected to an axial tensile force of 180 kN. Calculate the normal, shear and resultant stresses on a plane whose normal has the following direction cosines $l=m=n=1/\sqrt{3}$	7	1
12(b)	The state of stress at a point is given by the following array of terms	7	1

	$\begin{bmatrix} 3 & 6 & 3 \\ 6 & 6 & 2 \\ 3 & 2 & 9 \end{bmatrix}$ MPaDetermine the principal stresses and the principal directions. Find out the stress invariants in principal plane and show that it remains unchanged.		
	Module II		
13 (a)	By means of strain rosette, the following strains were recorded during the test on a structural member. ε_0 = 950 micrometres/m,ε_{45} = -110micrometres/m, ε_{90} = 110micrometres/m. Determine the magnitude and directions of principal strains.	7	1
13(b)	If the displacement field in a body is specified as u = $(x^2+4)\ 10^{-3}$,v= $5y^2z$ $*10^{-3}$ and w = (x + 2z) 10^{-3}.Determine the strain tensor at a point whose coordinates are (3,2,3)	7	1
	OR		
14	The strain components at a point with respect to xyz co-ordinate system are $\varepsilon_x = 0.15$, $\varepsilon_y = 0.16$, $\varepsilon_z = 0.35$, $\gamma_{xy} = \gamma_{yz} = \gamma_{xz} = 0.170$. If the coordinateaxes are rotated about the z-axis through 45° in the anticlockwise direction, determine the new strain components.	14	1
	Module III		
15	The state of strain at a point is given by strain tensor. $\begin{bmatrix} 0.002 & 0 & -0.002 \\ 0 & -0.004 & 0.0006 \\ -0.002 & 0.0006 & 0 \end{bmatrix}$ Determine stress tensor at this point. Take E = 200 GPa. Poisson's ratio = 0.3.	14	1
	OR		
16(a)	Under what conditions are the following expressions for the components of strain at a point compatible? $\varepsilon_x = 2axy^2 + by^2 + 2cxy$, $\varepsilon_y = ax^2 + bx$, $\gamma_{xy} = \alpha x^2 + \beta xy + ax^2 + \eta y$	7	1
16(b)	The stress components at a point in a body are given by $\sigma_x = 5xy^2z + 2x$, $\sigma_y = 3xyz + 3y$, $\sigma_z = x^2y + y^2z$, $\tau_{xy}=0$, $\tau_{yz}= \tau_{xz}= 2xy^2z+2xy$ Determine whether these components of stress satisfy the equilibrium equations or not at the point (1,-1,2). If not then determine the suitable body force required at this point so that these stress components are under equilibrium.	7	1

	Module IV		
17	Represent all the yield criteria for failure graphically in the 2D stress space with rectangular axes $\boldsymbol{\sigma_1}$ and $\boldsymbol{\sigma_2}$ for the material steel. Assume the yield point of steel as 350 MPa and poisson ratio as 0.25. Mention the equation also in the graph.	14	2
	OR		
18	A closed end thin-walled cylindrical of a metal with yield point = 700 MPa has an inside diameter of 20mm. The cylinder is subjected to an internal pressure of 22 MPa and an axial load of 50 kN. Determine the torque that can be applied to the cylinder if the factor of safety for design is 1.80. Check whether the material is safe under Von mises criteria.	14	2
	Module V		
19	A hollow thin-wall brass tube has an equilateral triangular cross section. The mean length of each side of the triangle is 40.0mm. The wall thickness is 4.00mm. Determine the torque and unit angle of twist for an average shearing stress of 20.0 MPa. (G = 31.1 GPa)	14	3
	OR		
20	A torsion member has an elliptical cross section with major and minor dimensions of 100 mm and 70 mm, respectively. The yield stress of the material is 350 MPa. Determine the maximum torque that can be applied to the torsion member based on a factor of safety 1.8 using maximum shearing stress criterion of failure.	14	3

SYLLABUS

Module 1 Stress in 3-D

Definition of stress at a point, Stress Notation, Stress Tensor, Normal stress and Shearing Stress on an oblique plane, Transformation of stress, Principal Stress, Stress Invariants, Octahedral Stress, Mean and Deviator Stress, Plane stress, Mohr's Circle in Two Dimensions, Differential Equations of motion of a deformable body.

Module 2 Strain in 3-D

Types of Strain, Deformation of a deformable body, Strain Tensor, Strain Transformation, Spherical and Deviatorial Strain Tensor, Principal Strains, Strain Invariants, Octahedral Strains, Mohr Circle for strain, Equations of Compatibility for Strain, Strain Rosettes

Module 3 Elements of Theory of Elasticity

Strain Energy Density, Complementary Internal Energy Density, Elasticity and Strain Energy Density,Elasticity and Complementary Internal Energy Density, Generalized Hooke's Law, Anisotropic Elasticity, Isotropic Elasticity,Displacements-strains and compatibility-equilibrium equations and boundary conditions

Module 4 Failure and Failure criteria

Modes of failure, yield failure criteria, Maximum Principal Stress Criteria, Maximum Shear stress criteria, Maximum Strain Criteria, Maximum Strain Energy Density Criteria, Von Mises Criteria, fatigue, Stress Concentration Factor, Palm Miner Rule, SN Curve

Module 5 Torsion

Torsion of a cylindrical bar of circular cross section- St.Venant's semi inverse method-stress function approach-elliptical, equilateral triangle & narrow rectangular cross sections - Prandtl's membrane analogy-Hollow thin wall torsion members

Text Books

1. A.P. Boresi and O.M.Sidebottom, Advanced Mechanics of Materials, 4th edition, John Wiley & Sons,1985

2.R.D. Cook and W.C. Young, Advanced Mechanics of Materials, 2nd edition, Prentice Hall Intl,Inc.1999

3. Srinath L.S, Advanced Mechanics of Solids, Tata McGraw Hill, 3e, 2009

Reference Books

1. S P Timoschenko, Strength of Materials Vol II ,CBS Publishers, 2002

2. Shames, E.H., Mechanics of Deformable solids, Prentice Hall Inc., 1964

3. Timoshenko S.P and Goodier J.N, Theory of elasticity, McGraw Hill, 3e, 1970

LECTURE PLAN – ADVANCED MECHANICS OF SOLIDS

Module	*Topic*	*Course outcomes addressed*	*No. of Lectures*
1	**Module I : Total lecture hours : 9**		
1.1	Definition of stress at a point, Stress Notation, Stress Tensor, Mean and Deviator Stress	CO1	Lecture 1
1.2	Definition of Plane, Normal Stress on an oblique plane	CO1	Lecture 2
1.3	Shearing Stress on an oblique plane	CO1	Lecture 3
1.4	Transformation of stress, Principal Stress,	CO1	Lecture 4
1.5	Stress Invariants &Octahedral Stress.	CO1	Lecture 5
1.6	Plane stress &Mohr's Circle in Two Dimensions	CO1	Lecture 6
1.7	Differential Equations of motion of a deformable body	CO1	Lecture 7
2	**Module II : Total lecture hours : 9**		
2.1	Types of Strain &Deformation of a deformable body	CO2	Lecture 1
2.2	Strain Tensor & Strain Transformation,	CO2	Lecture 2
2.3	Spherical and Deviatorial Strain Tensor	CO2	Lecture 3
2.4	Principal Strains & Strain Invariants	CO2	Lecture 4
2.5	Octahedral Strains & Mohr Circle for strain	CO2	Lecture 5
2.6	Equations of Compatibility for Strain	CO2	Lecture 6
2.7	Strain Rosettes	CO2	Lecture 7
3	**Module III : Total lecture hours : 9**		
3.1	Strain Energy Density & Complementary Internal Energy Density	CO3	Lecture 1
3.2	Elasticity and Strain Energy Density	CO3	Lecture 2
3.3	Elasticity and Complementary Internal Energy Density	CO3	Lecture 3
3.4	Generalized Hooke's Law	CO3	Lecture 4
3.5	Anisotropic Elasticity & Isotropic Elasticity	CO3	Lecture 5
3.6	Displacements-strains and compatibility	CO3	Lecture 6
3.7	Equilibrium equations and boundary conditions	CO3	Lecture 7

4	**Module IV : Total lecture hours : 9**		
4.1	Modes of failure, yield failure criteria,	CO4	Lecture 1
4.2	Maximum Principal Stress Criteria &Maximum Shear stress criteria	CO4	Lecture 2
4.3	Maximum Strain Criteria	CO4	Lecture 3
4.4	Maximum Strain Energy Density Criteria	CO4	Lecture 4
4.5	Von Mises Criteria	CO4	Lecture 5
4.6	fatigue, Stress Concentration Factor	CO4	Lecture 6
4.7	Palm Miner Rule & SN Curve	CO4	Lecture 7
5	**Module V : Total lecture hours : 9**		
5.1	Torsion of a cylindrical bar of circular cross section	CO3	Lecture 1
5.2	St.Venant's semi inverse method	CO3	Lecture 2
5.3	Stress function approach- elliptical	CO3	Lecture 3
5.4	Torsion- Equilateral triangle cross sections	CO3	Lecture 4
5.5	Torsion- narrow rectangular cross sections	CO3	Lecture 5
5.6	Prandtl's membrane analogy	CO3	Lecture 6
5.7	Hollow thin wall torsion members	CO3	Lecture 7

22CEHR 411.2	PAVEMENT CONSTRUCTION AND MANAGEMENT	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		VAC	4	0	0	4	2019

Preamble

Objective of the course is to introduce the principles and practice of Highway construction and infrastructure asset management

Prerequisite: NIL

Course Outcomes:

	Description
CO No.	At the end of the course, students will be able to:
CO 1	To understand the characterization of materials used for pavement construction
CO 2	To carry out mix design of various bituminous mixes
CO 3	To study construction practices of flexible pavement and equipment used
CO 4	To understand the construction practices and reinforcement design of rigid pavement
CO 5	To study the fundamentals of pavement evaluation and pavement management system

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	1		1	3	1		2		1	2	3
CO 2	3	1	3	1		1	1	1		1		1	2	2
CO 3	3	2	2	1					1	2		2	2	3
CO 4	2						2	1				2	2	3
CO 5	3	3	3			3		2					2	3

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (marks)
	Test 1 Marks	Test 2 Marks	
Remember	**10**	**10**	**30**
Understand	**10**	**10**	**30**
Apply	**5**	**5**	**20**
Analyse	**5**	**5**	**20**
Evaluate			
Create			

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern:
The question consists of two parts- Part A and Part B. Part A consists of 10 questions with 3 marks for each (two questions from each module). Part B consists of two questions from each module, out of which one has to be answered. Each question carries 14 marks and can have maximum 2 subdivisions.

Sample Course Level Assessment Questions:

Course Outcome 1 (CO1): Explain the desirable properties of aggregates to be used in different types of pavement construction?

Course Outcome 2 (CO2): A bitumen mixture contains 60% coarse aggregate; 35% fine aggregate; 5% asphalt (by weight). Determine unit weight of mixtureafter compaction with 7% air voids? G_{CA}=2.72, G_{FA}=2.66, G_A=1.0

Course Outcome 3 (CO3): Explain the method of preparation of mix and construction steps for laying bituminous macadam base course?

Course Outcome 4 (CO4): With neat sketch explain the joints in cement concrete pavements?
Course Outcome 5 (CO5): Compare project level and network level pavement management systems.

SYLLABUS

Module 1

Pavement: functions and characteristics- Types of pavement: flexible pavement, rigid pavement, comparison- Different layers of flexible and rigid pavement

Pavement materials: characterization of sub grade soil, soil classification system, properties of road aggregate, principles and methods of gradation of soil aggregate mixes, characteristics and uses of bitumen, emulsion cutback and modified bitumen.

Module 2

Bituminous pavement types: penetration layer system and premixed aggregate- specification of materials,

Mix design:physical and volumetric properties of bituminous mix, Marshall method of mix design, Super pave mix design

Module 3

Construction of flexible pavement: functions of various layers, preparation and construction of sub grade, granular sub base (GSB), WBM, WMM, Bituminous macadam, Different types of wearing courses. specifications/ guild lines, equipment used for the construction of different layers in flexible pavement, quality control for flexible pavement construction

Module 4

Construction of cement concrete pavement: material characterization, preparation of subgrade and base, Types of joints in Rigid pavements its functions and design, presetting reinforcement in joints and PCC slab construction

Module 5

Introduction to pavement management system(PMS): concept, definition, objectives, components, general structure- data collection pavement evaluation, functional and structural evaluation, pavement deterioration models, pavement management levels: network, programme and project level- types of pavement management system, Types of Maintenance and rehabilitation activities, life cycle cost analysis of strategies, popular software

TEXT BOOKS

1. Khanna, S.K, Justo E.G, .A Veeraragavan, Highway Engineering 10th edition, Khanna Publishers.2018

2. Kadiyali, L. R., Principles of Highway Engineering, Khanna Publishers, 2001

3. Rajib B. Mallick and TaharEl-Korchi, Pavement Engineering CRC press, 2009

4. Rao G. V, Principles of Transportation and Highway Engineering, Tata McGrawHill, 1996
5. Prithvi Singh Khandhal, Bituminous Road Construction in India, PHI Learning, 2019

REFERENCES

1. Manual for construction and supervision of Bituminous works, MoRTH 2001

2. Shahin M.Y, Pavement Management for Airports, Roads and Parking lots, Chapman & Hall, 2005
3. IRC: 37-2018, Guidelines for the Design of Flexible Pavements, IRC 2018, New Delhi

4. MoRTH, IRC code for pavement evaluation, data collection

Course Content and lecture Schedule:

Sl No.	Topic	Course Outcome	No of Hours
1	**Module 1**		Total:10
1.1	Functions and characteristics of pavements, Types of pavement and comparison (flexible pavement, rigid pavement)	CO1	1
1.2	Different layers and properties of flexible and rigid pavement	CO1	1
1.3	characterization of sub grade soil and soil classification system	CO1	2
1.4	Properties of road aggregate, principles and methods of gradation of soil aggregate mixes	CO1	3
1.5	Characteristics and uses of bitumen, emulsion cutback and modified bitumen	CO1	3
2	**Module 2**		Total:8
2.1	Penetration layer system and premixed aggregate system	CO2	2
2.2	Physical and volumetric properties of bituminous mix, Marshall method of mix design, Superpave Mix design	CO2	6
3	**Module 3**		Total:8
3.1	Functions of various layers of flexible pavement, preparation and construction of sub grade, granular sub base (GSB),WBM, WMM , Bituminous macadam, Different types of wearing courses specifications/ guidelines	CO3	4
3.2	Equipment used for the construction of different layers in flexible pavement, quality control for flexible pavement construction	CO3	4
	Module 4		Total:6
4.1	Construction of cement concrete pavement :material characterization, preparation of subgrade and base	CO4	3
4.2	Types of joints in Rigid pavements its functions and design, presetting reinforcement in joints and PCC slab construction	CO4	3
	Module 5		Total:13
5.1	Introduction to pavement management system(PMS): concept, definition, objectives, components, general structure-data collection	CO5	3
5.2	Pavement evaluation, functional and structural evaluation, pavement deterioration models,	CO5	3
5.3	Pavement management levels: network, program and project level	CO5	2
5.4	Types of pavement management system, Types of Maintenance and rehabilitation activities	CO5	2
5.5	life cycle cost analysis of strategies, popular software	CO5	3

THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: **22CEHR411.2**

Course Name: **PAVEMENT CONSTRUCTION AND MANAGEMENT**

Model Question Paper

Marks:100 Duration: 3 hrs

PART A

(Answer all Questions: Each question carries 3 marks)

1. What are the functions of pavement?
2. Define emulsified and cutback bitumen
3. What are the types of bitumen mixes for pavement?
4. Define VMA and VFB
5. Draw a typical cross section of a highway in cutting and show the various flexible pavement layers
6. What are the common types of equipment for compaction of soil for embankment and subgrade?
7. Draw a neat diagram showing various component layers of a CC pavement structure.
8. What are objects of providing dowel bars in CCpavement?
9. Differentiate between functional and structural evaluation of pavement.
10. What are the objectives of Pavement Management System?

(3 x 10 = 30)

PART B

(Answer one full question from each module)

11. a) Differentiate between flexible and rigid pavement
(7)

b) Explain CBR and the test procedure in the laboratory. How are the results of the test obtained and interpreted?
(7)

OR

12. a) What are the desirable properties of road aggregates? Explain aggregate impact test and shape test.
(10)

b) Explain grading of bitumen
(4)

13. a) Differentiate between dense graded and gap graded mixtures, giving one example for each
(6)

b) In a Marshall test, bituminous concrete cylinder is made whose weight is 1250 gms with the volume of 820 cc. The weights and specific gravities of various ingredients are given in the table. Determine VMA and VFB.
(8)

Type	**A1**	**A2**	**A3**	**Flyash**	**Bitumen**
Wt (g)	868	322	430	350	180
G	2.78	2.63	2.32	2.36	1.05

OR

14. a) Explain the Marshall method of bituminous mix design
(10)

b) In a bituminous concrete mix the theoretical specific gravity is 2.434, bulk specific gravity is 2.323, specific gravity of bitumen used is 1.05 with 4.35% weight of bitumen in the mix. Determine VMA, VFB.
(4)

15. a) Explain the construction procedure for base and sub-base courses in flexible pavement construction
(7)

b) List various excavating machinery used during highway construction. Mention the uses and limitations of each
(7)

OR

16. a) Write notes on the following types of bituminous pavement layers (i) stone matrix asphalt (ii) slurry seal (iii) micro-surfacing
(7)

b) What are the quality control tests during the construction of bituminous concrete layer? Mention the objectives of each
(7)

17. a) Write a note on importance and construction of (i) drainage layer for CC pavement (ii) dry lean concrete sub-base course (iii) separation membrane (10)

b) A rigid pavement is constructed at 28^{o}C, peak summer temperature is 45^{o}C, peak winter temperature is 10^{o}C, the gap at expansion joint is 25mm, α_c=10x10-6 /^{o}C. Calculate the spacing of expansion joint?
(4)

OR

18. a) What are the different materials required for the construction of a CC pavement? Mention how a concrete mix is designed for obtaining PQC.
(7)

b) Classify different types of joints in CC pavements and mention the objects of each. (7)

19. a) Differentiate between destructive and non-destructive structural evaluation of pavement. (7)

b) Compare project level and network level pavement management system (7)

OR

20. a) Discuss the structure (component) of a Pavement Management System (8)

b) Explain Life Cycle Cost Analysis
(6)

22CEHR 411.3	GEOGRAPHICAL INFORMATION SYSTEMS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		VAC	4	0	0	4	2019

Preamble: Goal of this course is to expose the students to the fundamental concepts and components of Geographical Information System (GIS). After successful completion this course, students will be able to identify the requirements for the development of GIS module for various applications.

Prerequisite: Nil

Course Outcomes: After completion of the course the student will be able:

Course outcome identifier	Description of course outcome	Prescribed learning level
CO 1	To define terms, basic concepts and operations in GIS	Remembering
CO2	To identify various data types and their characteristics.	Understanding
CO 3	To illustrate various approaches of spatial data analysis and their significance in decision making.	Applying
CO 4	To demonstrate the application of GIS and allied technologies across diverse fields.	Applying

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	-	-	-	-	-	-	-	-	-	-	-
CO 2	1	2	-	-	-	-	-	-	-	-	-	-
CO 3	2	3	2	-	2	-	-	-	-	-	-	-
CO 4	2	3	2	-	2	-	-	-	-	-	-	-
CO5												

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	7.5	7.5	30
Understand	7.5	7.5	30
Apply	10	10	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern:

There will be two parts: Part A and Part B.

Part A contains 10 questions with 2 questions from each module and each question shall carry 3 marks. Students should answer all questions.

Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions

SYLLABUS

Module 1

Basic concepts of GIS , History of GIS, Components of GIS-Geospatial Data, Attribute data, GIS operations, Application of GIS, Popular GIS Softwares.

Geographic Co-ordinate system, Map Projections, Commonly used Map Projections, Projected co-ordinate system, Georeferencing, Geometric Transformations.

Tutorial- Introducing any GIS software and its tools.

Module 2

Data structure -Vector Data model, Raster Data model, Types of Raster data, Data inputs to GIS platform, Metadata, Vector to Raster conversion, Digitization.

Geodatabase management, Attribute data management. Cartography and map making

elements. *Tutorial exercises: Georeferencing, raster to vector conversion, assigning*

attribute data **Module 3**

GIS Data Processing –Vector data Analysis- Buffering, Overlay-Point-in-Polygon, Line-in-polygon, Polygon- in-polygon, Distance measurement, Pattern analysis, Map manipulation, Network Analysis

Raster Data Analysis- Local operations, Neighbourhood operation, Zonal Operation, other Raster data operations.

Tutorial exercises: Digitization using available data source and creating a Map Using different map elements.

Module 4

Advanced Applications: Introduction to terrain mapping, DEM and TIN, terrain mapping techniques, Slope and aspect, WebGIS.

Data quality analysis – Sources of Error – Components of Data Quality
Tutorial exercises: working with a surface / terrain models

Module 5

Remote sensing: Definition, Basic Principles, Application of remote sensing in GIS.

Global Positioning System (GPS) - GPS Basic concepts, GPS segments-satellites & receivers, GPS applications. Application of *GPS data in GIS environment.*

Tutorial exercises: Create a small GIS module using GPS or RS data.

Text Books:

1. Chang,K , "Introduction to Geographic Information Systems", Tata McGraw-Hill Publishing Co. Ltd, 2008

2. George Joseph, "Fundamentals of Remote Sensing", University Press, 2003

3. Robert Laurini and Derek Thompson, "Fundamentals of Spatial Information Systems", Academic Press, 1996.

References:

1. BurroughP, Principles of Geographical Information systems, Oxford University Press, 1998
2. Iliffe, C.J., Datums and Map Projections for Remote Sensing, GIS and Surveying, Whittles Publishing, 2006
3. Kang-tsung Chang, „Introduction to GIS" , Tata McGraw-Hill Publishing Co. Ltd, 8e, 2016
4. Lillesand M and Kiefer W, "Remote Sensing and Image Interpretation". John Wiley and Sons,Inc., 2000

5. Iliffe, C.J., Datums and Map Projections for Remote Sensing, GIS and Surveying, Whittles Publishing, 2006

Course Contents and Lecture Schedule:

No.	Topic	Course Outcome	No. of Hrs
1	**Module 1**		Total: 9
1.1	**Basic concepts of GIS** , History of GIS, Components of GIS- Geospatial Data, Attribute data, GIS operations, Application of GIS , Popular GIS Softwares.	CO1, CO2	3
1.2	**Co-ordinate system:**Geographic Co-ordinate system, Map Projections, Commonly used Map Projections, Projected co-ordinate system, Georeferencing, Geometric Transformations.	CO1, CO2	4
1.3	Tutorial- Introducing a GIS software and its tools.	CO1, CO2	2
2	**Module 2**		Total: 9
2.1	**Data structure**-Vector Data model, Raster Data model, Types of Raster data, Data inputs to GIS platform, Metadata, Vector to Raster conversion, Digitization.	CO1. CO2 CO3	4
2.2	**Database management and map making:**Geodatabase management, Attribute data management. Cartography and map making elements.	CO1, CO2 CO3	3
2.3	*Tutorial exercises: Digitization using available data source and creating a Map Using different map elements.*	CO2, CO3	2
3	**Module 3**		Total: 9
3.1	**GIS Data Processing** – Vector data Analysis- Buffering, Overlay- Point-in-Polygon, Line-in-polygon, Polygon-in-polygon, Distance measurement, Pattern analysis, Map manipulation, Network Analysis	CO1, CO2 CO3,CO4	4
3.2	**Raster Data Analysis-** Local operations, Neighbourhood operation, Zonal Operation, other Raster data operations.	CO1,CO2 CO3,CO4	3
3.3	*Tutorial exercises: Digitization using available data source and creating a Map Using different map elements.*	CO3,CO4	2
4	**Module 4**		Total: 9
4.1	**Advanced Applications:** Introduction to terrain mapping, DEM and TIN, terrain mapping techniques, Slope and aspect, WebGIS.	CO1,CO2 CO3,CO4	4
4.2	**Data quality analysis –** Sources of Error – Components of Data Quality	CO1,CO2 CO3,CO4	3
4.3	*Tutorial exercises: working with a surface / terrain models*		2
5	**Module 5**		Total: 9
5.1	**Remote sensing:** Definition, Basic Principles, Application of remote sensing in GIS.	CO1,CO2 CO3,CO4	3
5.2	**Global Positioning System (GPS)** - GPS Basic concepts, GPS segments-satellites & receivers, GPS applications. Application of GPS data in GIS environment.	CO1,CO2 CO3,CO4	4
5.3	*Tutorial exercises: Create a small GIS module using GPS or RS data.*	CO3, CO4	2

Sample Course Level Assessment Questions

CO 1	To define terms, basic concepts and operations in GIS
CO2	To identify various data types and their characteristics.
CO 3	To illustrate various approaches of spatial data analysis and their significance in decision making.
CO 4	To demonstrate the application of GIS and allied technologies across diverse fields.

CO1

1. Prepare a short account on Geodetic datum, Ellipsoid earth model and Georeferencing
2. State any two functions of a GIS module
3. Write a short note on Digital Elevation Model.

CO2

1. Compare raster data sets and vector data sets. Highlight their significance in GIS environment
2. Briefly explain raster data form in GIS.
3. Explain any two approaches for spatial data acquisition for infrastructure development process.

CO3

1. Prepare short description on (i) Positional accuracy (ii) Attribute accuracy
2. Explain any two types of errors associated with spatial data analysis.
3. Explain different type of image resolutions and establish their importance in the GIS analysis.

CO4

1. Briefly illustrate the utility of GIS module in tracking and navigation.
2. Explain how GPS is used in the map preparation and locating ground features.
3. Highlight the advantages offered by remote sensing operation in the developmental decision making.

Model Question Paper

QP CODE:

Reg No.:_______________ **Name:__________________________**

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEHR411.3

Course Name: GEOGRAPHICAL INFORMATION SYSTEMS

Max. Marks: 100 Duration: 3 hours

PART A

(Answer all questions)

(10 ×3 = 30)

1. Illustrate any two spatial data collection methods adopted for preparation of GIS.
2. What are the different components in GIS?
3. Define (i) Vector data (ii) Raster data
4. Establish the role of shapefiles in GIS.
5. Distinguish between pattern analysis and network analysis.
6. Demonstrate the significance of buffering in GIS
7. State any two sources of data error.
8. Define the terms : Slope and Aspect
9. List any two applications of GIS in combination with GPS.
10. Illustrate the role of atomic clock in GPS.

PART B

11 (i) Explain different techniques of remote sensing used for data collection

(ii) What is the role of georeferencing in GIS operation

(7 + 7)

or

12 (i) illustrate any three applications of GIS

(ii) Compare cylindrical projections and conical projections

(6+ 8)

13 (i) What are the different models adopted to represent vector data?

(iii) Highlight the role of digitisation in map preparation

(7 + 7)

or

14 (i) List the steps involved in the preparation of a digital map.

(ii) Compare continuous raster and discrete raster

(6+ 8)

15. (i) Prepare a short account on (a) Pattern analysis (b) Network analysis.

(ii)Illustrate any two raster data operations

(7 + 7)

or

16. (i) Explain any three factors that influences the choice of weights in the analysis of networks.

(ii) What are the different zonal operations suggested in the neighborhood analysis of raster data ?

(6 + 8)

17. (i) Explain the importance of using DEM for various engineering analysis.

(ii) Prepare different sources of error in a GIS operation.

(7 + 7)

or

18 (i) State any two approaches to reduce the error in GPS data transfer

(ii)Prepare a brief description of GIS data standard.

(7+7)

19. (i) Differentiate between ground based remote sensing and satellite based remote sensing ?

(ii) Justify - integration of GIS and GPS technologies could solve different problems faced inlogistic operations.

(6 + 8)

or

20. (i) Explain different components of a GPS segment.

(ii) Illustrate the utility of remote sensing data in GIS module using any two cases.

(7+ 7)

SEMESTER 5

SEMESTER V

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	22CET 501 –	STRUCTURAL ANALYSIS I	3-1-0	4	4
B	22CET 502	DESIGN OF CONCRETE STRUCTURES	3-1-0	4	4
C	22CET 503	GEOTECHNICAL ENGINEERING II	4-0-0	4	4
D	22CET 504	HYDROLOGY & WATER RESOURCES ENGINEERING	4-0-0	4	4
E	22CET 505	CONSTRUCTION TECHNOLOGY& MANAGEMENT	3-0-0	3	3
F	22MNC506	DISASTER MANAGEMENT	2-0-0	2	--
S	22CEL 507	MATERIAL TESTING LAB II	0-0-3	3	2
T	22CEL 508	GEOTECHNICAL ENGINEERING LAB	0-0-3	3	2
R/M/H	22CEMR509.1/2/3 22CEHR510.1/2/3	Remedial/Minor/Honours course	3-1-0	4*	4
TOTAL				**27/31**	**23/27**

MINOR

SEMESTER	BASKET I				BASKET II				BASKET III			
	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT
S5	22CEMR509.1	STRUCTURAL MECHANICS	4	4	22CEMR509.2	ECO-FRIENDLY TRANSPORTATION SYSTEMS	4	4	22CEMR509.3	SUSTAINABILITY ANALYSIS & DESIGN	4	4

HONOURS

SEMESTER	GROUP I				GROUP II				GROUP III			
	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT
S 5	22CEHR510.1	STRUCTURAL DYNAMICS	4	4	22CEHR510.2	TRANSPORTATION SYSTEMS MANAGEMENT	4	4	22CEHR510.3	GROUND WATER HYDROLOGY	4	4

<table>
<tr><td rowspan="2">22CET 501</td><td rowspan="2">STRUCTURAL ANALYSIS - I</td><td>CATEGORY</td><td>L</td><td>T</td><td>P</td><td>CREDIT</td><td>Year of Introduction</td></tr>
<tr><td>PCC</td><td>3</td><td>1</td><td>0</td><td>4</td><td>2019</td></tr>
</table>

Preamble:

The course enables the students to analyse various types of simple structures using appropriate methods and tools. It introduces the applications of principles of mechanics of solids to determine stress resultants in statically determinate and indeterminate structures. Specific cases of cables, suspension bridges and arches are also discussed at length. The course trains the students to develop mathematical models and helps to sharpen their analytical skills. After this course students will be able to analyse structures subjected to moving loads as well.

Prerequisite: Mechanics of Solids

Course Outcomes: After the completion of the course the student will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Apply the principles of solid mechanics to analyse trusses.	Applying
CO2	Apply energy principles to analyse statically determinate structures.	Applying
CO3	Identify the problems with static indeterminacy and understand the basic concepts of tackling such problems by means of the method of consistent deformations.	Understanding, Analysing
CO4	Apply suitable methods of analysis for various types of structures including cables, suspension bridges and arches.	Applying
CO5	Analyse the effects of moving loads on structures using influence lines.	Analysing
CO6	Apply specific methods such as slope deflection and moment distribution methods of structural analysis for typical structures with different characteristics.	Applying

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	**2**	
Remember	10	05	10
Understand	20	10	20
Apply	30	25	50
Analyse	10	10	20
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

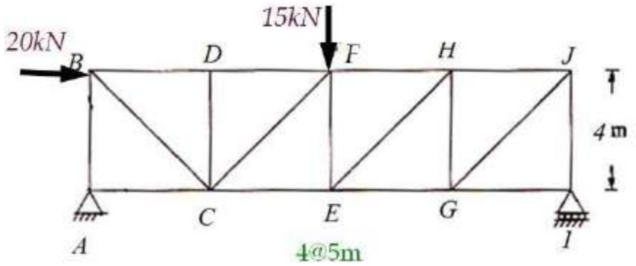
Continuous Internal Evaluation Pattern:

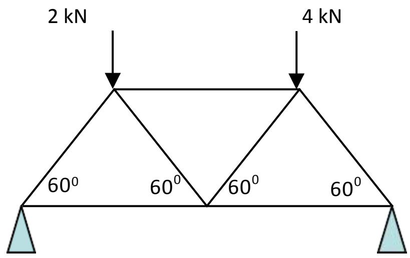
Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Course Level Assessment Questions

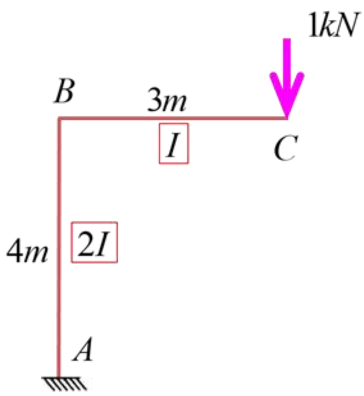
CO1: Apply the principles of solid mechanics to analyse trusses.

<table>
<tr><td>1.</td><td>Explain the method of joints to analyse trusses.</td></tr>
<tr><td>2.</td><td>Find the member forces in FH, EH and EG using method of sections.


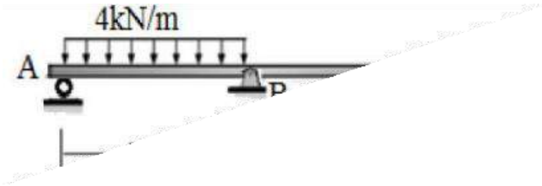
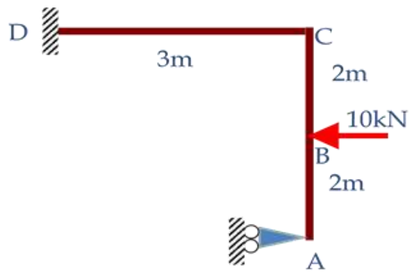
</td></tr>
<tr><td>3.</td><td>. Analyse the truss in figure using method of joints


</td></tr>
</table>

CO2: Apply energy principles to analyse statically determinate structures.

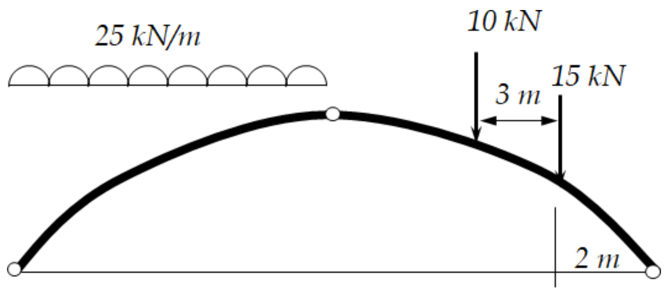
<table>
<tr><td>1.</td><td>Find from first principles, the shear strain energy in bending for a cantilever with uniform cross section, width 200mm, depth 300mm and span 3m. A point load of 10kN is acting at the free end. E= 2 MN/m^2.</td></tr>
<tr><td>2.</td><td>State and prove Betti's Theorem.</td></tr>
<tr><td>3.</td><td>Find the bending strain energy for a cantilever of span 3m with a point load of 10kN at the free end. Cross section is 200X300mm. E= 2 MN/m^2.</td></tr>
<tr><td>4.</td><td>Find the vertical deflection at C for the frame in figure using strain energy method.


</td></tr>
</table>

CO3:	**Identify the problems with static indeterminacy and understand the basic concepts of tackling such problems by means of the method of consistent deformations.**
1.	Explain static and kinematic indeterminacies with examples.
2.	Differentiate between force and displacement methods for analysing indeterminate structures
3.	Find the reaction at B for the beam shown in figure, using consistent deformation method. 
4.	Analyse the 2D frame using consistent deformation method (EI is constant). 

CO4: Apply suitable methods of analysis for various types of structures including cables, suspension bridges and arches.

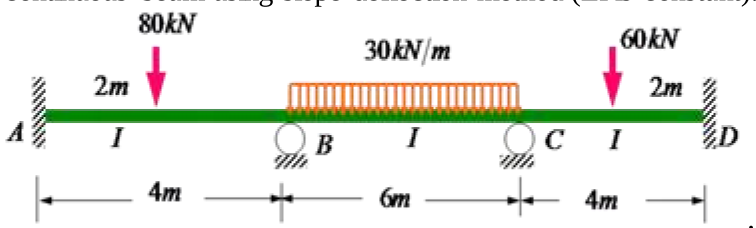
1.	Write a note on three-hinged and two-hinged stiffening girders.
2.	State and explain Eddy's theorem
3.	For a cable AB, the level difference between the supports A and B is 6m, and the lowest point is at a vertical distance of 4.5m from A. If the horizontal span AB is 24m and is loaded with 7.5kN/m throughout the span, find the length of the cable, and the minimum and maximum tension in the cable
4.	A suspension bridge with 25m span and central dip 2.5m transfers 4kN per horizontal metre to each cable. Find max and min pull in each cable, and the length of cable
5.	The span of the 3-hinged parabolic arch shown in figure is 30m and the rise is 6m. Find BM, normal thrust, and radial shear at a section 7.5 m from the left hinge. Find maximum BM on the arch.

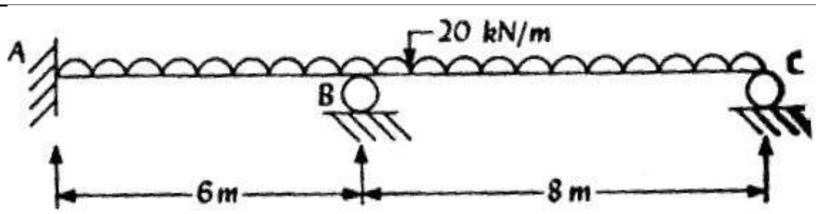
	

CO5: Analyse the effects of moving loads on structures using influence lines.

1.	State and explain the condition for absolute maximum bending moment in a simple beam when a series of concentrated loads is moving across it
2.	What are influence lines? Draw ILD for SF and BM at any intermediate section of a simply supported beam. What are the uses of influence lines?
3.	Four point loads 30kN, 40kN, 20kN and 15kN, distance between them being 2m, are moving across a simple beam (of span 15m) from left to right with 30kN load leading. Find position of the loads for maximum -ve SF and BM at a section 7m from left end. Also find maximum -ve SF and BM at the section.

CO6: Apply specific methods such as slope deflection and moment distribution methods of structural analysis for typical structures with different characteristics.

1.	Explain briefly on the analysis of frames with sidesway, using slope deflection method
2.	Derive expressions for stiffness at the near-end for a beam with hinged far-end
3.	Analyse the continuous beam using slope deflection method (EI is constant). 
4.	Analyse the continuous beam in figure using moment distribution method (EI is constant)

	 20 kN/m A B C 6m 8 m

SYLLABUS

Module – 1

Statically determinate structures:

Trusses: Method of joints and method of sections (Numerical problems) – 4 hrs.

Elastic theorems and energy principles: strain energy due to axial load, bending moment, shear and torsion - strain energy method, Castigliano's method for deflection (Derivations only). – 4 hrs.

Betti's theorem – Maxwell's law of reciprocal deflections - 1 hr.

Module – 2

Principle of least work; Application of unit load method and strain energy method for determination of deflection of statically determinate beams, frames - pin jointed trusses (simple numerical problems) – 4 hrs.

Concepts of temperature effects and lack of fit (No numerical problems) – 1 hr.

Statically indeterminate structures:

Degree of static and kinematic indeterminacies – Introduction to force and displacement methods - 1 hr.

Method of Consistent deformations: Analysis of beams frames and trusses with internal and external redundancy (Simple problems with maximum one redundant – Illustration only for two redundants)– 3 hrs.

Module – 3

Method of Consistent deformations (continued): Concepts of effect of prestrain, lack of fit, temperature changes and support settlement. (No numerical problems) – 1 hr.

Cables: Analysis of forces in cables under concentrated and uniformly distributed loads - Anchor Cable supports – 4 hrs.

Suspension Bridges: Un-stiffened suspension bridges, maximum tension in the suspension cable and backstays, pressure on towers – 4 hrs.

Module – 4

Arches: Theory of arches – Eddy's theorem - analysis of three hinged arches-Support reactions-normal thrust and radial shear at any section of a parabolic arch due to simple cases of loading. – 4 hrs.

Moving loads and influence lines: Introduction to moving loads - concept of influence lines - influence lines for reaction, shear force and bending moment in simply supported beams and over hanging beams - analysis single concentrated load, several concentrated loads, uniformly distributed load shorter and longer than the span. – 5 hrs.

Module – 5

Slope Deflection Method: Analysis of continuous beams and portal frames without sway. Frames with sway (illustration only). Settlement effects (derivation only) – 4 hrs.

Moment Distribution Method: Analysis of beams and frames – non sway analysis. Sway analysis (illustration only) – 4 hrs.

Introduction to structural analysis softwares (hands on exercises on two simple structural analysis problems) – 1 hr.

Text Books:

1. Gere and Timoshenko, Mechanics of materials, CBS Publishers
2. Kenneth Leet, Chia M Uang & Anne M Gilbert, Fundamentals of Structural Analysis, McGraw Hill
3. R. Vaidyanathan and P. Perumal, Comprehensive Structural Analysis Volume I & II, Laxmi Publications (P) Ltd

References:

1. Wang C.K., Intermediate Structural Analysis, McGraw Hill
2. Aslam Kassimali., Structural Analysis, Cenage Learning
3. Chandramouli P N, Structural Analysis I –Analysis of Statically Determinate Structures, Yes DeePublishing Pvt Ltd.,Chennai,Tamil Nadu.
4. DevdasMenon, Structural Analysis, Narosa Publications
5. Hibbeler., Structural Analysis, Pearson Education
6. Kinney S., Indeterminate Structural Analysis, Oxford & IBH
7. M.L. Gambhir, Fundamentals of structural Mechanics and analysis, Printice Hall India
8. Reddy C.S., Indeterminate Structural Analysis, Tata McGraw Hill
9. Timoshenko S.P.& Young D.H., Theory of Structures, McGraw Hill
10. Daniel L Schodak, Structures, Pearson Education, 7e, 2014
11. Negi L. S. and Jangid R. S, Structural Analysis, Tata McGraw Hill, 1997
12. Rajasekaran S. and Sankarasubramanian G., Computational Structural Mechanics, PHI, 2008
13. S.S. Bhavikatti, Structural Analysis II, Vikas Publication Houses (P) Ltd, 2016
14. Utku S, Norris C. H & Wilbur J. B, Elementary Structural Analysis, McGraw Hill, 1990

Lecture Plan – Structural Analysis I

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module I: Total lecture hours: 9**		
1.1	Statically determinate and indeterminate structures - introduction	CO3	1
1.2	Trusses: Method of joints	CO1	2
1.3	Trusses: Method of sections (Numerical problems).	CO1	1
1.4	Elastic theorems and energy principles: introduction	CO2	1
1.5	Strain energy due to axial load, bending moment, shear and torsion	CO2	2
1.6	Strain energy method, Castigliano's method for deflection (Derivations only).	CO2	1
1.7	Betti's theorem – Maxwell's law of reciprocal deflections.	CO2	1
2	**Module II: Total lecture hours: 9**		
2.1	Principle of least work; Application of unit load method for determination of deflection of statically determinate beams, frames - pin jointed trusses (simple numerical problems)	CO2	2
2.2	Application of strain energy method (simple numerical problems)	CO2	1
2.3	Application of unit load method and strain energy method: Concepts of temperature effects and lack of fit (No numerical problems)	CO2	1
2.3	Statically indeterminate structures: Degree of static and kinematic indeterminacies - examples – Introduction to force and displacement methods.	CO3	2
2.4	Method of Consistent deformations: Analysis of beams frames and trusses with internal and external redundancy (Simple problems with maximum one redundant – Illustration only for two redundants)	CO3	3
3	**Module III: Total lecture hours: 9**		
3.1	Method of Consistent deformations: Effect of prestrain, lack of fit, temperature changes and support settlement. (No numerical problems)	CO3	1
3.2	Cables: Analysis of forces in cables under concentrated and uniformly distributed loads	CO4	3

3.3	Anchor Cable supports	CO4	1
3.4	Suspension Bridges: Un-stiffened suspension bridges, maximum tension in the suspension cable and backstays, pressure on towers.	CO4	4
4	**Module IV: Total lecture hours: 9**		
4.1	Arches: Theory of arches – Eddy's theorem	CO4	1
4.2	Analysis of three hinged arches - Support reactions - normal thrust and radial shear at any section of a parabolic arch due to simple cases of loading	CO4	3
4.2	Moving loads and influence lines: Introduction to moving loads - concept of influence lines	CO5	1
4.3	Influence lines for reaction, shear force and bending moment in simply supported beams and over hanging beams	CO5	1
4.4	Analysis single concentrated load, several concentrated loads, uniformly distributed load shorter and longer than the span. Conditions for maximum shear and bending moment.	CO5	3
5	**Module V: Total lecture hours: 9**		
5.1	Slope Deflection Method: Concept and derivation of basic equations	CO3, CO6	1
5.2	Slope Deflection Method: Analysis of continuous beams and portal frames without sway.	CO6	2
5.3	Slope Deflection Method: Frames with sway (illustration only). Settlement effects (derivation only)	CO6	1
5.2	Moment Distribution Method: Concept and derivation of basic equations	CO3, CO6	1
5.3	Moment Distribution Method: Analysis of beams and frames – non sway analysis.	CO6	2
5.4	Moment Distribution Method: Sway analysis (illustration only)	CO6	1
5.3	Introduction to structural analysis software (hands on exercises on two simple structural analysis problems)	CO3	1

MODEL QUESTION PAPER

Reg. No.:_______________ Name:__________________________

FIFTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: 22CET 501

Course Name: STRUCTURAL ANALYSIS I

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions; each question carries 3 marks.

1. a) Explain static and kinematic indeterminacies with examples.

   b) State and prove Betti's Theorem.

   c) Explain the method of consistent deformations, with an example.

   d) Differentiate between force and displacement methods for analysing indeterminate structures.

   e) Explain how problems involving temperature change/lack of fit are solved using consistent deformation method.

   f) Write a note on three-hinged and two-hinged stiffening girders.

   g) State and explain the condition for absolute maximum bending moment in a simple beam when a series of concentrated loads is moving across it.

   h) State and explain Eddy's theorem.

   i) Explain briefly on the analysis of frames with sidesway, using slope deflection method.

   j) Derive expressions for stiffness at the near-end for a beam with hinged far-end.

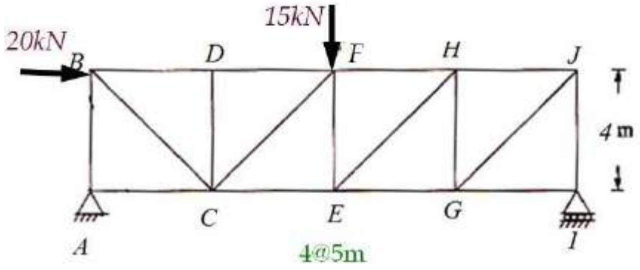
(10×3 marks = 30 marks)

PART B

Answer one full question from each module; each full question carries 14 marks.

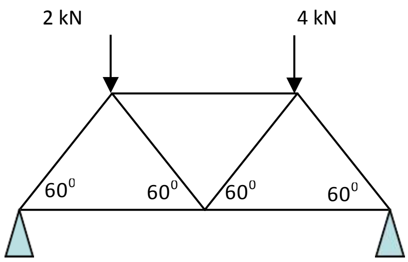
Module I

2. a. Find the member forces in FH and EH and EG using method of sections.



(6 marks)

b. Analyse the truss in figure using method of joints.



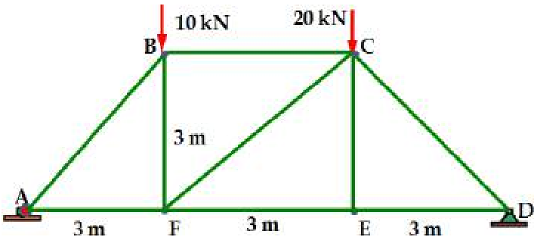
(8 marks)

3. a. Find the bending strain energy for a cantilever of span 3m with a point load of 10kN at the free end. Cross section is 200X300mm. E= 2 MN/m^2. (7 marks)

b. Find from first principles, the shear strain energy in bending for a cantilever with uniform cross section, width 200mm, depth 300mm and span 3m. A point load of 10kN is acting at the free end. E= 2 MN/m^2. (7 marks)

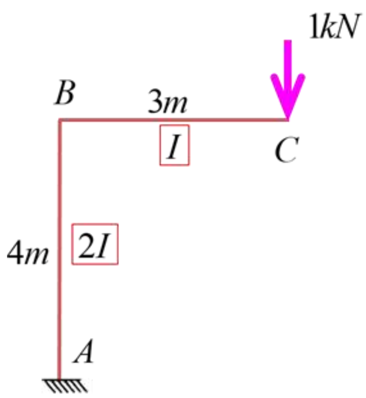
Module II

4. a. Find the deflection at E of the truss in figure, using unit load method. Cross-sectional areas of members are 1200mm2. E= 200 kN/mm^2.



(7 marks)

b. Find the vertical deflection at C for the frame in figure using strain energy method



(7 marks)

5. a. Find the reaction at B for the beam shown in figure, using consistent deformation method.

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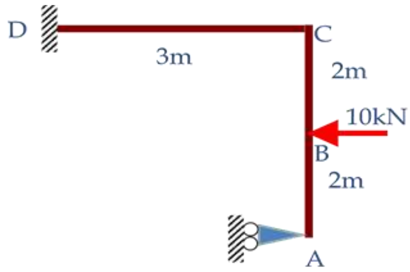
(7 marks)

b. Analyse the 2D frame using consistent deformation method (EI is constant).



(7 marks)

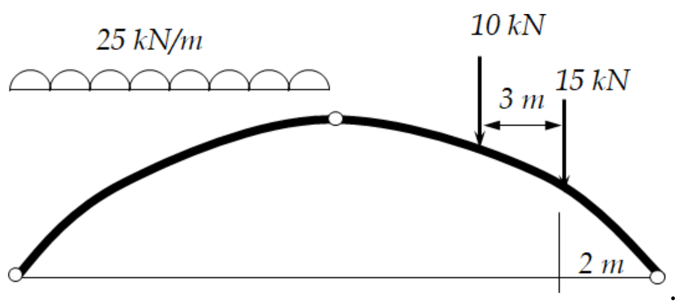
Module III

6. For a cable AB, the level difference between the supports A and B is 6m, and the lowest point is at a vertical distance of 4.5m from A. If the horizontal span AB is 24m and is loaded with 7.5kN/m throughout the span, find the length of the cable, and the minimum and maximum tension in the cable. (14 marks)

7. A suspension bridge with 25m span and central dip 2.5m transfers 4kN per horizontal metre to each cable. Find max and min pull in each cable, and the length of cable. (14 marks)

Module IV

8. The span of the 3-hinged parabolic arch shown in figure is 30m and the rise is 6m. Find BM, normal thrust, and radial shear at a section 7.5 m from the left hinge. Find maximum BM on the arch.



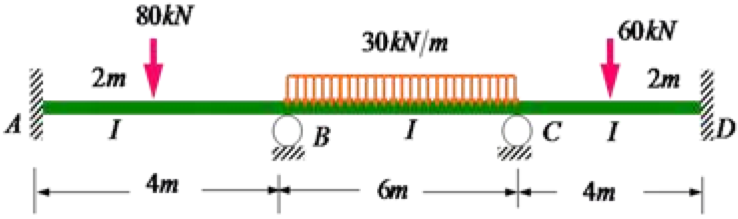
(14 marks)

9. a) What are influence lines? Draw ILD for SF and BM at any intermediate section of a simply supported beam. (5 marks)

   b) Four point loads 30kN, 40kN, 20kN and 15kN, distance between them being 2m, are moving across a simple beam (of span 15m) from left to right with 30kN load leading. Find position of the loads for maximum -ve SF and BM at a section 7m from left end. Also find maximum -ve SF and BM at the section. (9 marks)

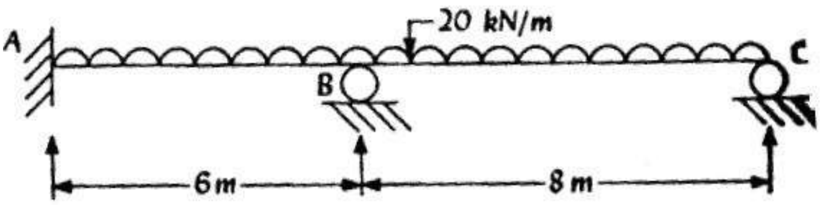
Module V

10. Analyse the continuous beam using slope deflection method (EI is constant).



(14 marks)

11. Analyse the continuous beam in figure using moment distribution method (EI is constant).



(14 marks)

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22CET 502	DESIGN OF CONCRETE STRUCTURES	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PCC	3	1	0	4	2019

Preamble:

Reinforced concrete members are designed according to the existing codes of practice [IS 456 (2000)]. The course provides all the fundamental topics in reinforced concrete design and enable students to design and detail reinforced concrete structural members such as beam, slab, column and footing. The course also provides an introduction to earthquake resistant design and detailing.

Prerequisite: Mechanics of Solids

Course Outcomes: After the completion of the course the student will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Recall the fundamental concepts of limit state design and code provisions for design of concrete members under bending, shear, compression and torsion.	Remembering/ Understanding
CO2	Analyse reinforced concrete sections to determine the ultimate capacity in bending, shear and compression.	Applying
CO3	Design and detail beams, slab, stairs and footings using IS code provisions.	Applying
CO4	Design and detail columns using IS code and SP 16 design charts.	Applying
CO5	Explain the criteria for earthquake resistant design of structures and ductile detailing of concrete structures subjected to seismic forces.	Understanding

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	1	-	-	-	-	-	-	-	-	-
CO2	3	3		-	-	-	-	-	-	-	-	-
CO3	3	-	3	-	-	-	-	2	-	-	-	-
CO4	3	-	3	-	-	-	-	2	-	-	-	-
CO5	1	-	1	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember			
Understand	10	10	30
Apply	30	30	60
Analyse	10	10	10
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

<u>Course Level Assessment (Sample) Questions</u>

CO1: Recall the fundamental concepts of limit state design and code provisions for design of concrete members under bending, shear, compression and torsion.

1. Explain the term limit state design.
2. Enumerate the five limit states commonly used in limit state design and state briefly how they are provided for in design.
3. Define the term partial safety factor as used in limit state design. Identify the various factors and state the values recommended in IS 456
4. Explain the term 'factored load' and 'characteristic loads. Why IS 456 specifies the same partial safety factor for dead and live loads? Is it technically correct?
5. How are the following factors incorporated in design formulae for limit design
   (a) partial safety factor for load,
   (b) partial safety factor for material strength,
   (c) difference between cube strength and strength of concrete in structure.
6. Explain the basis for the selection of partial load and safety factors by the Code for serviceability limit states
7. Why is the partial safety factor for concrete (γ_c) greater than that for reinforcing steel (γ_s) in the consideration of ultimate limit states?
8. Explain the necessity for specifying maximum and minimum tension steel in reinforced beams. What are their values?
9. What is equivalent shear as applied to torsion and shear in IS 456?
10. Explain the terms balanced', 'over reinforced' and 'under reinforced' section Explain which of these should be recommended in design. How is this ensured in design of beams according to IS 456?
11. Why is it necessary to put a limit on the x/d allowed in singly reinforced beams as stipulated in IS 456? Can this condition be relaxed for beams with compression steel? Give reasons for your answer
12. What are the types of reinforcements used to resist shear? Explain the action of difference types of shear steel in resisting shear.
13. What is meant by equivalent length of a column? Explain how column behaviour is affected by the effective length.
14. Why is it necessary to have lateral ties in a column?
15. How does helically reinforced columns differ from tied columns in their behaviour? In what situations would one recommend the use of helically reinforced column?

CO2: Analyse reinforced concrete sections to determine the ultimate capacity in bending, shear and compression.

1.	A rectangular beam 250mm wide and effective depth 450 mm has 4 bars of 20mm diameter. Find the moment of resistance of the section if M20 concrete and Fe 415 grade steel are used. As per IS 456:2000 find the

	limiting moment of resistance also.
2.	A rectangular RC beam 230 mm wide and 420 mm effective depth is reinforced with 2-16mm diameter bars at top and 4 – 16 mm bars at bottom. Estimate the ultimate moment carrying capacity of the section assuming M20 concrete and Fe415 steel.
3.	A rectangular beam 250mm wide and effective depth 450 mm has 4 bars of 20mm diameter. 8mm diameter two legged vertical stirrups are provided at 200 mm c/c. Determine the ultimate SF the section can resist. Assume M20 concrete and Fe415 steel.
4.	A square column 300 mm x 300 mm is reinforced with 8 bars of 16 mm diameter. Assuming M25 concrete and Fe415 steel, determine the safe axial load carrying capacity of the column

CO3: Design and detail beams, slab, stairs and footings using IS code provisions.

1. Design a simply supported beam of span 6m subjected to a live load of 4 kN/m. Use M20 concrete and Fe415 steel.
2. Design a simply supported rectangular beam to carry a superimposed load of 30 kN/m over a span of 5.5m. Assume support width as 300mm. Maximum overall depth is restricted to 550mm. Use M20 concrete and Fe 415 grade steel.
3. Design a slab for a room of size 3m x 5.5m carrying a live load of 7 kN/m^2. Use M20 concrete and Fe 415 grade steel. Assume that the corners are held down. The slab is having all the four edges discontinuous
4. Design a square isolated footing for a column of size 400mm x 400mm carrying a load of 1500 kN under service conditions. Safe bearing capacity of soil is 200 kN/m^2.Use M20 concrete and Fe 415 grade steel.
5. Design and detail an isolated rectangular footing for a column 400 mm x 600 mm to carry a load of 2000 kN. The SBC of the soil is 180 kN/m^2.Use M20 concrete and Fe 415 grade steel
6. A dog-legged staircase for a residential flat consists of 18 steps, each of 300 mm tread 180 mm rise, with an intermediate landing 1.2 m in width at the middle. The width of staircase is also 1.2 m. If the flights are of equal number of steps, design the staircase detail the steel. f_{ck} = 20 N/mm^2 and f_y = 415 N/mm^2.
7. Explain the design detail of a combined rectangular footing with reinforcement details.

CO4: Design and detail columns using IS code and SP 16 design charts.

1. Design a RCC rectangular column to carry an axial load of 1200 kN and a moment of 70 kNm, The length of the column is 3.5m. The one end is fixed and the other end is hinged. The width of the column is restricted to the wall thickness of 24 cm.
2. Design a reinforced concrete column to carry an axial load of 1600 kN. Use M20 concrete and Fe415 steel. The column has unsupported length of 3m and is effectively held in position at both the ends, but not restrained against rotation.
3. Design and detail a column under biaxial bending with the following data:
   Size of column = 40 x 60cm
   The column is effectively held in position at both ends but not restrained against rotation. The unsupported length of column is 3.5m
   Concrete grade = M20
   Grade of Steel = Fe 415
   Factored load Pu = 1900 kN
   Factored Moment Mux = 150 kNm and Muy = 110kNm
4. A short column 300 mm x 600 mm is carrying an axial working load of 750 kN and a moment of 160 kNm at an axis bisecting the depth. Design the reinforcement required if f_y = 250 N/mm^2 and f_{ck} 20 N/mm^2, Also sketch the reinforcement.

CO5: Explain the criteria for earthquake resistant design of structures and ductile detailing of concrete structures subjected to seismic forces.

1. What are the objectives of earthquake-resistant design of reinforced concrete structures?
2. What are the objectives behind the special detailing provisions in IS 13920?
3. Distinguish between ordinary moment resisting frame (OMRF) and special moment resisting frame (SMRF)
4. How do you fix the minimum width of columns of moment resisting frames in Zone III?
5. What are the design requirements of beam-column joints?
6. What is meant by special confining reinforcement in columns of ductile frames?
7. What are the design requirements of beam-column joints in earthquake resistant design?

SYLLABUS

Module I

Introduction – Limit states – Limit state of collapse in flexure – Analysis and design of singly reinforced beams.

Module II

Analysis & design of doubly reinforced beams. Analysis of T-beams . Limit state of collapse in shear. Bond and development length.

Module III

Design of slabs – one way and two way slabs. Design of stair case.

Module IV

Limit state of collapse – compression, Design of axially loaded short column.

Design of short columns subjected to compression and uniaxial/biaxial bending- design using SP16 charts.

Module V

Design of isolated and combined footings.

Limit state of serviceability.

Introduction to earthquake resistant design. Codal provisions – IS 1893, IS 13920

Text Book:

1. Punmia, B. C, Jain A.K and, Jain A.K , R C C Designs, Laxmi Publications Ltd., 10e, 2015

References:

1. Pillai S.U & Menon D – Reinforced Concrete Design, Tata McGraw Hill Book Co., 2009
2. Varghese P.C, Limit State Design of Reinforced Concrete, Prentice Hall of India Pvt Ltd, 2008
4. Relevant IS codes (IS 456, IS 875, IS 1893, IS 13920, SP 16, SP 34)

Lecture Plan – Design of Concrete Structures

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module I : Total lecture hours : 9**		
1.1	Introduction – Principles of Limit state method of design, Introduction to BIS code- Types of limit states-characteristic and design values-partial safety factors-types of loads and their factors.	CO1	2
1.2	Limit State of Collapse by flexure -assumptions-stress-strain	CO1	2

	relationship of steel and concrete-		
1.3	Analysis of singly reinforced rectangular beams-balanced-under reinforced-over reinforced sections-moment of resistance codal provisions	CO2	2
1.4	Design of singly reinforced rectangular beams- basic rules for design-.	CO3	1
1.5	Design example of simply supported beam- design of cantilever beam-detailing	CO3	2
2	**Module II : Total lecture hours : 9**		
2.1	Analysis of doubly reinforced beams	CO2	1
2.2	Design of doubly reinforced beams –detailing,	CO3	1
2.3	T-beams- terminology- Formulae for analysis of T beams-examples –	CO1, CO2	2
2.4	Limit state of collapse in shear and bond- shear stresses in beams-types of reinforcement-shear strength of RC beam-IS code recommendations for shear design-	CO1	2
2.5	Design of shear reinforcement-examples	CO3	1
2.6	Bond and development length - anchorage for reinforcement bars - code recommendations regarding curtailment of reinforcement	CO1, CO3	1
2.7	Design for torsion-IS code approach- examples	CO3	1
3	**Module III : Total lecture hours : 10**		
3.1	Design of slabs- introduction- one-way and two-way action of slabs - load distribution in a slab-	CO1, CO3	1
3.2	IS recommendations for design of slabs- design of one-way slab- numerical problems – concepts of detailing of continuous slab –code coefficients.	CO1, CO3	2
3.3	Two- way slabs- simply supported design using IS Code coefficients Reinforcement detailing	CO1, CO3	2
3.4	Two- way slabs- restrained slabs – design using IS Code coefficients Reinforcement detailing	CO1, CO3	2
3.5	Stair cases- Types-proportioning-loads- distribution of loads – codal provisions –Concepts of tread-riser type stairs (detailing only)	CO1, CO3	1
3.6	Design and detailing of dog legged stair-	CO1, CO3	2
4	**Module IV : Total lecture hours : 9**		
4.4	Columns- introduction –classification- effective length- short column - long column - reinforcement-IS specifications regarding columns- limit state of collapse: compression -	CO1, CO4	1
4.5	Design of axially loaded short columns-design examples with rectangular ties	CO4	2

4.6	Design of axially loaded short columns-design examples with helical reinforcement	CO4	2
5.1	Analysis and design of short columns subjected to compression and uniaxial bending- design using SP16 charts for limit state	CO4	2
5.2	Analysis and design of short columns subjected to combined axial load and biaxial bending moments-code procedure for design- design using SP16 charts for limit state	CO2, CO4	2
5	**Module V : Total lecture hours : 11**		
5.3	Foundations- classification-IS code provisions for design of isolated footings-	CO1, CO3	2
5.4	Design principles of rectangular footings- detailing.	CO1, CO3	2
5.5	Combined footings (design principles only)- analysis of combined footings-rectangular and trapezoidal.	CO1, CO3	2
4.1	Limit state of serviceability - limit state of deflection- short term and long term deflection-	CO1	1
4.2	Limit state of serviceability - IS code recommendations- limit state of cracking- estimation of crack width- simple numerical examples	CO1	2
4.3	Introduction to earthquake resistant design, Importance of Ductility in Seismic Design, Major Design Considerations, Codal provisions – IS 1893, IS 13920	CO5	2

MODEL QUESTION PAPER

Reg. No.:_______________ Name:___________________________

FIFTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: 22CET 502

Course Name: Design of Concrete Structures

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions; each question carries 3 marks.

1. a) Derive the limiting values of depth of neutral axis for different grades of steel
   b) Define characteristic strength & partial safety factor for materials. Why is partial safety factor for material high for concrete than steel?
   c) Explain the term development length and explain its significance in RC design. obtain the expression for it
   d) Explain why and how shear reinforcement is provided in beams
   e) Explain the difference in the behaviour of one-way and two-way slabs. Why it is essential to provide corner reinforcement in two way rectangular slabs whose corners are prevented from lifting up?
   f) What is meant by stair supported on landings? Explain the codal provision for the effective span of the stair slab in such cases?
   g) What are the objectives behind the special detailing provisions in IS 13920?
   h) Compare the behaviour of tied columns with spiral column subject to axial loading.
   i) Explain how interaction curves are used in the design of column
   j) Explain at what situations a combined footing is recommended.

(10×3 marks = 30 marks)

PART B

Answer one full question from each module; each full question carries 14 marks.

Module I

2. (a) Explain balanced, under reinforced and over reinforced sections in the context of Limit State Design of Reinforced Concrete structures. **(4 marks)**

(b) A rectangular beam 250mm wide and effective depth 450 mm has 4 bars of 20mm diameter. Find the moment of resistance of the section if M20 concrete and Fe 415 grade steel are used. As per IS 456:2000 find the limiting moment of resistance also. **(10 marks)**

3. (a) Explain the term Limit State. Enumerate the different limit states to be considered in reinforced concrete design. **(4 marks)**

(b).Design and detail an RC rectangular section subjected to a udl of 15 kN/m over the entire span. Clear span is 5m. The beam is supported on masonry walls, 230 mm thick on both sides. Assume moderate exposure conditions. Use M 25 grade concrete and Fe 415 grade steel.

(10 marks)

Module II

4. (a) Enumerate the situations in which a doubly reinforced section become necessary. Derive expression for the ultimate moment of resistance of doubly reinforced section Explain. **(4 marks)**

(b) Determine the ultimate moment of resistance of a doubly reinforced rectangular section of width 300 mm and overall depth 700 mm reinforced with 4 – 25mm diameter bars on tension side and 2 – 25mm diameter bars on compression side. Assume effective cover of 45 mm on both sides. Use M 20 concrete and Fe 415 steel. **(10 marks)**

5. (a) The provision of minimum stirrup reinforcement is mandatory in all reinforced concrete beams. Why? **(2 marks)**

(b) Determine the ultimate moment of resistance of an isolated beam of T-shaped cross-section having a span of 6m and cross sectional dimensions are flange width of 1000mm, flange thickness of 100mm, web width of 250mm and an effective depth of 520mm, having tension reinforcement of 6 x 28mm diameter bars. The materials used are concrete mix of grade M20 and mild steel of grade Fe 415. **(12 marks)**

Module III

6. (a) Distinguish between one way slab and two way slab**.** **(2 marks)**

(b) Design and detail a simply supported slab for a room of interior dimension 5m x 4m subjected to an imposed load of 8 kN/m^2. Thickness of supporting wall is 230 mm. Use M 20 concrete and Fe 415 grade steel. **(12 marks)**

7. (a) Explain the behavior of two way slabs and also the need of corner reinforcement in two way rectangular slabs whose corners are prevented from lifting. **(3 marks)**

(b) Design a staircase to be provided in a residential building in two straight opposite flights of 1.0m width connected by a landing for a floor height of 3.3m. The landing which is 1m wide spans in the same direction as the stair slab. The rise and tread shall be 150mm and 270mm respectively. The weight of finishes 1kN/m^2, live load =3kN/m^2. M20 concrete & Fe415 steel are to be used. **(11 marks)**

Module IV

8. (a) Classify the columns separately based on loadings and slenderness ratios. **(4 marks)**

b) Design a reinforced concrete column to carry an axial load of 1600 kN. Use M20 concrete and Fe415 steel. The column has unsupported length of 3m and is effectively held in position at both the ends, but not restrained against rotation. **(10 marks)**

9. a) Draw four typical strain profiles of a short, rectangular and symmetrically reinforced concrete column causing collapse subjected to different pairs of Pu and Mu when the depths of the neutral axis are (i) less than the depth of column D, (ii) equal to the depth of column D, (iii) $D < xu < \infty$ and (iv) $xu = \infty$. Explain the behaviour of column for each of the four strain profiles. **(4 marks)**

(b) Design a RCC rectangular column to carry an axial load of 1200 kN and a moment of 70 kNm, The length of the column is 3.5m. The one end is fixed and the other end is hinged. The width of the column is restricted to the wall thickness of 24 cm. **(10 marks)**

Module V

10. (a) Design a footing for a 400 mm x 400 mm column to carry a load of 100 kN with foundation resting on a soil of SBC 120 kN/m^2. Assume M20 concrete and Fe415 steel. **(8 marks)**

(b) What are the objectives of earthquake-resistant design of reinforced concrete structures? What are the design requirements of beam-column joints in earthquake resistant design? **(6 marks)**

11. (a) Explain the different types of shallow footings. **(2 marks)**

(b) Design an isolated rectangular footing for a column 450 mm x 600 mm to carry a load of 2400 kN. The SBC of the soil is 180 kN/m^2.Use M20 concrete and Fe 415 grade steel. **(10 marks)**

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22CET 503	GEOTECHNICAL ENGINEERING - II	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PCC	4	0	0	4	2019

Preamble: Goal of this course is to impart to the students, in-depth knowledge about the basic concepts and theories of foundation engineering. After this course, students will be able to recognize practical problems of foundations in real-world situations and respond accordingly.

Prerequisite : Geotechnical Engineering - I

Course Outcomes: After completion of the course the student will be able to:

CO 1	Understand soil exploration methods
CO 2	Explain the basic concepts, theories and methods of analysis in foundation engineering
CO 3	Calculate bearing capacity, pile capacity, foundation settlement and earth pressure
CO 4	Analyze shallow and deep foundations
CO 5	Solve the field problems related to geotechnical engineering

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	3	-	-	-	-	-	-	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	3	-	-	-	-	-	-	-	-	-	-
CO 4	2	2	3	-	-	-	-	-	-	-	-	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	5	5	10
Understand	10	10	20
Apply	25	25	50
Analyse	10	10	20
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation (CIE) Pattern :

Attendance : 10 Marks

Continuous Assessment Test (2 numbers) : 25 Marks

Assignment/Quiz/Course project : 15 Marks

End Semester Examination (ESE) Pattern : There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

Course Outcome 1 (CO1):

1. Understand Soil Investigation and Soil Exploration methods

Course Outcome 2 (CO2):

1. Explain the bearing capacity theory of shallow foundations
2. Explain the basic concepts and theory of settlement calculations of shallow foundations
3. Explain the concepts and theory of pile capacity
4. Explain the earth pressure theories for cohesionless and cohesive soils

Course Outcome 3 (CO3):

1. Calculate the bearing capacity of shallow foundations
2. Calculate pile capacity
3. Calculate the settlement of footings
4. Calculate the earth pressure acting on retaining walls

Course Outcome 4 (CO4):

1. Analyze and design shallow foundations
2. Analyze deep foundations

Course Outcome 5 (CO5):

1. Solve the field problems related to different types of shallow and deep foundations, retaining walls, etc.

SYLLABUS

Module 1

Earth pressure : Earth pressure - At rest, active and passive earth pressures - Practical examples Rankine's theory – Earth pressure and point of application for cohesionless and cohesive soils - Influence of surcharge and water table on earth pressure - Numerical problems - Earth pressure with layered backfill - Numerical problems - Coulomb's theory [no derivation required] – Comparison of Rankine's and Coulomb's theory

Foundation – General Considerations : Functions of foundations - definition of shallow and deep foundation - Selection of type of foundation - Different types of shallow foundations - advantages and limitations of various types of shallow foundations

Module 2

Bearing capacity of shallow foundations: Gross and Net bearing pressure - Ultimate and Safe bearing capacity - Failure mechanism - Allowable soil pressure - Terzaghi's bearing capacity theory for strip footing [no derivation required] – Assumptions – Bearing capacity factors - Numerical problems - Terzaghi's formulae for circular and square footings - Numerical problems - Factors affecting bearing capacity - Effect of water table on bearing capacity - Numerical problems - General, local and punching shear failure - Skempton's formula – Numerical problems

Module 3

Settlement analysis: Introduction- causes of settlement – estimation of immediate settlement – Numerical problems - Allowable settlement - Maximum and differential settlements as per Indian standard - Field test - Plate load test – Procedure, uses and limitations

Footings : Principles of design of footings – strip/continuous and individual footings - Numerical Problems - Combined footings- Rectangular and Trapezoidal combined footings - Numerical problems - Footings subjected to eccentric loading

Raft foundations: Types – Principles of design of raft foundation- Bearing capacity equations for raft on sand (Teng's equation based on SPT value) and for raft on clay (Skempton's formula) - Floating foundations - conventional design procedure for rigid mat.

Module 4

Pile foundations: uses of piles - classification of piles - determination of type and length of piles - Bearing capacity of single pile in clay and sand [I.S. Static formulae] - Numerical problems - Dynamic formulae (Modified Hiley formulae only) – Numerical Problems - I.S. Pile load test [conventional] - Negative skin friction - Group action - Group efficiency - Capacity of Pile groups - Numerical problems

Well foundation : Elements of a well foundation – construction details of well foundations - Problems encountered in well sinking – Methods to rectify tilts and shifts

Module 5

Site investigation and soil exploration: objectives - planning - reconnaissance - Guidelines for choosing spacing and depth of borings [I.S. guidelines only] - Methods of subsurface exploration - test pits - Auger borings – Wash Boring - Rotary drilling - Standard Penetration Test – procedure and correlations - Corrections for SPT value – Numerical Problems - Sampling - disturbed samples, undisturbed samples and chunk samples - types of samplers - Sampler parameters - Boring log - Soil profile- Location of Water table - Geophysical methods : Seismic Refraction method and Electrical Resistivity method (in brief).

Text Books:

1. Ranjan G. and A. S. R. Rao, Basic and Applied Soil Mechanics, New Age International, 2002.
2. Arora K. R., Geotechnical Engineering, Standard Publishers, 2006.

References:

1. Das B. M., Principles of Geotechnical Engineering, Cengage India Pvt. Ltd., 2010.
2. Venkatramaiah, Geotechnical Engg, Universities Press, 2000.
3. Terzaghi K. and R. B. Peck, Soil Mechanics in Engineering Practice, John Wiley, 1967.
4. A V Narasimha Rao and C Venkatramaiah, Numerical Problems, Examples and Objective questions in Geotechnical Engineering, Universities Press (India) Ltd., 2000
5. Purushothamaraj P., Soil Mechanics and Foundation Engineering, Dorling Indersley (India) Pvt. Ltd., 2013
6. Taylor D.W., Fundamentals of Soil Mechanics, Asia Publishing House, 1948.

Course Contents and Lecture Schedule:

Module	Contents	Outcomes Addressed	Hours
1	**Module 1**		**9**
1.1	**Earth pressure** : Earth pressure - At rest, active and passive earth pressures - Practical examples	CO 2 & CO 5	1
1.2	Rankine's theory – Earth pressure and point of application for cohesionless and cohesive soils	CO 2	1
1.3	Influence of surcharge and water table on earth pressure - Numerical problems	CO 2 & CO 3	2
1.4	Earth pressure with layered backfill - Numerical problems	CO 2 & CO 3	2
1.5	Coulomb's theory [no derivation required] – Comparison of Rankine's and Coulomb's theory	CO 2	1
1.6	**Foundation – General Considerations** : Functions of foundations - definition of shallow and deep foundation - Selection of type of foundation	CO 4 & CO 5	1
1.7	Different types of shallow foundations - advantages and limitations of various types of shallow foundations	CO 4 & CO 5	1
2	**Module 2**		**9**
2.1	**Bearing capacity of shallow foundations**: Gross and Net bearing pressure - Ultimate and Safe bearing capacity	CO 2	1
2.2	Failure mechanism - Allowable soil pressure	CO 2	1
2.3	Terzaghi's bearing capacity theory for strip footing [no derivation required] – Assumptions – Bearing capacity factors	CO 2	1
2.4	Numerical problems	CO 3	1

2.5	Terzaghi's formulae for circular and square footings - Numerical problems	CO 2 & CO 3	1
2.6	Factors affecting bearing capacity - Effect of water table on bearing capacity	CO 2	1
2.7	Numerical problems	CO 3	1
2.8	General, local and punching shear failure	CO 2 & CO 3	1
2.9	Skempton's formula – Numerical problems	CO 2 & CO 3	1
3	**Module 3**		**9**
3.1	**Settlement analysis**: Introduction- causes of settlement – estimation of immediate settlement – Numerical problems	CO 2 & CO 3	1
3.2	Allowable settlement-Maximum and differential settlements as per Indian standard	CO 2 & CO 5	1
3.3	Field test - Plate load test – Procedure, uses and limitations	CO 3 & CO 5	1
3.4	**Footings** : Principles of design of footings – strip/continuous and individual footings - Numerical Problems	CO 4	1
3.5	Combined footings- Rectangular and Trapezoidal combined footings	CO 4	1
3.6	Numerical problems	CO 4	1
3.7	Footings subjected to eccentric loading	CO 4	1
3.8	**Raft foundations**: Types – Principles of design of raft foundation- Bearing capacity equations for raft on sand (Teng's equation based on SPT value) and for raft on clay (Skempton's formula)	CO 3 & CO 4	1
3.9	Floating foundations - conventional design procedure for rigid mat.	CO 2 & CO 4	1
4	**Module 4**		**9**
4.1	**Pile foundations**: Uses of piles - classification of piles - determination of type and length of piles	CO 2 & CO 5	1
4.2	Bearing capacity of single pile in clay and sand [I.S. Static formulae]	CO 2	1
4.3	Numerical problems	CO 3	1
4.4	Dynamic formulae (Modified Hiley formulae only) – Numerical Problems	CO 2 & CO 3	1
4.5	I.S. Pile load test [conventional]	CO 5	1
4.6	Negative skin friction - Group action - Group efficiency	CO 2	1
4.7	Capacity of Pile groups - Numerical problems	CO 3 & CO 4	1
4.8	**Well foundation** : Elements of a well foundation – construction details of well foundations	CO 2 & CO 5	1
4.9	Problems encountered in well sinking – Methods to rectify tilts and shifts	CO 2 & CO 5	1

5	**Module 5**		**9**
5.1	**Site investigation and soil exploration**: objectives - planning - reconnaissance	CO 1	1
5.2	Guidelines for choosing spacing and depth of borings [I.S. guidelines only]	CO 1	1
5.3	methods of subsurface exploration - test pits - Auger borings – Wash Boring - Rotary drilling	CO 1	1
5.4	Standard Penetration Test – procedure and correlations	CO 1	1
5.5	Corrections for SPT value – Numerical Problems	CO 1	1
5.6	Sampling - disturbed samples, undisturbed samples and chunk samples	CO 1	1
5.7	types of samplers - Sampler parameters	CO 1	1
5.8	Boring log - soil profile- Location of Water table	CO 1	
5.9	Geophysical methods : Seismic Refraction method and Electrical Resistivity method (in brief).	CO 1	1

Model Question Paper

QP CODE:

Reg No.:_______________ **Name:___________________________**

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CET 503

Course Name : GEOTECHNICAL ENGINEERING - II

Max. Marks: 100 Duration: 3 hours

Part A

(***Answer all questions; each question carries 3 marks***)

1. List the assumptions of Rankine's theory of earth pressure.
2. Explain the situations in which combined footings are provided.
3. Write the assumptions of Terzaghi's method for bearing capacity.
4. Explain the factors affecting bearing capacity.
5. Explain Allowable settlement.
6. Explain floating foundation.
7. Explain negative skin friction.
8. List the elements of a well foundation.
9. List Objectives of soil exploration.

10. Define (i) Inside clearance, (ii) Outside clearance and (iii) Area ratio as applied to sampler.

PART B

(Answer one full question from each module, each question carries 14 marks)

Module – 1

17. (a) Explain different types of earth pressures with practical examples. (6 Marks)

(b) A wall of 8m height retains a non-cohesive layered backfill. Top 3 m soil is having γ = 18 kN/m^3 and ϕ =30°. Bottom 5 m soil is having γ = 17.5 kN/m^3 and ϕ =28°. Using Rankine's theory, find the total active thrust on the wall and the point of application. (8 Marks)

18. (a) A 6m high retaining wall with vertical back supports soil which is in level with the top of retaining wall carries a uniform surcharge load of 20 kPa. Backfill properties are c = 5 kN/m^2, γ = 18.5 kN/m^3, ϕ = 30°. Determine Rankine's passive earth pressure on the retaining wall. (6 Marks)

(b) A 6m high retaining wall with vertical back supports soil which is in level with the top of retaining wall. Backfill properties are c = 5 kN/m^2, γ = 18 kN/m^3, ϕ = 30°. Find the maximum depth up to which excavation can safely be done without the sides caving in? Also determine Rankine's active earth pressure on the retaining wall before the formation of tension crack. (8 Marks)

Module – 2

11. (a) Differentiate between General shear failure and local shear failure. (6 Marks)

(b) A strip footing of 2.0 m wide is to be founded at a depth of 1.6 m in a soil with following data:

γ = 19 kN/m^3 ; c = 10 kN/m^2 ; ϕ = 40^0

N_c = 95.7 ; N_q = 81.3 ; N_γ = 100.4

Determine the safe bearing capacity with a FS of 3, when

i) Water table is at great depth
ii) Water table is at a depth of 1.0 m from ground level.
iii) Water table is at a depth of 3.0 m from ground level. (8 Marks)

12. (a) A Circular footing rests in pure clay with unconfined compressive strength q_u = 200 kN/m^2 at a depth of 1.5 m. Using Skempton's method, determine the diameter of footing if it has to transmit a net load of 1000 kN. Take FS = 3. (6 Marks)

(b) A square footing 2m x 2m is at a depth of 1.5 m in a soil with c = 30 kN/m^2, ϕ = 35°, (Nc = 57.8, N_q = 41.4 and N_γ = 42.4). Take γ = 18 kN/m^3. Calculate the net safe load that can be carried by footing. (8 Marks)

Module – 3

13. (a) A rectangular surface footing 2m x 3m carries a column load of 600 kN. The footing rests on a c-ϕ soil strata 6 m thick having = 0.25 and E as 5000 kN/m^2. Calculate the immediate settlement of footing assuming the influence factor I_f = 1.36. (6 Marks)

(b) Explain Plate Load Test with neat sketch. List the limitations of plate load test. (8 Marks)

16. (a) What are the different types of raft foundations? Under what circumstances raft foundations are preferred? (6 Marks)

(b) Design a rectangular combined footing for uniform pressure for the column loads of 1000 kN and 1500 kN at column A and B respectively. Projection of footing beyond centre line of column A is restricted to 0.5 m. Distance of c/c of columns is 5 m. Net Allowable pressure = 150 kN/m^2.

Design a suitable combined footing if projection beyond centre line of both columns restricted to 0.5 m. (8 Marks)

Module – 4

19. (a) Explain the classification of pile foundations based on installation. (6 Marks)

(b) A RCC pile weighs 25 kN is driven by drop hammer weighing 35 kN, having effective fall of 0.85 m. Average set/blow is 1.3 cm. Take elastic compression as 1.6 cm. Assuming coefficient of restitution as 0.25. Find ultimate and safe load on pile by assuming factor of safety of 2.5. (8 Marks)

20. (a) Explain any three methods (with neat sketches) for rectification of tilts in a well foundation. (6 Marks)

(b) A bored pile in a clayey soil is 50 cm diameter and 10 m long, determine the capacity of a 3X3 pile group spaced 1 m centre to centre both ways. Take C_u = 70 kN/m^2 and α = 0.6.

(8 Marks)

Module – 5

14. (a) Explain Augur boring and wash boring methods used in soil exploration. (6 Marks)

(b) Explain Standard Penetration Test? How this is correlated with shear strength parameters? What are the corrections to the observed SPT (N) value? (8 Marks)

15. (a) A SPT is conducted in a sand deposit at a depth of 16 m. Water table is at 7 m below ground level. Unit weight of sand is 18 kN/m^3 above water table and 19 kN/m^3 below water table. If N value is 36, find the corrected N value. (6 Marks)

(b) Explain Geophysical Exploration using Seismic Refraction Method. What are its limitations? (8 Marks)

22CET 504	HYDROLOGY & WATER RESOURCES ENGINEERING	Category	L	T	P	Credit	Year of Introduction
		PCC	3	1	0	4	2019

Preamble: The general objective of this course is to expose the students to the fundamental concepts of surface and groundwater components of hydrology and basics of water resources engineering. The course aim to impart the knowledge on the availability of water on hydrosphere, its distribution and quantification, scientific methods for computing irrigation water requirements, reservoir engineering and river engineering

Pre-requisite: NIL

Course outcome

After the course, the student will be able to:

CO1	Describe and estimate the different components of hydrologic cycle by processing hydro-meteorological data
CO2	Determine the crop water requirements for the design of irrigation canals by recollecting he principles of irrigation engineering
CO3	Perform the estimation of streamflow and/or describe the river behavior and control structures
CO4	Describe and apply the principles of reservoir engineering to estimate the capacity of reservoirs and their useful life
CO5	Demonstrate the principles of groundwater engineering and apply them for computing the yield of aquifers and wells

CO - PO Mapping

CET307 Hydrology and Water Resources		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	3	3		1			1					
	CO2	3	3					1					
	CO3	3	2					1					
	CO4	3	3					1					
	CO5	3	3					1					

Assessment pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	5	5	15
Understand	10	10	15
Apply	20	20	40
Analyze	15	15	30
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment Test(2 numbers)	:	25 marks
Assignment/Quiz/Course project	:	15 marks
Total	**:**	**50 marks**

End semester examination pattern – There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code: 22CET 504
Hydrology and Water Resources Engineering
Syllabus

Module I

Hydrologic cycle-precipitation-mechanism, types, forms and measurement using rain gauges ; Optimum number of rain gauges, representation of rainfall data-mass curve and hyetograph, computation of mean precipitation over a catchment, Design rainfall - probable maximum rainfall; IDF curves (conceptual idea only). Infiltration-measurement by double ring infiltrometer, Horton's model, infiltration indices. Evaporation –measurement and control

Module II

Runoff-components of runoff- Hydrograph analysis-Hydrograph from isolated storm-Base flow separation. Unit hydrograph – uses, assumptions and limitations of unit hydrograph theory.

Computation of storm/flood hydrograph of different duration by method of superposition and by development of S– Hydrograph; Floods-methods of design flood estimation –Empirical methods; SPF and PMF, Return period (conceptual ideas only)

Module III

Irrigation– Necessity, Benefits and ill effects. Types: flow and lift irrigation - perennial and inundation irrigation. Soil-water –plant relationships. Irrigation efficiencies, Computation of crop water requirement: depth and frequency of Irrigation. Duty and delta, duty-factors affecting and method of improving duty, Computation of crop water requirement by using the concept of duty and delta

Module IV

Streamflow measurement-area velocity method of stream gauging, selection of site for stream gauging station, Stage-discharge curve, flow duration curve-uses and characteristics. River training works-types; Meandering and meander parameters; Reservoirs- types, zones, yield of reservoir; determination of storage capacity and yield by mass curve method; Reservoir sedimentation and control- trap efficiency- computation of life of reservoir

Module V

Vertical distribution of ground water- classification of saturated formation (review) Aquifer properties, Darcy’s law, Well hydraulics-Steady radial flow into a fully penetrating well in Confined and Unconfined aquifers; Types of wells, Types of tube wells; well losses; Yield of open wells-pumping test and recuperation test

Text Books:

1. Modi P. N. Irrigation, Water Resources and Water Power Engineering, S.B.H Publishers and Distributors New Delhi 2009.
2. Punmia B.C. Ashok K Jain, Arun K Jain, B. B. L Pande, Irrigation and Water Power Engineering, Laxmi Publications (P) Ltd. 2009

References:

3. VenTe Chow. Hand book of Applied Hydrology, Tata McGraw Hill, 1988
4. Todd D. K. Ground Water Hydrology, Wiley, 2005.
5. H.M Raghunath. Groundwater. New Age International New Delhi 2007
6. G.L.Asawa. Irrigation and Water Resources Engineering New Age International New Delhi 2008
7. Garg S. K. Hydrology and Water Resources Engineering, Khanna Publishers New Delhi 2005.
8. Garg SK, Irrigation Engineering and Hydraulic Structures Khanna Publishers New Delhi 2006.
9. Subramanya K. Engineering Hydrology, Tata McGraw Hill, 2013.
10. Raghunath H.M. Hydrology: Principles, Analysis and Design. New Age International New Delhi 2006.

Course Code: 22CET 504

Hydrology and Water Resources Engineering

(Course plan)

Module	Topic	Course outcome addressed	No of Hours
Module I (11 Hours)			
1.1	Hydrology-Hydrologic cycle	CO1	1
1.2	Precipitation- mechanism, types, forms	CO1	1
1.3	Measurements of rainfall- Use of rain gauges	CO1	1
1.4	Representation of rainfall data-Rainfall Mass curve, hyetograph; Optimum number of rain gauges	CO1	1
1.5	Estimation of missing precipitation	CO1	1
1.6	Computation of mean precipitation	CO1	1
1.7, 1.8	Problems	CO1	2
1.9	Design rainfall - probable maximum rainfall; IDF curves (conceptual idea only).	CO1	1
1.10	Water losses-Infiltration-measurement by double ring infiltrometer, Horton's equation; concept of infiltration indices	CO1	1
1.11	Evaporation-measurement by IMD land pan, control of evaporation	CO1	1
Module II (9 Hours)			
2.1	Runoff- Components, factors affecting runoff, Computation of runoff by different methods.	CO1	1
2.2	Runoff computation by rational formula and from infiltration indices	CO1	1
2.3	Hydrograph analysis-Hydrograph from isolated storm-Base flow separation	CO1	1
2.4	Concept of unit hydrograph-assumptions, uses, applications	CO1	1
2.5	Computation of storm/flood hydrograph ordinates of different duration by method of superposition	CO1	1
2.6	Computation of storm/flood hydrograph ordinates of different duration by development of S– Hydrograph	CO1	1
2.7,2.8	Problems	CO1	2
2.9	Floods-methods of design flood estimation –Empirical methods; SPF and PMF, Return period (conceptual ideas only)	CO1	1
Module III (7 Hours)			
3.1	Irrigation-Benefits and ill effects, lift and flow irrigation	CO2	1
3.2	Types of irrigation, Irrigation efficiencies	CO2	1

3.3	Soil water plant relationships	CO2	1
3.4	Computation of crop water requirement: depth and frequency of Irrigation	CO2	1
3.5	Duty and delta-Factors affecting and method of improving duty	CO2	1
3.6	Estimation of crop water requirement by using the concepts of duty and delta	CO2	1
3.7	Problems	CO2	1
Module IV (11 Hours)			
4.1	Streamflow measurement- measurement of stage and velocity	CO3	1
4.2	Stage-discharge curve- Selection of site for stream gauging station,	CO3	
4.3	Computation of discharge (Area-velocity method)-problem	CO3	
4.4	Flow duration curves-uses and characteristics	CO3	
4.5	River behavior-meandering-meander parameters, Objectives of river training	CO3	1
4.6	Types of river training works	CO3	1
4.7	Reservoirs- types, zones, yield of reservoir	CO4	1
4.8	Storage capacity and yield-by mass curve method	CO4	1
4.9	Reservoir sedimentation-control of sedimentation, trap efficiency	CO4	1
4.10	Useful life of reservoir-computation.	CO4	1
4.11	Problems	CO4	1
Module V (7 Hours)			
5.1	Vertical distribution of ground water - classification of saturated formation (Review)	CO5	1
5.2	Aquifer properties- Darcy’s law	CO5	1
5.3	Steady radial flow to a well-unconfined aquifers	CO5	1
5.4	Steady radial flow to a well-unconfined aquifers	CO5	1
5.5	Problems	CO5	1
5.6	Types of wells-open wells and tube well, Types of tube wells – description	CO5	1
5.7	Estimation of yield of an open well- pumping test and recuperation test	CO5	1

Course Code: 22CET 504

Hydrology and Water Resources Engineering

(Course Level Assessment Questions)

<table>
<tr><td>CO1</td><td>Describe and estimate the different components of hydrologic cycle by processing hydro-meteorological data</td></tr>
<tr><td>1</td><td>Differentiate rainfall mass curve and hyetograph</td></tr>
<tr><td>2</td><td>Explain the use of double ring infiltration for infiltration measurement</td></tr>
<tr><td>3</td><td>Explain any three methods for baseflow separation</td></tr>
<tr><td>4</td><td>Explain the limitations of unit hydrograph theory</td></tr>
<tr><td>5</td><td>A storm with 10 cm of precipitation produced a direct runoff of 5.8 cm. The duration of the rainfall was 16 hrs and its time distribution is given below : (10 Marks)
<table>
<tr><td>Time from start (h)</td><td>0</td><td>2</td><td>4</td><td>6</td><td>8</td><td>10</td><td>12</td><td>14</td><td>16</td></tr>
<tr><td>Cumulative rainfall (cm)</td><td>0</td><td>0.4</td><td>1.3</td><td>2.8</td><td>5.1</td><td>6.9</td><td>8.5</td><td>9.5</td><td>10</td></tr>
</table>
Determine the ϕ -index of the storm.</td></tr>
<tr><td>6</td><td>The ordinates of a 4-hour unit hydrograph for a particular basin are given below. Determine the ordinates of the 6-hour unit hydrograph.
<table>
<tr><td>Time (hrs)</td><td>0</td><td>2</td><td>4</td><td>6</td><td>8</td><td>10</td><td>12</td><td>14</td><td>16</td><td>18</td><td>20</td><td>22</td><td>24</td></tr>
<tr><td>Discharge (Cumecs)</td><td>0</td><td>25</td><td>100</td><td>160</td><td>190</td><td>170</td><td>110</td><td>70</td><td>30</td><td>20</td><td>16</td><td>1.5</td><td>0</td></tr>
</table></td></tr>
</table>

CO2	**Determine the crop water requirements for the design of irrigation canals by recollecting the principles of irrigation engineering**
1	Explain the factors affecting duty. Explain how can you improve the duty
2	Define duty and delta. Obtain the relation between the two

3	Define the different types of irrigation efficiencies
4	The following data pertaining to healthy growth of a crop: Root zone depth = 75 cm Field capacity = 27 %, Wilting point=14 % Dry density of soil=1500 kg/$m^{3.}$ Daily consumptive use =11 mm. Assuming 80 % depletion of available moisture as an indicator for application of water, determine how long the crop survive without irrigation
5	The CCA for a distributary is 15000 ha. The intensity of irrigation for Rabi is 40 % and for Kharif is 15 %. If the total water requirement of the two crops is 37.5 cm and 120 cm and their periods of growth are 160 days and 140 days respectively, determine the design discharge at the outlet.

CO3	**Perform the estimation of streamflow and/or describe the river behavior and control structures**
1	Explain Meandering. What are the causes of meandering ?
2	Explain the objectives of providing river training works
3	Enlist the factors affecting the selection of site for stream gauging station
4	The data pertaining to a stream gauging operation at a gauging station are given below. The rating equation of the current meter is $v \quad 0.32N_s \quad 0.032$ m/sec where N_s is the number of revolutions per second. Compute the discharge in the stream by area velocity method

Distance from left water edge (m)	0	2	4	6	9	12	15	18	20	22	23	24
Depth (m)	0	0.5	1.1	1.95	2.25	1.85	1.75	1.65	1.5	1.25	0.75	0
Revolutions of current meter kept at 0.6 depth	0	80	83	131	139	121	114	109	92	85	70	0
Duration of observation (s)	0	180	120	120	120	120	120	120	120	120	120	120

5	Describe with sketches different type of groynes

CO4	**Describe and apply the principles of reservoir engineering to estimate the capacity of reservoirs and their useful life**
1	Define safe yield, secondary yield and design yield of reservoirs
2	Explain mass inflow curve and mass demand curve
3	Explain with a neat sketch the zones of a storage reservoir
4	Explain the procedure for estimating the life of storage reservoir
5	The average annual discharge of a river for 11 years is given below Year: 1960, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70 Discharge (m^3/sec): 1750, 2650, 3010, 2240, 2630, 3200, 1000, 950, 1200, 4150, 3500 Determine the storage capacity of a reservoir required to meet a demand of 2000 cumec throughout the year by mass curve method.

Year	1960	61	62	63	64	65	66	67	68	69	70
Discharge (m^3/sec)	1750	2650	3010	2240	2630	3200	1000	950	1200	4150	3500

CO5	**Demonstrate the principles of groundwater engineering and apply them for computing the yield of aquifers and wells**
1	State Darcy's law and its limitations
2	Enlist the assumptions in the derivation of Dupuit's equation
3	Differentiate perched aquifer and leaky aquifer
4	Describe the working of strainer type tube well with a sketch
5	Pumping at the rate of 1500 litres per minute from a 30cm diameter well of depth 60m in an unconfined aquifer gives a drawdown of 2m and 1.1m in observation wells located at distances 120m and 160m respectively from it. Calculate the drawdown of the pumping well and the coefficient of permeability of the aquifer.
6	During a recuperation test conducted on an open well in a region, the water level in the well was depressed by 3 m and it was observed to rise by 1.75 m in 75 minutes. (a) What is the specific yield of open wells in that region (b) What will be the yield from a well of 5 m diameter under a depression head of 2.5 m ? (c) What diameter should be the diameter of the well to give a yield of 12 l/sec under a depression head of 2 m ?

Pages: 3

Model Question Paper

Reg No.:…………………. **QP CODE:……………….**

Name:…………………………………….

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CET 504

Hydrology and Water Resources Engineering

Max. Marks: 100 **Duration: 3 hours**

Part A

(Answer all questions; each question carries 3 marks)

1. Explain the different forms of precipitation
2. What are the methods of control of evaporation from water bodies?
3. Define unit hydrograph. Explain its uses
4. State the limitations of rational formula for runoff estimation
5. Explain irrigation efficiencies
6. Define duty and delta. Obtain the relation between the two
7. Enlist the factors to be considered in the selection of site for a stream gauging station
8. Explain meandering of rivers
9. Define (i) Storativity (ii) Transmissibility
10. Explain well losses

Part B

(Answer one full question from each module, each question carries 14 marks)

Module I

11 (a) Explain the working of a Siphon type rain gauge with a neat sketch (5 Marks)

(b) The average rainfall of 5 rain gauge stations in the base stations are 89, 54, 45, 41 and 55 cm. If the error in the estimation rainfall should not exceed 10 %, how many additional gauges may be required to be installed in the catchment? (9 Marks)

OR

12.(a) Compare different methods for determination of mean precipitation from a catchment (6 Marks)

(b) Explain the use of double ring infiltrometer for the measurement of infiltration. How will you develop Horton's model? (8 Marks)

Module II

13.(a) The rates of rainfall for the successive 30 min period of a 3-hour storm are:1.6, 3.6, 5.0, 2.8, 2.2, 1.0 cm/hr. The corresponding surface runoff is estimated to be 3.6 cm. Estimate the ϕ -index (7 Marks)

(b) Explain the characteristics of a single peak hydrograph from an isolated storm. How will you separate the base flow? (7 Marks)

OR

14. Find out the ordinates of a storm hydrograph resulting from a 9 hr storm with rainfall of 2, 5.75 and 2.75 cm during subsequent 3 hr intervals. The ordinates of 3hr unit hydrograph at 3 hr intervals are 0, 100, 355, 510, 380, 300, 260, 225,165, 120,85, 55,30, 22, 10, 0 (cumecs). Assume an initial loss of 0.5 cm and ϕ -index of 2.5 mm/hr and abase flow of 10 cumecs. (14 Marks)

Module III

15. (a) Differentiate lift irrigation and flow irrigation. (4 Marks)

(b) Estimate the frequency of irrigation required for certain crop for the following data: Root zone depth = 90 cm Field capacity = 22 %, Wilting point=12 % Dry density of soil=1500 kg/m$^{3.}$ Daily Consumptive use =22 mm. Assume 70 % depletion of available moisture as an indicator for application of water (10 Marks)

OR

16. (a) Explain the benefits and ill effects of irrigation (4 Marks)

(b) What are the factors affecting duty? How can you improve the duty of water.

(10 Marks)

Module IV

17 (a) Explain the use of current meter for velocity measurement in streams (7 Marks)

(b) Explain the method of determination of useful life of a reservoir. (7 Marks)

OR

18 (a) Explain the features of different types of groynes (8 Marks)

(b) Explain the types of storage reservoirs (6 Marks)

Module V

19 (a) State Darcy's law and its limitations (4 Marks)

(b) The following observations were recorded during a pumping out test on a tube well penetrating fully in an aquifer: Well diameter: 25 cm, Discharge from the well: 300 m^3/hr, RL of original water surface before pumping started: 122.000, RL of water in the well at constant pumping: 117.100 , RL of water in the observation well: 121.300, RL of impervious layer: 92.000, radial distance of observation well from the tube well: 50 m. Determine : (a) field permeability coefficient of the aquifer (b) radius of zero drawdown. (10 Marks)

OR

20.(a) Explain the method of determination of yield of an open well (7 Marks)

(b) Explain the working of a strainer type tube well with a sketch (7 Marks)

22CET 505	CONSTRUCTION TECHNOLOGY AND MANAGEMENT	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PCC	3	0	0	3	2019

Preamble:

Construction Technology and Management introduces the basic concepts of civil engineering construction and its management. The course provides a detailed insight into the materials used in construction, various building elements and construction technology. Management is essential for successful completion of construction projects and the course introduces the students to the basic concepts of construction project management and planning. After the course, students will be familiar with the fundamental concepts of building construction and management.

Prerequisite: Basics of Civil and Mechanical Engineering

Course Outcomes: After completion of the course, the student will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Describe the properties of materials used in construction	Understand
CO2	Explain the properties of concrete and its determination	Understand
CO3	Describe the various elements of building construction	Understand
CO4	Explain the technologies for construction	Understand
CO5	Describe the procedure for planning and executing public works	Understand
CO6	Apply scheduling techniques in project planning and control	Application

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					1	1	1		1		1
CO2	3					1		1		1		1
CO3	3					1				1		1
CO4	3					2	1			1		1
CO5	3	2				1				1	3	1
CO6	3	3	3		1				2	1	3	1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	40	30	76
Apply		10	14
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Course Level Assessment (Sample) Questions

CO1: Describe the properties of materials used in construction

1. Write a short note on manufacturing process of cement.
2. Explain any three laboratory tests on cement and its IS specifications.
3. Write a note on quality of water used for concrete.
4. Explain the various types of admixtures and their uses.

CO2: Explain the properties of concrete and its determination

1. Explain briefly the manufacturing process of concrete.
2. Explain a method to assess the workability of concrete. Also highlight the merits and demerits of the test.
3. Explain the factors affecting bleeding and segregation of concrete.
4. Explain the various factors affecting strength of concrete.

CO3: Describe the various elements of building construction

1. Discuss the purpose of providing damp proof course.
2. Distinguish between plastering and pointing.
3. Explain the various types of pointing with neat sketches.
4. State the advantages and disadvantages of framed structures.

CO4: Explain the technologies for construction

1. Explain voided slab construction.
2. Describe the classification of scaffolding.
3. Explain slipform construction.
4. Discuss the general reasons of building failure.

CO5: Describe the procedure for planning and executing public works

1. Differentiate between earnest money deposit and security deposit.
2. Discuss the advantages of a lump sum contract over an item-rate contract.

3. Explain the life cycle of a construction project.
4. Explain the process of tendering for a construction project.

CO6: Apply scheduling techniques in project planning and control

1. The following details regarding a project are given.

Activity	A	B	C	D	E	F	G	H	I	J
Immediate Predecessor	-	A	A	B	B	C	C	D	E, F	G
Duration (Days)	5	2	6	4	4	2	3	8	7	2

(a) Prepare an Activity on Node Diagram.

(b) Find the expected duration of the project.

(c) Determine the critical activities.

(d) Compute the total and free float of all the activities.

2. For the project details given below:

(a) Draw the network.

(b) Prepare the schedule of activities

(c) What is the project completion time?

(d) Which is the critical path?

(e) Determine the probability of completing the project in 55 days?

Activity	A	B	C	D	E	F	G	H	I
Predecessor	-	A	A	B	B	C	E	D,F	G,H
A	4	5	4	15	10	8	4	1	6
M	6	7	8	20	18	9	8	2	7
B	8	15	12	25	26	16	12	3	8

SYLLABUS

Module 1

Construction Materials

Timber products – properties and uses of veneer, plywood, fibre board, particle board, multi wood

Cement: Manufacturing, chemical composition, Tests on cement – specific gravity, standard consistency, initial and final setting time, fineness, soundness, compressive strength, IS specifications

Aggregates – types, Gradation, importance of gradation, bulking of fine aggregate

Quality of water for construction (Brief discussion only, Permissible limits of chemical constituents not required)

Admixtures, uses – mineral admixtures – fly ash and ground granulated blast furnace slag and chemical admixtures – plasticizers, superplasticizers, accelerators, retarders (brief discussion only)

Module 2

Concrete and Building Construction

Process of manufacturing concrete – batching, mixing, transportation, placing, compacting, finishing, curing

Properties of fresh concrete: Workability, factors affecting workability, test on workability (slump test), segregation and bleeding (brief discussion)

Properties of hardened concrete: Strength, factors affecting strength, tests for strength of concrete in compression, tension and flexure

Lintels and arches: Types and construction details

Damp proof course (brief discussion only)

Finishing works: Plastering, pointing, painting – objectives and types

Structural systems – load bearing and framed construction, RCC and steel framed structures

Module 3

Construction Technology

Cost-effective construction – rapid wall construction, soil-cement block masonry, voided slab technology, filler slab technology (brief discussion only)

Scaffolding – uses and classification (brief discussion only)

Formwork – requirements of good formwork, classification, slipform (brief discussion only)

Prefabricated construction – advantages and disadvantages, prefabricated building components.

Basic concept of prestressing – fundamental understanding of pre-tensioned and post-tensioned construction

Construction 3D printing (brief discussion only)

Building failures – general reasons

Causes of failures in RCC, steel and masonry structures

Module 4

Construction Project Management

Construction projects, categories, life cycle of a project – pre-project phase, project phase, post-project phase, Detailed Project Report – contents

Tendering: types of tenders, stages in tendering

Contracts: types of contracts – item rate contract, lumpsum contract, percentage rate contract, turnkey contracts, concession contracts – BOT

Module 5

Construction Planning

Work break down structure

Types of Schedules – Construction schedule, Material schedule, labour schedule, equipment schedule, financial schedule

Bar chart, Mile Stone Charts

Networks, Network representation – Activity on Node (AoN) Diagram

Network analysis – Critical Path Method (CPM), Programme Evaluation and Review Technique (PERT) – concepts and problems

Text books:

1. Shetty M.S. and A. K. Jain (2019), Concrete Technology: Theory and Practice, S. Chand &Company Pvt. Ltd.
2. Varghese P. C. (2007), Building Construction, Prentice Hall India.
3. Punmia B. C., Ashok Kumar Jain and Arun Kumar Jain (2016), Building Construction, Laxmi Publications (P) Ltd.
4. Sharma S.C. and S.V. Deodhar (2019), Construction Engineering & Management, Khanna Book Publishing Co. (P) Ltd.
5. Kumar Neeraj Jha (2015), Construction Project Management: Theory and Practice, Pearson India Education Services Pvt.Ltd.

Reference books:

1. Sahu G. C. and Joygopal Jena (2015), Building Materials and Construction, McGraw Hill Education (India) Private Limited.
2. Gambhir M. L. (2004), Concrete Technology, Tata McGraw-Hill Publishing Company Limited.
3. Sharma S. K. (2019), Civil Engineering Construction Materials, Khanna Book Publishing Co. (P) Ltd.
4. Neville A. M. and Brooks J. J. (2010), Concrete Technology, Pearson Education Ltd.
5. Mehta P. K. and Paulo J. M. Monteiro (2014), Concrete-Microstructure, Properties and Materials, McGraw Hill Education.
6. Santhakumar R. (2006), Concrete Technology, Oxford Universities Press India.
7. Tony Bryan (2010), Construction Technology – Analysis and Choice, Wiley-Blackwell.
8. Joseph J. Moder, Cecil R. Philips and Edward W. Davis (1983), Project Management with CPM, PERT and Precedence Diagramming, Van Nostrand Reinhold Company Inc.
9. Charles Patrick (2012), Construction Project Planning and Scheduling, Dorling Kindersley India Pvt. Ltd.
10. Daniel W. Halpin and Bolivar A. Senior (2011), Construction Management, John Wiley and Sons Inc.

Lecture Plan

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module I (6 hours)**		
1.1	Timber products – properties and uses of veneer, plywood, fibre board, particle board, multi wood	CO1	1
1.2	Cement – Manufacturing, chemical composition	CO1	1
1.3	Tests on cement – specific gravity, standard consistency, initial and final setting time, fineness, soundness, compressive strength, IS specifications	CO1	1
1.4	Aggregates – types, Gradation, importance of gradation, bulking of fine aggregate	CO1	1
1.5	Quality of water for construction (Brief discussion only, Permissible limits of chemical constituents not required) Admixtures, uses – mineral admixtures – fly ash and ground granulated blast furnace slag and chemical admixtures – plasticizers, superplasticizers, accelerators, retarders (brief discussion only)	CO1	2
2	**Module II (8 hours)**		
2.1	Concrete manufacturing – batching, mixing, transportation, placing, compacting, finishing, curing	CO2	2
2.2	Properties of fresh concrete: Workability, factors affecting workability, test on workability (slump test), segregation and bleeding (brief discussion)	CO2	1
2.3	Properties of hardened concrete: Strength, factors affecting strength, tests for strength of concrete in compression, tension and flexure	CO2	1
2.4	Lintels and arches: Types	CO3	1

2.5	Damp proof course (brief discussion only), Finishing works: Plastering, pointing (objectives and types)	CO3	1
2.6	Painting (objectives and types)	CO3	1
2.7	Structural systems – load bearing and framed construction, RCC and steel framed structures	CO3	1
3	**Module III (6 hours)**		
3.1	Cost-effective construction – rapid wall construction, soil-cement block masonry, voided slab technology, filler slab technology (brief discussion only)	CO4	1
3.2	Scaffolding – uses and classification (brief discussion only)	CO4	1
3.3	Formwork – requirements of good formwork, classification, slipform (brief discussion only)	CO4	1
3.4	Prefabricated construction – advantages and disadvantages, prefabricated building components. Basic concept of prestressing – fundamental understanding of pre-tensioned and post-tensioned construction Construction 3D printing (brief discussion only)	CO4	1
3.5	Building failures – general reasons Causes of failures in RCC, steel and masonry structures	CO4	2
4	**Module IV (7 hours)**		
4.1	Introduction to construction project management, construction projects, categories	CO5	1
4.2	Life cycle of construction project – pre-project phase, project phase, post-project phase, Detailed Project Report – contents	CO5	2
4.3	Tendering, types of tenders, stages in tendering	CO5	2
4.4	Contracts – types of contracts – item rate contract,	CO5	2

	lumpsum contract, percentage rate contract, turnkey contracts, concession contracts – BOT		
5	**Module V (8 hours)**		
5.1	Introduction to construction planning and scheduling, Work break down structure	CO6	1
5.2	Types of Schedules: Construction schedule, Material schedule, labour schedule, equipment schedule, financial schedule	CO6	1
5.3	Bar chart, Mile Stone Charts	CO6	1
5.4	Introduction of networks, Network representation – Activity on Node (AoN) Diagram, Critical Path Method (CPM) – concepts and problems on determination of critical path, floats	CO6	3
5.5	Programme Evaluation and Review Technique (PERT) – concepts and problems	CO6	2

MODEL QUESTION PAPER

Reg.No.:_______________ Name:__________________________

FIFTH SEMESTER B. TECH DEGREE EXAMINATION

Course Code: 22CET 505

Course Name: **CONSTRUCTION TECHNOLOGY AND MANAGEMENT**

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions. Each question carries 3 marks.

1. Explain bulking of fine aggregate.
2. State the IS specification for initial and final setting time of OPC.
3. Discuss the various objectives of plastering.
4. List the various requirements of an ideal paint.
5. Briefly describe rapid wall construction technology.
6. Explain 3D printing in construction.
7. Discuss the advantages and disadvantages of an item-rate contract.
8. Explain selective tendering.
9. Explain the three time estimates in PERT.
10. Illustrate the use of a material schedule in organizing construction activities at a site.

(10×3 marks = 30 marks)

PART B

Answer one full question from each module. Each full question carries 14 marks.

Module I

11. a) Discuss the role of plasticizers in concrete.

(6 marks)

b) Differentiate between fibre board and particle board. (8 marks)

OR

12. a) Discuss the chemical composition of cement. (5 marks)

b) Explain gradation of aggregates. Discuss the significance of gradation of aggregates.

(9 marks)

Module II

13. a) Define workability of concrete. Explain the factors affecting workability. (5 marks)

b) Explain any three laboratory tests on hardened concrete. (9 marks)

OR

14. a) Explain various types of arches with neat sketches. (8 marks)

b) Distinguish between RCC framed and steel framed structures. (6 marks)

Module III

15. Explain the causes of failure in RCC structures. (14 marks)

OR

16. a) Discuss the advantages and disadvantages of prefabricated construction. (6 marks)

b) Explain filler slab technology. (8 marks)

Module IV

17. Discuss the details included in the DPR of an infrastructure project. (14 marks)

OR

18. Explain the project formulation stage of a construction project. (14 marks)

Module V

19. For the given data, draw an AON network and determine the critical path. Also find the total float, free float and independent float of each activity.

Activity	A	B	C	D	E	F	G	H	I
Predecessor	-	A	A	C	B	B, D	C	F, G	E, H
Duration (days)	4	6	4	2	4	5	3	4	2

(14 marks)

OR

20. The table shows the details of various activities of a small project.

Activity	A	B	C	D	E	F	G	H	I	J
Predecessor	-	-	A	A	B	E	C	D, F	H	G
Optimistic time (days)	4	3	7	5	6	2	3		2	6
Most likely time (days)	6	5	8	7	7	3	4	9	4	8
Pessimistic time (days)	8	7	9	9	8	4	5	11	6	10

a) Draw an AON network and calculate the project completion time with 50% probability.

b) Find the probability of completing the project in (i) 30 days; (ii) 26 days.

c) What project completion date has 80% chance of being met? (14 marks)

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22MNC506	DISASTER MANAGEMENT	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC – COMMON	2	0	0	2	2019

Preamble

Objective of the course is to introduce the concept of disasters, their causes and their mitigation and management.

Prerequisite: Nil

Course Outcomes:

CO No.	Description
	At the end of the course, students will be able to:
CO 1	Distinguish between hazard and disaster, and **understand** the terminologies.
CO 2	**Analyse** the causes behind natural disasters and **evaluate** their magnitude and impacts
CO 3	**Analyse** the anthropogenic disasters, **evaluate** them and propose plans and **designs** for minimizing the same.
CO 4	**Understand** the concept of sustainable development and EIA and their role in mitigating disasters
CO 5	**Create** management plans for hazards and disasters, and **understand** the roles of agencies involved

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	1	-	2	1	2	3	1	-	1	1	2	2	2
CO 2	1	2	2	2	2	2	2	1	1	1	1	3	2	3
CO 3	2	1	3	2	2	3	3	2	2	1	3	3	2	3
CO 4	2	2	2	2	1	3	3	2	2	2	2	3	2	3
CO 5	2	3	3	3	3	3	2	2	3	3	3	3	2	3

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (marks)
	Test 1 Marks	Test 2 Marks	
Remember	7.5	7.5	30
Understand	7.5	7.5	30
Apply	-	-	-
Analyse	5	5	20
Evaluate	5	5	20
Create			

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern:
The question consists of two parts- Part A and Part B. Part A consists of 10 questions with 3 marks for each (two questions from each module). Part B consists of two questions from each module, out of which one has to be answered. Each question carries 14 marks and can have maximum 2 subdivisions.

Sample Course Level Assessment Questions:

1 **Course Outcome 1 (CO1):** Citing a few examples known to you, discuss how disaster differs from a hazard.

2 **Course Outcome 2 (CO2):** Compare a few earthquakes in history based on their magnitude and degree of damage.

3 **Course Outcome 3 (CO3):** Discuss how the quality of water in river is assessed.

4 **Course Outcome 4 (CO4):** Based on any disaster in an infrastructure project, prepare a report on how following EIA rules could have abated the disaster.

5 **Course Outcome 5 (CO5):** Prepare a disaster management plan in case of a landslide on a Railway track near to a station.

Module	Contents	Hours
1	Hazards and disasters: Relationship between disasters and development, implications. Introduction to key concepts and terminology: hazard, vulnerability, exposure, risk, crisis, emergencies, Disasters, Resilience.	3
2	Natural Disasters- Landslides: causes, types. Nature of impacts and assessment. Floods- types and causes of floods.	5
3	Anthropogenic Disasters I: Basic concepts –soil and soil degradation: Pollution on account of insecticides and chemical fertilizers.	5
4	Anthropogenic Disasters II: Atmospheric pollution- Pollutants, sources of SO_2, CO, NO_x and Particulates in air.	6
5	Hazard and disaster management plans for floods: Relief and Amenities, Concepts of EIA.	5

Syllabus

Text Books

1. Ariyabandu, M. and Sahni P. "Disaster Risk Reduction in South Asia", Prentice-Hall (India), 2003.
2. De, A.K., "Environmental Chemistry"., New Age International, Newdelhi. 2006
3. Valdiya, K.S. "Environmental Geology - Ecology, Resource and Hazard Management". McGraw-Hill Education (India) Private Limited. 2013
4. Shaw, R and Krishnamurthy, RR (Ed.) "Disaster Management: Global Problems and Local Solutions". Universities Press (India) Ltd. 2009

References

1. Andrew, S., "Environmental Modeling with GIS and Remote Sensing", John Willey, 2002
2. Bell, F.G., "Geological Hazards: Their assessment, avoidance and mitigation", E & FN SPON Routledge, London. 1999
3. Bossler, J.D., "Manual of Geospatial Science and Technology", Taylor and Francis, 2001
4. Alexander, D., "Natural Disasters", Research Press, New Delhi, 1993
5. Girard, J. "Principles of Environmental Chemistry". Jones & Bartlett Publishers,New York. 2013

6. Gupta, H.K. (Ed.), “Disaster management”. Universities Press (India) Ltd. 20038. Jha, M.K. (Ed.) “Natural and Anthropogenic Disasters- Vulnerability, Preparedness and Mitigation”. Springer, Amsterdam. 2010
7. Khorram-Manesh, A. (Ed.). “Handbook of Disaster and Emergency Management”. Kompendiet (Gothenburg). 2017
8. Mason, I., McGuire, B., and Kilburn, C., “Natural Hazards and Environmental Change (Key Issues in Environmental Change)”. Routledge, London. 2002
9. Nick Carter. W., “Disaster Management - A Disaster Manager's Handbook”. Asian Development Bank, Philippines. 1991
10. U.N.O, “Mitigating Natural Disasters, Phenomena, Effects and options, A Manual for policy makers and planners”, United Nations. New York, 1991

Course Content and lecture Schedule:

No.	Topic	Course Outcome	No. of Hrs
1	**Module 1**		Total: 24
1.1	Introduction, Hazard and disaster, Classification, How development is connected to disasters.	CO1	1.5
1.2	Hazard and disaster Terminology: vulnerability, exposure, risk, crisis, emergencies, resilience.	CO1	1.5
2	**Module 2**		Total: 3
2.1	Natural Disasters: General classification, Landslides: types, causes, impact and impact assessment.	CO2	3
2.2	Floods: types, causes, impact and impact assessment.	CO2	2
3	**Module 3**		Total: 5
3.1	Anthropogenic Disasters: Basic concepts of type and processes.	CO3	1
3.2	Soil- formation, and characteristics. Soil degradation	CO3	2
3.3	Chemical toxicity in soils due to industries and agriculture.		2
4	**Module 4**		Total: 5
4.1	Atmospheric pollution: Air quality, Types of pollutants, sources and diffusion of SO2, CO, NOx and Particulates in air	CO3	4
4.2	Impacts of atmospheric pollution	CO3	2
5	**Module 5**		Total: 6
5.1	Hazard and Disaster Management: General planning, relief camps and amenities.	CO4	1
5.2	Management of floods: pre-disaster phase, actual disaster phase, post-disaster phase.	CO5	3
5.3	Concepts of EIA.	CO5	1
			Total: 5

THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22MNC506

Course Name: **DISASTER MANAGEMENT**

Model Question Paper

Marks:100 Duration: 3 hrs

PART A

(Answer all questions. Each question carries three marks)

1. With a typical example explain how a hazard differs from a disaster
2. Explain the terms: vulnerability and risk and how they contribute to disasters
3. Enumerate natural disasters, and mention their impacts.
4. How are floods caused? What is the connection between floods and urbanisation?
5. How is soil formed? Why do soils differ in characteristics?
6. How do fertilizers affect soils? Mention any two examples.
7. Discuss how particulates pollute air, bringing out the implications.
8. Explain how the air pollution affects agriculture.
9. Illustrate the concept of hazards with an example.
10. How is environmental impact connected to disasters?

PART B

(Answer one full question from each module)

a) Describe how an infrastructure project could trigger disaster. (6)

b) How does resilience influence the recovery from a disaster? Illustrate with examples. (8)

OR

12 Bring out the differences between emergency and disaster. How is the risk for a disaster assessed? (14)

13 What are the causes of floods? How do they decide the magnitude of impact? (14)

OR

14 Discuss the triggering factors for landslides. Illustrate how they could become disastrous in the case of an infrastructure project. (14)

15 Discuss the impacts of insecticides on environment. Illustrate three remedial measures? (14)

OR

16 How does desertification occur? Discuss the mitigation measures. (14)

17 Discuss the health hazards of air pollution. (14)

OR

18 Explain the sources of SO_2, CO and NO_X? What are the implications of air pollution? (14)

19 Prepare a disaster management plan for a flood event in a hilly terrain. Discuss the organisational set up needed for the relief work. (14)

OR

20 Discuss the various factor to be considered in conducting environmental impact assessment of dams, keeping in mind the probable hazards/disasters. (14)

22CEL 507	MATERIAL TESTING LAB II	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		LAB	0	0	2	1	2019

Preamble: The course aims to enrich the students to gain hands-on experience in conducting laboratory tests on various construction materials and thereby evaluate material quality and performance.

Prerequisite: Basics of Construction Engineering Materials.

General Instructions to Faculty:

1. Any 12 of the 15 experiments included in the list of experiments need to be performed mandatorily. Virtual Lab facility cannot be used to substitute the conduct of these mandatory experiments.
2. The laboratory should have possession of modern testing equipment such as Rebound hammer, ultrasonic pulse velocity, rebar locator, core cutter, concrete penetrometer and crack detection microscope at least for demonstration purposes.
3. Periodic maintenance and calibration of various testing instruments needs to be made.
4. Use of data visualization packages such as may be required for making various plots.

Course Outcomes: After the completion of the course, the student will be able to:

Course Outcome	Course Outcome Description
CO 1	To describe the basic properties of various construction materials
CO 2	Characterize the physical and mechanical properties of various construction materials.
CO3	Interpret the quality of various construction materials as per IS Codal provisions.

Mapping of course outcomes with program outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	**3**	**2**	**2**	**2**	**1**	**3**	**-**	**-**	**2**	**2**	**-**	**2**
CO 2	**3**	**2**	**2**	**2**	**1**	**3**	**-**	**-**	**2**	**2**	**-**	**2**
CO 3	**3**	**2**	**2**	**2**	**1**	**3**	**-**	**-**	**2**	**2**	**-**	**2**

Assessment Pattern:

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance	:	15 marks
Continuous Assessment	:	30 marks
Internal Test (Immediately before the second series test)	:	30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work	: 15 Marks
(b) Implementing the work/Conducting the experiment	: 10 Marks
(c) Performance, result and inference (usage of equipment and trouble shooting)	: 25 Marks
(d) Viva voce	: 20 marks
(e) Record	: 5 Marks

General instructions:

Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

References

1. M. S. Shetty , Concrete Technology, Theory and Practice , S. Chand & Company, 2014 A. M. Neville and J.J Brooks, Concrete Technology, Second edition, Pearson.
2. **IS codes on cement:** IS 1489 (Part 1 & 2):1991 Specification for Portland pozzolana cement, IS 269:1989 – Specification for ordinary Portland cement, 33 grade, IS 8112 : 2013- Specification for ordinary Portland cement, 43 grade, IS 12269 : 2013- Specification for ordinary Portland cement, 53 grade,
3. **IS codes on aggregate**: IS 2386 (Part 1):1963 Methods of test for aggregates for concrete: Part 1 Particle size and shape, IS 2386(Part 3):1963 Methods of test for aggregates for concrete: Part 3 Specific gravity, density, voids, absorption and bulking, IS 383:1970 Specification for Coarse and Fine aggregate from natural sources of concrete
4. **IS codes on fresh and hardened concrete:** IS 1199:1959 Methods of sampling and analysis of concrete, IS 10262:2019 Concrete mix proportioning- Guidelines, IS 516:1959 Methods of tests for strength of concrete.

5. **IS codes on brick and tiles:** IS 3495 (Part 1 to 4):1992 Methods of tests of burned clay bricks, IS 1077:1992 Common burned clay building bricks (specification), IS 654:1992 Clay roofing tiles Mangalore pattern (specification).
6. IS 13311 (Part 1 & 2):1992 Non - destructive testing of concrete-methods of test.

SYLLABUS

Exercise 1. Testing of Cement: Fineness, normal consistency, initial &final setting time.

Exercise 2. Testing of Cement: Specific gravity and compressive strength

Exercise 3. Study on soundness of cement.

Exercise 4. Testing of Coarse and Fine Aggregate: Sieve analysis.

Exercise 5. Testing of Coarse and Fine Aggregate: Water absorption, bulk density, void ratio, porosity and specific gravity.

Exercise 6. Test on bulking of sand.

Exercise 7. Test on coarse aggregate crushing value

Exercise 8. Tests on fresh concrete : Measurement of workability of concrete by slump cone test and compacting factor test.

Exercise 9. Study on workability of concrete by Vee-Bee test and flow test.

Exercise10. Concrete mix design by IS code method and casting of cubes, cylinders with designed concrete mixes.

Exercise 11. Tests on hardened properties of concrete: Compressive, split and flexural strength.

Exercise 12. Tests on hardened properties of concrete: Modulus of elasticity of concrete

Exercise 13. Tests on brick, floor and roof tiles as per IS codal provision.

Exercise 14. Study on Non-destructive tests on hardened concrete (Rebound hammer, ultrasonic pulse velocity and Rebar locator).

Exercise 15. Study on concrete core cutter, concrete penetrometer and crack detection microscope.

22CEL 508	GEOTECHNICAL ENGINEERING LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	0	0	3	2	2019

Preamble:

Objective of the course is to familiarize students with the laboratory tests used to determine physical, index and engineering properties of geomaterials.

Prerequisite: GEOTECHNICAL ENGINEERING I

Course Outcomes: After the completion of the course, the student will be able to:

CO1	Identify and classify soil based on standard geotechnical experimental methods.
CO2	Perform and analyze permeability tests.
CO3	Interpret engineering behavior of soils based on test results.
CO4	Perform laboratory compaction, CBR and in-place density test for fill quality control in the field.
CO5	Evaluate the strength of soil by performing various tests viz. direct shear test, unconfined compressive strength test and triaxial shear test.
CO6	Evaluate settlement characteristics of soils.

Mapping of course outcomes (COs) with program outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3				1				2	2		
CO2	3				2				2	2		
CO3	3	2							2	2		
CO4	3				1				2	2		
CO5	3				2				2	2		
CO6	3	1			2				2	2		

Course Level Assessment Questions

Assessment Pattern

Mark distribution

Total Marks	Continuous Internal Evaluation (CIE)	End Semester Examination (ESE)	End Semester Examination (ESE) Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Assessment : 30 marks

Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks.

a) Preliminary work : 15 marks

b) Implementing the work/ Conducting the experiment : 10 marks

c) Performance, result and inference (usage of equipments and trouble shooting) : 25 marks

d) Viva voce : 20 marks

e) Record : 5 marks

General instructions:

Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

References

1. IS codes relevant to each test

2. C. Venkatramaiah, Geotechnical Engineering, New Age International publishers, 2012

3. Gopal Ranjan and A. S. R. Rao, Basic and Applied Soil Mechanics, New Age International Publishers, 2012

4. K. R. Arora, Soil Mechanics and Foundation Engineering, Standard Publishers, 2011

SYLLABUS

Part A

Estimation of physical and index properties of the given soil: After performing the set of experiments, students are expected to infer the results of the experiments in their engineering behavior.

1. Determination of Water Content and Specific Gravity
2. Sieve Analysis
3. Hydrometer/pipette Analysis
4. Atterberg Limits (Liquid Limit, Plastic Limit and Shrinkage Limit)

5. Swelling Test
6. Field Density determination

Part B

Determination of engineering properties of the given soil: Students should be familiarize with the tests to be performed to determine the engineering properties of the given soil and interpret the results for field application.

7. Permeability Test
8. Standard Proctor Compaction Test
9. Heavy compaction
10. California Bearing Ratio Test
11. Direct Shear test
12. Unconfined Compression Test
13. Consolidation Test

Study/demonstration

14. Triaxial test

22CEMR 509.1	STRUCTURAL MECHANICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		Minor	3	1	0	4	2019

Preamble:

Structural Mechanics is a basic course in the analysis of structural systems. The course helps students to develop their analytical and problem-solving skills. The course introduces students to the various internal effects induced in structural members as well as their deformations due to different types of loading. After this course students will be able to analyse simple structural systems.

Prerequisite: Engineering Mechanics

Course Outcomes: After the completion of the course the student will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Recall the fundamental terms/theorems associated with mechanics of linear elastic deformable bodies and explain the behavior/response of various structural elements under various loading conditions.	Remembering/ Understanding
CO2	Calculate the stresses/strains in structural elements subjected to axial load and bending/twisting moments.	Applying
CO3	Analyse statically determinate beams and trusses to determine the internal forces.	Applying
CO4	Determine the deflection of statically determinate beams.	Applying
CO5	Analyse statically indeterminate beams and frames.	Applying

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember/ Understand	20	20	30
Apply	30	30	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

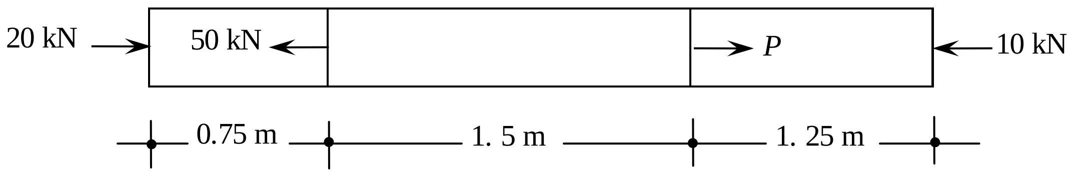
Course Level Assessment (Sample) Questions

CO1: Recall the fundamental terms/theorems associated with mechanics of linear elastic deformable bodies and explain the behavior/response of various structural elements under various loading conditions.

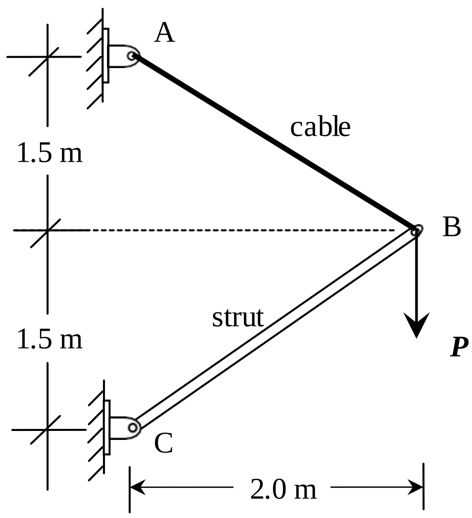
1. Explain Hooke's law.
2. Sketch the stress-strain curve of mild steel and mark the salient points
3. Explain the concept of BM and SF in beams, with the help of a cantilever beam subjected to uniformly distributed load over the whole span.
4. What is pure bending? Give an example.
5. What is point of contraflexure?
6. Explain (i) Section modulus and (ii) Moment of resistance
7. Distinguish between statically determinate and statically indeterminate structures.
8. What is degree of static indeterminacy? Explain with an example.
9. Explain (i) distribution factor and (ii) carry over moment.
10. Compare slope-deflection and moment distribution methods.

CO2: Calculate the stresses/strains in structural elements subjected to axial load and bending/twisting moments.

1. A 32 mm diameter steel bar is subjected to forces as shown in figure. Find the value of *P* necessary for equilibrium and stresses in different segments. Also calculate the final length of the bar. Take E = 200 GPa.



2. A strut and cable assembly ABC, shown in figure supports a vertical load *P* = 10 kN. The cable has an effective cross sectional area of 120 mm^2 and the strut has an area of 200 mm^2. Calculate the normal stresses induced in the cable and the strut and indicate whether they are tension or compression. If the cable elongates 1.15 mm and the strut shortens 0.58 mm find the strains also.



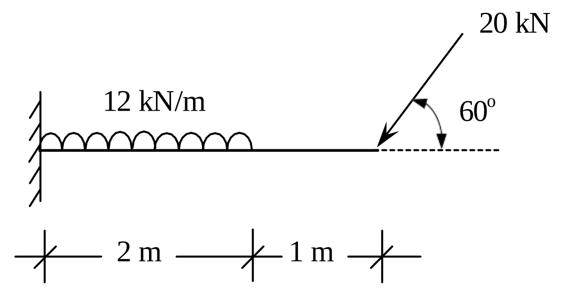
3. A tension test is carried out on a mild steel bar of 10 mm diameter. The bar yields

under a load of 20 kN, it reaches a maximum load of 40 kN and breaks at 25 kN. The diameter of the bar at breaking was found to be 7 mm. The increase in length of the bar over a gauge length of 50 mm was found to be 0.029 mm under a load of 10 kN. Estimate (a) Young's modulus, (b) yield strength, (c) ultimate strength and (d) actual breaking strength.

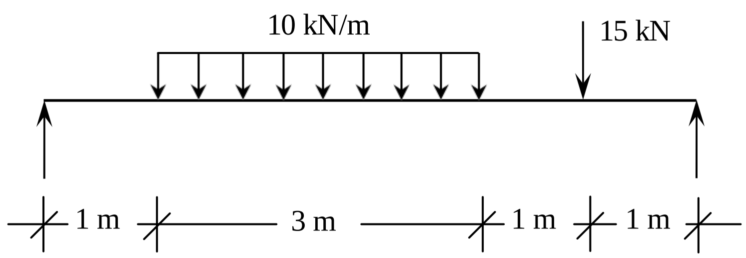
4. A steel flat 25 mm wide and 6 mm thick is required to be bend into a circular arc of radius 10 m. Find the bending moment required to bend the flat. Also find the maximum stress induced. Take E = 200 GPa.
5. A steel box section 100 mm × 150 mm with thickness 5 mm is used as a cantilever beam of span 2 m. If the beam carries a load of 1 kN at the free end, find the maximum bending stress at the mid span and the support. Neglect weight of the beam.
6. A timber beam 150 mm × 200 mm is used as a simply supported beam of span 3 m. Find the maximum load that can be applied at 1 m from one of the supports, if the maximum bending stress in the beam is not to exceed 8 N/mm^2. Neglect self weight of beam.
7. A beam of I section 400 mm deep has flanges 200 mm wide and 20 mm thick and web 15 mm thick. Compare its moment of resistance with that of a beam of rectangular section of the same weight, the depth being twice its breadth.
8. A solid circular shaft of diameter 50 mm is subjected to a torque. If the maximum shear stress induced in the shaft is 70 MPa, find the torque applied. If the modulus of rigidity of the material of the shaft is 80 GPa, find the angle of twist per meter length of the shaft.

CO3: Analyse statically determinate beams and trusses to determine the internal forces.

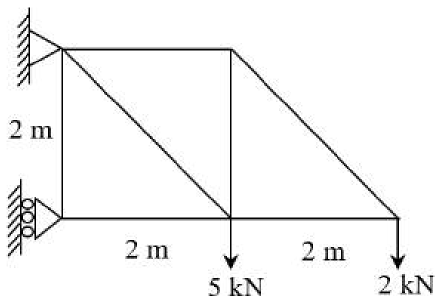
1. Draw the SFD and BMD of the beam shown.



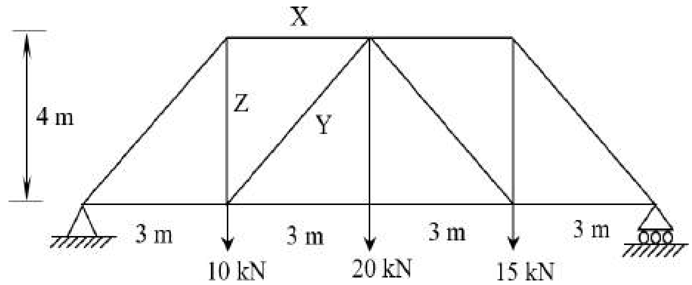
2. Draw SFD and BMD. Find the maximum BM also.



3. Analyse the truss by method of joints and determine the forces in all members.

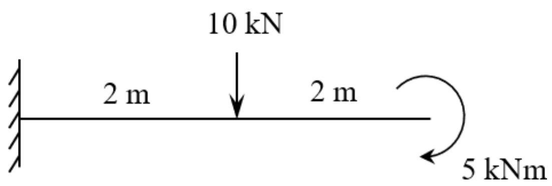


4. Analyse the truss by method of sections and determine the forces in members X, Y and Z.



CO4: Determine the deflection of statically determinate beams.

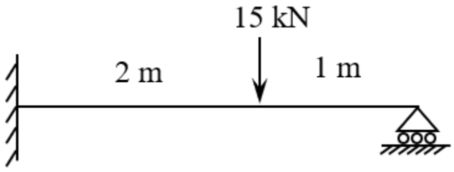
1. A cantilever beam of span 3 m carries a point load of 10 kN at the free end along with a udl of 5 kN/m covering a distance of 2 m starting from the support. Find the maximum deflection of the beam. Take EI = 3500 kNm^2.
2. Find the slope and deflection at the free end of the cantilever beam loaded as shown. Flexural rigidity (EI) of the beam may be assumed to be constant.



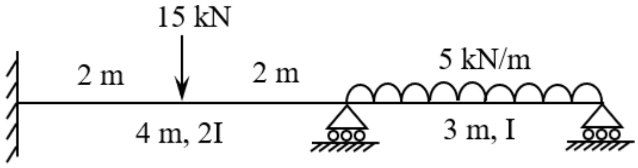
3. A simply supported beam of span 5 m carries a concentrated load of 20 kN at a distance of 2 m from the left support. Find the slope at supports and deflection under the load. Also find the maximum deflection and its location. Flexural rigidity of the beam is 2200 kNm^2.
4. A simply supported beam of span 4 m carries a udl of 10 kN/m covering half the span starting from the left support. Find the slope at supports and maximum deflection. Locate the point of maximum deflection also. Flexural rigidity of the beam is 1500 kNm^2.

CO5: Analyse statically indeterminate beams and frames.

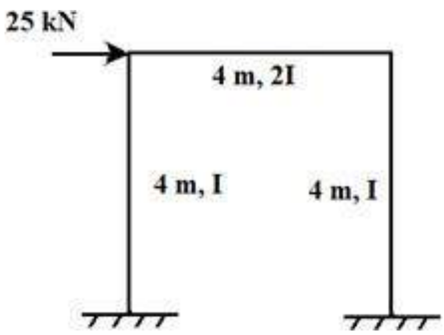
1. Analyse the propped cantilever beam shown by consistent deformation method and draw BMD and SFD.



2. Analyse the continuous beam by slope deflection method and draw BMD.

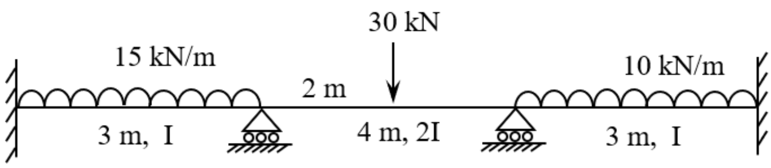


3. Analyse the frame by slope deflection method and draw BMD.



4. Analyse the frame shown in Question 2 using moment distribution method and draw BMD.

5. Analyse the continuous beam shown using moment distribution method and draw BMD.



SYLLABUS

Module – 1

Review of statics, Concept of stress and strain – types, Stress – strain relation - Hooke's law, Young's modulus of elasticity.

Axially loaded bars with uniform cross section–stress, strain and deformation.
Deformation of axially loaded bars with varying cross section and bars with varying axial loads.

Torsion of circular shafts – stress and deformation, Power transmitted by circular shafts.

Module – 2

Analysis of truss – method of joints and method of sections.
Beams – different types. Types of loading on beams. Concept of bending moment and shear force.
Shear force and bending moment diagrams of cantilever beams and simply supported beams for different type of loads.

Module – 3

Theory of simple bending, assumptions and limitations.

Calculation of normal stress in beams, moment of resistance

Shear stress in beams (concept only).

Moment-curvature relation. Deflection of beams by successive integration.

Macaulay's method - Deflection of cantilever beams and simply supported beams.

Module – 4

Statically indeterminate structures, degree of static and kinematic indeterminacy.

Fixed beam – fixed end moments for simple cases of loading (No analysis required).

Method of consistent deformation - Analysis of propped cantilever beam and continuous beams with maximum two redundants.

Module – 5

Slope deflection method – Analysis of continuous beams with maximum two unknowns, effect of support settlement. Analysis of frames with sway.
Moment distribution method – analysis of continuous beams and frames without sway.

Text Books:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall International Series.
2. James M Gere, S.P. Timoshenko, Mechanics of Materials, CBS Publishers and Distributors, New Delhi.
3. R. K. Bansal, A Text book of Strength of Materials, Laxmi Publications (P) Ltd, New Delhi.

References:

1. R.C. Hibbeler, Structural Analysis, Pearson.
2. DevdasMenon, Structural Analysis, Narosa Publications.

3. H. J. Shah and S. B. Junnarkar, Mechanics of Structures Vol - I, Charotar Publishing House.
4. S. Ramamrutham and R. Narayanan, Strength of Materials, Dhanpat Rai Publishing Co (P) Ltd.
5. B. C. Punmia, Ashok K. Jain, Arun Kumar Jain, Mechanics of Materials, Laxmi Publications (P) Ltd, New Delhi.

Lecture Plan – Structural Mechanics

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module I: Total lecture hours: 9**		
1.1	Review of statics – equilibrium conditions, free body diagrams, centroid, moment of inertia.	-	1
1.2	Concept of stress, types of stresses. Concept of strain, types of strains. Stress – strain relation - Hooke's law, Young's modulus of elasticity. Stress-strain ($\sigma - \varepsilon$) diagram of mild steel.	CO1	1
1.3	Axially loaded bars with uniform cross section– calculation of stress, strain and deformation.	CO1, CO2	1
1.4	Deformation of axially loaded bars with varying cross section. Stepped bars, deformation of axially loaded bars with varying axial loads	CO1, CO2	3
1.5	Torsion of circular shafts, assumptions, derivation of torsion equation. Variation of stress across the cross section. Polar modulus.	CO1	1
1.6	Calculation stress and deformation of circular shafts subjected to torsion. Power transmitted by circular shafts.	CO1, CO2	2
2	**Module II: Total lecture hours: 10**		
2.1	Analysis of truss – Method of joints	CO1, CO3	2
2.2	Analysis of Truss – Method of sections	CO1, CO3	2
2.3	Beams – different types. Types of loading on beams. Concept of bending moment and shear force. Shear force and bending moment diagrams.	CO1, CO3	2
2.4	Shear force and bending moment diagrams of cantilever beams subjected to point load, uniformly distributed load, uniformly varying load and concentrated moment.	CO3	2
2.5	Shear force and bending moment diagrams of simply supported beams subjected to point load and uniformly distributed load.	CO3	2
3	**Module III : Total lecture hours : 9**		
3.1	Theory of simple bending – derivation of equation, assumptions and limitations.	CO1, CO2	1

3.2	Calculation of normal stress in beams, moment of resistance. Problems involving bending stress. Shear stress in beams (concept only)- variation of shear stress across the cross section.	CO1, CO2	2
3.3	Moment-curvature relation. Basic differential equation for calculating the deflection of beams. Calculation of deflection by successive integration. Principle of superposition.	CO1, CO4	2
3.4	Macaulay's method - Deflection of cantilever beam subjected to point load and uniformly distributed loads.	CO1, CO4	2
3.5	Macaulay's method - Deflection of simply supported beams subjected to point load and uniformly distributed loads. Clerk Maxwell's theorem of reciprocal deflection	CO1, CO4	2
4	**Module IV: Total lecture hours: 8**		
4.1	Statically indeterminate structures, degree of static and kinematic indeterminacy - examples Force and displacement method of analysis (concept only)	CO1	1
4.2	Fixed beam – fixed end moments for simple cases of loading (No analysis required). BMD of fixed beam, point of contraflexure.	CO1, CO3	2
4.3	Method of consistent deformation - Analysis of propped cantilever beam.	CO1, CO5	2
4.4	Method of consistent deformation – analysis of beams with maximum two redundants.	CO1, CO5	3
5	**Module V: Total lecture hours: 9**		
5.1	Slope deflection method – equation (no derivation required). Analysis of continuous beams with maximum two unknowns.	CO1, CO5	2
5.2	Slope deflection method – analysis of continuous beam with support settlement.	CO1, CO5	1
5.3	Slope deflection method – analysis of frames with sway.	CO1, CO5	2
5.4	Moment distribution method – concept. Distribution factor and carry over moment.	CO1, CO5	1
5.5	Moment distribution method – analysis of continuous beams.	CO1, CO5	1
5.6	Moment distribution method – analysis of frames without sway.	CO1, CO5	2

MODEL QUESTION PAPER

Reg. No.:_______________ Name:__________________________

FIFTH SEMESTER BTECH DEGREE EXAMINATION

Course Code: 22CEMR509.1

Course Name: STRUCTURAL MECHANICS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions; each question carries 3 marks.

1. a) Sketch the stress-strain graph of mild steel and mark the salient points.
   b) A steel bar of length 1 m and diameter 12 mm was found to elongate by 0.64 mm under an axial load of 15 kN. Find the stress induced and modulus of elasticity of the material.
   c) What is the advantage of method of sections over method of joints in the analysis of trusses?
   d) What is the relationship between SF and BM? Illustrate with a simple example.
   e) What is pure bending? Give an example.
   f) Using successive integration method, find the deflection at the free end of a cantilever beam carrying a point load at the free end.
   g) Explain 'static indeterminacy' and 'kinematic indeterminacy' with a suitable example.
   h) Write down the consistent deformation equations for a beam with degree of static indeterminacy =2. Explain the basic terms in the equation.
   i) What are the reasons for side sway in frames?
   j) Write notes on (i) distribution factor and (ii) carry over moment.

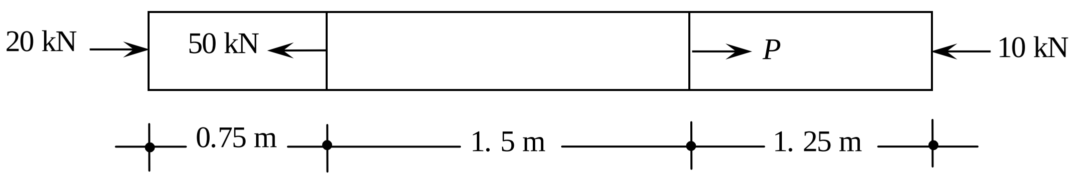
(10×3 marks = 30 marks)

PART B

Answer one full question from each module; each full question carries 14 marks.

Module I

2. A 32 mm diameter steel bar is subjected to forces as shown in figure. Find the value of *P* necessary for equilibrium and stresses in different segments. Also calculate the final length of the bar. Take E = 200 GPa.

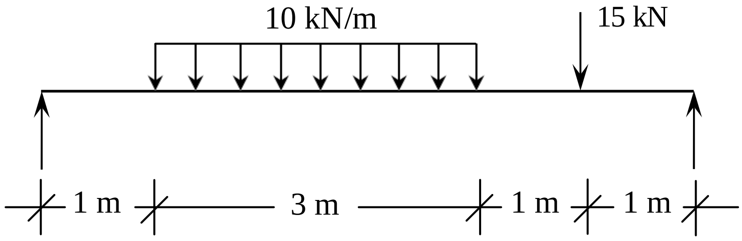


3. A tension test is carried out on a mild steel bar of 10 mm diameter. The bar yields under a load of 20

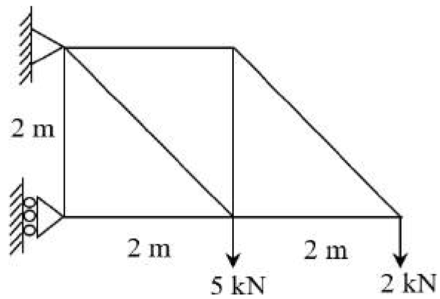
kN, it reaches a maximum load of 40 kN and breaks at 25 kN. The diameter of the bar at breaking was found to be 7 mm. The increase in length of the bar over a gauge length of 50 mm was found to be 0.029 mm under a load of 10 kN. Estimate (a) Young's modulus, (b) yield strength, (c) ultimate strength and (d) actual breaking strength.

Module II

4. Draw the SFD and BMD of the beam loaded as shown in figure. Find the maximum BM and locate the point of maximum BM also.



5. Analyse the truss by method of joints and determine the forces in all members.



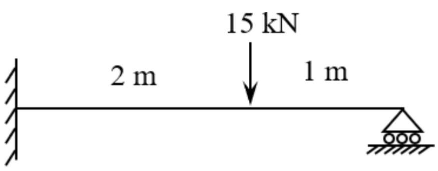
Module III

6. A beam of I section 400 mm deep has flanges 200 mm wide and 20 mm thick and web 15 mm thick. Compare its moment of resistance with that of a beam of rectangular section of the same weight, the depth being twice its breadth.
7. A simply supported beam of span 4 m carries a udl of 10 kN/m covering half the span starting from the left support. Find the slope at supports and maximum deflection. Locate the point of maximum deflection also. Flexural rigidity of the beam is 1500 kNm^2.

Module IV

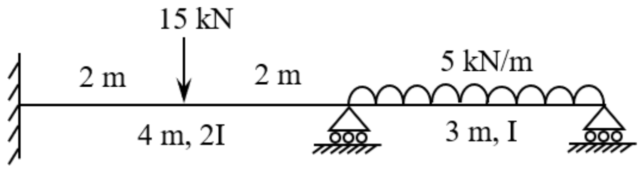
8. a) Draw the BMD of a fixed beam carrying udl through out its span. (4 marks)

   b) Analyse the propped cantilever beam shown by consistent deformation method and draw BMD and SFD.



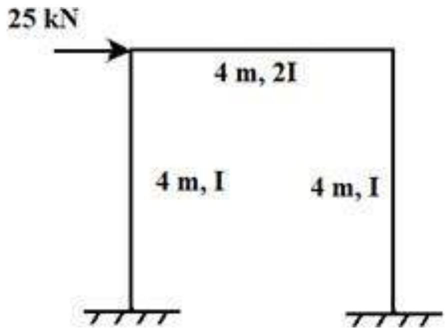
(10 marks)

9. Analyse the beam shown by consistent deformation method and draw BMD.

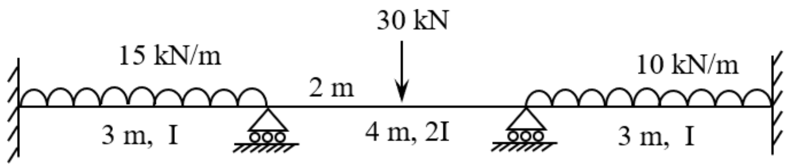


Module V

10. Analyse the frame by slope deflection method and draw BMD.



11. Analyse the continuous beam shown using moment distribution method and draw BMD.



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22CEMR5 09.2	ECO-FRIENDLY TRANSPORTATION SYSTEMS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		MINOR	3	1	0	4	2019

Preamble

Objective of the course is to introduce the principles and practice of sustainability on transportation systems and development of an eco-friendly transport system.

Prerequisite: Nil

Course Outcomes:

	Description
CO No.	At the end of the course, students will be able to:
CO 1	Apply the basic principles of sustainability to infrastructure related problems
CO 2	Analyse Transportation network for eco-friendliness and quantify the levels.
CO 3	Design eco-friendly transportation systems
CO 4	Apply concepts of sustainability in developing green fuels and vehicles.
CO 5	Design for sustainability in public transport, Applications of tools like GIS, GPS.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	2	1		1	3	1		2		1	2	3
CO 2	2	2	1	2	1	1	1	1	1	1		1	2	2
CO 3	2	1	3	1	2	1	1	1	2	2	1	2	2	3
CO 4	2	2	2	1	1	2	2	1	1	1	1	2	2	3
CO 5	1	3	3	3	3	3	2	2	3	3	2	2	2	3

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (marks)
	Test 1 Marks	Test 2 Marks	
Remember	7.5	7.5	30
Understand	7.5	7.5	30
Apply	-	-	-
Analyse	5	5	20
Evaluate	5	5	20
Create			

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern:
The question consists of two parts- Part A and Part B. Part A consists of 10 questions with 3 marks for each (two questions from each module). Part B consists of two questions from each module, out of which one has to be answered. Each question carries 14 marks and can have maximum 2 subdivisions.

Sample Course Level Assessment Questions:

1 **Course Outcome 1 (CO1):** Define sustainability in transportation context. How can the principles be applied here?

2 **Course Outcome 2 (CO2):** Describe the procedure of evaluating the performance of a transportation network, citing any example.

3 **Course Outcome 3 (CO3):** What are the characteristics of eco-friendly transportation system? What changes are to be incorporated in designing the same?

4 **Course Outcome 4 (CO4):** Discuss the concept of green vehicles describing the aspects that make them green.

5 **Course Outcome 5 (CO5):** Giving KSRTC as an example explain how sustainability can be achieved in public transport.

Syllabus

Module	Contents	Hours
1	Introduction to the concept of sustainability, basic principles.	10
2	Transport networks basics, Performance measures, Advanced transport systems	10
3	Design for eco-friendly Transportation, Professional praxis in sustainability, concept and applications	9
4	Emerging concepts in sustainable transportation: green vehicles and green roads	9
5	Sustainable public transport: Promoting public transport, Transit oriented development, integrated multi-modal transport.	7

Text Books

1. Chisty, J, Lall, K. Introduction to Transportation Engineering. PHI
2. O' Flaherty, C.A (Ed.)., Transport Planning and Traffic Engineering, Elsevier.
3. Jeffrey Tumlin: Sustainable Transportation Planning: Tools for Creating Vibrant, Healthy, and Resilient Communities, John Wiley & Sons

References

1. Green Transportation Logistics: The Quest for Win-Win Solutions Editors: Psaraftis, Harilaos N. (Ed.), Springer
2. Thomas Abdallah: Sustainable Mass Transit: Challenges and Opportunities in Urban Public Transportation.
3. Chester Patton, Public Transit Operations: The Strategic Professional
4. Sustainable and Efficient Transport: Incentives for Promoting a Green Transport Market- Edited by Ellen Eftestøl-Wilhelmsson, et al, Edward Elgar
5. Rani Iyer : Green Transport: Exploring Eco-Friendly Travel for a Better Tomorrow:
6. Smart City project reports.
7. Environmental Impact Assessment Reports on Infrastructure projects.

Course Content and lecture Schedule:

No.	Topic	Course Outcome	No. of Hrs
1	**Module 1**		Total: 10
1.1	Sustainability: Definition, concepts	CO1	2
1.2	Environmental impacts of infrastructure projects, depletion of natural resources and pollution.	CO1	2
1.3	Problems of present transportation systems, performance analysis. Introduction to eco-friendly systems.	CO1	6
2	**Module 2**		Total: 10
2.1	Transportation network basics: network planning, design, operation and management (elementary ideas only)	CO2	3
2.2	Measures of network performance, factors and parameters.	CO2	4
2.3	Introduction to advanced transport systems: metro, monorail, maglev, hyperloop.	CO2	3
3	**Module 3**		Total: 7
3.1	Eco-friendly transport: Necessity, Basics: reducing natural fuels	CO3	2
3.2	Eco-friendly transport network. Parameters, design, implementation.	CO3	3
3.3	Professional praxis in sustainability: concepts, practical applications. Paradigm shift: Mobility and accessibility.		2
4	**Module 4**		Total: 9
4.1	Emerging concepts in sustainable transportation: green vehicles and green roads: basics and necessity.	CO4	2
4.2	Green vehicles: minimizing fuel consumption, alternate fuels. Green pathways: sustainable design, construction,	CO4	4
4.3	Forgiving designs for safety, ITS applications.	CO4	3
5	**Module 5**		Total: 9
5.1	Sustainable public transport: Promoting public transport, Fleet management and scheduling: Concepts and tools only.	CO5	3
5.2	Transit oriented development (smart cities), integrated multi-modal transport, GIS applications.	CO5	6
5.3	Micro projects: i) Compilation of studies on green fuels and transport, with comparison. ii) A study on literature available on a typical smart city project, in the transport context, and propose designs. (may be given as assignments)		

THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEMR509.2

Course Name: **Eco-friendly Transportation Systems (Minor)**
Model Question Paper

Marks:100 Duration: 3 hrs

PART A
(Answer all questions. Each question carry three marks)

11. Define sustainability with emphasis on transport.
12. List the principles of sustainability.
13. What are the fundamental elements of a transport network? How do they contribute to performance?
14. Compare metro and maglev technologies.
15. Why is an eco-friendly transport necessary? Cite a typical example.
16. Why is a paradigm shift necessary in sustainability?
17. Explain the terms: Green roads, Green fuels.
18. With a typical example, explain forgiving designs.
19. List a few methods of promoting public transport.
20. What do you understand from Transit Oriented Development?

PART B
(Answer one full question from each module)

21. a) Describe how an infrastructure project affects environment. (10)
b) What are the issues with present transport systems? (4)

OR

12 a) When is a system deemed eco-friendly? Explain in transport context. (6)

b). What are the parameters of performance analysis of transportation systems? Explain (8)

13 a) With a typical example, illustrate the performance evaluation of a transport network (6)
b) What is hyperloop? Is it eco-friendly? How? (8)

OR

14 a) Describe the process of network planning, design, operations and management (10)
b) What are the challenges faced by metro rail systems? (4)

15 a) Explain the principles of an eco-friendly transport network (8)
b) Discuss the term professional praxis in a sustainability scenario. (6)

OR

19 a) How is the eco-friendliness of a transport network evaluated? Discuss the steps involved. (8)
b)Explain the factors involved in designing an eco-friendly network (6)

20 a) List the alternate fuels for transport and discuss any two (6)
b) Define ITS. What are its application in eco-friendly transport. Expalin any two. (8)

OR

21 a) Discuss any two eco-friendly construction methods for roads (8)
b) What are the methods of reducing fuel consumption in vehicles
c) (6)

19 a)Write a note on public transport fleet management. (6)
b) /what is meant by integrated multi-modal transport? Discuss it's possibilities in a city in Kerala. (8)

OR

20 Discuss the applications of GIS and GPS in transport, explaining how eco-friendliness can be achieved. (14)

22CEMR509.3	SUSTAINABILITY ANALYSIS AND DESIGN	CATEGORY	L	T	P	CREDIT	Year of Introduction
		MINOR	4	0	0	4	2019

Preamble: Goal of this course is to introduce various tools and techniques of sustainability analysis and its significance in design and engineering decision making.

Prerequisite: Nil

Course Outcomes: After completion of the course the student will be able to:

Course outcome identifier	Description of course outcome	Prescribed learning level
CO 1	Identify the impacts of various materials and processes on the biosphere	Remembering
CO2	Identify the parameters used in the calculation of sustainability	Understanding
CO 3	Estimate sustainability metrics for application-material combinations.	Applying
CO 4	Apply the design approaches by integrating sustainability concepts	Applying

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	-	-	-	-	-	-	-	-	-	-	-
CO 2	1	2	-	-	-	-	-	-	-	-	-	-
CO 3	2	3	2	-	2	-	-	-	-	-	-	-
CO 4	2	3	2	-	2	-	-	-	-	-	-	-
CO5												

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	7.5	7.5	30
Understand	7.5	7.5	30
Apply	10	10	40
Analyse			
Evaluate			

Create			

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern:

There will be two parts: Part A and Part B.

Part A contains 10 questions with 2 questions from each module and each question shall carry 3 marks. Students should answer all questions.

Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions

Course level Assessment Questions

Course Outcome 1 -Identify the impacts of various materials and processes on the biosphere.

1. How are materials classified as renewable and non-renewable?
2. Compare infinitely available and regenerative renewable resources.
3. Prepare a short description on zero waste production system.

Course Outcome 2 -Identify the parameters used in the calculation of sustainability

1. Compare "output pulled" and "input pushed" systems
2. Prepare short note on "dematerialization" and "remanufacturing".
3. Explain ecological footprint

Course Outcome 3 -Estimate sustainability metrics for application-material combinations

1. Illustrate the significance of biomimicry taxonomy in sustainable design.
2. How is global warning potential assessed?
3. Illustrate water foot print of a process.

Course Outcome 4 - Apply the design approaches by integrating sustainability concepts

1. Illustrate the role of biomimicry in the design for sustainability approaches.
2. Explain the significance of "cradle to cradle" design concept.
3. List any five commonly used life cycle impact categories

Syllabus

Module 1

Introduction to sustainability - Sustainable use of materials: Energy, ecology and natural resources

Engineering design process- Role of materials in design: important material characteristics, construction ecology and metabolism - specifications and market.

Module 2

Material flow analysis - efficiencies in mass flow — Constructing a material flow system — embodied energy—engineering *models* based on waste and materials management

Module 3

Sustainability metrics — mass balance and footprint concept Sustainable design - Specifications for sustainable material use — waste management and material life cycles - Environmentally sensitive design — Green engineering

Module 4

Life-cycle assessment — Life cycle assessment framework- Inventory analysis —impact assessment – interpretation

Module 5

Sustainable designs approaches - Sustainable urbanization – sustainable cities – sustainable transport - energy efficiency.

Text Books:

I. Allen, D.T and Shor nard, D R , Sustainability Engineering, Concepts, Design and Case Studies, Prentice Ha 1.

2. Bradley A.S., Adebryo, A. 0., Maria P, Engineering Applications in Sustainable Design and Development, Ceng ige Learning

References:

1. UNDP (1987), Our Common Future, Report of the World Commission on Environment and Development

2. Riley, D.R., Thatche, C.E., and Workman, E.A. (2006), Developing and applying green building technology in an indigenous community: An engaged approach to sustainability education, International Journal of Sustainability in Higher Education, 7(2), 142-157.

3. LSF-LST (2007). Understanding Sustainability, Learning for a Sustainable Future, http://www.lsfIst.cz /en/teachers/understanding.php, York University, Ontario, Canada.

4. ASCE (2004), Sustainable Engineering Practice: An Introduction, Jorge A. Vanegas (Editor).

5. USGBC (2008), LEEE Rating Systems, US Green Building Council, http://www.usgbc.t rg/DisplayPage.aspx?CMSPagelD=222 (2008), Thematic Strategy on the prevention and

recycling of waste, The European Commission, http:// ec.euroaa.eu/ environment/ waste/ index.htm

Course Contents and Lecture Schedule:

No.	Topic	Course Outcome	No. of Hrs
1	**Module 1**		Total: 9
1.1	Introduction to sustainability - Sustainable use of materials	CO1, CO2	2
1.2	Energy, ecology and natural resources	CO1, CO2	3
1.3	Engineering design process- Role of materials in design	CO1, CO2	2
1.4	Construction ecology and metabolism - specifications and market	CO1, CO2	2
2	**Module 2**		Total: 9
2.1	Material flow analysis - efficiencies in mass flow	CO1. CO2 CO3	3
2.2	Constructing a material flow system— embodied energy	CO1, CO2 CO3	3
2.3	Embodied energy	CO2, CO3	1
2.4	Engineering *models* based on waste and materials management	CO2, CO3	2
3	**Module 3**		Total: 9
3.1	Sustainability metrics — mass balance and footprint concept Sustainable design	CO1, CO2 CO3,CO4	2
3.2	Specifications for sustainable material use	CO1,CO2 CO3,CO4	3
3.3	Waste management and material life cycles	CO3,CO4	2
3.4	Environmentally sensitive design — Green engineering	**CO3,CO4**	2
4	**Module 4**		Total: 9
4.1	Life-cycle assessment —Life cycle assessment framework	CO1,CO2 CO3,CO4	3
4.2	Inventory analysis	CO1,CO2 CO3,CO4	3
4.3	impact assessment – interpretation	CO1,CO2 CO3,CO4	3
5	**Module 5**		Total: 9
5.1	Sustainable designs approaches	CO1,CO2 CO3,CO4	3
5.2	Sustainable urbanization – sustainable cities	CO1,CO2 CO3,CO4	3
5.3	Sustainable transport - energy efficiency.	CO3, CO4	3

Model Question Paper

QP CODE:

Reg No.:_______________ Name:___________________________

ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFITH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEMR509.3

Course Name: SUSTAINABILITY ANALYSIS AND DESIGN

Max. Marks: 100 Duration: 3 hours

Answer All Questions - 10 × 3 = 30 marks
Each question carries 3 marks

1. Narrate any one material characteristic that is needed to ensure sustainability.
2. Highlight any one approach that could enable products in the market to be preferred on environmental performance.
3. State any one of the observation from material flow analysis that would supplement sustainability evaluation.
4. What is embodied energy of a material?
5. Define footprint based sustainability indicators.
6. Illustrate the term "Reuse factor"
7. Additive operations in LCA
8. LCA helps to arrive at lower entropy form of a material. Substantiate the statement giving any one reason.
9. Prepare a short account on sustainable urbanization
10. How is energy efficiency linked with sustainable design process.

PART B

Each question carries 14 marks

11. Identify any three engineering materials that are used as environmental substitutes for the conventional systems. Also narrate the factors considered in their selection based on engineering design requirement.

or

12. Explore the possibility of creating ecosystem based approach for construction process and highlight its significance to ensure sustainability.

13. "Buildings embody large quantity of material energy". Prepare a short description narrating how this resource could be used to create energy efficient material use road map for Kerala.

or

14. Establish the industrial ecological model as an outcome of engineering models proposed for waste and material management.

15. Explore the possibility of creating ecosystem based approach for construction process and highlight its significance to ensure sustainability. Case based justification is expected.

or

16. Explain a few interventions incorporated as part of design for environment concept for improving the material handing process.

17. Explain the four major steps involved in the LCA programme.

or

18. (i) List any two challenges faced while implementing the LCA for an impact assessment programme.

    (ii) Justify ,giving two reasons, how LCA enables to take environmentally informed decisions

22CEHR510.1	STRUCTURAL DYNAMICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		HONOURS	3	1	0	4	2019

Preamble:

Structural Dynamics deals with the study of the behavior of structures under dynamic loads. The course provides the basic concepts of structural dynamics and the theoretical background to perform dynamic analysis of structures. The course focuses on analysis of single and multi-degree of freedom systems. An introduction to continuous system is also included. The course also provides an introduction to earthquake analysis of structures.

Prerequisite: --

Course Outcomes: After the completion of the course the student will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Explain the basic terms and principles associated with structural dynamics.	Remembering/ Understanding
CO2	Model single and multi-degree freedom systems for dynamic analysis and develop equations of motion.	Applying
CO3	Estimate parameters of dynamic systems	Applying
CO4	Perform dynamic analysis of single and multi degree freedom systems.	Applying
CO5	Analyse and design vibration isolation systems.	Applying
CO6	Develop equations of motion for dynamic analysis of beams and perform free vibration analysis of simply supported beam.	Applying

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember/ Understand	15	15	30
Apply	35	35	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

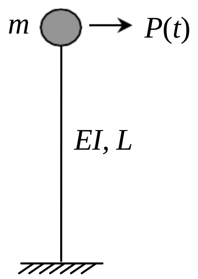
<u>Course Level Assessment (Sample) Questions</u>

CO1: Explain the basic terms and principles associated with structural dynamics.

1. State and explain D'Alembert's principle.
2. How do you model a system for dynamic analysis?
3. What are the components of a dynamic system? Explain.
4. What is natural frequency of a dynamic system?
5. Explain critically damped, over damped and under damped systems.
6. What is damping ratio? What is its significance?
7. Write short notes on 'transient state' and 'steady state' responses.
8. Explain 'dynamic magnification factor'.
9. What is 'impulse response function'? What is its significance?
10. Write short notes on 'Duhamel integral'.
11. Define 'Transmissibility' and explain its use in the design of vibration isolation systems.
12. State and derive the orthogonality properties of mode shape vectors.
14. Explain proportional and non-proportional damping models.
14. Write short notes on 'earthquake response spectrum'.

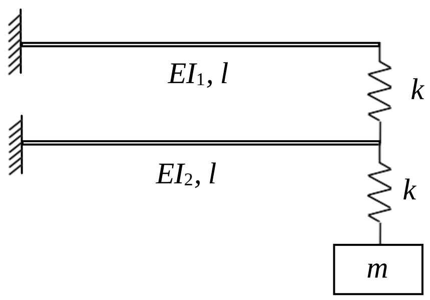
CO2: Model single and multi degree freedom systems for dynamic analysis and develop equations of motion.

1. Obtain the spring mass model of the system shown and develop the equation of motion. Mass of column may be neglected.



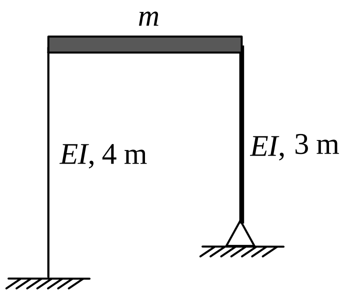
2. A simply supported beam of span L carried a central concentrated mass M. Model the system for analysis of tranverse vibrations. Neglect mass of the beam and damping. The flexural rigidity of the beam is EI.

3. Develop spring mass model of the System shown.
Take m 30 kg, EI_1 4000 Nm^2, EI_2 3200 Nm^2, l 1 m and k 2500N/m.



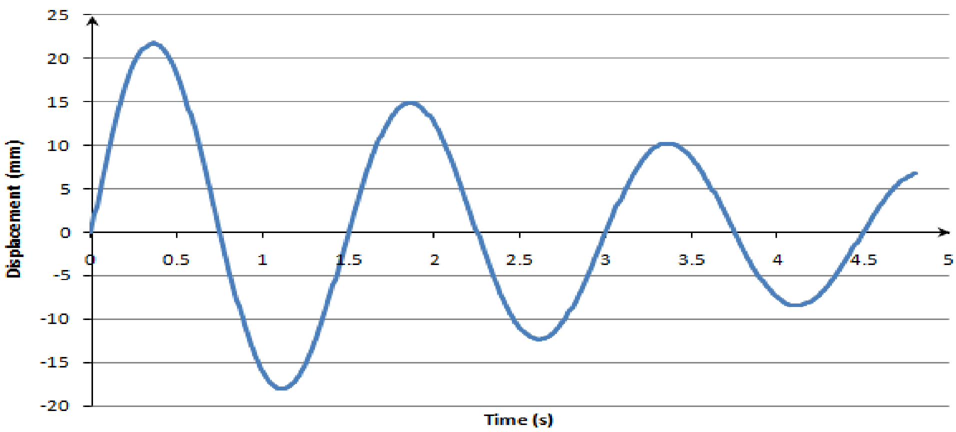
4. A rigid bar of length L is hinged at one end and carries a mass m at the other end. The bar is kept in a horizontal position with the support of a spring of stiffness k placed at a distance a from the hinged end. Formulate the equation of motion. Neglect mass of the bar and damping.

5. Develop spring- mass model of the following frame.



CO3: Estimate parameters of dynamic systems

1. Estimate the stiffness of the system shown in sample Qn. 3 of CO1.
2. A free vibration test is conducted on an empty elevated water tank. A cable attached to the tank applies a horizontal force of 100 kN and pulls the tank horizontally by 40 mm. The cable is suddenly cut and the resulting free vibration is recorded. At the end of four complete cycles, the time is 2 s and the amplitude is 25 mm. From these data compute the following: (a) damped natural frequency, (b) damping ratio, (c) effective stiffness and (d) effective mass
3. Figure shows the time history of displacement response of a SDOF system, of mass 50 kg, undergoing free vibration. Estimate the damped natural frequency, damping ratio and undamped natural frequency of the system. Also determine the stiffness and damping coefficient of the system.



4. A portable harmonic loading machine is used to conduct a test on a single storied building. Harmonic loads of magnitude 2000 N are applied at the floor level at two different frequencies. The data is given below.

Frequncy of load (rad/s)	Response Amplitude (cm)	Phase angle (degree)
8	1.50	7
10	2.25	13

Estimate the mass, stiffness and damping of the system assuming it as a single degree of freedom system.

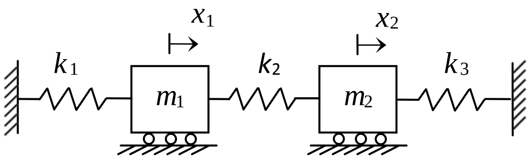
CO4: Perform dynamic analysis of single and multi degree freedom systems.

1. Calculate the natural frequency and natural period of transverse vibrations of a cantilever beam 50 mm diameter circular section carrying a load of 600 N at the free end. Span of the cantilever is 1.0 m. Modulus of elasticity of the material of the beam is 205 GPa. If a spring of stiffness 50 kN/m is introduced between the load and the beam, calculate the change in the natural frequency and natural period.

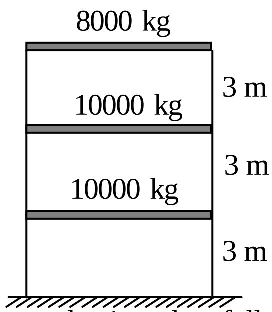
2. A SDOF system with mass 20 kg and stiffness 1800 N/m is given an initial displacement of 10 mm and initial velocity of 250 mm/s. Find the displacement of the system at t = 1.0 s. Also find the maximum displacement of the system. Neglect damping.

3. A single degree of freedom system with mass 100 kg and stiffness 5000 N/m is subjected to a harmonic load of amplitude 25 N and frequency 6 rad/s. Assuming 10% of critical damping find the steady state amplitude. If the frequency of load is varied, at what frequency the steady state amplitude will reach maximum. Find the maximum value of steady state amplitude also.

4. Find the natural frequencies and mode shapes of the spring-mass system shown in figure. Take m_1 = 20 kg, m_2 = 15 kg, k_1 = 1000 N/m, k_2 = 1200 N/m and k_3 = 900 N/m.



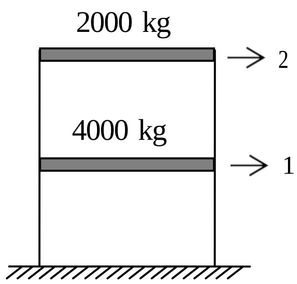
5. Find the natural frequencies and mode shapes of the shear building frame shown. Sketch the mode shapes. Flexural rigidity of the columns 2×10^6 Nm^2 Workout the mass normalized mode shape vectors also.



6. Determine the free vibration response of a two storied frame having the following properties: Mass of first floor - 1200 kg, Mass of second floor - 800 kg, Stiffness of first storey columns - 50 kN/m and Stiffness of second storey columns - 30 kN/m. The initial displacements of first and second stories are 5 mm and 12 mm respectively.

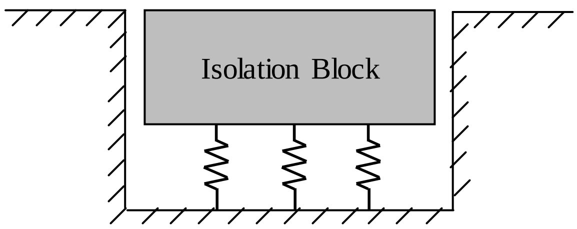
7. For a two degrees of freedom lumped mass system, $M \begin{bmatrix} m & 0 \\ 0 & 2m \end{bmatrix}$; $K \begin{bmatrix} 2k & k \\ k & 3k \end{bmatrix}$ and the modal matrix $\begin{bmatrix} 1 & 1 \\ 1 & 0.5 \end{bmatrix}$. The natural frequencies are given by $\omega_1^2 \frac{k}{m}$ and $\omega_2^2 \frac{5}{2}\frac{k}{m}$. The first mass of the system is subjected to a harmonic force $P_0 \cos(\omega t)$. Determine the response of each of the masses. Neglect damping.

8. For the frame shown in figure the natural frequencies are 15.81 rad/s and 31.62 rad/s. The modal matrix $\begin{bmatrix} 1 & 1 \\ 2 & 1 \end{bmatrix}$. Obtain the response of the floors due to a constant ground acceleration of 2 m/s^2. Also, calculate the floor displacements at t 1 s.



CO5: Analyse and design vibration isolation systems.

1. An instrument is attached to a rubber mounting having a static deflection of 3.6 mm. The supporting structure vibrates at a frequency of 30 Hz. If the damping is 3% of critical, estimate the % reduction in the transmitted support motion.
2. A delicate instrument of weight 200 kg is to be mounted on a factory floor using a vibration isolation suspension. The floor is vibrating with an amplitude of 0.25 mm and frequency 15 Hz. The maximum displacement that can be tolerated by the instrument for reliable operation is 0.1 mm. Find the stiffness of the suspension springs assuming 5% of critical damping.
3. A vibration isolation block (as shown in figure) is to be installed in a laboratory so that the vibration from adjacent factory operations will not disturb certain experiments. If the isolation block weighs 900 kg and the surrounding floor and foundation vibrates at 1500 cycles/minute, determine the stiffness of the isolation system such that the motion of the isolation block is limited to 20% of floor vibration. Assume damping as 10%.



CO6: Develop equations of motion for dynamic analysis of beams and perform free vibration analysis of simply supported beam.

1. Derive the differential equation governing the flexural vibration of beams.
2. Find the first three natural frequencies and mode shapes of a simply supported beam of span *L* having uniform flexural rigidity *EI* and mass $\overline{m}$ per unit length. Sketch the mode shapes also.
3. A steel rod of 20 mm diameter having length 2.0 m is simply supported at its ends. Find its fundamental frequency of flexural vibration. Take density of steel as 7850 kg/m^3. Modulus of elasticity of steel may be taken as 200 GPa.

SYLLABUS

Module I

Introduction – Parameters of dynamic system – D'Alembert's principle, Equation of motion of SDOF systems – undamped free vibration analysis. Damped free vibration analysis. Measurement of damping – Logarithmic decrement, Response to harmonic loading - steady state and transient states – steady sate amplitude, Dynamic magnification factor.

Module II

Response of SDOF systems to rectangular load, triangular load and half sine pulse.
Impulse response function, Response to general loads-Duhamel's integral.
Response of SDOF system to support motion, Vibration Isolation, transmissibility

Module III

Multi degree of freedom systems – Lumped mass systems, shear building frame, Equation of motion, free vibration analysis, Natural frequencies and mode shapes, orthogonality of normal modes.

Module IV

Forced vibration analysis of multi degree of freedom systems – mode superposition method.
Response of MDOF systems subjected to harmonic load.
MDOF system subjected to support motion.

Module V

Introduction to earthquake analysis - Response spectrum. Response spectrum analysis of MDOF systems.
Distributed parameter systems, Differential equation – beam flexure (elementary case), undamped free vibration analysis of simply supported beams.

Text Books:

1) Mario Paz, *Structural Dynamics*, CBS Publishers, New Delhi, India, 2001.
2) Mukhopadhyay M., *Vibrations, Dynamics and Structural Systems*, Taylor & Francis, London, 2000.

References:

1) Clough R. W. and J. Penzien, Dynamics of Structures, McGraw Hill, 1993.
2) Chopra A. K., *Dynamics of Structures- Theory and application to Earthquake Engineering*, Pearson Education India, 2007.
3) Biggs J. M., *Introduction to Structural Dynamics*, McGraw-Hill Book Inc., New York, 1964.
4) J.W. Smith, Vibration of Structures, Chapman and Hall, London.

Lecture Plan – Structural Dynamics

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module I : Total lecture hours : 10**		
1.1	Introduction to structural dynamics and its importance in Civil Engineering. Dynamic Load, Parameters of dynamic system	CO1	1
1.2	D'Alembers's principle, Equation of motion of SDOF system. Undamped free vibration analysis, concept of natural frequency	CO1, CO2	1
1.3	Modeling systems as SDOF spring-mass model, estimation of stiffness, determination of natural frequency	CO2, CO3	2
1.4	Free vibration response of undamped SDOF systems	CO4	1
1.5	Damped free vibration analysis – concept of critical damping and damping ratio, underdamped and overdamped systems	CO1, CO4	1
1.6	Free vibration response of damped SDOF systems – measurement of damping – logarithmic decrement.	CO1, CO3, CO4	1
1.7	Response of damped SDOF systems to harmonic loading – transient state and steady state responses. Response of undamped SDOF systems to harmonic loading.	CO1, CO4	2
1.8	Steady state amplitude, Dynamic magnification factor, concept of resonance, frequency response plot of SDOF systems.	CO1, CO4	1
2	**Module II : Total lecture hours : 10**		
2.1	Response of undamped and damped SDOF systems to rectangular load.	CO4	1
2.2	Response of undamped and damped SDOF systems to triangular load.	CO4	2
2.3	Response of undamped and damped SDOF systems to half sine pulse.	CO4	1
2.4	Impulse response function for undamped and damped systems Response to general load – concept of Duhamel's integral.	CO1, CO4	1
2.5	Response of undamped and damped SDOF systems to support motion.	CO4	2
2.6	Vibration isolation – force and displacement isolation, Transmissibility ratio.	CO1, CO5	2
2.7	Design of vibration isolation systems	CO5	1
3	**Module III : Total lecture hours : 10**		
3.1	Multi-degree of freedom (MDOF) systems- examples, Lumped mass systems, Shear building frames	CO1, CO4	1
3.2	Modelling of MDOF systems, Equation of motion	CO2, CO3	2
3.3	Undamped free vibration analysis, Natural frequencies and mode shapes, orthogonality of mode shapes	CO1, CO4	3

3.4	Mode superposition method - Free vibration response of undamped MDOF systems	CO1, CO4	2
3.5	Mode superposition method -Free vibration response of damped MDOF systems, concept of modal damping.	CO1, CO4	2
4	**Module IV : Total lecture hours : 8**		
4.1	Forced vibration analysis - Mode superposition method.	CO1, CO4	1
4.2	Response of MDOF systems subjected to harmonic load. Maximum modal responses and modal combination using SRSS rule.	CO1, CO4	3
4.3	MDOF system subjected to support motion – Equation of motion.	CO2	1
4.4	Response of shear building frames subjected to support acceleration - maximum floor response using SRSS rule.	CO2, CO4	2
4.5	Concept of frequency response function (FRF) of MDOF systems.	CO1	1
5	**Module V : Total lecture hours : 7**		
5.1	Introduction to earthquake analysis, Response spectrum – concept, Development of response spectrum	CO1	1
5.2	Response spectrum analysis of MDOF systems.	CO4	2
5.3	Distributed parameter systems, Differential equation for beam flexure (elementary case) and its solution	CO1, CO6	2
5.4	Undamped free vibration analysis of simply supported beam – natural frequencies and mode shapes	CO6	1
5.5	Undamped free vibration analysis of beams with different boundary conditions (formulation only)	CO6	1

MODEL QUESTION PAPER

Reg. No.:_______________ Name:___________________________

FIFTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: 22CEHR510.1

Course Name: STRUCTURAL DYNAMICS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions; each question carries 3 marks.

1. a) Explain critically damped, over damped and under damped systems.
   b) Distinguish between 'transient state' and 'steady state' responses.
   c) What is 'impulse response function'? What is its significance?
   d) Define 'Transmissibility' and explain its use in the design of vibration isolation systems.
   e) What do you mean by shear building frames?
   f) Explain orthogonality of mode shapes.
   g) Explain mode superposition method of analysis.
   h) Derive the equation of motion of a two storied shear building frame subjected to support motion.
   i) What is earthquake response spectrum?
   j) Derive the partial differential equation governing the flexural vibration of beams. Neglect damping and effect of axial force.

(10×3 marks = 30 marks)

PART B

Answer one full question from each module; each full question carries 14 marks.

Module I

2. A free vibration test is conducted on an empty elevated water tank. A cable attached to the tank applies a horizontal force of 100 kN and pulls the tank horizontally by 40 mm. The cable is suddenly cut and the resulting free vibration is recorded. At the end of four complete cycles, the time is 2 s and the amplitude is 25 mm. From these data compute the following: (a) damped natural frequency, (b) damping ratio, (c) effective stiffness, (d) effective mass and (e) amplitude of displacement after 10 cycles.

3. A portable harmonic loading machine is used to conduct a test on a single storied building. Harmonic loads of magnitude 2000 N are applied at the floor level at two different frequencies. The data is given below.

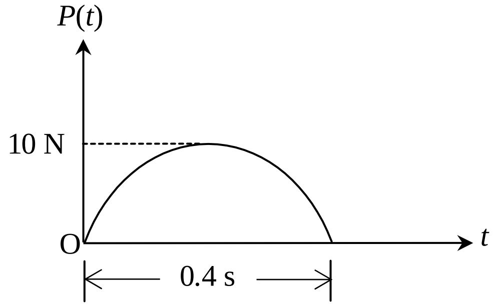
Frequency of load (rad/s)	Response Amplitude (cm)	Phase angle (degree)
8	1.50	7
10	2.25	13

Estimate the mass, stiffness and damping of the system assuming it as a single degree of freedom system

Module II

4. A single degree of freedom system with m = 10 kg and k = 1.2 kN/m is subjected to a half sine load as shown in figure. Find expressions for the displacement of the system for t < 0.4 s and t > 0.4 s. Neglect damping. Assume that the system starts from rest.

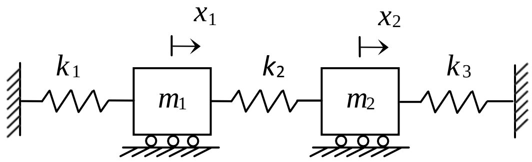
   What is the displacement at t = 0.4 s ?



5. A sieving machine weighs 2500 kg and when operating at full capacity, it exerts a harmonic force of 3 kN amplitude at 20 Hz on its supports. After mounting the machine on spring-type vibration isolators, it was found that the amplitude of the harmonic force exerted on the supports had been reduced to 250 N. Determine the stiffness of the isolator springs. Assume damping as 10% of critical.

Module III

6. Find the natural frequencies and mode shapes of the spring-mass system shown in figure. Take m_1 = 20 kg, m_2 = 15 kg, k_1 = 1000 N/m, k_2 = 1200 N/m and k_3 = 900 N/m.



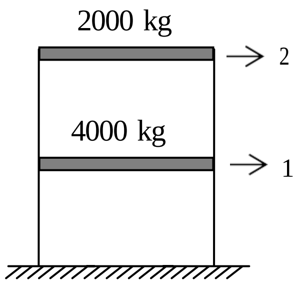
7. Determine the free vibration response of a two storied frame having the following properties: Mass of first floor - 1200 kg, Mass of second floor - 800 kg, Stiffness of first storey columns - 50 kN/m and Stiffness of second storey columns - 30 kN/m. The initial displacements of first and second stories are 5 mm and 12 mm respectively.

Module IV

8. For a two degrees of freedom lumped mass system, $M = \begin{bmatrix} m & 0 \\ 0 & 2m \end{bmatrix}$; $K = \begin{bmatrix} 2k & k \\ k & 3k \end{bmatrix}$ and the modal matrix $\begin{bmatrix} 1 & 1 \\ 1 & 0.5 \end{bmatrix}$. The natural frequencies are given by $\omega_1^2 = \frac{k}{m}$ and $\omega_2^2 = \frac{5}{2}\frac{k}{m}$. The first mass of the system is subjected to a

harmonic force $P_0 \cos(\ t)$. Determine the response of each of the masses. Neglect damping.

9. For the frame shown in figure the natural frequencies are 15.81 rad/s and 31.62 rad/s. The modal matrix $\begin{matrix} 1 & 1 \\ 2 & 1 \end{matrix}$. Obtain the response of the floors due to a constant ground acceleration of 2 m/s^2. Also, calculate the floor displacements at $t \quad 1$ s.



Module V

10. Explain response spectrum analysis of MDOF shear building frames subjected to earthquake ground acceleration. Derive the relevant equations.

11. Find the first three natural frequencies and mode shapes of a simply supported beam of span L having uniform flexural rigidity EI and mass $\overline{m}$ per unit length. Sketch the mode shapes also.

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22CEHR510.2	TRANSPORTATION SYSTEMS MANAGEMENT	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		HONOURS	3	1	0	4	2019

Preamble:
Objective of the course is to impart an awareness on transportation system management, TSM strategies, promotion of non-transport modes and advanced transit technologies.

Prerequisite: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Apply a transportation system management strategy based on TSM goal or objective.
CO 2	Recommend methods to manage a transit system to improve its management efficiency.
CO 3	Recommend measures for the promotion of non-transport modes for a transportation system based on a goal or objective.
CO 4	Assess the suitability of advanced transit technologies in a transportation system.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1				2		1			1	2
CO 2	2	1				2		1			1	2
CO 3	1					2	3	1			1	2
CO 4	1				1	2	1	1	1		1	2

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (marks)
	Test 1 Marks	Test 2 Marks	
Remember	**10**	**10**	**40**
Understand	**10**	**10**	**40**
Apply	**5**	**5**	**20**
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 15 marks

End Semester Examination Pattern:

The question consists of two parts- Part A and Part B. Part A consists of 10 questions with 3 marks for each (two questions from each module). Part B consists of two questions from each module, out of which one has to be answered. Each question carries 14 marks and can have maximum 2 subdivisions.

Sample Course Level Assessment Questions:

Course Outcome 1 (CO1): Recommend and discuss two methods for reducing peak period traffic?

Course Outcome 2 (CO2): Identify the issues of multi-modal coordination?

Course Outcome 3 (CO3): As per IRC code, describe the features adopted for bicycle tracks to popularise bicycle traffic in an Indian urban area.

Course Outcome 4 (CO4): Discuss on whether Indian population would adapt to the various advanced transit measures popular in many developed nations.

Syllabus

Module 1

System approach to Transportation Planning; The need for TSM, Long range verses TSM Planning TSM characteristics: TSM planning cycle, TSM strategies, Objectives and Philosophy; Relevance of TSM actions in Indian context. Measures for Improving vehicular flow – one-way Streets, Signal Improvement, Transit Stop Relocation, Parking Management, Reversible lanes- Reducing Peak Period Traffic – Strategies for working hours, Congestion Pricing; Traffic calming measures

Module 2

Public Transport: Preferential Treatment to high Occupancy Vehicles; Transit system operations, Service and characteristics, Transit Service Improvement Measures; Car Pooling; Transit Management Improvement Measure; Multi-Modal Coordination; Transit and Para transit integration;

Module 3

Bus Route Network Planning and Management: Type of Bus Route Networks; Suitability for a given Urban Area; Types of routes – Corridor routes, activity routes and residential routes; Issues in route networks evaluation – number of route, length of route; Route alignment methods; service coverage and accessibility index.

Module 4

Local area traffic management: Promotion of Non – motorised modes: Measures to promote; Pedestrianisation: Pedestrian facilities and management. Bicycle Transportation – advantages; Planning Bicycle Facilities Junction Treats for cycle tracks; LOS criteria for Pedestrian and bicycle Facilities.

Module 5

Advanced Transit Technologies: Conventional and Unconventional Systems; Rapid Transportation System; New technologies – LRT, monorail, Automated Highways- Hovercraft; System Characteristics and Suitability.

Text Books :

1. C. J. Khisty and B. K. Lall, Transportation Engineering: An Introduction, Prentice- Hall India, 2003.
2. Transportation Demand Management (TDM) Encyclopedia, Victoria Transport Policy Institute Canada, 2006.

References :

1. Transportation Engineering and Planning, by C. S. Papacostas and P. D. Prevedouros, Prentice Hall of India Private Limited 2001
2. Roger P. Roess, William R.McShane & Elena S.Prassas, Traffic Engineering, Prentice-Hall, 1990.

Course Content and lecture Schedule:

No.	Topic	Course Outcome	No. of Hrs
1	**Module 1**		Total: 9
1.1	System approach to Transportation Planning; The need for TSM, Long range verses TSM Planning	CO1	1
1.2	TSM characteristics: TSM planning cycle, TSM strategies, Objectives and Philosophy; Relevance of TSM actions in Indian context.	CO1	1
1.3	Measures for Improving vehicular flow – one-way Streets, Signal Improvement, Transit Stop Relocation, Parking Management, Reversible lanes- Reducing Peak Period Traffic – Strategies for working hours, Congestion Pricing.	CO1	7
2	**Module 2**		Total: 9

2.1	Public Transport: Preferential Treatment to high Occupancy Vehicles; Transit system operations, Service and characteristics, Transit Service Improvement Measures; Car Pooling;	CO2	4
2.2	Transit Management Improvement Measure; Multi-Modal Coordination; Transit and Para transit integration;	CO2	5
3	**Module 3**		Total: 9
3.1	Bus Route Network Planning and Management: Type of Bus Route Networks; Suitability for a given Urban Area;	CO2	2
3.2	Types of routes – Corridor routes, activity routes and residential routes;	CO2	2
3.3	Issues in route networks evaluation – number of route, length of route;	CO2	2
3.4	Route alignment methods; service coverage and accessibility index.	CO2	3
4	**Module 4**		Total: 9
4.1	Local area traffic management: Promotion of Non – motorised modes: Measures to promote;	CO3	1
4.2	Pedestrianisation: Pedestrian facilities and management. IRC codes.	CO3	2
4.3	Bicycle Transportation – advantages; Planning Bicycle Facilities Junction Treats for cycle tracks; IRC codes for bicycle facilities.	CO3	4
4.4	LOS criteria for Pedestrian and bicycle Facilities.	CO3	2
5	**Module 5**		Total: 9
5.1	Advanced Transit Technologies: low carbon vehicles; Automated Highways: System Characteristics and Suitability, Electric vehicles, Automated vehicles: Planning, infrastructure and implementation; issues.	CO4	4
5.2	Rapid Transportation System; New technologies – LRT, monorail, Bus rapid transit system (BRTS), Rail rapid transit system(RRTS).	CO4	5

FIFTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEHR510.2

Course Name: **TRANSPORTATION SYSTEMS MANAGEMENT**

Model Question Paper

Marks:100 Duration: 3 hrs

PART A

(Answer all Questions: Each question carries 3 marks)

1 Mention the need for Transportation System Management.
2 Discuss about the relevance of TSM actions in Indian context?
3 What are the issues related to transit and para transit integration?
4 Discuss about carpooling.
5 What are the strategies adopted for fixing suitable bus network for a given Urban Area?
6 Comment on how to arrive at an accessibility index for a transit route.
7 Suggest the measures to be taken to promote NMT in Indian cities.
8 What considerations are to be made for planning proper bicycle Facilities for an urban area?
9 Mention some important features suggested for automated highways.
10 Why should planners recommend BRTS for urban areas?

(3 x 10=30 marks)

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PART B

(Answer one full question from each module)

11	a.	Describe the system approach to transportation planning	7
	b.	What are reversible lanes? How does it help to improve traffic flow?	7
		OR	
12	a.	Mention the objectives of TSM?	7
	b.	How is congestion pricing carried out to improve traffic flow?	7
13	a.	What are the service characteristics of transit operations?	7
	b.	List out the five pillars of multi-modal integration? Explain each.	7
		OR	
14		List out the preferential treatments to High Occupancy Vehicles. Explain any five in detail.	14
15		Compare and contrast the different route adopted under network planning strategies.	14
		OR	
16	a.	How do you evaluate the effectiveness of bus route network?	7

b.	Describe in detail any method adopted by planners to align route in the urban road netwroks.	7
17 a.	List down the characteristics of Non – motorised modes of traffic.	7
b.	How can the LOS criteria for Pedestrian formulated?	7
	OR	
18 a	Suggest the modifications to be adopted in an urban roadway to enhance the pedestrian facilities in reference to the IRC codes.	7
b.	Discuss the Junction Treatments to be facilitated for laying cycle tracks.	7
19 a.	What are the infrastructural facilities required for a properly planned electric transit vehicle system in a typical Indian city	7
b.	Compare and contrast any two popular Rapid Transportation Systems.	7
	OR	
20 a.	What are the infrastructural and service characteristics advised for a typical Indian city to be employed with an automatic highway?	7
b.	What are the measures that can be adopted for enhancing the usage of rail as a transit mode?	7

22CEHR510.3	GROUND WATER HYDROLOGY	Category	L	T	P	Credit	Year of Introduction
		HONOURS	3	1	0	4	2019

Preamble: The general objective of this course is to expose the students to the fundamental concepts of groundwater hydrology and its engineering applications. The course aim to impart the knowledge on the hydraulics of subsurface fluid flow, characteristics of porous media, well flow near aquifer boundaries, surface investigation of ground water, quality of ground water, artificial recharge and ground water flow modeling.

Pre-requisite: NIL

Course outcome

After the course, the student will be able to:

CO1	Understand the occurrence and movement of ground water through porous media and apply Darcy's law to simple ground water flow problems
CO2	Determine the aquifer parameters using different methods
CO3	Estimate drawdown in wells due to the effect of aquifer boundaries and thickness of aquifers
CO4	Estimate sea water intrusion length and fresh water discharge into the sea
CO5	Perform numerical modeling of ground water system

CO-PO Mapping

CET397 Ground Water Hydrology		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	3	3					1					
	CO2	3	3					1					
	CO3	3	2					1					
	CO4	3	3					1					
	CO5	3	3					1					

Assessment pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	5	5	15
Understand	10	10	15
Apply	20	20	40
Analyze	15	15	30
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment Test(2 numbers)	:	25 marks
Assignment/Quiz/Course project	:	15 marks
Total	**:**	**50 marks**

End semester examination pattern – There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

22CEHR510.3: Ground Water Hydrology
Syllabus

Module I

Vertical distribution of groundwater- Types of geologic formations, Properties of aquifer related to storage and transmissivity of water, Darcy's law, Steady unidirectional flow- steady flow in a homogenous aquifer- aquifer with recharge- flow into infiltration galleries. (Problems from unidirectional flow)

Module II

Partial differential equation governing unsteady groundwater flow- unsteady radial flow towards well. Evaluation of aquifer parameters by Theis, Jacob's and Chow's method. (Problems from evaluation of aquifer parameters)

Module III

Well flow near aquifer boundaries- Image well system. Method of images- Practical cases (Problems from method of images). Surface investigation of ground water- different methods- electrical resistivity method, seismic refraction method- determination of aquifer thickness of horizontal aquifers (Problems from resistivity method, seismic refraction)

Module IV

Quality of ground water- Graphical representations. Pollution of ground water- sources, distribution and evaluation of ground water pollution (Brief description only). Sea water intrusion- Ghyben-Herzberg equation, sea water-fresh water interface, length of intrusion, upconing, preventive measures.(Problems from sea water intrusion)

Module V

Artificial recharge of ground water-different techniques. Modelling of ground water flow- governing equations of ground water flow and boundary conditions (basic ideas only), solution of partial differential equation of ground water flow for 1D steady ground water flow in homogenous aquifers (confined and unconfined) using finite difference method (uniform mesh interval only)

Text Books:

1. D.K. Todd, "Ground Water Hydrology", Wiley International Ed; Toppan &Company Ltd, Tokyo, 1995.
2. H.M. Raghunath, "Groundwater", New Age International Publishers, New Delhi, 2007.
3. A.K. Rastogi, "Numerical Ground Water Hydrology", Penram International Publishers, Mumbai

References:

1. Karanth, "Ground Water Assessment, Development and Management" Tata McGraw Hill publishing company Ltd.
2. "Ground Water Manual", A Water Resources Technical Publication.
3. S.P Garg, "Ground Water and tube wells", Oxford &IBH Publishing Company.
4. Punmia B.C. Ashok K Jain, Arun K Jain, B. B. L Pande, " Irrigation and Water Power Engineering", Laxmi Publications (P) Ltd. 2009
5. Herman Bouwer, "Ground Water Hydrology", MC Graw Hill Kogakusha Ltd.
6. H.M. Raghunath, "Ground Water Hydrology", Wiley Eastern Limited.
7. Neven Kresic, "Hydrogeology and Ground Water modeling", CRC press, Taylor&Francis group, 2007.
8. Freeze and Cherry, "Ground Water", Prentice Hall

Course Code: 22CEHR510.3

Ground Water Hydrology
(Course plan)

Module	Topic	Course outcome addressed	No of Hours
Module I (10 Hours)			
1.1	Vertical distribution of ground water-Types of geologic formations	CO1	1
1.2	Properties of aquifer related to storage and transmissivity of water	CO1	1
1.3	Darcy's law, Steady unidirectional flow	CO1	1
1.4	Steady flow in a homogenous aquifer	CO1	1
1.5	Problems from unidirectional flow	CO1	2
1.6	Aquifer with recharge	CO1	1
1.7	Flow into infiltration galleries	CO1	1
1.8	Problems	CO1	2
Module II (8 Hours)			
2.1	Partial differential equation governing unsteady ground water flow	CO2	1
2.2	Unsteady radial flow towards well	CO2	1
2.3	Evaluation of aquifer parameters- Theis method	CO2	1
2.4	Evaluation of aquifer parameters- Jacob's method	CO2	1
2.5	Evaluation of aquifer parameters- Chow's method	CO2	1
2.6	Problems- Evaluation of aquifer parameters	CO2	3
Module III (11 Hours)			
3.1	Well flow near aquifer boundaries	CO3	1
3.2	Image well system	CO3	1
3.3	Method of images –particular cases	CO3	1
3.4	Problems from method of images	CO3	2
3.5	Surface investigation of ground water	CO3	1
3.6	Electrical resistivity method	CO3	1
3.7	Seismic refraction method	CO3	1
3.8	Determination of aquifer thickness of horizontal aquifers	CO3	1
3.9	Problems- resistivity method, seismic refraction	CO3	2
Module IV (9 Hours)			
4.1	Quality of ground water –Graphical representations	CO4	1
4.2	Pollution of ground water-sources	CO4	1
4.3	Distribution and evaluation of ground water pollution	CO4	1
4.4	Sea water intrusion-Ghyben-Herzberg equation	CO4	1

4.5	Sea water-fresh water interface	CO4	1
4.6	Length of intrusion	CO4	1
4.7	Upconing , Sea water intrusion- preventive measures	CO4	1
4.8	Problems- Sea water intrusion	CO4	2
Module V (7 Hours)			
5.1	Artificial recharge of ground water- different techniques	CO5	1
5.2	Modelling of ground water flow	CO5	1
5.3	Governing equations of ground water flow and boundary conditions	CO5	1
5.4	Solution of partial differential equation of ground water flow for 1D steady ground water flow in homogenous aquifer using finite difference method	CO5	4

Course Code: 22CEHR510.3

Ground Water Hydrology

(Course Level Assessment Questions)

Qn No	Question	Marks	Course outcome (CO) Assessed
	Part A **(Answer ALL Questions)**		
1	Explain different properties of aquifer	3	CO1
2	What is an infiltration gallery? Explain with figure.	3	CO1
3	Briefly explain Theis method of estimation of aquifer parameters	3	CO2
4	What are the assumptions in the derivation of partial differential equation of unsteady radial flow towards wells?	3	CO2
5	Find the number of image wells and locate the image wells when the aquifer is delimited by two converging recharge boundaries at right angles.	3	CO3
6	What are the applications of electrical resistivity method?	3	CO3
7	What are the different sources of pollution of ground water? Explain briefly	3	CO4
8	Explain upconing with neat sketch	3	CO4
9	Write the equations for the second order head gradient of an aquifer using central, forward and backward difference schemes	3	CO5
10	Write the governing equations of groundwater flow and boundary conditions	3	CO5
	Part B **(Answer ANY ONE FULL question from each module)**		
	Module I		
11(a)	Explain different types of aquifer with neat sketches	7	CO1
11(b)	In a field test, time of 6 hour was required for a tracer to travel between two observation wells 42 m apart. If the	7	CO1

<table>
<tr><td></td><td>difference in water-table elevations in these wells were 0.85 m and the porosity of the aquifer is 20%, calculate the coefficient of permeability of the aquifer.</td><td></td><td></td></tr>
<tr><td>12(a)</td><td>State Darcy's law and its limitations</td><td>4</td><td>CO1</td></tr>
<tr><td>12(b)</td><td>Sketch a typical infiltration gallery. Derive the equation for discharge per unit length of the infiltration gallery and phreatic surface by making suitable assumptions.</td><td>10</td><td>CO1</td></tr>
<tr><td></td><td>Module II</td><td></td><td></td></tr>
<tr><td>13(a)</td><td>Derive partial differential equation for unsteady ground water flow</td><td>10</td><td>CO2</td></tr>
<tr><td>13(b)</td><td>A well of 30 cm diameter is located in a confined aquifer of transmissibility 500m^2/day and storage coefficient of 0.005. What pumping rate will have to be adopted if the drawdown at the well is not to exceed 10 m in 2 days.</td><td>4</td><td>CO2</td></tr>
<tr><td>14(a)</td><td>The time drawdown data recorded at an observation well situated at a distance of 50 m from the pumping well is given below.
<table>
<tr><td>Time (min)</td><td>Drawdown (m)</td></tr>
<tr><td>1.5</td><td>0.15</td></tr>
<tr><td>3</td><td>0.6</td></tr>
<tr><td>4.4</td><td>1</td></tr>
<tr><td>6</td><td>1.4</td></tr>
<tr><td>10</td><td>2.4</td></tr>
<tr><td>20</td><td>3.7</td></tr>
<tr><td>40</td><td>5.1</td></tr>
<tr><td>100</td><td>6.9</td></tr>
</table>
If the well discharge is 1.8 m^3/min, calculate the transmissibility and storage coefficient of the aquifer using modified Theis method.</td><td>9</td><td>CO2</td></tr>
<tr><td>14(b)</td><td>Describe the method for the estimation of aquifer parameters by Chow's method.</td><td>5</td><td>CO2</td></tr>
<tr><td></td><td>Module III</td><td></td><td></td></tr>
<tr><td>15 (a)</td><td>Describe the seismic refraction method for groundwater investigation with a neat sketch.</td><td>7</td><td>CO3</td></tr>
<tr><td>15(b)</td><td>An aquifer is delineated by two converging barrier boundaries, the angle of wedge being 45^0.Compute the number of image wells associated with the wedge shaped boundary system and mark them neatly in a sketch.</td><td>7</td><td>CO3</td></tr>
</table>

16 (a)	In a seismic refraction survey for locating an aquifer, slopes of 1.66 x 10^{-3} and 0.000625 s/m were noted from the time-distance plots. If the cross-over distance is 20.76 m, compute the depth to the aquifer, the critical shot-geophone distance, and the correct angle of incidence for the refraction along the interface.	5	CO3
16 (b)	A 30cm well is pumped at the rate of 1000 lpm. The transmissibility of the aquifer is 0.015m^2/s. If the well is located at a distance of 120m from a stream, what should be the drawdown (i) In the pumping well (ii) In an observation well 100m away from the pumping well on the side opposite to the stream (iii) In an observation well 85m away from the pumping well, on a line parallel to the stream.	9	CO3
	Module IV		
17(a)	Derive the relationship between length of interface and freshwater discharge in a confined aquifer.	8	CO4
17(b)	Explain different water quality plots with neat sketches	6	CO4
18(a)	Describe the preventive measures to control saltwater intrusion into coastal aquifers with neat sketches.	7	CO4
18(b)	By conductivity measurements in a well in a coastal aquifer extending 4 km along the shore, the interface was located at a depth of 20 m below m.s.l. at 100 m from the shore, inland. The depth of the homogenous aquifer is 30 m below m.s.l. and has a permeability of 50 m/day. What is the rate of fresh water flow into the sea and the width of gap at the shore bottom through which it escapes into the sea? What is the position of the toe of the saltwater wedge? Use Glover's method.	7	CO4
	Module V		
19 (a)	Explain different techniques of artificial recharge of ground water with neat sketches.	8	CO5
19 (b)	Find the numerical value of the third and fourth order aquifer head gradient by the forward, backward and central difference method assuming uniform head distribution in a confined aquifer between two wells	6	CO5

	located 4 Km apart with piezometric levels of 100 m and 102 m respectively. Take these two wells as the extreme nodes.		
20 (a)	One dimensional steady state flow is happening in a confined aquifer with transmissivity T. The aquifer is bounded by an impervious boundary to the left and a constant head boundary to the right. Ground water flows into the aquifer due to a constant recharge Q through an aquitard. Assuming Q=0.0005m/day, T= 500 m/day, thickness of aquifer b=100m, length of aquifer L= 5 Km, Constant head of right boundary H=100 m, find the head at different nodes using central difference scheme.(Take discretization interval as 1250 m)	10	CO5
20 (b)	Write any six applications of ground water models.	4	CO5

Pages: 3

Model Question Paper

Reg No.:..................... **QP CODE:..................**

Name:...

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEHR510.3

Ground Water Hydrology

Max. Marks: 100 **Duration: 3 hours**

Part A

(Answer all questions; each question carries 3 marks)

11. Explain different properties of aquifer
12. What is an infiltration gallery? Explain with figure.
13. Briefly explain Theis method of estimation of aquifer parameters
14. What are the assumptions in the derivation of partial differential equation of unsteady radial flow towards wells?
15. Find the number of image wells and locate the image wells when the aquifer is delimited by two converging recharge boundaries at right angles.
16. What are the applications of electrical resistivity method?
17. What are the different sources of pollution of ground water? Explain briefly
18. Explain upconing with neat sketch
19. Write the equations for the second order head gradient of an aquifer using central, forward and backward difference schemes
20. Write the governing equations of groundwater flow and boundary conditions

Part B

(Answer one full question from each module, each question carries 14 marks)

Module I

11 (a) Explain different types of aquifer with neat sketches (7 Marks)

(b) In a field test, time of 6 hour was required for a tracer to travel between two observation wells 42 m apart. If the difference in water-table elevations in these wells were 0.85 m and the porosity of the aquifer is 20%, calculate the coefficient of permeability of the aquifer. (7 Marks)

OR

12.(a) State Darcy's law and its limitations

(4 Marks)

(b) Sketch a typical infiltration gallery. Derive the equation for discharge per unit length of the infiltration gallery and phreatic surface by making suitable assumptions.

(10 Marks)

Module II

13(a) Derive partial differential equation for unsteady ground water flow

(10 Marks)

(b) A well of 30 cm diameter is located in a confined aquifer of transmissibility 500 m^2/day and storage coefficient of 0.005. What pumping rate will have to be adopted if the drawdown at the well is not to exceed 10 m in 2 days. (4 Marks)

OR

14.(a) The time drawdown data recorded at an observation well situated at a distance of 50 m from the pumping well is given below.

Time (min)	Drawdown (m)
1.5	0.15
3	0.6
4.4	1
6	1.4
10	2.4
20	3.7
40	5.1
100	6.9

If the well discharge is 1.8 m^3/min, calculate the transmissibility and storage coefficient of the aquifer using modified Theis method. (9 Marks)

(b) Describe the method for the estimation of aquifer parameters by Chow's method.

(5 Marks)

Module III

15. (a) Describe the seismic refraction method for groundwater investigation with a neat sketch. (7 Marks)

(b) An aquifer is delineated by two converging barrier boundaries, the angle of wedge being 45^0.Compute the number of image wells associated with the wedge shaped boundary system and mark them neatly in a sketch. (7 Marks)

OR

16. (a) In a seismic refraction survey for locating an aquifer, slopes of 1.66 x 10^{-3} and 0.000625 s/m were noted from the time-distance plots. If the cross-over distance is 20.76 m, compute the depth to the aquifer, the critical shot-geophone distance, and the correct angle of incidence for the refraction along the interface.

(5 Marks)

(b) A 30cm well is pumped at the rate of 1000 lpm. The transmissibility of the aquifer is $0.015m^2/s$. If the well is located at a distance of 120m from a stream, what should be the drawdown

(i) In the pumping well

(ii) In an observation well 100m away from the pumping well on the side opposite to the stream

(iii) In an observation well 85m away from the pumping well, on a line parallel to the stream. (9 Marks)

Module IV

17 (a) Derive the relationship between length of interface and freshwater discharge in a confined aquifer. (8 Marks)

(b) Explain different water quality plots with neat sketches . (6 Marks)

OR

18 (a) Describe the preventive measures to control saltwater intrusion into coastal aquifers with neat sketches. (7 Marks)

(b) By conductivity measurements in a well in a coastal aquifer extending 4 km along the shore, the interface was located at a depth of 20 m below m.s.l. at 100 m from the shore, inland. The depth of the homogenous aquifer is 30 m below m.s.l. and has a permeability of 50 m/day. What is the rate of fresh water flow into the sea and the width of gap at the shore bottom through which it escapes into the sea? What is the position of the toe of the saltwater wedge? Use Glover's method. (7 Marks)

Module V

19 (a) Explain different techniques of artificial recharge of ground water with neat sketches. (8 Marks)

(b) Find the numerical value of the third and fourth order aquifer head gradient by the forward, backward and central difference method assuming uniform head distribution in a confined aquifer between two wells located 4 Km apart with piezometric levels of 100 m and 102 m respectively. Take these two wells as the extreme nodes. (6 Marks)

OR

20.(a) One dimensional steady state flow is happening in a confined aquifer with transmissivity T. The aquifer is bounded by an impervious boundary to the left and a constant head boundary to the right. Ground water flows into the aquifer due to a constant recharge Q through an aquitard. Assuming Q=0.0005m/day, T= 500 m/day, thickness of aquifer b=100m, length of aquifer L= 5 Km, Constant head of right boundary H=100 m, find the head at different nodes using central difference scheme.(Take discretization interval as 1250 m) (10 Marks)

(b) Write any six applications of ground water models. (4 Marks)

SEMESTER 6

SEMESTER VI

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	22CET 601	STRUCTURAL ANALYSIS –II	3-1-0	4	4
B	22CET 602	ENVIRONMENTAL ENGINEERING	4-0-0	4	4
C	22CET 603	DESIGN OF HYDRAULIC STRUCTURES	4-0-0	4	4
D	22CEE 604	PROGRAM ELECTIVE I	3-0-0	3	3
E	22HUT 605	INDUSTRIAL ECONOMICS & FOREIGN TRADE	3-0-0	3	3
F	22CET 606	COMREHENSIVE COURSE WORK	1-0-0	1	1
S	22CEL 607	TRANSPORTATION ENGINEERING LAB	0-0-3	3	2
T	22CEL 608	CIVIL ENGINEERING SOFTWARE LAB	0-0-3	3	2
R/M/H	22CEMR609.1/2/3 22CEHR610.1/2/3	Remedial/Minor/Honours course	3-1-0	4*	4
TOTAL				**25/29**	**23/27**

PROGRAM ELECTIVE I

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
D	22CEE 604.1	ADVANCED COMPUTATIONAL METHODS	3-0-0	3	3
	22CEE 604.2	GEOTECHNICAL INVESTIGATION	3-0-0		
	22CEE 604.3	TRAFFIC ENGINEERING & MANAGEMENT	3-0-0		
	22CEE 604.4	MECHANICS OF FLUID FLOW	3-0-0		
	22CEE 604.5	ADVANCED CONCRETE TECHNOLOGY	3-0-0		
	22CEE 604.6	ENVIRONMENTAL IMPACT ASSESSMENT	3-0-0		
	22CEE 604.7	FUNCTIONAL DESIGN OF BUILDINGS	3-0-0		

MINOR

SEMESTER	BASKET I				BASKET II				BASKET III			
	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT
S6	22CEMR609.1	ESTIMATION COSTING AND VALUATION	4	4	22CEMR609.2	GEOTECHNICAL INVESTIGATION & GROUND IMPROVEMENT TECHNIQUES	4	4	22CEMR609.3	ENVIRONMENTAL HEALTH& SAFETY	4	4

HONOURS

SEMESTER	GROUP I				GROUP II				GROUP III			
	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT
S 6	22CEHR610.1	FINITE ELEMENT METHODS	4	4	22CEHR610.2	EARTH DAMS AND EARTH RETAINING STRUCTURES	4	4	22CEHR610.3	ENVIRONMENTAL POLLUTION MODELLING	4	4

<table>
<tr><td rowspan="2">22CET 601</td><td rowspan="2">STRUCTURAL ANALYSIS - II</td><td>CATEGORY</td><td>L</td><td>T</td><td>P</td><td>CREDIT</td><td>Year of Introduction</td></tr>
<tr><td>PCC</td><td>3</td><td>1</td><td>0</td><td>4</td><td>2019</td></tr>
</table>

Preamble:

The course enables the students to analyse various types of multistoreyed structures using appropriate methods and tools. It utilises the procedures of force methods and displacememt methods for analysing framed structures. Plastic theory and its applications are introduced to students. A very important topic of applications of principles of dynamics to analyse structures while undergoing dynamic deformations is also made familiar with. The course trains the students to develop mathematical models and helps to sharpen their analytical skills, which also helps the student to lay foundation for further advanced topics like finite element method.

Prerequisite: 22CET 501 Structural Analysis I

Course Outcomes: After the completion of the course the student will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Understand the principles of plastic theory and its applications in structural analysis.	Understanding, Applying
CO2	Examine the type of structure and decide on the method of analysis.	Analysing, Applying
CO3	Apply approximate methods of analysis for framed structures to ascertain stress resultants approximately but quickly.	Analysing, Applying
CO4	Apply the force method to analyse framed structures.	Understanding, Analysing, Applying
CO5	Apply the displacement methods to analyse framed structures.	Understanding, Analysing, Applying
CO6	Remember basic dynamics, understand the basic principles of structural dynamics and apply the same to simple structures.	Remembering, Understanding, Applying

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-
CO3	3	3	1	-	-	-	-	-	-	-	-	-
CO4	3	3	1	-	-	-	-	-	-	-	-	-
CO5	3	3	1	-	-	-	-	-	-	-	-	-
CO6	3	3	1	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	05	05	10
Understand	10	10	20
Apply	20	20	50
Analyse	15	15	20
Evaluate			
Create			

Mark distribution

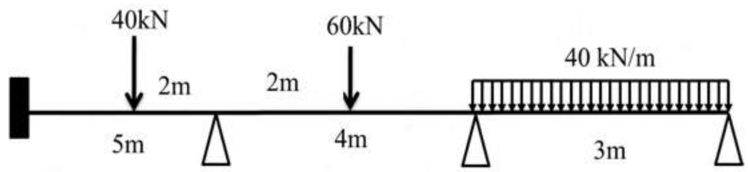
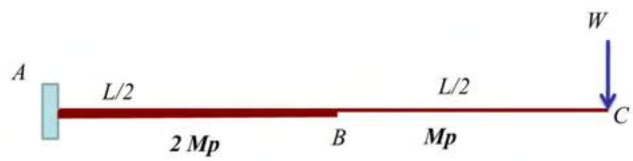
Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

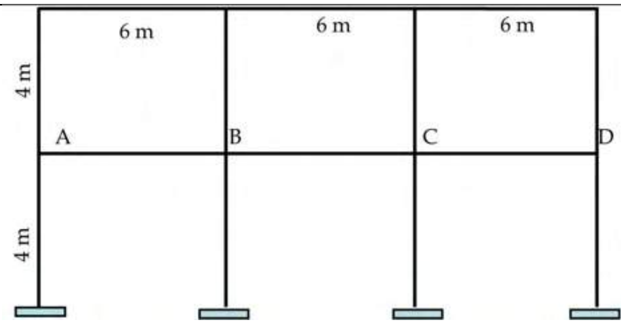
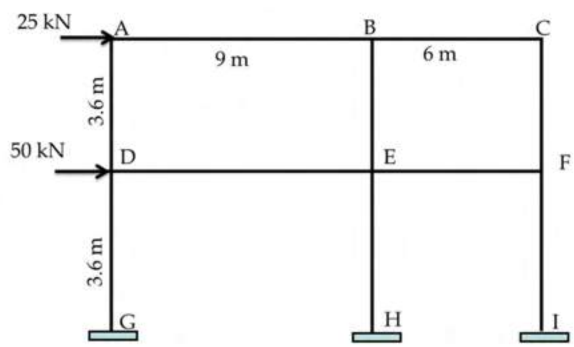
End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

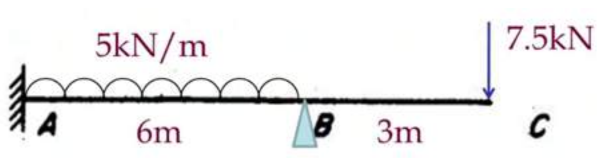
Course Level Assessment Questions

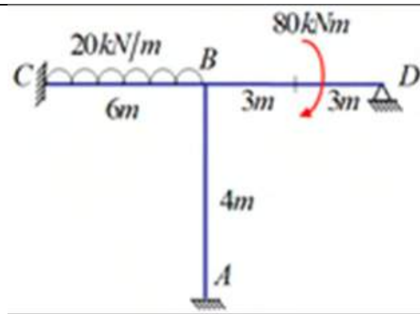
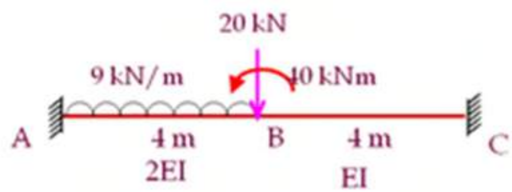
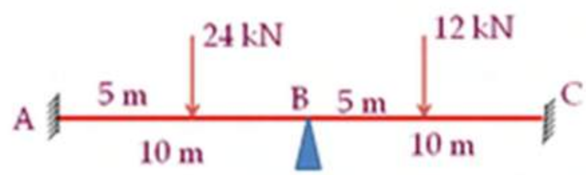
CO1:	**Understand the principles of plastic theory and its applications in structural analysis.**
1.	Derive an expression for the shape factor of a rectangular cross section.
2.	Explain the terms 'design plastic moment capacity of a member' and 'collapse load of a structure'
3.	Find the plastic moment capacity of the beam shown in figure. Assume uniform section throughout. 
4.	For the cantilever in Fig.2, determine the collapse load. 

CO2:	**Examine the type of structure and decide on the method of analysis.**
1.	Differentiate between force and displacement methods of analysis of framed structures.
2.	Explain how you will determine the suitability of force method or displacement method for analysis of a structure?
3.	Which are the situations in which an analyst uses approximate methods of structural analysis? What are their advantages and disadvantages?

CO3:	**Apply approximate methods of analysis for framed structures to ascertain stress resultants approximately but quickly.**
1.	What are the assumptions in cantilever method?
2.	Total dead load is 12 kN/m and total live load is 20 kN/m on ABCD. Analyse the frame for midspan positive moment on BC, using substitute frame method.

	
3.	Analyse the frame in figure using portal method. 

CO4:	**Apply the force method or displacement method to analyse structures accurately.**
1.	Derive stiffness matrix for the degrees of freedom shown for the beam in figure. 
2.	Prove that flexibility matrix is the inverse of stiffness matrix for a given set of actions and corresponding displacements.
3.	Analyse the beam in figure using flexibility method. 
4.	Determine all the member end moments for the frame shown in figure, using stiffness method.

	
5.	Determine the displacements at B for the beam shown in figure, using stiffness method. 
6.	Find all the joint displacements for the beam in Figure 5, using direct stiffness method. 

CO5:	**Remember basic dynamics, understand the basic principles of structural dynamics and apply the same to simple structures.**
1.	Explain the components of the basic dynamic system
2.	Derive an expression for the free-vibration response of a damped SDOF system.
3.	Explain transient and steady-state responses
4.	A vibrating system consists of a weight of W = 100kN and a spring with stiffness k = 20 N/m is viscously damped so that the ratio of two consecutive amplitudes is 1/0.85. Detemine: a) the natural frequency of the undamped system, b) the damping ratio, c) the damping coefficient and d) the damped natural frequency.

SYLLABUS

MODULE I – 9 hrs.
Plastic Theory: Introduction – plastic hinge concepts – plastic modulus – shape factor – redistribution of moments – collapse mechanisms – Plastic analysis of beams and portal frames by equilibrium and mechanism methods. (single storey and single bay frames only) – 6 hrs.

Approximate methods of analysis of multistoried frames:
Analysis for vertical loads-substitute frames-loading condition for maximum hogging and sagging moments in beams and maximum bending moment in columns – 3 hrs.

MODULE II – 9 hrs.
Approximate methods (continued): Wind load analysis of multistoried frames – portal method and cantilever method for lateral load analysis. – 2 hrs.

Matrix analysis of structures:
Definition of flexibility and stiffness influence coefficients - Concepts of physical approach – 1 hr.
Flexibility method: flexibility matrices for truss and frame elements-load transformation matrix-development of total flexibility matrix of the structure-analysis of simple structures-plane truss and plane frame-nodal loads and element loads-lack of fit and temperature effects. – 6 hrs.

MODULE III – 9 hrs.
Stiffness method: Development of stiffness matrices by physical approach-stiffness matrices for truss and frame elements-displacement transformation matrix-analysis of simple structures-plane truss and plane frame-nodal loads and element loads-lack of fit and temperature effects. – 9 hrs.

MODULE IV – 9 hrs.
Direct stiffness method: Introduction to direct stiffness method-Rotation of axes in two dimensions, stiffness matrix of elements in global co- ordinates from element co-ordinates- assembly of load vector and stiffness matrix, solution of two span continuous beam-single bay single storey portal frame. – 9 hrs.

MODULE V
Structural dynamics:
Introduction - degrees of freedom - equation of motion, D'Alembert's principle-damping- free response of damped and undamped systems- logarithmic decrement-- single degree of freedom systems subjected to harmonic load - transient and steady state responses, simple portal frame problems. – 9 hrs.

Text Books:

1. James M Gere & William Weaver, Matrix Analysis of Framed Structures - (CBS Publishers)
2. Mechanics of Structures Vol I & II, Junnarkar S.B., Charotar Publishing House
3. Devdas Menon, Structural Analysis, Narosa Publications
4. Wang C.K., Intermediate Structural Analysis, McGraw Hill
5. Mario Paz, Structural Dynamics

References:

1. Pandit and Gupta, Structural Analysis – A Matrix Approach
2. Reddy C. S., Basic Structural Analysis, Tata McGraw Hill
3. Norris and Wilbur, Elementary Structural Analysis, Tata McGraw Hill
4. Punmia B. C., Strength of Materials and Mechanics of Structures, Laxmi Publications
5. RC Hibbeler, Structural Analysis
6. Wang C K, Matrix Method of Structural Analysis
7. Anil. K. Chopra, Dynamics of structures, Pearson Education/ Prentice Hall India,
8. Clough R.W. and Penzein, J., Dynamics of structures - Tata McGraw Hill
9. Madhujith Mukhopadhyay and Abdul Hamid Sheikh, Matrix and Finite Element Analysis of Structures, Ane Books India.
10. Rajasekharan & Sankara Subramanian, Computational Structural Mechanics
11. William T Thomson, Theory of vibration with application
12. Tse, Morse Hinkle, Mechanical Vibrations

Lecture Plan – Structural Analysis II

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module I: Total lecture hours: 9**		
1.1	Plastic Theory: Introduction – concept of plastic hinge	CO1	1
1.2	Plastic modulus – shape factor	CO1	1
1.3	Redistribution of moments – collapse mechanisms – plastic analysis of beams and portal frames by equilibrium and mechanism methods (single storey and single bay frames only)	CO1	4
1.4	Introduction to approximate methods of analysis of multistoried frames, analysis for vertical loads-substitute frames	CO2, CO3	1
1.5	Loading condition for maximum hogging and sagging moments in beams and maximum bending moment in columns – numerical problems	CO3	2
2	**Module II: Total lecture hours: 9**		
2.1	Approximate methods (continued): Wind load analysis of multistoried frames – portal method and cantilever method for lateral load analysis.	CO3	2
2.2	Introduction to matrix analysis of structures: Definition of flexibility and stiffness influence coefficients - Concepts of physical approach	CO2, CO4	1
2.3	Flexibility method: flexibility matrices for truss and frame elements	CO4	1
2.3	Load transformation matrix - development of total flexibility matrix of the structure	CO4	1
2.4	Analysis of simple structures - plane truss and plane frame - nodal loads and element loads	CO4	3
2.5	Lack of fit and temperature effects		1
3	**Module III: Total lecture hours: 9**		
3.1	Stiffness method: Development of stiffness matrices by physical approach	CO5	1
3.2	Stiffness matrices for truss and frame elements - displacement transformation matrix	CO5	2

3.3	Analysis of simple structures - plane truss and plane frame - nodal loads and element loads	CO5	5
3.4	Lack of fit and temperature effects	CO5	1
4	**Module IV: Total lecture hours: 9**		
4.1	Direct stiffness method: Introduction to direct stiffness method - global co-ordinates and local co-ordinates.	CO2, CO5	1
4.2	Rotation of axes in two dimensions, stiffness matrix of elements in global co- ordinates from element co-ordinates - assembly of load vector and stiffness matrix	CO5	2
4.3	Solution of numerical problems on two span continuous beam – single bay single storey portal frame	CO5	6
5	**Module V: Total lecture hours: 9**		
5.1	Structural dynamics: Introduction - degrees of freedom - equation of motion, D'Alembert's principle – Damping	CO6	2
5.2	Free response of damped and undamped systems	CO6	2
5.3	Logarithmic decrement	CO6	1
5.4	Single degree of freedom systems subjected to harmonic load - transient and steady state responses	CO6	2
5.5	Simple portal frame problems	CO6	2

MODEL QUESTION PAPER

Reg. No.:________________		Name:____________________________

SIXTH SEMESTER B.TECH DEGREE EXAMINATION

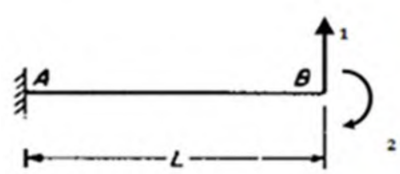
Course Code: 22CET 601

Course Name: STRUCTURAL ANALYSIS II

Max. Marks: 100		Duration: 3 Hours

PART A

Answer all questions; each question carries 3 marks.

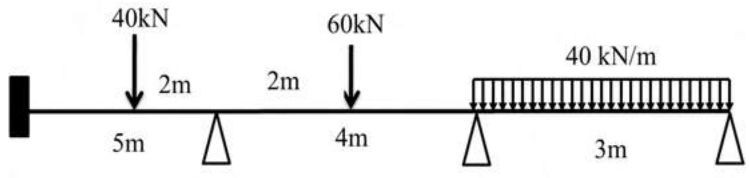
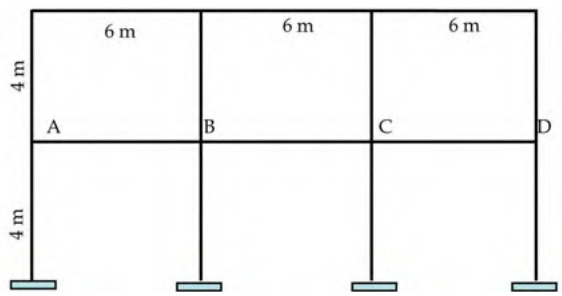
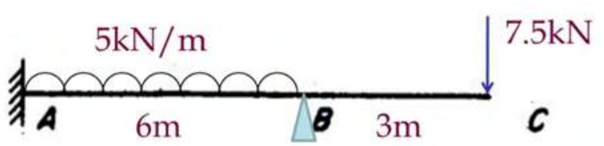
1.	a)	Derive an expression for the shape factor of a rectangular cross section.
	b)	What are the advantages and disadvantages of approximate methods of structural analysis?
	c)	Derive flexibility matrix for the co-ordinates shown for the beam in figure. 
	d)	What are the assumptions in cantilever method?
	e)	Derive stiffness matrix for the degrees of freedom shown for the beam in figure. 
	f)	Prove that flexibility matrix is the inverse of stiffness matrix for a given set of actions and corresponding displacements.
	g)	Explain local co-ordinates and global co-ordinates.
	h)	Write down the steps involved in direct stiffness method.
	i)	Explain the components of the basic dynamic system.
	j)	Explain transient and steady-state responses.

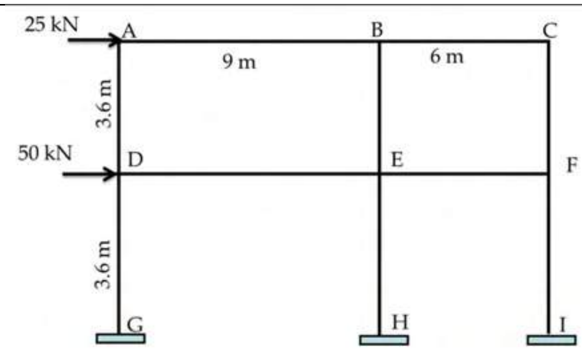
(10×3 marks = 30 marks)

PART B

Answer one full question from each module; each full question carries 14 marks.

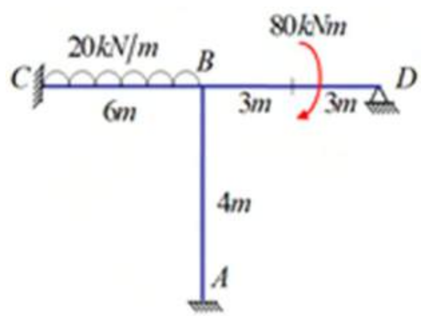
Module I

2.	Find the plastic moment capacity of the beam shown in figure. Assume uniform section throughout .  (14 marks)
3.	Total dead load is 12 kN/m and total live load is 20 kN/m on ABCD. Analyse the frame for midspan positive moment on BC, using substitute frame method.  (14 marks)
	Module II
4.	Analyse the beam in figure using flexibility method.  (14 marks)
5	Analyse the frame in figure using portal method.



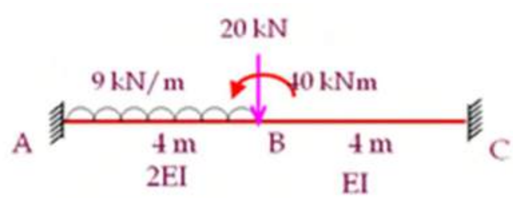
Module III

6. Determine all the member end moments for the frame shown in figure, using stiffness method.



(14 marks)

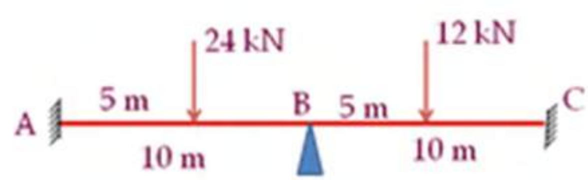
7. Determine the displacements at B for the beam shown in figure, using stiffness method.



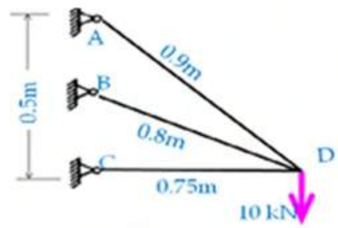
(14 marks)

Module IV

8. Find all the joint displacements for the beam in Figure 5, using direct stiffness method.



(14 marks)

9.	Find the joint displacements for the pin-jointed truss shown in figure, using direct stiffness method.  (14 marks)
Module V	
10.	Derive an expression for the free-vibration response of a damped SDOF system (Underdamped case only). (14 marks)
11.	A vibrating system consists of a weight of W = 100kN and a spring with stiffness k = 20 N/m is viscously damped so that the ratio of two consecutive amplitudes is 1/0.85. Detemine: a) the natural frequency of the undamped system, b) the damping ratio, c) the damping coefficient and d) the damped natural frequency (14 marks)
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22CET 602	ENVIRONMENTAL ENGINEERING	CATEGORY	L		T	P	CREDIT	Year of Introduction
		PCC	3		1	0	4	2019

Preamble

This course introduces students to various treatment technologies for drinking water and domestic waste water. Students will learn the role of an environmental engineer in ensuring public health. They will understand how engineering approach can enhance the environmental quality by scaling up the physical and biological purification processes that exist in nature.

Prerequisite: 22CET 303 Fluid Mechanics and Hydraulics, 22CET 504 Hydrology & Water Resources Engineering

Course Outcomes: After the completion of the course the student will be able

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	To appreciate the role of environmental engineering in improving the quality of environment	Understanding
CO2	To plan for collection and conveyance of water and waste water	Applying
CO3	To enhance natural water purification processes in an engineered environment	Analysing
CO4	To decide on appropriate technology for water and waste water treatment	Evaluating

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	2	2	-	-	-	-	-
CO 2	3	-	3	-	-	-	-	-	-	-	-	-
CO 3	3	-	3	-	-	-	-	-	-	-	-	-
CO4	3	-	3	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	15
Understand	10	10	15
Apply	15	15	35
Analyse	15	15	35
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Course Level Assessment Questions

CO1: To be able to appreciate the role of environmental engineering in improving the quality of environment

1.Explain from a health perspective the need for treating drinking water and safe disposal of waste water

2.How to dispose the sludge from waste water treatment plant safely?

3. How to remove colloidal range particles from water to satisfy drinking water norms?

CO 2: To be able to plan for collection and conveyance of water and waste water

1. How design period is decided for water supply schemes?

2. Discuss various types of pumps used in a water supply scheme

3. Compare separate and combined sewerage systems

CO3: To be able to enhance natural water purification processes in an engineered environment

1. Discuss different types of aerators with their advantage and limitations

2. Design a continuous flow rectangular sedimentation tank for a population of 20,000 persons with an average per capita demand of 120 litres per day. Assume a detention period of 6 hours.

3. Design an activated sludge plant to treat 6.0 Mld of sewage with BOD of 210 mg/l. The final effluent should be 30 mg/l

CO4: To be able to decide on appropriate technology for water and waste water treatment

1. Compare aerobic and anaerobic biological processes for treating waste water

2. Explain in detail the different disinfection techniques available for water and waste water treatment?

3.Discuss the treatment method available for high strength waste water

SYLLABUS

Module 1

Introduction to environmental engineering and role of environmental engineers-enhancing natural purification processes in an engineered environment-public health perspective for treating water and waste water - 1hr

Water quantity estimation:
Population forecast- water demand estimation-types of demand- demand fluctuation -3 hrs

Estimation for waste water quantity:
Dry weather flow and storm water flow-population equivalent-design period - 2 hrs
Collection and conveyance:
water intake structures- -gravity flow and pressure flow systems- 1 hr

Systems of sewerage: separate and combined-types of pumps for water and waste water conveyance - 2 hrs

Module 2

Layout plan of a conventional water treatment plant- site selection-concept of unit operations and unit processes-Screening-types of screens -aeration -aerator types- 3 hrs

Theory and principles of sedimentation-Stoke’s law-Types of settling -Design of plain sedimentation tanks - 4 hrs

Mechanisms of coagulation and flocculation, popular coagulants and feeding devices -2 hrs

Module 3

Filtration of water-theory of filtration-types of filters - design of a rapid sand filter - 3hrs

Disinfection of water - various methods - advantages and limitations -2 hrs

Lay out of water distribution network-types-methods of distribution-network analysis -Hardy cross and equivalent pipe methods-4 hrs

Module 4

Layout plan of a conventional waste water treatment plant- site selection- concept of primary, secondary and tertiary treatment- 1hr

Unit operations in waste water- primary treatment -equalization of flow- 2hrs

Secondary treatment methods- basic concepts of biological unit processes-aerobic and anaerobic- attached and suspended growth processes (Concepts only)- 2 hr

Activated sludge process- basic concepts-design of a conventional Activated Sludge Plant -3hrs

Trickling filter (Concept only)- types- construction & operation - 1 hr

Module 5

Anaerobic treatment of high strength waste water- Up flow Anaerobic Sludge Blanket (UASB) reactor (Concept only)- 2 hrs

Natural waste water treatment systems-Oxidation Ponds and Lagoons-Wetlands and Root-zone systems (Concepts only)- 3 hrs

Low cost sanitation systems- Design of a septic tank and soak-pit - 2 hr

Sludge treatment (concepts only) - thickening- digestion- dewatering- drying- composting-2hrs

Text Books:

1. Howard S Peavy, Donald R Rowe and George Tchobanoglous, Environmental Engineering, Mc Graw Hill Education , 2013
2. Mackenzie L Davis, David A Cornwell, Introduction to Environmental Engineering, Mc Graw Hill Education, 2014
3. S.K.Garg, Water Supply Engineering, Khanna Publishers. 2010
4. G S Birdie, Water Supply and Engineering, Dhanapat Rai Publishing Company, 2014
5. J. Arceivala, Shyam R. Asolekar, Wastewater Treatment for Pollution Control and Reuse, McGrawhill Education, 2007
6. S.K. Garg, Sewage disposal and air pollution engineering, Khanna Publishers. 2008

References:

1. Metcalf and Eddy, Waste Water Engineering, Tata McGraw Hill publishing Co Ltd, 2003
2. Syed R Qasim, Edward M Motley, Guang Zhu, Water Works Engineering-Planning, Design & Operation, PHI Learning, 2012.
3. Syed R Qasim, Wastewater Treatment Plants-Planning, Design & Operation, CRC Press,1999

Lecture Plan- Environmental Engineering

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module 1: Total Lecture Hours -9**		
1.1	Introduction to environmental engineering and role of environmental engineers-enhancing natural purification processes in an engineered environment-public health perspective for treating water and waste water	CO1	1
1.2	Water and waste water quantity estimation: Population forecast- water demand estimation-types of demand- demand fluctuation	CO2	3
1.3	Estimation for waste water quantity- dry weather flow and storm water flow-population equivalent-design period	CO2	2
1.4	Collection and conveyance: water intake structures- -gravity flow and pressure flow systems-	CO2	1
1.5	Systems of sewerage: separate and combined-types of pumps for water and waste water conveyance	CO2	2
2	**Module II: Total Lecture Hours- 9**		
2.1	Layout plan of a conventional water treatment plant-site selection-concept of unit operations and unit processes-Screening-types of screens -aeration-aerator types	CO1,CO4	3
2.2	Theory and principles of sedimentation-Stoke's law-Types of settling -Design of plain sedimentation tanks	CO3	4
2.3	Mechanisms of coagulation and flocculation, popular coagulants and feeding devices	CO3	2
3	**Module III: Total Lecture Hours-9**		
3.1	Filtration of water-theory of filtration-types of filters - design of rapid sand filter	CO3,CO4	3
3.2	Disinfection of water - various methods - advantages and limitations	CO4	2
3.3	Lay out of water distribution network-methods of distribution-network analysis -Hardy cross and equivalent pipe methods	CO4	4
4	**Module IV: Total Lecture Hours- 9**		
4.1	Layout plan of a conventional waste water treatment plant- site selection- concept of primary, secondary and tertiary treatment	CO1	1

4.2	Unit operations in waste water- primary treatment - equalization of flow	CO3	2
4.3	Secondary treatment methods- basic concepts of biological unit processes-aerobic and anaerobic- attached and suspended growth processes (Concepts only)	CO4	2
4.4	Activated sludge process- basic concepts-design of a conventional Activated Sludge Plant	CO3	3
4.5	Trickling filter (Concept only)- types- construction & operation	CO3	1
5	**Module V: Total Lecture Hours- 9**		
5.1	Anaerobic treatment of high strength waste water- Up flow Anaerobic Sludge Blanket (UASB) reactor (Concept only)	CO3	2
5.2	Natural waste water treatment systems-Oxidation Ponds and Lagoons-Wetlands and Root-zone systems (Concepts only)	CO3, CO4	3
5.3	Low cost sanitation systems- Design of a septic tank and soak-pit	CO3	2
5.4	Sludge treatment (concepts only) - thickening- digestion- dewatering- drying- composting	CO4	2

Model Question Paper

Reg No.:_______________ **Name:___________________________**

SIXTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: 22CET 602
Course Name: ENVIRONMENTAL ENGINEERING

Max. Marks: 100 Duration: 3 Hours

Part A
(***Answer all questions; each question carries 3 marks***)

1. Explain dry weather flow
2. What is an intake?
3. Why screens are used in water and waste water treatment plants?
4. What is hindered settling?
5. Compare slow sand filter and rapid sand filter
6. Explain the principle of disinfection
7. Discuss the unit operations and unit processes in a waste water treatment plant
8. Compare aerobic and anaerobic processes
9. How wetlands treat waste water?
10. Explain the working of a septic tank with a neat sketch

PART B
(Answer one full question from each module, each question carries 14 marks)

11. (a) Explain in brief different methods used for prediction of future population of a city (9 Marks)

    (b) What is fire demand? How will you calculate fire demand (5 Marks)

OR

12. (a) Explain the term "Design Period" (5 Marks)

(b) Forecast the population of the town in the year 2040 from the following data using arithmetic increase method and geometric increase method

Year	1990	2000	2010	2020
Population	13400	19500	28500	36300

(9 Marks)

13. (a) Explain with sketches the types of aerators with advantages and limitations (6 Marks)
(b) Explain different types of settling (8 Marks)

OR

14. (a) Explain the mechanisms of coagulation (5 Marks)
(b) Design a plain sedimentation tank for treating 6 MLD of water. Make suitable assumption. Prepare a neat sketch (9 Marks)

15. (a) Explain the theory of filtration (5 Marks)
(b) Explain and compare various disinfection methods (9Marks)

OR

16. Design a rapid sand filter to treat 10 million litres of raw water per day allowing 0.5% of filtered water for backwashing. Half hour per day is used for backwashing. Assume necessary data. (14 Marks)

17. (a) Discuss the role of an equalization tank at a waste water treatment plant (4Marks)
(b) Discuss in detail various biological processes available for treating waste water . (10 marks)

OR

18. (a)Explain primary, secondary and tertiary treatment phases (5 Marks)
(b) Design an activated sludge plant treat 6.0 Mld of domestic sewage having a BOD of 210 mg/l. The final effluent should have a BOD of 30 mg/l. (9 Marks)

19. (a) Discuss sludge treatment processes for safe disposal (9 Marks)
(b) Explain the working of a UASB with neat sketch (5 Marks)

OR

20. Discuss natural waste water treatment systems with neat sketches (14 Marks)

22CET 603	DESIGN OF HYDRAULIC STRUCTURES	Category	L	T	P	Credit	Year of Introduction
		PCC	4	0	0	4	2019

Preamble:

The general objective of this course is to expose the students to the fundamental concepts of hydraulic design of different hydraulic structures and to develop the drawings of minor irrigation structures. This course equip the students to perform the hydraulic design of minor irrigation structures such as cross drainage works, canal falls and regulators and prepare drawings of the same. To impart the knowledge on causes of failure and design criteria of hydraulic structures like dams and canal structures

Pre-requisite: Fluid Mechanics and Hydraulics, Hydrology & Water Resources Engineering

Course outcome

After the course, the student will able to:

CO1	Elucidate the causes of failure, principles of design of different components of hydraulic structures
CO2	Describe the features of canal structures and perform the design of alluvial canals
CO3	Perform the hydraulic design of minor irrigation structures such as cross drainage works, canal falls, cross regulator.
CO4	Prepare the scaled drawings of different minor irrigation structures
CO5	Describe the design principles and features of dams and perform the stability analysis of gravity dams

CO - PO Mapping

CET306 DESIGN OF HYDRAULIC STRUCTURES		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	3	2					1					
	CO2		2	3									
	CO3	3	3	3									
	CO4										3		
	CO5	3	2				1	1					

Assessment pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	5	5	15
Understand	10	10	15
Apply	20	20	40
Analyze	15	15	30
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
(For the first internal test, minimum two designs should be included)
Assignment/Quiz/Course project : 15 marks
Assignment should be scaled drawings (in A_2 size sheet)
Total : 50 marks

End semester examination pattern – There will be three parts; Part A, Part B and Part C. Part A contains 2 questions each from Modules I and II, out of which student can answer any one. Total marks for this part will be 30. Each question can have maximum 2 sub-divisions and carry 15 marks. Part B will be for 50 marks with 25 mark for design and 25 mark for drawing based on Module III. In the drawing part, two views shall be asked. Part C will be for 20 Marks. Two full questions each from Modules IV and V carrying 10 mark should be asked and the student can answer any one from each module. The examination will be for 3 hours.

Course Code: 22CET 603

Design of Hydraulic Structures

Syllabus

Module I

Diversion headwork-components and functions; Weirs – types and causes of failure- Impervious floor of hydraulic structures –Bligh's theory, Design of vertical drop weir; Design of impervious floor of hydraulic structures by Khosla's theory

Module II

Canals-types, Cross section of unlined canals and alignment; Design of canals through alluvial soils- Kennedy's theory and Lacey's silt theory. Canal structures- cross drainage structures-types; Canal falls-Necessity, types

Module III

Hydraulic design and drawing of canal structures
(i) Aqueduct; (ii) Siphon Aqueduct; (iii) Canal drop (Trapezoidal Notch Fall); (iv) Sarda type fall (trapezoidal crest- impervious floor design using Khosla's theory); (iv) Cross regulator (impervious floor design using Khosla's theory)

Module IV

Dams-types; Gravity Dams-computation of forces-modes of failure and stability criteria, stability analysis. Elementary and practical profile, limiting height of gravity dams, Galleries, joints, keys, water stops, instrumentation, grouting (brief description only)

Module V

Earth dams-types, causes of failure and design criteria, Arch dams- thin cylinder theory; Spillways-types-Ogee spillway profile; Energy dissipation- stilling basins-Indian standard Type I and Type II (description only)

Text Books:

- Sathyanarayana M. C. Water Resources Engineering-Principles and Practice, New Age International Publishers. 2009
- Garg S.K., Irrigation Engineering and Hydraulic Structures, Khanna Publishers, New Delhi 2006.
- KR Arora. Irrigation, Water Resources and Water Power Engineering, S.B.H Publishers and Distributors, New Delhi. 2010.

References:

- Punmia B.C.Ashok K Jain, Arun K Jain, B. B. L Pande, Irrigation and Water Power Engineering. Laxmi Publications (P) Ltd 2009.

- Modi P.N. Irrigation, Water Resources and Water Power Engineering, S.B.H Publishers and Distributors, New Delhi 2009.
- Varshney, R.S. Theory & Design of Irrigation Structures -Vol III, Nem Chand & Bros., Roorkee

Course Code: 22CET 603

Design of Hydraulic Structures
Course Plan

Module	Topic	Course outcome addressed	No of Hours
Module I (8 Hours)			
1.1	Introduction to different types of Irrigation structures	CO2	1
1.2	Layout of diversion headwork- components and functions	CO2	1
1.3	Causes of failure of weirs on permeable soils and remedies	CO1	1
1.4	Bligh's theory, problem	CO1	1
1.5	Design of vertical drop weir	CO1	1
1.6	Khosla's theory-Interim conclusions and Khosla's first problem	CO1	1
1.7, 1.8	Khosla's method of independent variables- use of charts and corrections	CO1	2
Module II (8 Hours)			
2.1	Types of canals, alignment of canals	CO2	1
2.2	Typical cross sections of unlined canals	CO2	1
2.3	Design of channels through alluvial soils- Kennedy's theory	CO2	1
2.4, 2.5	Lacey's silt theory- problems	CO2	2
2.6	Classification of cross drainage structures	CO2	1
2.7, 2.8	Canal falls – necessity and types	CO1	2
Module III (15 Hours)			
3.1-3.3	Hydraulic design of Aqueduct and demonstration of drawing	CO3, CO4	3
3.4-3.6	Hydraulic design of Siphon Aqueduct and demonstration of drawing	CO3, CO4	3
3.7-3.9	Hydraulic design of Canal drop (Trapezoidal Notch Fall) and demonstration of drawing	CO3, CO4	3
3.10-3.12	Hydraulic design of Sarda Fall with trapezoidal crest and demonstration of drawing	CO3, CO4	3
3.13-3.15	Hydraulic design of Cross regulator and demonstration of drawing	CO3, CO4	3

Module IV (7 Hours)			
4.1	Dams-Types, Computation of Forces acting on dams	CO5	1
4.2	Stability analysis- modes of failure and stability criteria of gravity dams	CO5, CO1	1
4.3	Stresses-No tension criteria, derivation of principal stress	CO5, CO1	1
4.4	Problems on stability analysis of gravity dams	CO5, CO1	1
4.5	Elementary and practical profile of gravity dams	CO5, CO1	1
4.6	Functions and types of galleries, keys and water stops etc in dams	CO5	1
4.7	Instrumentation and grouting of dams	CO5	1
Module V (7 Hours)			
5.1	Arch dams- types, thin cylinder theory	CO5, CO1	1
5.2	Most economical central angle of arch dam, Limitations of thin cylinder theory	CO5, CO1	1
5.3. 5.4	Earth dams, types, causes of failure and design criteria	CO5, CO1	2
5.5	Spillways- Types	CO5	1
5.6	Ogee spillway profile	CO5, CO1	1
5.7	Energy dissipation below spillways-stilling basins	CO5, CO1	1

Course Code: 22CET 603

Design of Hydraulic Structures

Course Level Assessment Questions

CO1	Elucidate the causes of failure, principles of design of different components of hydraulic structures
1	State Khosla's interim conclusions
2	Explain the causes of failure of weirs on permeable soils and state the remedial measures
3	Explain the corrections to be applied on % uplift pressure estimated by the method of independent variables
4.	Obtain the expression for floor thickness as per Bligh's theory

CO2	**Describe the features of canal structures and perform the design of alluvial canals**
1	State the functions of under-sluices and divide walls
2	Explain the classification of cross drainage structures
3	Describe the features of a Siphon well drop with a sketch
4.	Explain Kennedy's theory for the design of Alluvial channels
5.	Explain (i) level crossing (ii) canal siphon with sketches
6.	Design an irrigation canal through alluvial soils for the following data : Discharge =20 m^3/sec; Lacey's silt factor =1

CO3	**Perform the hydraulic design of minor irrigation structures such as cross drainage works, canal falls, cross regulator.**
CO4	**Prepare the scaled drawings of different minor irrigation structures**
1 (a) (b)	**Design a 1.5 m Sarda Type Fall for a canal carrying a discharge of 40 cumecs with the following data** Bed Level Upstream-105.0m Bed Level Downstream-103.5m Side Slopes of canal-1:1 Full Supply Level Upstream-106.8 m Bank level upstream-107.4 m Bed width-U/s and D/s-30 m Safe Exit Gradient for Khosla's theory-1/5 Draw to a suitable scale, the following views of the structure: (a) Half sectional plan at foundation level and at top level (b) Longitudinal sectional elevation
2. (a) (b)	Design a 1.8 m trapezoidal notch fall for the following data: Details above drop: Full supply discharge= 5.5 cumec Bed width= 5 m Bed level= 19.8 Full supply depth=1.6 m Level at the top of the bank=22.4 The bank top width is 1.8 m Details below drop: Full supply discharge= 5.5 cumec Bed width= 5 m Full supply level=19.6 Level at the top of the bank=20.6 The bank top width is 1.8 m Prepare the following drawings to a suitable scale

	(a) Half sectional plan at foundation level (b) Section along the centre line of the canal

CO5	**Describe the design principles and features of dams and perform the stability analysis of gravity dams**
1	Explain the features of different types of spillways
2	State the functions of Galleries and Keys in gravity dam
3	Obtain the expression for base width of elementary profile of gravity dams for no tension criteria
4	Differentiate low dams and high dams
4.	Explain the causes of failure of earth dams
5.	Enlist the design criteria of earth dams
6.	State the limitations of thin cylinder theory

Model Question Paper

Reg No.:………………… **QP CODE:……………….**

Name:……………………………………

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CET 603

Design of Hydraulic Structures

Max. Marks: 100 **Duration: 3 hours**

- *Use of Khosla's chart and Blench Curves and Montague Curves are permitted in the Examination Hall*
- *Assume suitable design data wherever necessary*

PART A

(Answer one full question from each module, each question carries 15 marks)

Module I

1 (a) State the functions of undersluices and divide walls (6 Marks)

(b) Explain Khosla's corrections (9 Marks)

OR

2. (a) State and explain Bligh's theory (5 Marks)

(b) Explain the causes of failure of weirs on permeable soils and state the remedial measures (10 Marks)

Module II

3. (a) Explain the factors to be considered in the alignment of canals (5 Marks)

(b) Explain the classification of cross drainage structures (10 Marks)

OR

4. (a) Compare Kennedy's theory and Lacey's theory. (6 Marks)

(b) Design an irrigation canal through alluvial soils for the following data:
Discharge =20 m^3/sec; Lacey's silt factor = 1 (9 Marks)

PART B

(Answer any ONE full question)

Module III

5. **a**) Design a suitable cross drainage work for the following hydraulic particulars:

(25 Marks)

Canal

Full supply discharge = 50 m^3/sec

Full supply level=202.00
Full supply depth= 1.2 m
Bed width=36
Cross section is trapezoidal with side slope 1.5H:1V

Drain

High flood discharge = 450 cumecs
Bed level=199.3
High flood depth=2 m

b) Develop the drawings of:

(a) Half plan at top and half at foundation level (15 Marks)
(b) Section along the canal (10 Marks)

OR

6. **a**) Design a 2 m trapezoidal notch fall for the following data: (25 Marks)

Details above drop:

Full supply discharge= 5.5 cumec
Bed width= 6 m Bed level= 12.00
Full supply depth=1.5 m
Level at the top of the bank=14.5
Bank top width is 3 m

Details below drop:

Full supply discharge= 5.5 cumec
Bed width= 6 m
Full supply level=11.5
Level at the top of the bank=12.5
Bank top width is 3 m

b) Develop the drawings of:

(a) Half sectional plan at foundation level (15 Marks)
(b) Section along the centre line of the canal (10 Marks)

PART C

(Answer one full question from each module, each question carries 10 marks)

Module IV

7 (a) Obtain an expression for principal stress at the toe of a gravity dam (5 Marks)

(b) Explain elementary profile of gravity dam. How you will develop the practical profile from it? (5 Marks)

OR

8 (a) Differentiate consolidation grouting and curtain grouting (4 Marks)

(b) Determine the uplift force at the base of gravity dam of base width 25 m, height of water in the u/s face = 30 m, free board 3m, top width 6 m and height of water in the d/s face = 5 m. The drainage gallery is at a distance of 5 m from the u/s end. (6 Marks)

Module V

9 (a) State the limitations of thin cylinder theory (4 Marks)

(b) Explain the classification of earth dams with sketches (6 Marks)

OR

10 (a) Explain the design features of Ogee spillways (4 Marks)

(b) Explain the hydraulic and structural causes of failure of earth dams (6 Marks)

22CEE 604.1	Advanced Computational Methods	Category	L	T	P	Credit	Year of Introduction
		PEC	3	0	0	3	2019

Preamble: The general objective of this course is to expose the students to the fundamental concepts of different numerical computational procedures. The course aim to equip the students to find solutions for many real-world engineering problems by applying appropriate numerical methods

Pre-requisite: Engineering Mathematics

Course outcome

After the course, the student will able to:

Course Outcome	Description	Prescribed learning level
CO1	Describe the procedures or principles of numerical computational approaches	Remembering/understanding
CO2	Obtain the solution of simultaneous equations or eigen value problems	Applying
CO3	Apply appropriate data smoothing technique for a given set of data	Applying
CO4	Obtain the numerical solutions of ordinary differential equations	Applying
CO5	Obtain the numerical solutions for solving boundary value problems of ordinary and partial differential equations	Applying
CO6	Describe the concepts or apply discretization based solution methods	Remembering/applying

CET312 Advanced Computational Methods		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	1	1										
	CO2	3	3										
	CO3	3	3										
	CO4	3	2										
	CO5	3	3										
	CO6	3	3										

Assessment pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	5	5	15
Understand	10	10	15
Apply	20	20	40
Analyze	15	15	30
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment Test (2 numbers)	:	25 marks
Assignment/Course project	:	15 marks
Total	**:**	**50 marks**

Note: Enough exposure to practical examples from civil engineering should be given to the students. One assignment/course project should be based on the coding of practical civil engineering problems

End semester examination pattern – There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment (Sample) Questions

CO1: Describe the procedures or principles of numerical computational approaches

1. Enlist the different errors in numerical computation
2. Explain the procedure of Newton-Raphson method for solving system of non linear equations
3. Explain the procedure of multiple linear regression
4. Compare Lagrange and Hermite interpolation
5. Explain the stability of numerical solutions of ordinary differential equations
6. Explain the procedure of modified Euler's method for solving ordinary differential equations
7. Describe the classification of partial differential equations
8. Explain Crank- Nicolson implicit scheme
9. Explain collocation method
10. Describe the principle of meshless method

CO2: Obtain the solution of simultaneous equations or eigen value problems

1. Find all the eigen values and eigen vectors of the following matrix by Jacobi's transformation

$$A = \begin{bmatrix} 10 & 3 & 2 \\ 3 & 5 & 1 \\ 2 & 1 & 0 \end{bmatrix}$$

2. Apply Gauss Seidal iteration method to solve the equations

   20x+y-2z=17; 3x+20y-z= -18; 2x-3y+20z=25

CO3: Apply appropriate data smoothing technique for a given set of data

1. Fit the quadratic splines with M(0)=0 f''(0)=0 for the following data. Hence fiand f(2.5)

X	0	1	2	3
Y	1	2	33	244

2. Evaluate $\int_0^1 \frac{1}{1+x^2}dx$ using (i) Simpson's 3/8 rule taking h=1/6 (ii) Weddle's rule taking h=1/6

CO4: Obtain the numerical solutions of ordinary differential equations

1 Apply Milne's method to find the solution of $y' = x - y^2$ in the range $0 \le x \le 1$ for the boundary condition

2. Using fourth order Runge-Kutta method, find y for z=0.1, 0.2 and 0.3 , given $y' = xy + y^2$ y(0)=1

CO5: Obtain the numerical solutions for solving boundary value problems of ordinary and partial differential equations

1. Solve $\nabla^2 u = 10(x^2 + y^2 + 10)$ over the square with side x=0=y; x=3=y with u=0 on the boundary and mesh length =1

2. Solve $\frac{d^4y}{dy^4} + 81y = \phi(x)$ with

X	1/3	2/3	1
Y	81	162	243

y(0)=*y*'(0)=*y*''(1)=*y*'''(1)=0

CO6: Describe the concepts or apply discretization based solution methods

1 Explain the procedure of weighted residual approaches for solving boundary value problems

2. Explain the different steps in Finite element analysis

3. Explain the characteristics of different types of elements in FEM

4. Solve $y'' + y + x = 0$ in the range $0 \le x \le 1$ by Galerkin's method. Given *y*(0)=*y*(1)=0

Course Code: 22CEE 604.1

Advanced Computational Methods

Syllabus

Module I

Introduction to numerical methods-Errors in numerical computation – System of linear algebraic equations –Ill-conditioned systems – Symmetric and Banded systems. Elimination methods – Gauss Elimination (review), Gauss Seidel iteration, Factorization method-Choleski's method. System of non linear equations – Newton-Raphson method. Eigen value problems - largest and smallest eigen values- Power method, Jacobi's transformation

Module II

Lagrangian and Hermite interpolation, Spline interpolation-Quadratic and Cubic splines (example of equal intervals), Data smoothing by least squares criterion- Non- polynomial models like exponential model and power equation, Multiple linear regression. Numerical integration- Newton – Cotes open quadrature formule-Trapezoidal rule, Simpson's rules, Weddles rule

Module III

Solution of first-order ordinary differential equations-stability of solution, Use of Taylor series, Euler's method, Modified Euler's method, Predictor-corrector method – Milne's method, Fourth order Runge-Kutta method; Higher order equations of initial value type by Runge-Kutta method.

Module IV

Ordinary differential equations of the boundary value type – Finite difference solution.

Partial differential equations in two-dimension-types, Elliptic equations-Laplace Equation and Poisson's equation, Parabolic equations – Explicit finite difference method –Bender-Schmidt method. Crank-Nicholson implicit method, Finite difference method – Problems with irregular boundaries

Module V

Weighted residual methods for initial value problems and boundary value problems – Collocation method, Subdomain method, Method of least squares, Galerkin's method.

Introduction to FEM- outline of the procedure – Types of 1D, 2D and 3D elements- element properties- polynomial form- shape function form- equilibrium and compatibility in the solution- convergence requirements, boundary conditions. Conceptual ideas of finite volume, boundary element and meshless methods.

Text Books

1. Grewal B. S., *Numerical Methods for Engineers & Scientists, Khanna Publishers*.
2. Rajasekharan S., *Numerical Methods in Science and Engineering,* S Chand & Company, 2003.

References:

1. Gerald and Wheatly*, Applied Numerical Analysis,* Pearson Education.
2. Chapra S. C. and R. P. Canale, *Numerical Methods for Engineers,* McGraw Hill, 2006.
3. Smith G. D. *Numerical solutions for Differential Equations,* McGraw Hill.
4. Ketter and Prawel*, Modern Methods for Engineering Computations,* McGraw Hill.
5. Rajasekharan S., *Numerical Methods for Initial and Boundary value problems,* Khanna Publishers, 1989.
6. Terrence. J. Akai, *Applied Numerical Methods for Engineers,* Wiley Publishers, 1994.
7. Krishnamoorthy C S, *Finite Element Analysis- Theory and Programming*, Tata McGraw Hill, New Delhi., 1994
8. Bathe K J, *Finite Element Procedures in Engineering Analysis*, Prentice Hall, New Delhi. 1982
9. Chandrupatla T R and Belegundu A D, *Introduction to Finite Elements in Engineering*, Pearson Education, New Delhi 1998
10. Rajasekharan S, *Finite Element Analysis in Engineering Design*, Wheeler, New Delhi
11. Hutton D V, *Fundamentals of Finite Element Analysis*, Tata McGraw Hill Education Private Ltd, New Delhi

Course Plan: Advanced Computational Methods

Module	Topic	Course outcome addressed	No of Hours
Module I (7 Hours)			
1.1	Introduction to numerical methods-Necessity, Errors in numerical computation	CO1	1
1.2	System of linear algebraic equations, Ill-conditioned systems, Symmetric and Banded systems	CO1	1
1.3	Direct and indirect methods of solution of linear equations- Gauss elimination method(review), Gauss Siedal iteration	CO1, CO2	1
1.4	Factorization method-Choleski's method	CO1, CO2	1
1.5	System of non linear equations – Newton-Raphson Method	CO1, CO2	1
1.6	Eigen value problems, Power method-largest & smallest Eigen values	CO1, CO2	1
1.7	Jacobi's transformation	CO1, CO2	1
Module II (7 Hours)			
2.1	Lagrangian and Hermite interpolation	CO1, CO3	1
2.2	Spline interpolation - Quadratic and Cubic splines	CO1, CO3	1
2.3	Problems on interpolation	CO3	1
2.4	Data smoothing by least squares criterion- Non- polynomial models like exponential model, power equation	CO1, CO3	1
2.5	Multiple linear regression	CO1, CO3	1
2.6	Numerical integration- Newton – Cotes open quadrature	CO1, CO3	1
2.7	Problems on numerical integration	CO3	1
Module III (7 Hours)			
3.1	Solution of first-order ordinary differential equations ; stability of solutions	CO1	1
3.2	Solution of first-order ordinary differential equations by use of Taylor series.	CO1, CO4	1
3.3	Euler's method	CO1, CO4	1
3.4	Modified Euler's method	CO1, CO4	1

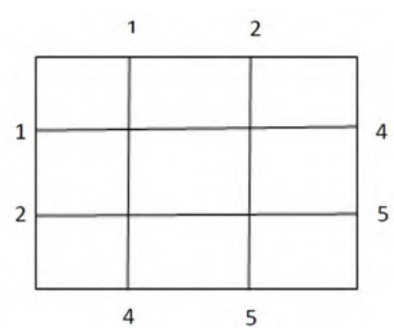
3.5	Predictor-corrector methods – Milne's method	CO1, CO4	1
3.6	Fourth order Runge-Kutta method-Problems	CO1, CO4	1
3.7	Higher order equations of initial value type by Runge-Kutta method	CO1, CO4	1
Module IV (7 Hours)			
4.1	Ordinary differential equations of the boundary value type – Finite difference solution.	CO1, CO5	1
4.2	Partial differential equations in two-dimension- types. Laplace Equation	CO1, CO5	1
4.3	Poisson's Equation and its solution	CO1, CO5	1
4.4	Parabolic equations – Explicit finite difference method- Schmidt method	CO1, CO5	1
4.5	Crank-Nicholson implicit method	CO1	1
4.6	Finite difference method – Problems with irregular boundaries	CO1, CO5	1
4.7	Problems	CO5	1
Module V (7 Hours)			
5.1	Weighted residual methods for initial value problems and boundary value problems – Collocation method – Subdomain method	CO1, CO6	1
5.2	Method of least squares – Galerkin's method	CO1, CO6	1
5.3	Introduction to FEM- outline of the procedure	CO1, CO6	1
5.4	Types of 1-D, 2-D and 3-D finite elements	CO1, CO6	1
5.5	Element properties- polynomial form- shape function form	CO1, CO6	1
5.6	Equilibrium and compatibility in the solution- convergence requirements; Boundary conditions	CO1, CO6	1
5.7	General awareness on finite volume, boundary element and mesh less methods and their difference with FEM	CO1, CO6	1

Course Code: 22CEE 604.1

Advanced Computational Methods

(Model question paper)

Qn No	Question	Marks	Course outcome (CO) Assessed
	Part A **(Answer ALL Questions)**		
1	Enlist the different errors in numerical computation	3	CO1
2	Explain symmetric and banded systems	3	CO1
3	Explain Hermite interpolation	3	CO1
4	Describe mulitiple linear regression	3	CO1
5	Explain Taylor's method for solution of differential equations	3	CO1
6	Explain stability of solutions of differential equations	3	CO1
7	Explain Crank Nicholson implicit method	3	CO1
8	State the types of partial differential equations with examples	3	CO1
9	Describe the principle of meshless method	3	CO1
10	Explain convergence requirements in finite element analysis	3	CO1
	Part B **(Answer ANY ONE FULL question from each module)**		
	Module I		
11	Sole by Choleski's method $\begin{bmatrix} 2 & -3 & -1 & 2 \\ -1 & -1 & 2 & -2 \\ 1 & -1 & 1 & 1 \\ 3 & 2 & -1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 15 \\ -13 \\ 4 \\ 3 \end{bmatrix}$	14	CO2
12	Find the largest eigen value by power method $A=\begin{bmatrix} 2 & 12 & 2 \\ 2 & 4 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	14	CO2
	Module II		

13	Obtain the cubic spline approximation of the given data and determine $y(0.5)$ and $y'(0.2)$ x 0 1 2 3 y -5 -4 3 6	14	CO3
14	Evaluate $\int_0^6 \frac{1}{1+x^2}dx$ using (i) Simpson's 3/8 rule and Weddle's rule	14	CO3
	Module III		
15	Find $y(0.1)$, $y(0.2)$ given $\frac{dy}{dx}=x-2y$ = x - 2y, $y(0)=1$ taking $h=0.1$ using 4th order Runge-Kutta method.	14	CO4
16	Solve $y'=1+y^2$ y(0)=0Find y(0.8) and y(1) by Milne's predictor corrector method	14	CO4
	Module IV		
17	Solve the boundary value problem $xy''+y=0$, $y(1)=1$,$y(2)=2$ take $h=1/4$	14	CO5
18	Solve the equation $u_{xx} + u_{yy} = 0$ for the square mesh with boundary value as shown in figure 	14	CO5
	Module V		
19	Solve $y''+y+x=0$ in the range $0 \le x \le 1$ by Galerkin's method. Given $y(0)=y(1)=0$	14	CO6
20 (a)	Explain in detail the steps of finite element analysis	8	CO1, CO6
20 (b)	Explain forms of shape functions in finite element analysis	6	CO1, CO6

22CEE 604.2	GEOTECHNICAL INVESTIGATION	CATEGORY	L	T	P	CREDIT	YEAR OF INDUCTION
		PEC	3	0	0	3	2019

Preamble:

Geotechnical Investigation is a course in the stream of Soil mechanics and foundation engineering. The course is aimed to impart to the students, a clear idea about how a geotechnical investigation program is to be planned and executed. It enables the students an in-depth knowledge of the various methods of geotechnical investigation and the field tests to be conducted in different situations. After the successful completion of the course, the students will be able to plan and execute the soil investigation at a site depending on the need and availability.

Prerequisite: Geotechnical Engineering -1

Course Outcomes

CO 1	The students will be able to understand the procedure, applicability, and limitations of various methods of geotechnical investigation	Remembering, Understanding
CO 2	The students will be able to make engineering judgments and take appropriate decisions related to geotechnical investigations	Applying & Analysing
CO 3	The students will be able to understand the procedure and applications of penetration tests and geophysical tests for exploration of the soil profile	Remembering, Understanding
CO 4	The students will be able to choose the right soil sampling technique and analyse the dependability of samples collected	Applying & Analysing
CO5	The students will be able to understand the procedure and applications of field load tests and rock quality indices.	Applying & Analysing

Mapping of the Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2		2	2								
CO 2	3	2	2	2								
CO 3	2				2							
CO 4	3	2	2	2								
CO 5	2				2							

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	10	10	20
Apply	25	25	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation (CIE) Pattern

Attendance	:	10 Marks
Continuous Assessment Test (2 numbers)	:	25 Marks
Assignment/Quiz/Course project	:	15 Marks

End Semester Evaluation (ESE) Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.
Note : 1.Each part should have at least one question from each module. 2.Each question can have a maximum of 4 subdivisions (a, b, c, d)

Course Level Assessment Questions

(Questions may be framed based on the outline given under each course outcome)

Course Outcome 1 (CO1): The students will be able to understand the procedure, applicability, and limitations of various methods of geotechnical investigation.

1. Explain the various methods adopted for preliminary investigation.
2. What are the I.S. guidelines for deciding the number, size, spacing, and depth of boreholes?
3. What are the limitations of standard penetration test?

Course Outcome 2 (CO2): The students will be able to make engineering judgments and take appropriate decisions related to geotechnical investigations

1. Determine the bearing capacity, from a given SPT data.
2. Explain the procedures for geotechnical investigation of a profile which shows, rejection in SPT test.
3. What are the situations in which wash boring can be used as an exploration technique?

Course Outcome 3 (CO3): The students will be able to understand the procedure and applications of penetration tests and geophysical tests for exploration of the soil profile

1. Explain the procedure of determination of thickness of a strata using electrical resistivity method.
2. What are the effects of water table in geophysical methods?
3. What are the limitations of seismic refraction method?

Course Outcome 4 (CO4): The students will be able to choose the right soil sampling technique and analyse the dependability of samples collected.

1. What are the type of soil samples in a soil investigation procedure?
2. What are the factors affecting the quality of a soil sample?
3. Explain the methods of collection of soil samples.

Course Outcome 5 (CO5): The students will be able to understand the procedure and applications of field load tests and rock quality indices.

1. What are the limitations of a plate load test?
2. What are the situations in which pressure meter test becomes Ideal?
3. Explain the concept of subgrade reaction.
4. Explain the methods of representing the quality of rocks is a soil investigation report.

Syllabus

Module	Content
I	Introduction and practical importance - Objectives of soil exploration – Planning of a sub-surface exploration program –Collection of existing information, reconnaissance, preliminary and detailed investigation - I.S. and other guidelines for deciding the number, size, spacing, and depth of boreholes Methods of exploration - Open pits – Auger boring- -Wash boring, percussion drilling, rotary drilling
II	Sounding methods Standard Penetration Test – Procedure – corrections to be applied to observed N values – Numerical examples - Factors influencing the SPT results and precautions to obtain reliable results – Merits/drawbacks of the test – Correlations of N value with various engineering and index properties of soils Static Cone Penetration Test – Procedure – Merits/drawbacks – Correlation of static CPT results with soil properties -Dynamic Cone Penetration Test – Brief Procedure – Merits/drawbacks – Critical comparison of SPT, static CPT, and dynamic CPT
III	Geophysical methods – Seismic refraction method – Procedure, uses, limitations – Solution of numerical problems to estimate the velocity of seismic waves and the thickness of the upper layer of a two-layered soil system - Electrical resistivity method – Electrical profiling and electrical sounding – Procedure, uses, limitations Stabilization of boreholes, Groundwater level estimation
IV	Soil sampling – Undisturbed, disturbed, and representative samples – Chunk and tube samples – Factors affecting sample disturbance and methods to minimize them –Area ratio - Inside clearance – Outside clearance - Recovery ratio –Ball check valve – Numerical Problems -Handling and transportation of samples – Extrusion of samples Types of samplers – Thin-walled sampler – Piston sampler – Split spoon sampler – Methods for collection of sand samples from beneath the water table - Core retainers
V	Pressure meter test - Procedure –Uses – limitations, Flat Dilatometer Test (Brief only) Plate load test – Procedure, uses, and limitations – modulus of subgrade reaction- Solution of numerical problems using plate load test data Rock core sampling, Rock Quality Designation, Core Recovery Ratio –Bore log – Soil profile – Sub-soil investigation report

Textbooks:

1. Gopal Ranjan and Rao A.S.R., “Basic and Applied Soil Mechanics”, New Age International (P) Limited, New Delhi, 2002.
2. Venkata Ramaiah, “Geotechnical Engineering”, Universities Press (India) Limited, Hyderabad, 2000.

References:

1. Arora K.R., “Geotechnical Engineering”, Standard Publishers Distributors, New Delhi, 2006.
2. Joseph E. Bowles, „Foundation Analysis and Design“, Mc. Graw Hill Inc., New York, 1988.

3. Purushothamaraj P., Soil Mechanics and Foundation Engineering, Dorling Kindersley (India) Pvt. Ltd., 2013
4. Terzaghi K. and R. B. Peck, Soil Mechanics in Engineering Practice, John Wiley, 1967.

Course content and Lecture schedule

Module	Contents	Outcomes Addressed	Hours
I	**Module 1**		7
1.1	Introduction and practical importance - Objectives of soil exploration –	CO1	1
1.2	Planning of a sub-surface exploration program – Collection of existing information,	CO1	1
1.3	reconnaissance, preliminary and detailed investigation	CO1	1
1.4	I.S. and other guidelines for deciding the number, size, spacing, and depth of boreholes	CO1	1
1.5	Methods of exploration - Open pits – Auger boring-	CO1	1
1.6	Wash boring, percussion drilling, rotary drilling	CO1	2
	Module 2		7
II			
2.1	Sounding methods Standard Penetration Test – Procedure	CO3	1
2.2	corrections to be applied to observed N values – Numerical examples	CO2	1
2.3	Factors influencing the SPT results and precautions to obtain reliable results – Merits/drawbacks of the test	CO2	1
2.4	Correlations of N value with various engineering and index properties of soils	CO2	1
2.5	Static Cone Penetration Test – Procedure Merits/drawbacks	CO3	1
2.6	Correlation of static CPT results with soil properties	CO2	1
2.7	-Dynamic Cone Penetration Test – Brief Procedure – Merits/drawbacks – Critical comparison of SPT, static CPT, and dynamic CPT	CO3	1
	Module 3		7
III			
3.1	Geophysical methods – Seismic refraction method – Procedure	CO3	1
3.2	uses, limitations	CO3	1

3.3	Solution of numerical problems to estimate the velocity of seismic waves and the thickness of the upper layer of a two-layered soil system	CO3	2
3.4	Electrical resistivity method – Electrical profiling and electrical sounding – Procedure	CO3	1
3.5	uses, limitations	CO3	1
3.6	Stabilization of boreholes, Groundwater level estimation	CO4	1
	Module 4		7
IV			
4.1	Soil sampling – Undisturbed, disturbed, and representative samples –	CO4	1
4.2	Chunk and tube samples – Factors affecting sample disturbance and methods to minimize them –	CO4	1
4.3	Area ratio - Inside clearance – Outside clearance - Recovery ratio –Ball check valve –	CO4	1
4.4	Numerical Problems	CO4	1
4.5	Handling and transportation of samples – Extrusion of samples	CO4	1
4.6	Types of samplers – Thin-walled sampler – Piston sampler – Split spoon sampler –	CO4	1
4.7	Methods for collection of sand samples from beneath the water table - Core retainers	CO4	1
	Module 5		7
V			
5.1	Pressure meter test - Procedure – Uses – limitations,	CO5	1
5.2	Flat Dilatometer Test (Brief only)	CO5	1
5.3	Plate load test – Procedure, uses, and limitations –	CO5	1
5.4	modulus of subgrade reaction- Solution of numerical problems using plate load test data	CO5	2
5.5	Rock core sampling, Rock Quality Designation, Core Recovery Ratio	CO5	1
5.6	Bore log – Soil profile – Sub-soil investigation report	CO1	1

Model Question Paper

QP CODE:
Reg No.: _______________ **Name:**__________________________

FOURTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEE 604.2
Course Name: INTRODUCTION TO GEOTECHNICAL ENGINEERING
Max. Marks: 100 **Duration: 3 hours**

Part A
(Answer all questions; each question carries 3 marks)

1. What are the objectives of soil exploration?
2. Differentiate preliminary investigation and detailed investigation.
3. Explain dilatancy correction to be applied to the N value.
4. List out the factors influencing SPT value.
5. Explain stabilization of borehole using Bentonite slurry.
6. Write the principle behind the seismic refraction method.
7. What are the precautions to be adopted during the transportation of sample?
8. Define i) Area ratio, ii) Inside clearance iii) Outside clearance
9. Differentiate between bore log and soil profile.
10. What is rock quality designation?

Part B
(Answer one full question from each module, each question carries 14 marks)

Module 1

11. a. Explain wash boring with the help of a sketch.
b. Explain the major steps involved in reconnaissance for a geotechnical investigation of a multi storied building.

OR

12. **a.** Differentiate preliminary investigation and detailed investigation.
b. Explain percussion drilling with the help of a sketch.

Module 2

13. **a.** The observed SPT value (N) in a deposit of fully submerged fine silty sand was 45 at a depth of 6.5m. The average saturated unit weight of soil is 19.5 kN/m3 Find the corrected SPT number.
b. Explain the factors influencing SPT value.

OR

14. **a.** The field N value in a deposit of fully submerged fine sand was 47 at a depth of 7m. The average saturated unit weight of the soil is 19kN/m3. Calculate the corrected N value.

b. Explain the procedure for conducting SPT test with neat figure.

Module 3

15. **a.** Explain the seismic refraction method
b. Explain the procedure to employ electrical sounding method.

OR

16. **a.** Explain the electrical profiling method.
b. Explain stabilization of borehole using Bentonite slurry.

Module 4

17. **a.** Explain any two types of samplers used for undisturbed soil sample.
b. If the external diameter of a sampling tube is 75 mm and area ratio is 20%, determine the thickness of sampling tube.

OR

18. **a.** Explain the factors affecting sample disturbance. What are the precautions to be taken in handling and transporting soil samples?
b. Compute the area ratio of a thin walled tube sampler of external diameter 6.0 cm and wall thickness 2.25mm and comment on the type of soil sample obtained using this sampler.

Module 5

19. **a.** What is a bore log and draw an example of bore log?
b. What are the salient features of a sub soil investigation report? With a neat sketch, explain the term 'soil profile'.

OR

20. **a.** Explain Pressure meter test and comment on the Uses and limitations
b. Two plate load tests with square plates were performed on a soil deposit. For a 30 mm settlement, the following loads were obtained. Determine the width of a square footing which would carry a net load of 1,500 kN for a limiting settlement of 30 mm.

Width of square plate in mm	**Load in kN**
300	38.2
600	118.5

22CEE 604.3	TRAFFIC ENGINEERING AND MANAGEMENT	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	3	0	0	3	2019

Preamble

The course aims to impart in-depth knowledge pertinent to traffic flow theory, traffic management measures, capacity analysis, design of road intersections and road safety**.**

Prerequisite: CET 206 Transportation Engineering

Course Outcomes:
After the completion of the course the students will be able to

CO 1	Identify the relationship among various traffic stream variables. (K2, K3)
CO 2	Apply traffic management measures and regulations so as to solve issues related to traffic flow in road network. (K2, K3)
CO 3	Explain the concept of capacity and LOS and its estimation for various traffic facilities (K2,K3)
CO 4	Identify the need for intersection control and design of various types.(K2,K3)
CO 5	Analyse causes of road accidents and suggest preventive measures (K2, K3)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	2									
CO 2	3					3						
CO 3	3	2		2		2						2
CO 4	3	2	3	2		2	3					2
CO 5	3	2	2	3		3						2

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (marks)
	Test 1 Marks	Test 2 Marks	
Remember	5	5	20
Understand	10	10	40
Apply	5	5	20
Analyse	5	5	20
Evaluate			
Create			

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern:

The question consists of two parts- Part A and Part B. Part A consists of 10 questions with 3 marks for each (two questions from each module). Part B consists of two questions from each module, out of which one has to be answered. Each question carries 14 marks and can have maximum 2 subdivisions.

Sample Course Level Assessment Questions:

Course Outcome 1 (CO1): Illustrate through diagrams the basic relationship between the fundamental variables of traffic flow.
Course Outcome 2 (CO2):. Suggest traffic management measures so as to avoid locking of vehicle flow due to turning traffic.
Course Outcome 3 (CO3): Define adjusted capacity. What are the measures of effectiveness used for urban roads and two lane highways?
Course Outcome 4 (CO4): Explain the hierarchy of intersection control. What do you understand by optimum cycle length?
Course Outcome 5 (CO5): With neat sketches differentiate between collision and condition diagram

Syllabus- Traffic Engineering and Management

Module 1	**Traffic Flow Characteristics**: ***Fundamental Parameters-*** speed, density, volume, travel time, headway, spacing, time-space diagram, time mean speed, space mean speed and their relation. Fundamental diagrams of traffic flow. ***Traffic stream models***: Single Regime models - Greenshields model, Greenberg logarithmic model Multi-regime models – Two and three regime linear models.
Module 2	**Regulation of Traffic** – Need and scope of traffic regulations- Motor Vehicle Act – Regulation of speed- Regulation of vehicles – Regulations concerning driver- General rules concerning traffic- parking regulations- Enforcement of regulations. **Traffic Management** – scope of traffic management measures – restrictions to turning movements – one way streets – tidal flow operations - Closing side streets –Exclusive bus lanes.
Module3	**Capacity and Level of service (LOS)**: Concept- Base capacity, Adjusted capacity, LOS definition, Factors Affecting Capacity and LOS, Homogeneous and heterogeneous traffic conditions- vehicle types - Concept of PCU. Capacity and LOS analysis – Single lane, Intermediate lane and two lane interurban roads - Base capacity and adjustment factors - Indo HCM (2017) Guidelines Capacity and LOS analysis of Urban roads - Base conditions- Adjustment factors- Indo HCM (2017) Guidelines
Module 4	**Intersections:** At-grade intersections- basic forms- conflict points -visibility triangle- design principles- Channelization. Roundabouts- Geometric layout, types- design elements. Traffic Signals – Warrants - pre-timed and traffic actuated. Design of signal timing at isolated intersections- Phase design-optimum cycle time (Webster's approach), green splitting- pedestrian phase -phase diagrams, timing diagram. Grade separated intersection: Grade separated intersections without interchange and with interchange- Three leg interchange, Four leg interchange and multi leg interchange. **Traffic Control Measures** - Traffic Signs, Road Markings, and Traffic control aids.
Module 5	**Traffic Safety :** Road Safety Situation in India, Causes of road accidents – influence of road, vehicle, driver and environmental factors - Pedestrian Safety, Collection and statistical analysis of accident data, Collision and condition diagram, **Road Safety Audit**- concept and need- organizations involved- stages of road safety audit (brief description only)

Text Books:

1. Kadiyali L.R. Traffic Engineering and Transport planning, Khanna Publishers, 2011

2. Khanna S.K and Justo C.E.G; Highway Engineering, Nem Chand Publishers, 10^{th} Ed,2018.
3. CA O' Flaherty, Transport planning and Traffic Engineering, Elsevier, 2006.

References

1. Roger P. Roess, William R. McShane& Elena S. Prassas, Traffic Engineering, Fourth Edition, Prentice-Hall, 2010.
2. Pignataro L. J., Traffic Engineering – Theory and Practice, Prentice Hall, 1973.
3. C. J. Khisty and B. K. Lall, Transportation Engineering: An Introduction,Prentice- Hall India, 2002.
4. P. Chakroborty and A. Das, Principles of Transportation Engineering, PrenticeHall of India Pvt. Ltd., 2003.
5. A. D. May, Traffic Flow Fundamentals, Prentice–Hall, 1990.
6. C.S. Papacostas, Transportation Engineering and Planning, Prentice-Hall India,2002.
7. Highway Capacity Manual (HCM), Transportation Research Board, USA, 2010.
8. Indian Highway Capacity Manual (Indo-HCM), CSIR, New Delhi, 2017
9. Relevant IRC codes

Course Content and lecture Schedule:

No.	Topic	Course Outcome	No. of Hrs
1	**Module 1**		Total:7
1.1	***Fundamental parameters-*** speed, density, volume, travel time, headway, spacing, time-space diagram, time mean speed, space mean speed and their relation. Fundamental diagrams of traffic flow.	CO1	2
1.2	**Single Regime models** - Greenshields model, Greenberg logarithmic model	CO1	3
1.3	**Multi-Regime models** – Two and three regime linear models.	CO1	2
2	**Module 2**		Total: 7
2.1	Need and scope of traffic regulations- Motor Vehicle Act – Regulation of speed- Regulation of vehicles – Regulations concerning driver- General rules concerning traffic- parking regulations- Enforcement of regulations.	CO2	4
2.2	Scope of traffic management measures – restrictions to turning movements – one way streets – tidal flow operations-Closing side streets –Exclusive bus lanes.	CO2	3
3	**Module 3**		Total: 7
3.1	**Capacity and Level of service (LOS)**: Concept- Base capacity, Adjusted capacity, LOS definition, Factors Affecting Capacity	CO3	2

	and LOS, Homogeneous and heterogeneous traffic conditions-vehicle types - Concept of PCU.		
3.2	Capacity and LOS analysis –Single lane, Intermediate lane and two lane interurban roads- Base capacity and adjustment factors- Indo HCM (2017) Approach	CO3	3
3.3	Capacity and LOS analysis of Urban roads - Base conditions-Adjustment factors- Indo HCM (2017) approach	CO3	2
4	**Module 4**		Total: 9
4.1	**Intersections:** At-grade intersections- basic forms- conflict points -visibility triangle- design principles- Channelization.	CO4	2
4.2	**Roundabouts**- Geometric layout, types- design elements.	CO4	2
4.3	**Traffic Signals** - Warrants- pre-timed and traffic actuated. Design of signal timing at isolated intersections- Phase design-optimum cycle time (Webster's approach), green splitting-pedestrian phase -phase diagrams, timing diagram.	CO4	3
4.4	**Grade separated intersection:** Grade separated intersections without interchange, and with interchange- Three leg interchange, Four leg interchange and multi leg interchange. **Traffic Control Measures** - Traffic Signs, Road Markings, Traffic control aids.	CO4	2
5	**Module 5**		Total: 5
5.1	**Traffic Safety :** Road Safety Situation in India, Causes of road accidents – influence of road, vehicle, driver and environmental factors - Pedestrian Safety, Collection and statistical analysis analysis of accident data, Collision and condition diagram,	CO5	3
5.2	**Road safety audit**- concept and need- organizations involved-stages of road safety audit (brief description only)	CO5	2

FIFTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR
Course Code: **22CEE 604.3**
Course Name: **TRAFFIC ENGINEERING AND MANAGEMENT**
Model Question Paper

Max. Marks:100 Duration: 3 hrs

PART A
(Answer all Questions: Each question carries 3 marks)

1 Differentiate time mean speed and space mean speed.
2 Explain multi regime models citing examples.
3 Suggest traffic management measures so as to avoid locking of vehicle flow due to turning traffic.
4 Mention priority rules at intersections.
5 Explain base capacity and adjusted capacity.
6 Discuss the importance of passenger car units under heterogeneous traffic conditions.
7 How channelizing islands control speed and separate conflicts at intersections? Explain with sketches.
8 Which locations justify grade- separated intersections?
9 What is the basic difference between collision diagram and condition diagram?
10 What is the probability of involvement of exactly 5 drivers out of the 500 drivers who are employed in a bus operating company in an accident during a year. It has been found that on an average 1 in 100 drivers are involved in an accident every year.

(3 x 10=30 marks)
.

PART B
(Answer one full question from each module)

11 a. The data shown below were obtained from a highway stretch. Fit these data to Greenshields model and determine i) free speed ii) jam density iii) capacity and iv) speed at maximum flow 7

Speed (km/h)	Density (veh/km)
14.2	85
24.1	70
30.3	55
40.1	41
50.6	20
55	15

b. Explain single regime speed- density models 7

OR

12	a.	Observers stationed at two sections XX and YY, 150m apart on a highway, record the arrival times of four vehicles as shown in the accompanying table. If the total time of observation at XX was 15 s, determine a) the time mean speed, b) the space mean speed and c) the flow at section XX.	7

Vehicle	Time of Arrival (Seconds)	
	Section XX	Section YY
A	T_0	T_0 +7.58
B	T_0 + 3	T_0 +9.18
C	T_0 +6	T_0 +12.36
D	T_0 +12	T_0 +21.74

	b.	Using basic stream flow diagram, explain speed- density, speed- flow and flow-density relationships	7
13	a.	Mention general principles governing speed limit in urban area and rural area.	7
	b.	Suggest traffic management measures that can take care of the imbalance in directional distribution of traffic during peak hours.	7
		OR	
14		Explain the aspects covered under regulation of vehicles and regulation concerning driver in motor vehicles act.	14
15	a.	Explain the adjustment factors mentioned in Indo HCM (2017) that are to be considered in the capacity estimation of urban roads.	7
	b.	Differentiate base capacity and adjusted capacity of single lane interurban roads.	7
		OR	
16	a.	What is level of service? What are the factors affecting capacity and level of service?	7
	b.	Explain the procedure mentioned in Indo HCM (2017) for the determination of base capacity and level of service of two lane two way interurban roads.	7
17	a.	Draw a neat sketch of a full cloverleaf and show the movement of traffic.	7
	b.	Show conflict points at the following intersections i) cross roads, both two way, ii)T-intersection, both two way roads iii) Y-intersection, one one-way iv) Cross roads, one way roads	7
		OR	
18	a.	Explain briefly the various design factors that are to be considered in rotary intersection design.	7
	b.	Design a four phase signal timing plan for the data given below. The intersection is four legged. All approaches have 3 lanes and each lane is 3.5 m width. Saturation flow is 1800pcu/hr/lane. The equivalent hourly flows at the intersection are as shown below: Using the Webster model, determine the	7

optimal cycle length for the intersection. Assume lost times equal to 3.5 s/phase, amber interval equal to 3 s, and all red period is not provided. Also draw the phase and timing diagram.

East bound			West bound			North bound			South bound		
L	T	R	L	T	R	L	T	R	L	T	R
280	850	80	320	700	120	50	280	40	35	360	10

19	a.	What are the different methods for maintaining accident records? Briefly explain with neat sketches.	7
	b.	Explain various measures that may be taken to prevent accidents.	7

OR

20	a.	Briefly explain various stages of road safety audit.	7
	b.	Explain any three statistical methods for analysis of accident data.	7

22CEE 604.4	MECHANICS OF FLUID FLOW	Category	L	T	P	Credit	Year of Introduction
		PEC	3	0	0	3	2019

Preamble: The general objective of this course is to expose the students to the fundamental concepts of different types of fluid flow.

Pre-requisite: Fluid Mechanics and Hydraulics

Course outcome

CO1	Describe and apply the principles of potential flow and viscous flow
CO2	Perform the computations of turbulent flows through pipes and pipe bends by recollecting the relevant hydraulic principles
CO3	Describe and apply the principles of the pressure and specific energy in open channel flow for practical applications
CO4	Describe and apply the principles of unsteady flow for practical applications in pipes and channels
CO5	Prepare physical models for performing experiments recalling the principles of fluid flow

CO-PO Mapping

CET342 MECHANICS OF FLUID FLOW		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	3	3					1					
	CO2	3	3					1					
	CO3	3	3					1					
	CO4	3	3					1					
	CO5	3	3										

Assessment pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	5	5	15
Understand	10	10	15
Apply	20	20	40
Analyze	15	15	30
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment Test (2 numbers)	:	25 marks
Assignment/Quiz/Course project	:	15 marks
Total	**:**	**50 marks**

End semester examination pattern – There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code: 22CEE 604.4

MECHANICS OF FLUID FLOW

Syllabus

Module I

Fluid flow: Types of fluid flow (Review) Potential flow-velocity potential, stream function, streamlines and equipotential lines, flow net-uses and limitations

Viscous flow –Reynold's experiment; Shear stress- pressure gradient relationship - Laminar flow through pipes (Hagen-Poiseulle Equation), laminar flow between stationary parallel plates

Module II

Turbulent flow- Computation, velocity distribution, Head loss due to friction in pipes-Nikuradse experiment with artificially roughened pipe, Friction coefficient for laminar and turbulent flows, Moody's diagram, reduction of carrying capacity of pipes with age. Hazen William's formula. Flow through pipe bends - application of linear momentum principle

Module III

Open channel flow-Hydraulic exponents and section factor for uniform and critical flow, Pressure distribution in curvilinear flows- spillway crest and spillway bucket. Computation of discharge through compound channels. Application of Specific energy for channel transitions- hump and reduction in channel width

Module IV

Rapidly varied steady flow-hydraulic jumps –types based on tail water conditions; Uses of hydraulic jumps for energy dissipation below spillways- jump height curve; tail water curve

Unsteady flow through open channels – Surges- positive surges (problems) and concept of negative surges; Transients in pipes-water hammer

Module V

Experimental hydraulics- Physical modeling-Dimensional analysis- Reyleigh's method Buckingham's pi- theorem, Similitude, Model laws for viscous and open channel flows-Reynold's and Froude's model law; Scale effect, distorted and undistorted models

Text Books:

1. Modi P. N. and S. M. Seth, Hydraulics & Fluid Mechanics, S.B.H Publishers, New Delhi, 2002.
2. Subramanya K., Theory and Applications of Fluid Mechanics, Tata McGraw-Hill, 1993.
3. Subramanya K., Flow in Open channels, Tata McGraw-Hill, 2009.

References

1. Streeter.V.L. Fluid Mechanics, Mc Graw Hill Publishers.
2. Bruce R Munson, Donald F Young . Fundamentals of Fluid Mechanics, John Wiley & sons, 2011.
3. Jain A. K., Fluid Mechanics, Khanna Publishers, Delhi, 1996.
4. Arora.K.R. Fluid Mechanics, Hydraulics and Hydraulic Machines, Standard Publishers, 2005.
5. Narasimhan S., A First Course in Fluid Mechanics, University Press (India) Pvt. Ltd., 2006.
6. Frank.M.White, Fluid Mechanics, Mc Graw Hill, 2013.
7. Mohanty.A.K. Fluid Mechanics, Prentice Hall, New Delhi, 2011
8. Narayana Pillai,N. Principles of Fluid Mechanics and Fluid Machines, University Press, 2011.
9. Kumar.D.N. Fluid Mechanics and Fluid power Engineering, S.K.Kataria & sons, 2013.

Course Code: 22CEE 604.4

MECHANICS OF FLUID FLOW
(Course plan)

Module	Topic	Course outcome addressed	No of Hours
Module I (8 Hours)			
1.1	Fluid flow: Types of fluid flow (Review)	CO1	1
1.2	Potential flow-velocity potential and stream function	CO1	1
1.3	Problems on velocity potential and stream function	CO1	1
1.4	Streamlines and equipotential lines, flow net-uses and limitations	CO1	1
1.5	Flow through pipes: Viscous flow - Shear stress, pressure gradient relationship Laminar flow-Basic concepts, Reynold's experiment	CO1	1
1.6	Laminar flow between parallel plates	CO1	1
1.7	Hagen-Poiseuille equation	CO1	1
1.8	Problems	CO1	1
Module II (7 Hours)			
2.1	Turbulent flow- fundamentals	CO2	1
2.2	Velocity profile- computations	CO2	1
2.3	Pipe roughness -friction factor- Moody's diagram; Hazen williems formula	CO2	1
2.4	Head loss due to friction in pipes-Nikuradse experiment with artificially roughened pipe	CO2	1
2.5	Reduction of carrying capacity of pipes with age	CO2	1
2.6	Flow through pipe bends- application of linear momentum principle	CO2	1
2.7	Problems on Flow through pipe bends	CO2	1
Module III (7 Hours)			

3.1	Open channel flow- uniform flow and critical flow computations- section factor	CO3	1
3.2	Hydraulic exponents for uniform flow and critical flow	CO3	1
3.3	Computation of discharge through compound channels	CO3	1
3.4	Pressure distribution in curvilinear flows- spillway crest and spillway buckets	CO3	1
3.5	Specific energy (review)- Application of Specific energy for channel transitions- hump and reduction in channel width	CO3	1
3.6	Application of Specific energy for channel transitions- reduction in channel width	CO3	1
3.7	Problems on Application of Specific energy for channel transitions	CO3	1
Module IV (7 Hours)			
4.1	Rapidly varied steady flow-hydraulic jumps –tail water conditions -types	CO4	1
4.2	Uses of hydraulic jumps for energy dissipation below spillways- jump height curve; tail water curve	CO4	1
4.3	Unsteady flow through open channels- Surges in open channels- Positive surges and negative surges (concept only)	CO4	1
4.4	Positive surges – derivation of equations-continuity and momentum	CO4	1
4.5	Problems on Positive surges	CO4	1
4.6	Unsteady flow through pipes –water hammer analysis	CO4	1
4.7	Problems on water hammer analysis	CO4	1
Module V (6 Hours)			
5.1	Experimental hydraulics- Dimensional analysis Dimensional analysis-Dimensions and dimensional homogeneity	CO5	1
5.2	Rayleigh method-Problems	CO5	1
5.3	Buckingham pi theorem- Problems	CO5	1
5.4	Model Analysis-Dimensionless numbers, Similitude	CO5	1
5.5	Model laws and scale ratios- Problems	CO5	1
5.6	Scale effect, distorted and undistorted models	CO5	1

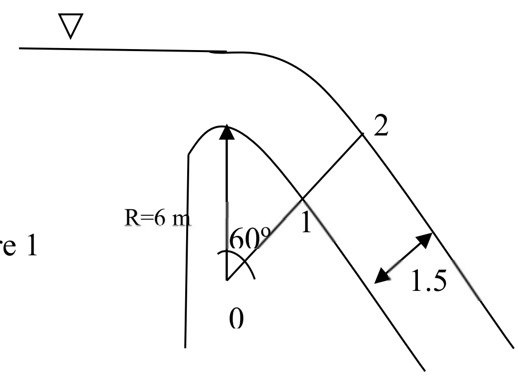
Course Code: 22CEE 604.4

MECHANICS OF FLUID FLOW
(Course Level Assessment Questions)

CO1	**Describe and apply the principles of potential flow and viscous flow**
1	Describe Reynold's experiment
2	Show that stream lines and equi potential lines intersect orthogonally
3	Crude oil of dynamic viscosity 1.5 Poise and relative density 0.9 flows through a 20 mm vertical pipe. The pressure gauges fitted at an upper point A measures 58.86 N/cm^2 while that fitted at another point B, 20 m below A reads 19.62 N/cm^2. Is the flow laminar ? Find the direction of flow and rate of flow.
4	Obtain the expression for local velocity of steady, uniform laminar flow through the space between two stationary parallel plates. Also show that the local velocity becomes average velocity at a point 0.211B from one of the plates, where B is the spacing between the plates
5	The velocity components in a two dimensional incompressible flow are $u = \frac{y^3}{3} + 2x - x^2 y$ and $v = xy^2 - 2y - \frac{x^3}{3}$. (i) Is the flow irrotational? (ii) Evaluate the potential function and stream function

CO2	**Perform the computations of turbulent flows through pipes and pipe bends**
1	Explain the use and characteristics of Moody's diagram
2	Describe the characteristics of velocity distribution in turbulent regime
3	Explain the role of surface aging in carrying capacity of commercial pipes
4	360 l/sec of water is flowing in a pipe. The pipe is bent by 120°. The pipe bend measures 360 mm x 240 mm and volume of the bend is 0.14 m^3. The pressure at entrance is 73 kN/m^2 and the exit is 2.4 m above the entrance section. Find the magnitude of resultant force exerted on the bend.
5	A pipeline 30 cm diameter carries 300 l/s of petrol (density=600 kg/m3; dynamic viscosity=2.9 x 10^{-4} Pas). Calculate (i) the friction factor (ii) shear stress at the boundary (iii) shear stress and velocity at 5 cm from the pipe axis (iv) maximum velocity and thickness of laminar sublayer Assume the pipe to be hydrodynamically rough

CO3	**Describe and apply the principles of the pressure and specific energy in open channel flow for practical applications**
1	Explain hydraulic exponents in open channel computation
2	Derive the relations for Pressure distribution in curvilinear flows

3	A discharge of 15 cumecs flows through a rectangular channel 3 m wide. The depth of flow is 2 m. What is the minimum width beyond which the flow depth at upstream gets disturbed ?. A smooth hump of 0.1 m is built in the channel and at this section the width is 2.8 m. Analyze the water depth at contracted section and the upstream section.
4	For the flow over a spillway with circular arc shown in Figure 1, obtain the value of pressure at point 1for discharge q=5 m^3/s/m for a constant flow depth of 1.5 m assuming (i) forced vortex flow and (ii) free vortex flow  Figure 1

CO4	**Describe and apply the principles of unsteady flow for practical applications in pipes and channels**
1	Explain negative surges. Give examples
2	What is water hammer in pipes ?
3	A steel pipeline is 30 cm in diameter and has a wall thickness of 3 mm. The pipe is 1000 m long and conveys a flow of 100 l/s (Relative density =0.82).The static head at the outlet is 160 m of oil. If the working stress of steel is 0.1 kN/mm^2, calculate the minimum time of closure of a downstream valve. For oil, K=10^9 Pa and for steel E=2.14 x10^{11} Pa
4	A horizontal rectangular channel of 3 m width and 2 m water depth conveys water at 18 m^3/sec. If the flow rate is suddenly reduced to 2/3 of its original value, compute the height and velocity of the surge developed in the channel

CO5	**Prepare physical models for performing experiments recalling the principles of fluid flow**
1	Describe Reyligh's method of dimensional analysis
2	Describe scale effect in physical model studies
3	Explain similitude in hydraulic model studies

4	A 1:20 spillway model has a discharge of 2.25 m^3/s. what is the corresponding prototype discharge ? If a flood phenomenon takes 10 h to occur in the prototype, how long will it in the model ?
5	The discharge Q over a small rectangular weir is known to depend upon head H over the weir, the height of the weir P, acceleration due to gravity g, width of the weir L and fluid properties ρ, dynamic viscosity μ an surface tension σ. Express the relationship between the variables in dimensionless form $\frac{Q}{gH^{5/2}} = f\left[\frac{P}{H}, \frac{L}{H}, \frac{\mu}{H^{3/2} g^{1/2} \rho}, \frac{\sigma}{\rho g H^2}\right]$ using Buckingham π - theorem

Pages: 3

Model Question Paper

Reg No.:………………….. **QP CODE:………………..**

Name:………………………………………

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEE 604.4

Course Name: MECHANICS OF FLUID FLOW

Max. Marks: 100 **Duration: 3 hours**

Part A

(Answer all questions; each question carries 3 marks)

1. Describe Reynold's experiment.
2. Explain the uses of flownet.
3. Describe the features of Moody's diagram.
4. Explain the concept of application of linear momentum principle in pipe bends.
5. Define section factor for uniform flow and critical flow computations and state their uses.
6. Describe the application of specific energy concept in channel transitions.
7. Enlist the classification of hydraulic jumps based on tail water conditions.
8. Differentiate positive surges and negative surges.
9. Explain similitude in hydraulic model studies.
10. Differentiate distorted and undistorted models.

Part B

(Answer one full question from each module, each question carries 14 marks)

Module I

11. (a) Derive Hagen-Poiseullie equation (10Marks)

    (b) Obtain the relation between mean velocity and maximum velocity of laminar flow between parallel plates (4 Marks)

Or

12. (a). The velocity potential for a two dimensional flow is $\phi = x(2y-1)$ at P(4,5) determine (i) the velocity and (b) stream function (10Marks)

12. (b) Show that the streamlines and equipotential lines are orthogonal to each other

(4 Marks)

Module II

13. The diameter of a pipe bend is 30 cm at inlet and 15 cm at outlet and the flow is turned through 120^o in a vertical plane. The axis at inlet is horizontal and the centre of the outlet section is 1.5 m below the centre of the inlet section. Total volume of water in the bend is 0.9 m3. Neglecting friction, calculate the magnitude and direction of force exerted on the bend by water flowing through it at 250 l/sec and when the inlet pressure is 0.15N/mm^2

(14 Marks)

Or

14. A 300 mm diameter water supply pipe had a friction factor of 0.02 when freshly laid. After 10 years of service, the friction factor was found to be 0.025. what friction factor can be expected after another 15 years ? The pipe is assumed to be in rough turbulent flow regime (14 Marks)

Module III

15. Derive the pressure distribution in curvilinear flows (a) spillway crest (ii) spillway bucket (14 Marks)

Or

16. Uniform flow occurs in a 3m wide rectangular channel of bed slope 0.003 at a depth of 2.5 m. Due to sedimentation, the channel bed is raised at certain section. Calculate the maximum height of the hump which will cause any change in upstream depth. If the depth of water at upstream is raised to 2.9 m, determine the height of the hump. Take Manning's coefficient as 0.012 (14 Marks)

Module IV

17. In a wide tidal river, the velocity is 0.75 m/s and the depth of flow is 1.3 m. If a tidal bore is observed to move upstream with a velocity of 4 m/s in this river, determine the velocity and depth of flow after the bore had passed (14 Marks)

Or

18. A steel pipeline is 30 cm in diameter and has a wall thickness of 3 mm. The pipe is 1000 m long and conveys a flow of 100 l/s (Relative density =0.82).The static head at the outlet is 160 m of oil. If the working stress of steel is 0.1 kN/mm^2, calculate the minimum time of closure of a downstream valve. For oil, K=10^9 Pa and for steel E=2.14 x10^{11} Pa

(14 Marks)

Module V

19. (a) Explain Reyliegh's method of dimensional analysis. State its limitations

(8 Marks)

(b) A 1:50 spillway model has a discharge of 1.25 m^3/s. what is the corresponding prototype discharge ? If a flood phenomenon takes 12 h to occur in the prototype, how long will it in the model ? (6 Marks)

Or

20. A small sphere of density ρ_s and diameter D settles at a terminal velocity V in a liquid of density ρ_f and dynamic viscosity μ. Acceleration due to gravity g is known to be a parameter Express the functional relationships between these variables in the form

$$\frac{V}{\sqrt{gD}} = f\left[\frac{\rho_s}{\rho_f}, \frac{\mu}{\rho_f D\sqrt{gD}}\right]$$ using Buckingham π - theorem (14 Marks)

22CEE 604.5	ADVANCED CONCRETE TECHNOLOGY	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PEC	3	0	0	3	2019

Preamble: This course is aimed at exposing the students to the fundamentals of properties of concrete materials, its testing procedures, various types of concretes, NDT of concrete and mix design. After this course, students will be in a position to determine the properties of concrete materials, testing of concrete and do a mix design based on requirement.

Prerequisite: CET309 CONSTRUCTION TECHNOLOGY& MANAGEMENT

Course Outcomes:

Course Outcome	Description of Course Outcome	Prescribed learning level
CO 1	To recall the properties and testing procedure of concrete materials as per IS code	Remembering, Understanding
CO 2	To describe the procedure of determining the properties of fresh and hardened concrete	Remembering, Understanding
CO 3	To design concrete mix using IS Code Methods.	Applying & Analysing
CO4	To explain nondestructive testing of concrete	Remembering, Understanding
CO5	To describe the various special types of concretes	Remembering, Understanding

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	2	2	3	-	-	-	-	-
CO 2	3	-	-	-	2	2	3	-	-	-	-	-
CO 3	3	3	3	2	2	2	3	-	-	-	-	-
CO4	3	-	-	-	2	2	3	-	-	-	-	-
CO5	3	-			3	2	3					

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	40
Understand	20	20	40
Apply			
Analyse	10	10	20

Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

Course Outcome 1 (CO1): To recall the properties and testing procedure of concrete materials as per IS code

1. Discuss the hydration reaction of different cement compounds.
2. List the advantages and disadvantages of artificial aggregates.
3. Explain the classification of aggregates.
4. What are mineral admixtures? Explain GGBS and Flyash.

Course Outcome 2 (CO2): To describe the procedure of determining the properties of fresh and hardened concrete

1. What are the factors affecting strength and elasticity of concrete?
2. Define creep. What are the factors affecting creep.
3. Why is cube strength more than cylinder strength in concrete?

Course Outcome 3 (CO3): To design concrete mix using IS Code Methods.

1. List the methods available for proportioning concrete mix.
2. Design a concrete mix for any strength from the given data.
3. Write the properties of normal distribution curve. What are its uses in quality control'?

Course Outcome 4 (CO4): To explain nondestructive testing of concrete

1. State advanced non-destructive testing methods. Explain ány one in details.
2. Explain Schmidt's rebound hammer test to assess the strength of concrete.

Course Outcome 5 (CO5): To describe the various special types of concretes

1. Write short notes on underwater concreting and mass concreting.
2. Explain step by step procedure to design the Self compacting concrete.
3. Explain basic concept of Fibre reinforced concrete. Give examples of fibres suitable to improve
   i) flexural strength
   ii) impact strength
   iii) shear strength
4. Explain green concrete. State the various materials used in green concrete.

Syllabus

Module 1 Concrete materials

Cement -Review of manufacturing process- chemical composition, Bogue's compounds, mechanism of hydration-heat of hydration-**Aggregate**-Review of types, sampling and testing, artificial aggregates - **Chemical Admixtures**- types, uses, mechanism of action - effects on properties of concrete - **Mineral admixtures**- types, chemical composition - physical characteristics - effects on properties of concrete - **Rheology** – basic concepts – Bingham model

Module 2 Mix proportioning

Mix design - nominal mix- design mix – concept of mix design - variables of proportioning - general considerations - factors considered in the design of concrete mix- various methods of mix design - design of concrete mix as per IS 10262-2019 - **Statistical quality control of concrete** – mean strength – standard deviation – coefficient of variation – sampling - testing -acceptance criteria

Module 3 Properties of fresh and hardened Concrete

Properties of fresh concrete- workability-factors affecting workability - slump test-compaction factor test- Vee Bee consistometer test- **Properties of hardened concrete** - modulus of elasticity, compressive strength, split tensile strength, flexural strength- effect of water cement ratio – maturity concept- **Creep** - factors affecting creep - effect of creep-**Shrinkage**- factors affecting shrinkage - plastic shrinkage, drying shrinkage, autogenous shrinkage, carbonation shrinkage.

Module 4 Durability & NDT of concrete

Durability of concrete- Factors affecting durability - permeability- cracking-reinforcement corrosion; carbonation, chloride penetration, sulphate attack, acid attack, fire resistance; frost damage, alkali silica reaction, concrete in sea water - **Non-destructive testing of concrete-** surface hardness test- ultrasonic pulse velocity method - penetration resistance- pull-out test- core cutting - measuring reinforcement cover.

Module 5 Special Topics in Concrete Technology

Special concretes - lightweight concrete-heavy weight concrete - high strength concrete – high performance concrete - self compacting concrete -roller compacted concrete– fibre reinforced concrete - polymer concrete-pumped concrete - ready mix concrete - green concrete. **Special processes and**

technology - sprayed concrete; underwater concrete, mass concrete; slip form construction, prefabrication technology- 3D concrete printing

Text Books:

1. Neville A.M., "Properties of Concrete", Trans-Atlantic Publications, Inc.; 5e, 2016
2. R. Santhakumar „ Concrete Technology", Oxford Universities Press, 2018
3. Shetty M. S., Concrete Technology", S. Chand & Co., 2018

Reference Books

4. Mehta and Monteiro, Concrete-Micro structure, Properties and Materials", McGraw Hill Professional 2017
5. Neville A. M. and Brooks J. J., Concrete Technology, Pearson Education, 2019
6. Lea, Chemistry of Cement and Concrete", Butterworth-Heinemann Ltd, 5e, 2017

Lecture Plan – Advanced Concrete Technology.

Module	*Topic*	*Course outcomes addressed*	*No. of Lectures*
1	**Module I Concrete materials Total lecture hours: 7**		
1.1	Cement -Review of manufacturing process- chemical composition,	CO1	1
1.2	Bogue's compounds, mechanism of hydration-heat of hydration	CO1	1
1.3	Aggregate-Review of types, sampling and testing, artificial aggregates	CO1	1
1.4	Chemical Admixtures- types, uses, mechanism of action - effects on properties of concrete	CO1	1
1.5	- Mineral admixtures- types, chemical composition - physical characteristics - effects on properties of concrete	CO1	1
1.6	Rheology – basic concepts	CO2	1
1.7	Bingham model	CO2	1
2	**Module II: Mix proportioning Total lecture hours: 7**		
2.1	Mix design - nominal mix- design mix – concept of mix design	CO3	1
2.2	Variables of proportioning - general considerations	CO3	1
2.3	Factors considered in the design of concrete mix- various methods of mix design	CO3	1
2.4	Design of concrete mix as per IS 10262-2019	CO3	2

2.6	Statistical quality control of concrete – mean strength – standard deviation	CO3	1
2.7	Coefficient of variation – sampling - testing -acceptance criteria	C03	1
	FIRST INTERNAL EXAMINATION		
	Module III : Properties of fresh and hardened Concrete Total lecture hours: 7		
3.1	Properties of fresh concrete- workability-factors affecting workability -	CO2	1
3.2	Slump test-compaction factor test- Vee Bee consistometer test	CO2	1
3.3	Properties of hardened concrete - modulus of elasticity, compressive strength	CO2	1
3.4	split tensile strength, flexural strength- effect of water cement ratio – maturity concept	CO2	1
3.5	Creep - factors affecting creep - effect of creep	CO2	1
3.6	Shrinkage- factors affecting shrinkage - plastic shrinkage, drying shrinkage	CO2	1
3.7	Autogenous shrinkage, carbonation shrinkage.	CO2	1
4	**Module IV: Durability & NDT of concrete Total lecture hours :7**		
4.1	Durability of concrete- Factors affecting durability	CO2	1
4.2	Permeability- cracking-reinforcement corrosion; carbonation,	CO2	1
4.3	Chloride penetration, sulphate attack, acid attack, fire resistance	CO2	1
4.4	Frost damage, alkali silica reaction, concrete in sea water	CO2	1
4.5	Non-destructive testing of concrete- surface hardness test	CO4	1
4.6	Ultrasonic pulse velocity method - penetration resistance	CO4	1
4.7	Pull-out test- core cutting - measuring reinforcement cover.	CO4	1
5	**Module V: Special Topics in Concrete Technology -Total lecture hours : 7**		
5.1	Special concretes - lightweight concrete-heavy weight concrete	CO5	1
5.2	High strength concrete – high performance concrete -	CO5	1
5.3	self compacting concrete	CO5	1
5.4	Roller compacted concrete– fibre reinforced concrete - polymer concrete	CO5	1

5.5	Special processes and technology - sprayed concrete; underwater concrete	CO5	1
5.6	mass concrete; slip form construction	CO5	1
5.7	Prefabrication technology- 3D concrete printing	CO5	1

Model Question Paper

QP CODE:

Reg No.:_______________ **Name:___________________________**

THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEE 604.5
Course Name: ADVANCED CONCRETE TECHNOLOGY

Max. Marks: 100 Duration: 3 hours

Part A
(***Answer all questions; each question carries 3 marks***)

16. What are the properties of Bogue's compound?
17. What is the role of chemical admixtures in concrete?
18. Describe the factors considered in mixture proportioning.
19. Explain statistical quality control measures of concrete.
20. What is meant by shrinkage of concrete?
21. What are the factors affecting workability of concrete?
22. Describe the effect of fire on concrete.
23. Explain the pull-out test on concrete.
24. Write short notes on underwater concreting?
25. What are the applications of roller compacted concrete?

PART B
(Answer one full question from each module, each question carries 14 marks)

26. (a) . Explain concrete flow behaviour using a Bingham model. (6 Marks)
    (b) . Describe the influence of mineral admixtures in concrete. Explain any two mineral admixtures in detail. (8 Marks)

OR

27. (a) Describe various tests for determining the quality of aggregate to be used for concreting work. (7 Marks)
    (b) Discuss the hydration reaction of different cement compounds. (7 Marks)

28. Design a concrete mix for the following data.
    Grade of concrete: M25, cement of 43 grade, moderate exposure, Zone III sand, compaction factor 0.9, 20mm maximum sized rounded aggregate. (14 marks)

OR

29. (a) Write down the procedure for concrete mix design by IS method. (8 Marks)
    (b) Explain different methods of mix design. (6 Marks)

30. (a) Explain the factors affecting the strength of concrete. (7 Marks)
(b) Explain the procedure of determining flexural strength of concrete under four point bending (7 Marks)

OR

16. (a) Explain the procedure for determining modulus of elasticity of concrete. (7 Marks)
(b) Explain the term creep, its effects and factors affecting creep. (7 marks)

21. (a) Explain the sulphate attack on concrete and explain the effect of sea water in concrete. (6 Marks)
(b) Explain any two non-destructive tests in concrete. (8 marks)

OR

22. (a). Discuss the causes of corrosion of steel in concrete. (8 Marks)
(b) What is meant by reinforcement cover? How is it measured? (6 Marks)

23. (a) Explain any two methods for testing fresh stage properties of self-compacting concrete. (8 Marks)
(b) Explain green concrete. (6 Marks)

OR

24. (a) What is the influence of prefabrication technology on modern construction industry (8 Marks)
(b) Describe sprayed concrete. (6 Marks)

22CEE 604.6	ENVIRONMENTAL IMPACT ASSESSMENT	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PEC	3	0	0	3	2019

Preamble

This course introduces the methodologies for identifying, predicting, evaluating and mitigating the impacts on environment due to any developmental project or activities. Students will learn how to prepare an impact assessment report and devise an environment management plan. Sufficient background will be provided on the environmental clearance procedures in India.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	To appreciate the need for minimizing the environmental impacts of developmental activities	Understanding
CO2	To understand environmental legislation & clearance procedure in the country	Remembering, Understanding
CO 3	To apply various methodologies for assessing the environmental impacts of any developmental activity	Applying & Analysing
CO 4	To prepare an environmental impact assessment report	Analysing & Evaluating
CO 5	To conduct an environmental audit	Analysing & Evaluating

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	2	2	-	-	-	-	-
CO 2	-	-	-	-	-	2	-	-	-	-	-	-
CO 3	2	-	-	3	2	-	3	-	-	-	-	-
CO4	-	-	-	2	-	2	2	3	-	3	-	-
CO5	-	-	-	2	1	-	2	2	-	2	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	15
Understand	10	10	15
Apply	15	15	35
Analyse	15	15	35
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Course Level Assessment Questions

CO1: To be able to appreciate the need for minimizing the environmental impacts of developmental activities

1.Explain the evolution of EIA in India

2.Explain why EIA is needed for developmental projects.

3. What are the different ways in which development projects impact the water quality and quantity?

CO 2: To be able to understand environmental legislation & clearance procedure in the country

1. Two municipalities in Kerala plan to set up a Common Municipal Solid Waste Management Facility (CMSWMF). Explain the procedure required for the Environmental Clearance (EC) for the project as per the EIA Notification of 2006.(All CMSWMFs are category B projects)

2. Describe the procedure for obtaining environmental clearance according to EIA notification 2006.

3. The Environment (Protection) Act, 1986 is called an umbrella legislation. Substantiate the statement.

CO3: To be able to apply various methodologies for assessing the environmental impacts of any developmental activity

1. Prepare a simple checklist for assessment of socio economic impact due to the development of a highway.

2. Explain overlay mapping as an EIA method

3. Explain how to predict the impact of a highway project on air quality

CO4: To be able to prepare an environmental impact assessment report

1.Explain the Terms of Reference (ToR) for EIA report of a highway project

2.Explain the structure of EIA report

3.Explain the importance of an environmental management plan.

CO5: To be able to conduct an environmental audit

1. Explain the need for environmental auditing

2.What are the different types of environmental audits?

3. Explain the importance of ISO 14001 standard.

SYLLABUS

Module 1

Definition, Need for EIA, Evolution of EIA: Global & Indian scenario -Environmental legislations in India- The Water (Prevention & Control of Pollution) Act 1974, The Air (Prevention & Control of Pollution) Act 1981, The Environmental (Protection) Act 1986- Environmental standards for water, air and noise quality- EIA Notification 2006

Module 2

Environmental clearance process in India: Screening, Scoping, Public Consultation, Appraisal-Form1-Category of projects- Generic structure of EIA report- Terms of Reference (ToR) -Types of EIA: strategic, regional, sectoral, project level- Rapid EIA and Comprehensive EIA- Initial Environmental Examination (IEE)

Module 3

EIA methodologies: Ad hoc, checklist, matrix, network and overlay- Impact Prediction, Evaluation and Mitigation-Prediction and assessment of the impact on water (surface water and groundwater), air, and noise environment- assessment of ecological impacts and Socio economic Impacts.

Module 4

Environmental Management Plan (EMP): Goal and purpose- Importance of EMP- Content of an EMP-Role of environmental monitoring program
Environment Audit: need for audit- audit types and benefits- environmental audit procedure
ISO 14001 standards: Importance, salient features - Stages in implementation- Benefits

Module 5

EIA case studies (Indian)- a highway project, a hydro electric power plant, an air port project, a quarry mining project and a solid waste management project.

Text Books:

7. Larry W Canter, “Environmental Impact Assessment”, McGraw Hill Inc. , New York, 1995
8. Betty Bowers Marriott, Environmental Impact Assessment: A Practical Guide, McGraw-Hill Professional, 1997
9. Environmental Impact Assessment, 2003, Y.Anjaneyulu, B.S Publications

References:

4. Lawrence, David P., Environmental Impact Assessment (Practical Solutions to Recurrent Problems), Wiley International, New Jersey.
5. Ministry of Environment & Forests, Govt. of India 2006 EIA Notification
6. Jain, R.K., Urban, L.V. and Stacey, G.S., Environment Impact Analysis, Von Nostrand Reinhold Company.

Lecture Plan- Environmental Impact Assessment

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module 1: Total Lecture Hours -7**		
1.1	Definition, Need for EIA, Evolution of EIA: Global & Indian scenario	CO1	1
1.2	Environmental legislations in India- The Water (Prevention & Control of Pollution) Act 1974, The Air (Prevention & Control of Pollution) Act 1981, The Environmental (Protection) Act 1986	CO2	3
1.3	Environmental standards for water, air and noise quality	CO2	1
1.4	EIA Notification 2006	CO2	2
2	**Module II: Total Lecture Hours- 7**		
2.1	Environmental clearance process in India: Screening, Scoping, Public Consultation, Appraisal- Form1- Category of projects	CO2	3
2.2	Generic structure of EIA report- Terms of Reference (ToR)	CO4	1
2.3	Types of EIA: strategic, regional, sectoral, project level-	CO3	1
2.4	Rapid EIA and Comprehensive EIA	CO3	1
2.5	Initial Environmental Examination (IEE)	CO3	1
3	**Module III: Total Lecture Hours-7**		
3.1	EIA methodologies: Ad hoc, checklist, matrix, network and overlay	CO3	3
3.2	Impact Prediction, Evaluation and Mitigation- Prediction and assessment of the impact on water	CO3	2

	(surface water and groundwater), air, and noise environment		
3.3	assessment of ecological impacts and Socio economic Impacts	CO3	2
4	**Module IV: Total Lecture Hours- 7**		
4.1	Environmental Management Plan (EMP): Goal and purpose- Importance of EMP- Content of an EMP	CO4	2
4.2	Role of environmental monitoring program	CO4	1
4.3	Environment Audit: need for audit- audit types and benefits- environmental audit procedure	CO5	2
4.4	ISO 14001 standards: Importance, salient features - Stages in implementation- Benefits	CO5	2
5	**Module V: Total Lecture Hours- 7**		
5.1	EIA case studies (Indian)- a highway project	CO1, CO4	2
5.2	Hydro electric power plant, air port project	CO1, CO4	3
5.3	Quarry mining project, solid waste management project	CO1, CO4	3

Model Question Paper

Reg No.:_______________ **Name:__________________________**

SIXTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: 22CEE 604.6
Course Name: ENVIRONMENTAL IMPACT ASSESSMENT

Max. Marks: 100 Duration: 3 Hours

Part A
(***Answer all questions; each question carries 3 marks***)

31. Explain the need for EIA
32. Why environmental (protection) act, 1986 is called an umbrella act?
33. Discuss screening of projects
34. What is rapid EIA?
35. What is ad hoc method for impact assessment?
36. How to predict the impact of a proposed food industry on the water quality of a nearby river
37. Explain the benefits of an environmental audit
38. What is ISO 14001 standard?
39. What are the impacts of a highway project on local air quality
40. Discuss the environment monitoring program for a quarry mining industry.

PART B
(Answer one full question from each module, each question carries 14 marks)

41. (a) Discuss environmental standards for water, air and noise (6 Marks)
    (b) Discuss evolution of EIA in India (8 Marks)

OR

42. (a) Discuss Air (Prevention & Control of Pollution) Act 1981 (5 Marks)
    (b) Explain salient features of EIA notification 2006 (9 Marks)

43. (a) Discuss environmental clearance process in India (10 Marks)
    (c) What is Form-1 ? (4 Marks)

OR

44. (a) What is Initial Environmental Examination? (5 Marks)
    (b) Explain different types of EIA (9 Marks)

45. (a) Discuss in detail EIA methodologies (10 Marks)
    (b) How can air quality modelling help in assessing the impact on air (4 Marks)

OR

16. (a) Explain the steps to assess the impacts on the ecological environment due to a project (7Marks)
    (b) Explain the steps involved in assessment of impacts on the water environment. (7 Marks)

25. (a) What are the different types of Environmental Audit? (5 Marks)
    (b) Discuss the content of an environment management plan .(9 marks)

OR

26. (a) Discuss the salient features of an Environmental Monitoring Plan (5 Marks)
    (b) Explain in detail the procedure for conducting an environmental audit (9 Marks)

27. Explain environmental clearance procedure for an airport (14 Marks)

OR

28. Discuss how to assess the impacts of a hydro electric project (14 Marks)

22CEE 604.7	FUNCTIONAL DESIGN OF BUILDINGS	Category	L	T	P	Credit	Year of Introduction
		PEC	3	0	0	3	2019

Preamble: The general objective of this course is to provide an insight to the students to various aspects of functional design of buildings and innovative construction methods.

Pre-requisite: CE204 Construction Technology

Course outcome

After the course, the student will able to:

CO1	Develop an understanding of acoustical design and noise control techniques
CO2	Understand elemental concepts of natural and artificial lighting designs
CO3	Know the principles involved in the design of buildings for thermal comfort and influence of climate on design of buildings
CO4	Have basic concept for electrical load calculation, plumbing design, HVAC load Calculation, functioning of elevators and escalators and rough cost estimation.
CO5	Acquire knowledge of innovative construction concepts

CET 372 Functional Design of Buildings		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	3	3										
	CO2	3	3										
	CO3	3	3										
	CO4	3	3										
	CO5	3	3										

Assessment pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	5	5	15
Understand	10	10	15
Apply	20	20	40
Analyze	15	15	30
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment Test (2 numbers)	:	25 marks
Assignment/Quiz/Course project	:	15 marks
Total	**:**	**50 marks**

End semester examination pattern – There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub- divisions and carry 14 marks.

Course Level Assessment Questions
(Questions may be framed based on the outline given under each course outcome)

Course Outcome 1 (CO1)
1. Develop an understanding of acoustical design and noise control techniques
2. Applications of acoustics
3. Explain the acoustical considerations for offices, hospitals and industrial buildings

Course Outcome 2 (CO2)
1. Explain the purposes of lighting
2. Explain the basic concepts of natural and artificial lighting
3. Explain the different methods used for the design of natural lighting
4. Explain the different methods used for the design of artificial lighting

Course Outcome 3 (CO3)
1. Evaluate the principles involved in the design of buildings for thermal comfort
2. Explain the influence of climate on design of buildings
3. Compute solar radiation on different surfaces
4. Describe thermo physical properties of buildings

Course Outcome 4 (CO4)
1. Describe the basic concepts for electrical load calculation of structures
2. Explain the basic criteria for plumbing design
3. Calculation of HVAC load
4. Explain the functioning of elevators and escalators
5. Understand the rough cost estimation

Course Outcome 5 (CO5)

1. Understand traditional techniques in Tropical climate with vernacular buildings in Kerala
2. Explain the concepts of green building
3. Describe concepts for intelligent buildings
4. Explain innovative construction methods

Course Code: 22CEE 604.7

FUNCTIONAL DESIGN OF BUILDINGS

Syllabus

Module I

Acoustical / Sonic Environment and acoustical comfort: Sound, Nature of sound- Behavior of sound in enclosed spaces-Concept of Geometric Acoustics-Reflection of sound and their applications-Absorption of sound-Sound absorption coefficient-Human Audibility range- Reverberation & Reverberation Time Calculation- Flanking paths- Sound absorption-materials and fixings-Reverberation-Sabine's formula-Eyrings modification.-Basic design of the elements for the required degree of sound insulation- Air and structure born noises-equivalent noise levels-day and night equivalent.

Acoustics, applications: Measures of noise control- Source-path and receiving end. TL value and computation of TL value, Acoustical defects- acoustical design of auditoriums and small lecture halls-Acoustical considerations of offices, hospitals and Industrial buildings.

Module II

Natural lighting: Visual task requirements, Units of Light, Light, Vision and Buildings, Standards of Lighting and Visual comfort-The sky as a source of light, Daylight factor, Daylight penetration-Calculation of daylight factor. Design of side-lit windows-BIS and CBRI methods-skylights

Artificial lighting: Artificial lighting- illumination requirements-lux meter – lamps and luminaries – polar distribution curves– Color temperature and color rendering index- glare - Design of artificial lighting – lumen method – point by point method. Basic idea of street lighting and outside lighting

Module III

Thermal comfort: Factors affecting thermal comfort- effective temperature- thermal comfort indices-ET-CET Charts- Bioclimatic chart- Psychrometry and Psycrometric chart.

Earth-Sun relationship: Sun's apparent movement with respect to the earth. Solar angles- Computation of solar radiation on different surfaces-solar path diagram-shadow-throw concept and design of shading devices

Thermal design of buildings: Thermo physical properties of building materials and thermal control: passive and active building design- Steady and periodic heat flow through building envelope.

Design approaches: Climate conscious designs- Climatic zones in India- orientation and shape of buildings in different climatic zones- Passive solar-Active solar and Active approaches. Requirements of buildings in tropical areas-Thermal insulation

Module IV

Functional elements: Concept for electrical load calculation of structures- basic criteria for plumbing design – basic concept of HVAC load calculation – Basic concept of functioning of elevators and escalators- basic cost estimation.

Functional protection: Causes of fire, Mechanism of fire spread in buildings, classification of fire-High temperature effects and combustibility of building materials and structure- Fire alarm system, and means of escape-Firefighting installations.

Module V

Functionality as per Vastusastra: Basic concepts- Governing criteria of functionality- Energy pattern- understand traditional techniques in Tropical climate with vernacular buildings in Kerala as case study.

Innovative concepts of functionality: Concept of green building- case studies on low energy and green buildings-Concepts of Intelligent building- Thirsty concrete- Blue roads- self healing concrete

Text Books and References:

1. Knudsen V.O. and Harris C.M., Acoustical Design in Architecture, John Wiley, 1980

2. M David Egan , Architectural Acoustics, J.Ross Publishing, 2007

3. Marshall Long, "Architectural Acoustics", Second Edition, Academic Press, Waltham, USA, 2014

4. Bureau of Indian standards, Handbook on Functional Requirement of Buildings – SP:41(S and T) -1987

5. Pritchard, D.C., "Lighting", Longman Scientific & Technical, Harlow, 1995.

6. Benjamin Evans, "Daylight in Architecture", McGraw - Hill Book Company, Newyork, 1981.

7.Koenigseberger, Manual of tropical Housing and Building Part I – Climatic design, Orient Longman, 2011

8. Ajitha Simha.D, Building Environment, Tata McGraw Hill Publishing Co., New Delhi, 1985

9. Jain. V.K., "Design and Installation of Services in Building complexes & High Rise Buildings", Khanna Tech. Publishers, New Delhi, 1986.

10. National Building Code of India (NBC 2016)

11. Wayne Forster and Dean Hawkes, "Energy Efficient Buildings: Architecture, Engineering, and Environment". W.W. Norton Company Inc. 2002.

12. Bureau of Energy Efficiency, India. Design Guidelines for Energy Efficient Multi-Storey Buildings, 2014.

Module	Topic	Course outcome addressed	No of Hours
Module I (8 Hours)			
1.1	Acoustical / Sonic Environment and acoustical comfort: Sound, Nature of sound- Behavior of sound in enclosed spaces	CO1	1
1.2	Concept of Geometric Acoustics-Reflection of sound and their applications- Absorption of sound-Sound absorption coefficient-	CO1	1
1.3	Human Audibility range-Reverberation & Reverberation Time Calculation- Flanking paths. Sound absorption-materials and fixings. Reverberation-Sabine’s formula-Eyrings modification.	CO1	2
1.4	Basic design of the elements for the required degree of sound insulation- Air and structure born noises-equivalent noise levels-day and night equivalent	CO1	1
1.5	Acoustics, applications: Measures of noise control- Source-path and receiving end. TL value and computation of TL value, Acoustical defects-	CO1	1
1.6	Acoustical design of auditoriums and small lecture halls. Acoustical considerations of offices, hospitals and Industrial buildings.	CO1	2
Module II (6 Hours)			
2.1	Natural lighting: Visual task requirements, Units of Light, Light, Vision and Buildings	CO2	1
2.2	Standards of Lighting and Visual comfort-The sky as a source of light, Daylight factor, Daylight penetration-Calculation of daylight factor.	CO2	1
2.3	Design of side-lit windows-BIS and CBRI methods-skylights	CO2	1
2.4	Artificial lighting: Artificial lighting- illumination requirements- lux meter – lamps and luminaries – polar distribution curves	CO2	1
2.5	Color temperature and color rendering index- glare - Design of artificial lighting – lumen method – point by point method. Basic idea of street lighting and outside lighting	CO2	2
Module III (8 Hours)			
3.1	Thermal comfort: Factors affecting thermal comfort- effective Temperature	CO3	1
3.2	Thermal comfort indices-ET-CET Charts- Bioclimatic chart- Psychrometry and Psycrometric chart.	CO3	1
3.3	Earth-Sun relationship: Sun’s apparent movement with respect to the earth. Solar angles	CO3	1

3.4	Computation of solar radiation on different surfaces-solar path diagram-shadow-throw concept and design of shading devices	CO3	1
3.5	Thermal design of buildings: Thermo physical properties of building materials and thermal control- Passive and active building design- Steady and periodic heat flow through building envelope.	CO3	1
3.6	Design approaches: Climate conscious designs- Climatic zones in India- orientation and shape of buildings in different climatic Zones	CO3	2
3.7	Passive solar-Active solar and Active approaches. Requirements of buildings in tropical areas-Thermal insulation	CO3	1
Module IV (7 Hours)			
4.1	Functional elements: Concept for electrical load calculation of Structures	CO4	1
4.2	Basic criteria for plumbing design	CO4	1
4.3	Basic concept of HVAC load calculation	CO4	1
4.4	Functional protection: Causes of fire, Mechanism of fire spread in buildings, classification of fire-High temperature effects and combustibility of building materials and structure- Fire alarm system, and means of escape. Firefighting installations	CO4	2
4.5	Basic concept of functioning of elevators and escalators and basic cost estimation of services.	CO4	2
Module V (6 Hours)			
5.1	Functionality as per Vastusastra: Basic concepts- Governing criteria of functionality - Energy pattern	CO5	1
5.2	Understand traditional techniques in Tropical climate with vernacular buildings in Kerala as case study	CO5	2
5.3	Innovative concepts of functionality: Concept of green building-case studies on low energy and green buildings-	CO5	2
5.4	Concepts of Intelligent building- Thirsty concrete- Blue roads-self healing concrete	CO5	1

MODEL QUESTION PAPER

Reg. No.:_______________ Name:__________________________

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEE 604.7
Course Name: FUNCTIONAL DESIGN OF BUILDINGS

Max. Marks: 100 Duration: 3 hours

Part A

(Answer all questions; each question carries 3 marks)

1. Write briefly about the audibility range of human beings. (3 Marks)
2. Discuss any three common acoustical defects seen in an auditorium. (3 Marks)
3. What are the advantages and disadvantages of sky lighting? (3 Marks)
4. Briefly describe polar distribution curves (3 Marks)
5. What are the thermal insulating materials used to maintain comfortable conditions inside a building? (3 Marks)
6. What do you understand by the following (i) Solar Constant (ii) Solar Azimuth (iii) Solar Altitude (3 Marks)
7. Write short note on "Handling capacity of Lifts" (3 Marks)
8. Briefly describe firefighting installations (3 Marks)
9. Describe self healing concrete. (3 Marks)
10. List out the advantages of self healing concrete. (3 Marks)

PART B

(Answer one full question from each module, each question carries 14 marks)

Module – 1

11. (a) TL value of a $16 m^2$ solid wall is 45 dB. If a hole of $2 cm^2$ is drilled through it, find the reduction in TL value? (10 Marks)

    (b) Discuss how the TL value of a separating wall varies with its mass. (4 Marks)

12. (a) Explain how sound intensity varies with distance from a point source

    I. In free field

    II. In a reverberant field (8 Marks)

    (b) What you mean by Acoustical Day Time and Acoustical Night Time. Explain the concepts of L_{eq} and L_{dn} ? (6 Marks)

Module – 2

13. (a) Explain the procedure of design of Artificial lighting by Lumen Method. (7 Marks)

    (b) A point source of light has an intensity 2000 candela in the vertically downward direction. The intensity reduces with the angle and reaches 1000 cd at the horizontal direction (90degrees with vertical). If the source is mounted 4m above the working plane, find the illumination due to this light source at points (i) directly under the lamp (ii) at 3m away in the same plane. (7 Marks)

14. (a) Define the different components of daylight factor? (6 Marks)

    (b) What do you understand by the concepts Passive solar design, Active solar design and active design? (8 Marks)

Module – 3

15. (a) Explain the considerations to be made in achieving thermal comfort in hot & dry and Warm and humid regions? (7 Marks)

    (b) Explain the concept of shadow angles and shadow throws. How shadow throws are used in the design of shading devices? (7 Marks)

16. (a) Explain the concept of comfort zone based on Bio-climatic chart (7 Marks)

    (b) What is Psychrometry? What are the usual input parameters to a Psychrometric chart? What are the various informations we get from a Psychrometric chart? (7 Marks)

Module – 4

17. Explain the features, operation arrangements, location and types of Elevators in public buildings. (14 Marks)
18. Explain the high temperature effects and combustibility of building materials and structures (14Marks)

Module – 5

19. (a) Explain the concepts of green building. (7 Marks)

    (b) Describe LEED and GRIHA ratings for the evaluation of green buildings. (7 Marks)

20. Describe the modern construction materials and its merits (14 Marks)

22HUT 605	Industrial Economics & Foreign Trade	Category	L	T	P	CREDIT
		HSMC	3	0	0	3

Preamble: To equip the students to take industrial decisions and to create awareness of economic environment.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain the problem of scarcity of resources and consumer behaviour, and to evaluate the impact of government policies on the general economic welfare. (Cognitive knowledge level: **Understand**)
CO2	Take appropriate decisions regarding volume of output and to evaluate the social cost of production. (Cognitive knowledge level: **Apply**)
CO3	Determine the functional requirement of a firm under various competitive conditions. (Cognitive knowledge level: **Analyse**)
CO4	Examine the overall performance of the economy, and the regulation of economic fluctuations and its impact on various sections in the society. (Cognitive knowledge level: **Analyse**)
CO5	Determine the impact of changes in global economic policies on the business opportunities of a firm. (Cognitive knowledge level: **Analyse**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2										3	
CO2	2	2			2	2	3				3	
CO3	2	2	1								3	
CO4	2	2	1			1					3	
CO5	2	2	1								3	

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
Remember	**15**	**15**	**30**
Understand	**20**	**20**	**40**
Apply	**15**	**15**	**30**

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment - Test (2 numbers)	: 25 marks
Continuous Assessment - Assignment	: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B.

Part A	: 30 marks
Part B	: 70 marks

Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 3 sub-divisions and carries 14 marks.

SYLLABUS

22HUT605 Industrial Economics & Foreign Trade

Module 1 (Basic Concepts and Demand and Supply Analysis)

Scarcity and choice - Basic economic problems- PPC – Firms and its objectives – types of firms – Utility – Law of diminishing marginal utility – Demand and its determinants – law of demand – elasticity of demand – measurement of elasticity and its applications – Supply, law of supply and determinants of supply – Equilibrium – Changes in demand and supply and its effects – Consumer surplus and producer surplus (Concepts) – Taxation and deadweight loss.

Module 2 (Production and cost)

Production function – law of variable proportion – economies of scale – internal and external economies – Isoquants, isocost line and producer's equilibrium – Expansion path – Technical progress and its implications – Cobb-Douglas production function - Cost concepts – Social cost: private cost and external cost – Explicit and implicit cost – sunk cost - Short run cost curves - long run cost curves – Revenue (concepts) – Shutdown point – Break-even point.

Module 3 (Market Structure)

Perfect and imperfect competition – monopoly, regulation of monopoly, monopolistic completion (features and equilibrium of a firm) – oligopoly – Kinked demand curve – Collusive oligopoly (meaning) – Non-price competition – Product pricing – Cost plus pricing – Target return pricing – Penetration pricing – Predatory pricing – Going rate pricing – Price skimming.

Module 4 (Macroeconomic concepts)

Circular flow of economic activities – Stock and flow – Final goods and intermediate goods - Gross Domestic Product - National Income – Three sectors of an economy- Methods of measuring national income – Inflation- causes and effects – Measures to control inflation-Monetary and fiscal policies – Business financing- Bonds and shares -Money market and Capitalmarket – Stock market – Demat account and Trading account - SENSEX and NIFTY.

Module 5 (International Trade)

Advantages and disadvantages of international trade - Absolute and Comparative advantage theory - Heckscher - Ohlin theory - Balance of payments – Components – Balance of Payments deficit and devaluation – Trade policy – Free trade versus protection – Tariff and non-tariff barriers.

Reference Materials

1. Gregory N Mankiw, 'Principles of Micro Economics', Cengage Publications
2. Gregory N Mankiw, 'Principles of Macro Economics', Cengage Publications
3. Dwivedi D N, 'Macro Economics', Tata McGraw Hill, New Delhi.
4. Mithani D M, 'Managerial Economics', Himalaya Publishing House, Mumbai.
5. Francis Cherunilam, 'International Economics', McGraw Hill, New Delhi.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Why does the problem of choice arise?
2. What are the central problems?
3. How do we solve the basic economic problems?
4. What is the relation between price and demand?
5. Explain deadweight loss due to the imposition of a tax.

Course Outcome 2 (CO2):

1. What is shutdown point?
2. What do you mean by producer equilibrium?
3. Explain break-even point;
4. Suppose a chemical factory is functioning in a residential area. What are the external costs?

Course Outcome 3 (CO3):

1. Explain the equilibrium of a firm under monopolistic competition.
2. Why is a monopolist called price maker?
3. What are the methods of non-price competition under oligopoly?

4. What is collusive oligopoly?

Course Outcome 4 (CO4):

1. What is the significance of national income estimation?
2. How is GDP estimated?
3. What are the measures to control inflation?
4. How does inflation affect fixed income group and wage earners?

Course Outcome 5 (CO5):

1. What is devaluation?
2. Suppose a foreign country imposes a tariff on Indian goods. How does it affect India's exports?
3. What is free trade?
4. What are the arguments in favour of protection?

Model Question paper

QP CODE: **PAGES:3**

Reg No:______________ **Name :______________**

B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22HUT605

Course Name: Industrial Economics & Foreign Trade

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Why does an economic problem arise?
2. What should be the percentage change in price of a product if the sale is to be increased by 50 percent and its price elasticity of demand is 2?
3. In the production function Q= $2L^{1/2}K^{1/2}$ if L=36 how many units of capital are needed to produce 60 units of output?
4. Suppose in the short run AVC 4. Suppose in the short run $AVC<P<AC$. Will this firm produce or shut down? Give reason.
5. What is predatory pricing?
6. What do you mean by non- price competition under oligopoly?
7. What are the important economic activities under primary sector?
8. Distinguish between a bond and share?
9. What are the major components of balance of payments?

10. What is devaluation? **(10 x 3 = 30 marks)**

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Prepare a utility schedule showing units of consumption, total utility and marginal utility, and explain the law of diminishing marginal utility. Point out any three limitations of the law.

b) How is elasticity of demand measured according to the percentage method? How is the measurement of elasticity of demand useful for the government?

Or

12. a) Explain the concepts consumer surplus and producer surplus.

b) Suppose the government imposes a tax on a commodity where the tax burden met by the consumers. Draw a diagram and explain dead weight loss. Mark consumer surplus, producer surplus, tax revenue and dead weight loss in the diagram.

MODULE II

13. a) What are the advantages of large-scale production?

b) Explain Producer equilibrium with the help of isoquants and isocost line. What is expansion path?

Or

14. a) Explain break-even analysis with the help of a diagram.

b) Suppose the monthly fixed cost of a firm is Rs. 40000 and its monthly total variable cost is Rs. 60000.

i. If the monthly sales is Rs. 120000 estimate contribution and break-even sales.
ii. If the firm wants to get a monthly profit of Rs.40000, what should be the sales?

c) The total cost function of a firm is given as $TC=100+50Q - 11Q^2+Q^3$. Find marginal cost when output equals 5 units.

MODULE III

15. a) What are the features of monopolistic competition?

b) Explain the equilibrium of a firm earning supernormal profit under monopolistic competition.

Or

16. a) Make comparison between perfect competition and monopoly.

b) Explain price rigidity under oligopoly with the help of a kinked demand curve.

MODULE IV

17. a) How is national income estimated under product method and expenditure method?

b) Estimate GDPmp, GNPmp and National income

Private consumption expenditure	= 2000 (in 000 cores)
Government Consumption	= 500
NFIA	= -(300)
Investment	= 800
Net=exports	=700
Depreciation	= 400
Net-indirect tax	= 300

Or

18. a) What are the monetary and fiscal policy measures to control inflation?

b) What is SENSEX?

MODULE V

19. a) What are the advantages of disadvantages of foreign trade?

b) Explain the comparative cost advantage.

Or

20. a) What are the arguments in favour protection?

b) Examine the tariff and non-tariff barriers to international trade.

(5 × 14 = 70 marks)

Teaching Plan

Module 1 (Basic concepts and Demand and Supply Analysis)		**7 Hours**
1.1	Scarcity and choice – Basic economic problems - PPC	1 Hour
1.2	Firms and its objectives – types of firms	1 Hour
1.3	Utility – Law of diminishing marginal utility – Demand – law of demand	1 Hour
1.4	Measurement of elasticity and its applications	1 Hour
1.5	Supply, law of supply and determinants of supply	1 Hour
1.6	Equilibrium – changes in demand and supply and its effects	1 Hour
1.7	Consumer surplus and producer surplus (Concepts) – Taxation and deadweight loss.	1 Hour
Module 2 (Production and cost)		**7 Hours**
2.1	Productions function – law of variable proportion	1 Hour
2.2	Economies of scale – internal and external economies	1 Hour
2.3	producers equilibrium – Expansion path	1 Hour
2.4	Technical progress and its implications – cob Douglas Production function	1 Hour
2.5	Cost concepts – social cost: private cost and external cost – Explicit and implicit cost – sunk cost	1 Hour
2.6	Short run cost curves & Long run cost curves	1 Hour
2.7	Revenue (concepts) – shutdown point – Break-even point.	1 Hour
Module 3 (Market Structure)		**6 hours**
3.1	Equilibrium of a firm, MC – MR approach and TC – TR approach	1 Hour
3.2	Perfect competition & Imperfect competition	1 Hour
3.3	Monopoly – Regulation of monopoly – Monopolistic competition	1 Hour
3.4	Oligopoly – kinked demand curve	1 Hour
3.5	Collusive oligopoly (meaning) – Non price competition	1 Hour
3.6	Cost plus pricing – Target return pricing – Penetration, Predatory pricing – Going rate pricing – price skimming	1 Hour

Module 4 (Macroeconomic concepts)		7 Hours
4.1	Circular flow of economic activities	1 Hour
4.2	Stock and flow – Final goods and intermediate goods – Gross Domestic Product - National income – Three sectors of an economy	1 Hour
4.3	Methods of measuring national income	1 Hour
4.4	Inflation – Demand pull and cost push – Causes and effects	1 Hour
4.5	Measures to control inflation – Monetary and fiscal policies	1 Hour
4.6	Business financing – Bonds and shares – Money market and capital market	1 Hour
4.7	Stock market – Demat account and Trading account – SENSEX and NIFTY	1 Hour
Module 5 (International Trade)		**8 Hours**
5.1	Advantages and disadvantages of international trade	1 Hour
5.2	Absolute and comparative advantage theory	2 Hour
5.3	Heckscher – Ohlin theory	1 Hour
5.4	Balance of payments – components	1 Hour
5.5	Balance of payments deficit and devaluation	1 Hour
5.6	Trade policy – Free trade versus protection	1 Hour
5.7	Tariff and non tariff barriers.	1 Hour

22CET 606	Comprehensive Course Work	Category	L	T	P	Credit	Year of Introduction
		PCC	1	0	0	1	2019

Preamble: The course is designed to ensure that the student have firmly grasped the foundational knowledge in Civil Engineering familiar enough with the technological concepts. It provides an opportunity for the students to demonstrate their knowledge in various Civil Engineering subjects.

Pre-requisite: Nil

Course outcomes: After the course, the student will able to:

CO1	Learn to prepare for a competitive examination
CO2	Comprehend the questions in Civil Engineering field and answer them with confidence
CO3	Communicate effectively with faculty in scholarly environments
CO4	Analyze the comprehensive knowledge gained in basic courses in the field of Civil Engineering

CET 308 Comprehensive Course Work		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
	CO1	3	1	1			2							1	1	
	CO2	3	1				2				3					
	CO3	3	1			1	2				3				1	
	CO4	3	3			1	2									

Assessment pattern

Bloom's Category	End Semester Examination (Marks)
Remember	25
Understand	15
Apply	5
Analyze	5
Evaluate	
Create	

End Semester Examination Pattern:

A written examination will be conducted by the University at the end of the sixth semester. The written examination will be of objective type similar to the GATE examination. Syllabus for the comprehensive examination is based on following five Civil Engineering core courses.

CET 201- Mechanics of Solids

CET 203- Fluid Mechanics and Hydraulics

CET 205- Surveying & Geomatics

CET 204- Geotechnical Engineering I

CET 309 – Construction Technology and Management

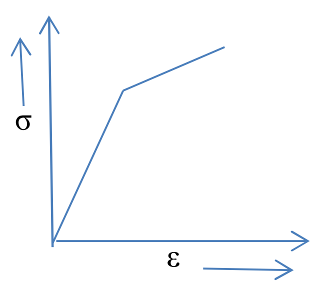
The written test will be of 50 marks with 50 multiple choice questions (10 questions from each module) with 4 choices of 1 mark each covering all the five core courses. There will be no negative marking. The pass minimum for this course is 25. The course should be mapped with a faculty and classes shall be arranged for practising questions based on the core courses listed above.

Written examination	:	50 marks
Total	**:**	**50 marks**

Course Level Assessment and Sample Questions:

1) Poisson’s ratio for an incompressible isotropic material is:
   A) 0.25 B) 0.5 C) Zero D) Indeterminate

2) The following stress-strain curve is obtained for a material. It indicates



A) Rigid body behaviour
B) Perfectly plastic behaviour
C) Elastic-linear strain hardening behaviour
D) Elastic- plastic behaviour

3) A principal plane is one where the shear stress will be:
   A) Maximum B) Minimum C) Zero D) Coverage of principal stress

4) In a differential manometer, the flowing fluid is water and the gauge fluid is mercury. If the manometer reading is 100mm, the differential head in meters is:
   A) 13.6 B) 1.36 C)1.47 D)1.26

5) A rectangular open channel carries a flow of $2m^3$/sec/m, what is the value of minimum specific energy?
   A) 0.74m B) 1.11m C) 1.48m D) 1.85m

6) A pipe has diameter 0.4m, length 0.1km and coefficient of friction 0.005. What is the length of an equivalent pipe which has diameter 0.2m and coefficient of friction 0.008?
   A) 195m B) 19.5m C)1.95m D) 1950m

7) The true bearing of a line is 40°30'. Declination is 3°W. The magnetic bearing of line is:
   A) 43°30' B) 37°30' C) 36°30' D) 44°30'

8) Points C and D are 1530m apart across a wide river. The following reciprocal levels are taken with one level.

Level at	Reading on	
	C	D
C	3.810 m	2.165 m
D	2.355 m	0.910 m

   The true difference in elevation between C and D is:

   A)1.645 m B) 1.545 m C) 1.745 m D) 1.345 m

9) Fore bearing of a line is 540°. Declination is 2°W. True bearing of line is:
   A)222° B) 218° C) S 42°E D) S 38° E

10) The dry density of a soil is 1.5 g/cc. If the saturation water content were 50%, then its saturated density and submersed density would respectively be,
    A)1.5 g/cc and 1.0g/cc B)2.0 g/cc and 1.0 g/cc C)2.25 g/cc and 0.25 g/cc
    D)2.50 g/cc and 1.50 g/cc

11) A clay sample has a void ratio of 0.50 in dry state and if the specific gravity of solids is 2.70, its shrinkage limit will be
    A)12% B)13.5% C)18.5% D)22%

12) A non–homogenous soil deposit consists of a silt layer sandwiched between a fine–sand layer at top and a clay layer below. Permeability of the silt layer is 10 times the permeability of the clay layer and one–tenth of the permeability of the sand layer. Thickness of the silt layer is 2 times the thickness of the sand layer and two–third of the thickness of the clay layer. The ratio of equivalent horizontal and equivalent vertical permeability of the deposit is __________.
A)10.967 B)10.968 C)10.969 D)None of these

13) Which cement contains high percentage of C_3S and less percentage of C_2S?
A) Rapid Hardening Cement B) Ordinary Portland Cement C) Quick Setting Cement D) Low Heat Cement

14) Workability of concrete is measured by __________
A) Vicat apparatus test B) Slump test C) Minimum void method D) Talbot Richard test

15) The shortest possible time in which an activity can be achieved under ideal circumstances is known as ________
A) Pessimistic time estimate B) Optimistic time estimate C) Expected time estimate D) None of these

Course Code: 22CET 606

Comprehensive Course Work

MODULE 1

Concept of stress and strain, Hooke's law, Stress-strain diagram of mild steel; Axially loaded bars. Temperature stress in composite bars, Poisson's ratio, Elastic constants and the relationship between them. Beams, Concept of bending moment and shear force, Shear force and bending moment diagrams of cantilever beams, simply supported beams and overhanging beams for different type of loads. Theory of simple bending; Shear stress in beams. Principal stresses and principal planes in 2D problems, maximum shear stress; Mohr's circle .

MODULE 2

Fluid properties; Fluid statics, measurement of fluid pressure. Buoyancy and Floatation: Buoyant force, Principle of floatation, stability of floating and submerged bodies, metacentre and metacentric height; continuity equation in one, two and three dimensions. Bernoulli's equation and its applications; Pipe flow- computation of major and minor losses in pipes, equivalent pipe. Open channel flow, velocity distribution in open channels, uniform flow computations, Most economical sections, Specific energy, Critical flow; Hydraulic jump.

MODULE 3

Introduction to Surveying- Principles, Linear, angular and graphical methods. Bearing of survey lines, Local attraction, Declination; Principles of levelling, Methods of levelling. Theodolite surveying, Measurement of horizontal and vertical angle; Triangulation. Traverse Surveying, Checks in closed traverse; Theory of Errors – Types, theory of least squares, Weighting of observations. Total Station – concept of EDM, principles and working. GPS-Components and principles. Remote Sensing.

MODULE 4

Definitions and properties of soil, 3 phase system, Index properties of soil, Soil classification, Effective stress, Quick sand condition, Stress distribution, Permeability of soil, Darcy's law, Factors affecting permeability, Laboratory tests, Consolidation, Normally consolidated, over consolidated and under consolidated soils, Time factor, Coefficient of consolidation, Compaction Tests – OMC and MDD, shear strength of soil, Triaxial compression test, Unconfined compression test, Direct shear test and Vane shear test

MODULE 5

Cement: Manufacturing, chemical composition, Types, Tests, Hydration of cement. Properties of fresh concrete and hardened concrete. Types of stone masonry – composite walls - cavity walls and partition walls - Construction details and features. Finishing works: Plastering, Pointing, Painting – objectives and types. Prefabricated construction – advantages and disadvantages, Prefabricated building components. Causes of failures in RCC and Steel structures. Types of tenders, Types of contracts. Types of Schedules. Network analysis –CPM, PERT – concepts and problems

22CEL 607	Transportation Engineering Lab	Category	L	T	P	Credit
		PCC	0	0	3	2

Preamble: The objective of this course is to enable students to assess the quality of various pavement materials and their suitability in highway construction. The course is designed to make student familiar with mix design and do functional evaluation of pavements.

Prerequisite: 22CET 404 Transportation Engineering I

Course Outcomes:

After the completion of the course the student will be able to

CO 1	Analyse the suitability of soil as a pavement subgrade material
CO 2	Assess the suitability of aggregates as a pavement construction material
CO 3	Characterize bitumen based on its properties so as to recommend it as a pavement construction material.
CO 4	Design bituminous mixes for pavement layers
CO 5	Assess functional adequacy of pavements based on roughness of pavement surface.

Mapping of Course Outcome with Programme Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			2				1	2			
CO2	3			2				1	2			
CO3	3			2				1	2			2
CO4	3			2				1	2			2
CO5	3			2				1	2			2

Course level assessment questions

CO1 : Determine CBR value of the given sample of soil. Comment on its suitability as a subgrade material.

CO2 : Find the impact value of the given sample of aggregates. Assess its suitability as a pavement construction material based on specifications given relevant codes/guidelines.

CO3 : Determine softening point of the given sample of bitumen.

CO4 : Determine optimum binder content of the given bituminous mix by Marshall method of mix design.

CO5 : Determine IRI value of the given road surface using MERLIN. Comment on the condition of road surface comparing standard values.

Assessment pattern

Bloom's Taxonomy	Continuous Internal Evaluation (CIE) (Marks)	End Semester Examination (ESE) (Marks)
Remember	10	15
Understand	10	15
Apply	40	40

Marks Distribution

Total marks	CIE (marks)	ESE (marks)	ESE duration
150	75	75	3 hours

Continuous Internal Assessment (CIE) pattern

Attendance: 15 marks

Continuous Assessment: 30 marks

Internal Test: 30 marks

End Semester examination (ESE)pattern

The following guidelines should be followed regarding award of marks

Preliminary Work: 15 marks

Conduct of Experiment: 10 marks

Tabulation of readings, Calculation, Result and Inference: 25 marks

Viva: 20 marks

Record: 5 marks

General Instructions regarding ESE

End semester evaluation is to be conducted under the equal responsibility of both internal and external examiners. The students shall be allowed for the ESE only on submitting the duly certified record. External examiner shall endorse the record

Syllabus

List of Experiments

1. Test on soil : 1 session
2. Tests on coarse aggregates : 6 sessions
3. Tests on bitumen : 4 sessions
4. Mix design of bituminous mix : 1 session
5. Functional evaluation of pavement : 1 session

Course Content and Practical Schedule

Expt. No	List of Experiments	Course Outcome	No.of Hours
1	**Test on soil** California Bearing Ratio Test (soaked/unsoaked specimen)	**CO1**	3
	Test on Coarse Aggregate	**CO 2**	
2	Specific Gravity and Water Absorption Test		3
3	Aggregate Impact Test		3
4	Los Angeles Abrasion Test		3
5	Aggregate Crushing Value Test		3
6	Shape Test (Angularity number, flakiness index, Elongation index, Combined flakiness and elongation index)		3
7	Stripping value of road aggregates		3
	Tests on Bitumen	**CO 3**	
8	Determination of grade of bitumen based on viscosity		3
9	Softening point		3
10	Ductility of bitumen		3
11	Flash and fire point of bitumen		3
12	**Design of Bituminous Mix** Design of bituminous mix by Marshall method of mix design	**CO4**	3
13	**Functional Evaluation of Pavement** Use of MERLIN apparatus to determine road roughness	**CO5**	3

*** Any twelve experiments are mandatory**

Reference Books

1. Khanna, S.K., Justo, C.E.G. and Veeraragavan, A., "Highway Materials and Pavement Testing", Nem Chand & Bros., Roorkee

2. G. Venkatappa Rao, K. Ramachandra Rao, Kausik Pahari and D.V. Bhavanna Rao., "Highway Material Testing and Quality Control", I.K. International.

3. L.R.Kadiyali and N.B Lal., "Principles and Practices of Highway Engineering", Khanna Publishers.

22CEL 608	CIVIL ENGINEERING SOFTWARE LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		LAB	0	0	3	2	2019

Preamble: The course aims to train the students to use different software tools needed for professional practice in civil engineering. Also. the field expertise needed for undertaking the surveying activity using modern instruments and hence to prepare the necessary engineering documentation are included in this laboratory course.

Prerequisite: Civil Engineering drawing, structural analysis and design courses, surveying lab.

General Instructions to Faculty:

1. All exercise listed in the syllabus need to be performed mandatorily.
2. The laboratory should have possession of required software and survey equipment for effective delivery of laboratory sessions
3. Periodic maintenance and calibration of various testing instruments needs to be made.
4. Use of data visualization packages needs to promoted for making various plots.

Course Outcomes: After the completion of the course, the student will be able to:

Course Outcome	Course Outcome Description
CO 1	To undertake analysis and design of multi-storeyed framed structure, schedule a given set of project activities using a software.
CO 2	To prepare design details of different structural components, implementation plan for a project.
CO3	To prepare a technical document on engineering activities like surveying , structural design and project planning.

Mapping of course outcomes with program outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	2	1	3	-	-	2	2	-	2
CO 2	3	2	2	2	1	3	-	-	2	2	-	2
CO 3	3	2	2	2	1	3	-	-	2	2	-	2

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks
Continuous Assessment : 30 marks
Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks
(b) Implementing the work/Conducting the experiment : 10 Marks
(c) Performance, result and inference (usage of equipment and troubleshooting) : 25 Marks
(d) Viva voce : 20 marks
(e) Record : 5 Marks

General instructions:
Practical examination to be conducted immediately after the second series test and covering entire syllabus given below. Evaluation is to be conducted by both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

References

1. N Krishna Raju, Structural Design and Drawing, Second Edition, Universities Press (India), Private Limited, Hyderabad, 2009

2. Reference Manual of the Relevant Software

3. Satheesh Gopi, Dr. R Sathikumar, N Madhu, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson Education India, 2006

4. AutoCAD Essentials, Autodesk official Press, John Wiley & Sons, US, 2015

SYLLABUS

1. Analysis and design of steel and RCC elements using any standard software used in the industry.

    Exercise 1: Analysis and design of continuous and cantilever beams

    Exercise 2; Analysis and design of plane truss and frames

    Exercise 3: Analysis and design of multi-storied RCC framed structures.

2. Preparation of structural drawings of slabs and beams

    Exercise 4: Detailed structural drawing of one way / two ay and continuous slabs.

    Exercise 5: Detailed structural drawing of singly reinforced / double reinforced Beams.

    Exercise 6: Detailed structural drawing of continuous / flanged beams.

    Exercise 7: Detailed structural drawing of foundation units – isolated and combined footing (rectangular)

3. Use of Building Information Modelling tools

    Introduction to BIM process and describe the workflow in using BIM in the building lifecycle (Theory discussion – 2 hours)

    Exercise 8: Preparation of building model from a given architectural drawing of a residential unit and perform model based cost estimation

    Exercise 9: Create a schedule and import it into the 4D modelling environment, so that each activity in the schedule can be linked to an object in the model.

    Exercise 10: Develop schedules for the construction of slabs, walls, columns, beams and windows of a section of a residential building

    Exercise 11: Effect of rescheduling the activities to complete the project in minimum time frame.

4. Use of Project Management Software (MS Project/Primavera)

    Introduction to project management -CPM & PERT (Theory class-2 hours)

    Exercise 12: Preparation of Bar Chart/Gantt Charts/CPM/PERT Charts

    Exercise 13: To find the critical Path based on the given set of activity / event data

Exercise 14: Practice on Resource allocation and Project Monitoring (Cost and Time).

4. Field exercise to use Total Station

   Exercise 15: Field exercise on preparation of contour map for a given terrain using advanced surveying instruments like Total Stations (The survey activity undertaken shall be of at least 5000 Sq. m)

22CEMR 609.1	ESTIMATION, COSTING AND VALUATION	CATEGORY	L	T	P	CREDIT	Year of Introduction
		Minor	3	1	0	4	2019

Preamble:
The course introduces the various types of estimation, specification writing, analysis of rate and various methods to determine the valuation of building. It enables the students to prepare the detailed estimate of various items of work related to civil engineering construction. This course trains the student to find out the valuation of building by various methods.

Prerequisite: Building drawing

Course Outcomes: After the completion of the course the student will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Explain the specifications for various items of work associated with building construction	Understanding
CO2	Analyse the unit rates of different items of work associated with building construction	Applying
CO3	Prepare the approximate estimate of building	Applying
CO4	Prepare detailed estimates of buildings and the bar bending schedules for R.C.C works	Applying
CO5	Describe various principles and methods of valuation	Understanding
CO6	Determine the valuation of buildings by different methods	Analyse

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		-	-	-	-	-	-	-	-	2	-
CO2	3		-	-	-	-	-	-	-	-	3	-
CO3	3	2	-	-	-	-	-	-	-	-	3	-
CO4	3	2	-	-	-	-	-	-	-	-	3	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember			
Understand	20	10	35
Apply	30	10	40
Analyse		30	25
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10marks
Continuous Assessment Test (2numbers) : 25 marks
Assignment/Quiz/Course project : 15marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from modules 1 to 3 and 4 questions from module 4, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each full question carries 16 marks from module 1, 2 and 4 and 22 marks from module 3 and can have maximum 2 sub- divisions.

Note: For analysis of rate and cost estimation, unit rate and labour requirement should be given along with the questions in the question paper. No other charts, tables, codes are permitted in the Examination Hall. If necessary, relevant data shall be given along with the question paper.

Course Level Assessment Questions

CO1: Explain the specifications for various items of work associated with building construction

1.	Write the detailed specification of earth work in excavation
2.	Differentiate general specification and detailed specification with suitable example

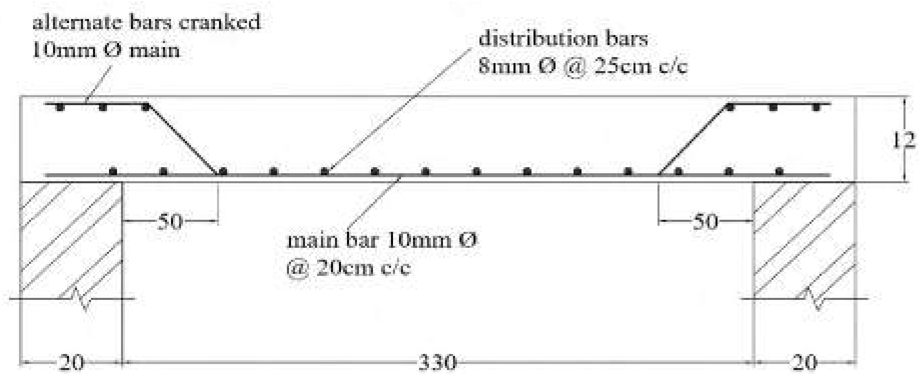
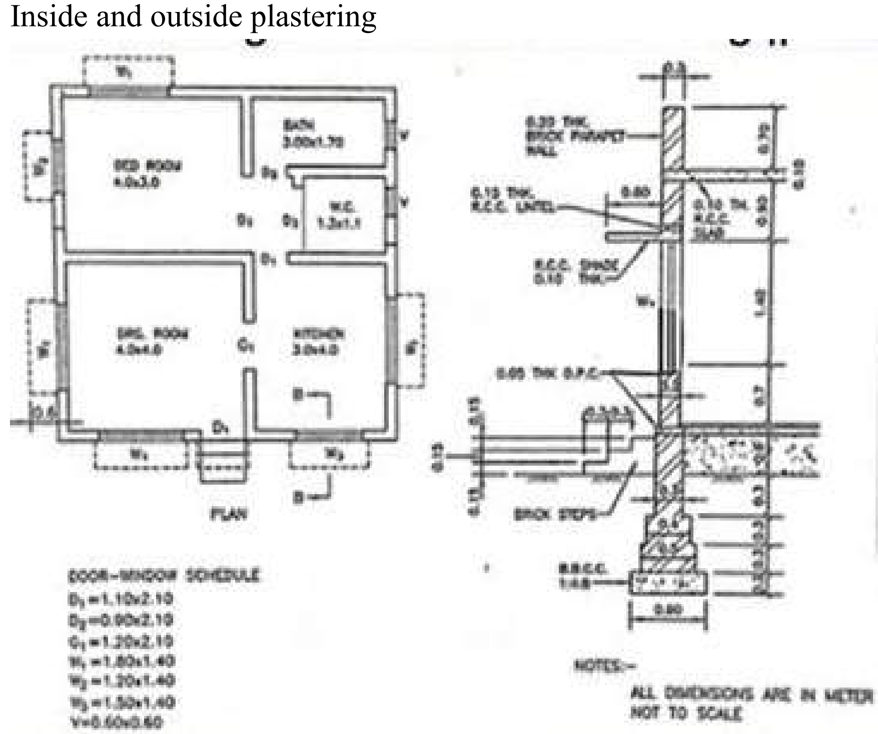
CO2: Analyse the unit rates of different items of work associated with building construction

1.	Explain DAR and DSR.
2.	Develop rate analysis for DSR item No.5.3, Reinforced cement concrete work with 1:1.5:3 (3 graded stone aggregate 20 mm nominal size) in beams, suspended floors, roofs having slope up to 15° landings, above plinth level up to floor five level, excluding the cost of centering, shuttering, finishing and reinforcement. **Material**: 20mm Aggregate 0.57m^3@₹1300/m^3, 10mm 0.28m^3@ ₹1300/m^3, coarse sand (Zone III) 0.425m^3@₹1200/m^3, Portland cement 400kg@₹5700/tonne. **Labour :** Mason 0.24@₹467/day, Beldar 2.75@₹368/day, Bhisti 0.90@₹407/day, Coolie 1.88@₹368/day **Carriage provisions**: Stone aggregate below 40mm 0.85m^3@₹103.77, Portland cement 0.40tonne@₹5700/tonne. **Hire Charges** for concrete mixer 0.08@₹800/day, Vibrator needle type ₹0.08@350/day **Sundries** (LS) 14.30@₹1.73. Adopt water charges, contractor profit and overheads as per the CPWD DSR2018 provisions.

CO3: Prepare the approximate estimate of building

1.	Differentiate plinth area estimate and cubic content estimate
2.	Prepare the approximate estimate of building project with total plinth area of all building is 800sqm from the following data a) Plinth area rate ₹. 45000 per sqm b) Cost of water supply @7.5% of cost of building c) Cost of sanitary and electrical installations each @ 7.5% of cost of building d) Cost of architectural features @ 1% of cost of building e) Cost of roads and lawns @5% of cost of building f) Cost of PS and contingencies @4% of cost of building Determine the total cost of building project

CO4: Prepare detailed estimates of buildings and the bar bending schedules for R.C.C works

1.	Explain bar bending schedule. State its uses
2.	Write the unit of measurement of (i) Carpentry fittings (ii) Pointing of Brick wall
3.	Calculate the quantity of RCC and Prepare a bar bending schedule of the slab of size 330cm x 550cm (internal dimensions) shown in the figure. (All dimensions are in centimeters) 
4.	Prepare detailed estimate for the following items of work for the construction of residential building shown below a) RRM for foundation and basement b) RCC works c) Inside and outside plastering 

CO5: Describe various principles and methods of valuation

1.	Explain how depreciation in building is worked out.
2.	Discuss about the different types of values and the term obsolescence
3	Discuss the importance of valuation in civil engineering.

CO6: Calculate the value of buildings by different methods

1.	A building is situated by the side of a main road of Mumbai city on a land of 500sqm. The built up portion is 20m x 15 m. The building is first class type and provided with water supply, sanitary and electrical fittings, and the age of the building is 30 years. Workout the valuation of the property.
2.	A three storied building is standing on a plot of land measuring 800sqm. The plinth area of each storey is 400sqm. There is an RCC framed structure and the future life may take as 70 years. The building fetches a gross rent of ₹.18000per month, Work out the capitalized value of the property on the basis of 6% net yield. For sinking fund 3% compound interest may be assumed. Cost of the land may be taken as ₹. 10000 per sqm. The other data may assume suitably
3.	Workout the valuation of a commercial building with the following data: Cost of land for life-time period of building is ₹.5,20,000/-. Gross income per year is ₹.8,50,000/- Expenses required per year: (a) staff salary, electric charges, municipal taxes including licenses fees, stationery and printing etc. is 20% of the gross income. (b) For repair and maintenance of lift, furniture etc. @ 5% of their capital cost of ₹.10,50,000/- (c) sinking fund for the items considered in capital cost, whose life is 25years @ 4% after allowing 10% scrap value. (d) Insurance premium is ₹.25, 000/- per year. Take year's purchase @ 8% and annual repair of the building @ 2% on gross income.

SYLLABUS

MODULE 1. General introduction- Quantity surveying- Basic principles, Types of Estimates- purposes, Specifications-General & detailed specification for building materials and execution of major item of work (Earth work excavation, masonry, concrete, finishing) of building work with reference to CPWD specifications-Method of measurement with reference to IS1200.

MODULE 2. Analysis of rates, Introduction to the use of CPWD schedule of rates as per latest DSR and Analysis of rate as per latest DAR, Overhead charges. Analysis of rates for Earth work in excavation for foundation, mortar~~s~~, reinforced cement concrete Works, finishing work, masonry work, stone works, flooring with reference to latest DSR and latest DAR .Types of tender, contracts, General and important conditions of contract, contract document (concept only). Duties and roles of client, architect/engineer, contractor and local bodies.

MODULE 3. Detailed Estimate- Preparation of detailed measurement and abstract of estimate using Centre line method & Long wall short wall (separate wall) method for RCC single storey building, (students may answer the question by using any of the two methods) Septic tank and Soak Pit, preparation of Bar Bending Schedule– lintel, beams, slabs, RCC column footings.

MODULE 4. Valuation – explanation of different technical terms, purpose. Depreciation – methods of calculating depreciation – straight line method, constant percentage method, sinking fund method and quantity survey method, obsolescence.

Principles of valuation of open land- comparative method, abstractive method, belting method, valuation based on hypothetical building schemes. Methods of valuation of land with building – rental method, direct comparison of capital cost, valuation based on profit, depreciation method. Free hold and leasehold properties, Forms of rent, Rent fixation- Methods.

Text Books:

1. B. N. Dutta, Estimation and Costing in Civil Engineering, UBS publishers
2. Rangwala, Estimation Costing and Valuation, Charotar publishing house pvt. ltd
3. Dr. S. Seetha Raman, M.Chinna Swami, Estimation and Quantity Surveying, Anuradha publications Chennai.
4. M Chakraborthy, Estimating, Costing, Specification and valuation, published by the author, 21 B, Babanda Road, Calcutta 26

References:

1. B S Patil, Civil Engineering Contracts and Estimates, university press
2. V N Vazirani & S P Chandola, Civil Engineering Estimation and Costing, Khanna Publishers
3. IS 1200-1968; Methods of Measurement of Building & Civil Engineering Works
4. CPWD DAR 2018 and DSR 2018 or latest

Lecture Plan

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module I: Total lecture hours: 7**		
1.1	Introduction, estimation, purpose of estimation	CO3	1
1.2	Types of estimates, simple problems of approximate estimate	CO3	2
1.3	Specification, objectives, principles of specification writing, design of ideal specification	CO1	1
1.4	Types of specifications	CO1	1
1.5	Detailed specification of excavation, PCC & RCC, mortars, brick works.	CO2	2

2	**Module II: Total lecture hours: 6**		
2.1	Analysis of rate, need, factors affecting, Introduction to the use of CPWD DSR and DAR,-overhead charges	CO2	1
2.2	Analysis of rates for earth works, PCC, RCC Works, finishes, masonry works, stone works, flooring, with reference to latest DSR and DAR. (Required data for rate analysis will be provided in the question paper.)	CO2	3
2.3	Tender, types, Contract, types, factors affecting, contract document, General and important conditions of contact. Duties and roles of client, architect/engineer, contractor and local bodies	CO2	2
3	**Module III: Total lecture hours: 16**		
3.1	Different methods of detailed estimation- center line method and long wall short wall method.	CO4	2
3.2	Preparation of detailed measurement and abstract of estimate for RCC single storey buildings- Excavation for foundation, Foundation and basement, DPC, Masonry in superstructure, RCC, Plastering, Painting, Flooring, Woodwork.	CO4	8
3.3	Estimation of Septic tank and soak pit	CO4	2
3.4	BBS of lintel, beam, slab and column footing	CO4	4
4	**Module IV: Total lecture hours:16**		
4.1	Valuation-purpose, different forms of values	CO5	1
4.2	Capitalized value, years purchase, sinking fund, Gross income, net income, outgoings –simple problems	CO5	3
4.3	Depreciation – methods of calculating depreciation – straight line method, constant percentage method, sinking fund method, and quantity survey method-problems, obsolescence	CO5	3
4.4	Methods of valuation of open land – comparative method, abstractive method, belting method, valuation based on hypothetical building schemes-	CO5, CO6	3

	Problems based on this		
4.5	Methods of valuation of land with buildings – rental method, direct comparison with capital cost, valuation based on profit, depreciation method- Problems based on this	CO5, CO6	4
4.6	Free hold and leasehold properties, Forms of rent, Rent fixation- Methods. Simple problems based on this	CO6	2

MODEL QUESTION PAPER

Reg.No.:____________ Name:_____________________

SIXTH SEMESTER B.TECH. DEGREE EXAMINATION

Course Code: 22CEMR609.1

Course Name: ESTIMATION, COSTING AND VALUATION

Max.Marks:100 Duration: 3Hours

PART A

Answer all questions; each question carries 3 marks. (10×3 marks = 30 marks)

1. a) Differentiate revised estimate and supplementary estimate

   b) What are the principles of specification writing?

   c) Explain the use of data book and schedule of rates

   d) What are the important points to be noted while preparing contract document?

   e) In a simply supported beam of depth 450mm is provided with a 3, 20mm diameter bar at bottom, in this one bar is provided as bendup bar near both the supports. 10mm stirrups are provided with top and bottom cover 25mm. Calculate the additional length provided for bend up in both end. If the (i) bendup angle is 45^{o} and (ii) bendup angle is 30^{o}.

   f) Write the unit of measurement of (i) DPC using waterproofing compound (ii) Iron work for window (iii) Water proof Painting above roof slab

   g) Differentiate book value and market value

   h) Differentiate depreciation and obsolescence

   i) Explain how will you find out the valuation of land by hypothetical building scheme

   j) Explain the depreciation method of valuation

PART B

Answer one full question from each module (Assume any missing data suitably)

Module I

2. a) Prepare approximate estimate of a public building having plinth area equal to1800 sq.m.

   i. Plinth area rate as ₹. 35,000 / sq. m.
   ii. Special architectural treatment = 3% of cost of building.
   iii. Water supply and sanitary installation = 5% of cost of building.
   iv. Electric installation =14% of cost of building.
   v. Other services = 5% of cost of building.
   vi. Contingencies = 3% of overall cost of building.

vii. Supervision charges = 8% of overall cost of building. (10marks)

b) Differentiate detailed estimate and preliminary estimate. What are the documents to be accompanied with detailed estimate? (6marks)

OR

3. Differentiate general specification and detailed specification with suitable example(16marks)

Module II

4. a) What are the factors affecting the rate of a particular item of work. (6 marks)

b) Develop unit rate analysis for Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level 1:1½:3 (1 Cement: 1½ coarse sand (zone-III) : 3 graded stone aggregate 20 mm nominal size)
Details of cost for 1 cum.
MATERIAL: Stone Aggregate (Single size) 20 mm nominal size 0.57 m^3@₹1350/m^3, Stone Aggregate (Single size): 10 mm nominal size 0.28 m^3@₹1350/m^3, Coarse sand (zone III) 0.425 m^3@₹1350/m^3, Portland Cement (0.2833 cum) 0.40 tonne@₹4940/tone
LABOUR: Mason (average) 0.1/day @ ₹709/day, Beldar 1.63/day @ ₹558/day, Bhisti 0.70/day @ ₹617/day
HIRE CHARGES: Concrete Mixer 0.25 to 0.40 cum with hooper 0.07/day @ ₹800/day Vibrator (Needle type 40mm) 0.07/day @ ₹370/day
CARRIAGE CHARGES: Stone aggregate below 40 mm nominal size 0.85 m^3@₹103.77/m^3, Coarse sand 0.425 m^3@₹103.77/m^3, Portland cement 0.40 tonne@₹92.24/tone
Sundries: 14.3LS @₹2.00/LS (10marks)

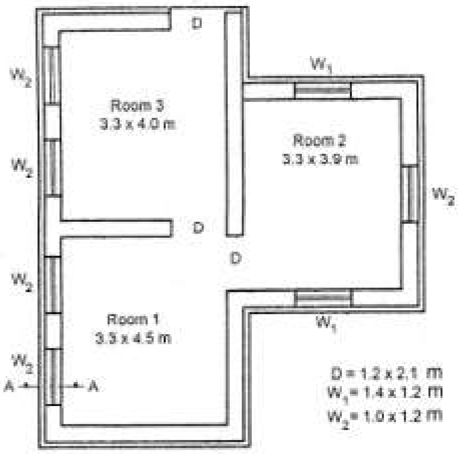
OR

5. a. Explain the different types of contracts (8 marks)
b. What are the general and important conditions of contract? (8 marks)

Module III

6. Prepare the detailed estimate of the following items of the building. Refer Fig. No. 1 (22 marks)

i. Excavation for foundation.
ii. RR masonry in foundation and plinth (1:6)
iii. Brick Masonry in superstructure (1:6).
iv. Mosaic tile flooring.



Plan

* All dimensions are in meter

FIG. NO. 1

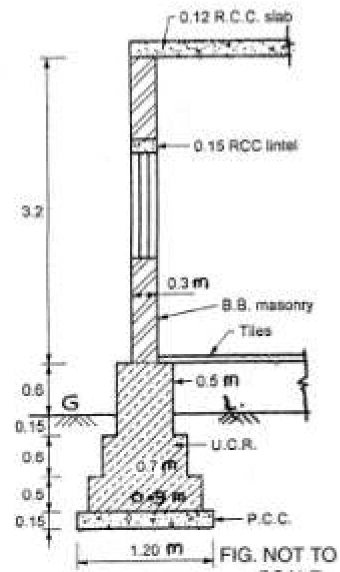
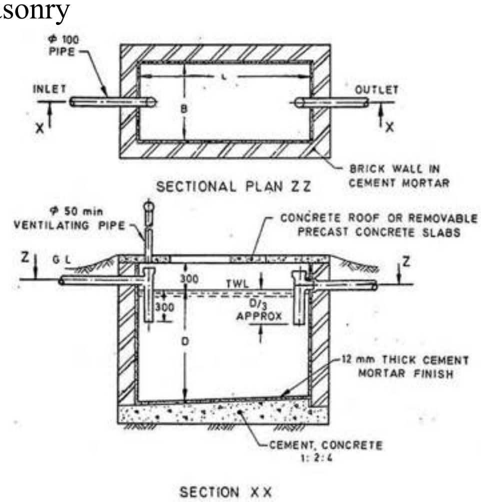


FIG. NOT TO SCALE

Section of wall at A-A

OR

7. Prepare the detailed estimate of following items of septic tank shown below (22 marks)
   - a) Earth work in excavation
   - b) Cement concrete 1:2:4
   - c) R.C.C work 1:1 ½:3
   - d) Plastering in C.M 1:3
   - e) Brick masonry



Module IV

8. a) A concrete mixer was purchased at ₹.8000/-. Assuming salvage value to be ₹.1000, after 5years, calculate depreciation for each year adopting (a) Straight line method (b) Constant percentage method and (c) Sinking fund method considering 6% interest. (8 marks)

   b) A lease-hold property is to produce a net income of ₹.1,20,000/- per annum for the next 60years. What is the value of the property? Assume that the land lord desires a return of 6% on his capital and the sinking fund to replace the capital is also to accumulate at 6%. What will be the value of the property if the rate of interest for redemption of capital is 3%? (8 marks)

OR

9. a) A property consists of a south facing plot of land, having south-east and north sides in due directions, which measures 60m, 180m and 80m respectively. It consists of an old two storied building, having a total cubical content of 2840 cubic metres. Assuming prime cost of construction of the building as ₹.20000/- per cubic metre and allowing 10% old materials value only for the building, what would you recommend as the fair value of the property, if the front belt land (depth of front belt being 25m) be estimated at ₹.9000/- per sqm? (8 marks)

   b) The owner of a building gets a net annual rent of ₹.85,500. The future life of building is estimated to be 12 years. But if recommended repairs are carried out immediately at an estimated cost of ₹.3, 00,000, it is expected to last for at least 30 years. Assuming rate of interest as 8%, determine whether it is economical to carry out the recommended repairs to the building or leave it as it is. (8 marks)

22CEMR609.2	**GEOTECHNICAL INVESTIGATION & GROUND IMPROVEMENT TECHNIQUES**	**CATEGORY**	**L**	**T**	**P**	**CREDIT**	**Year of Introduction**
		MINOR	**4**	**0**	**0**	**4**	**2019**

Preamble: Goal of this course is to expose the students to various methods of soil exploration, to recognize weak soils based on the soil investigation reports and to analyze suitable remedial measures to improve the properties of weak soils. After this course, students will be able to recognize practical problems in real-world situations and respond accordingly.

Prerequisite : CET283 Introduction to Geotechnical Engineering

Course Outcomes: After completion of the course the student will be able to:

CO 1	Understand soil exploration methods
CO 2	Explain different methods of ground improvement techniques with and without addition of other materials
CO 3	List various types, functions and practical applications of Geosynthetics
CO 4	Describe the application of reinforcement function of geosynthetics in retaining structures like Reinforced Earth Retaining Walls, Gabions and Soil nailing
CO 5	Solve the field problems related to geotechnical engineering by applying ground improvement techniques

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	3	-	-	-	-	-	-	-	-	-	-
CO 3	3		-	-	-	-	-	-	-	-	-	-
CO 4	2	3	-	-	-	-	-	-	-	-	-	-
CO5	2	2	3									

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			

Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation (CIE) Pattern :

Attendance : 10 Marks

Continuous Assessment Test (2 numbers) : 25 Marks

Assignment/Quiz/Course project : 15 Marks

End Semester Examination (ESE) Pattern : There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

Course Outcome 1 (CO1):

1. Understand Soil Investigation and Soil Exploration methods

Course Outcome 2 (CO2):

1. Explain different methods of ground improvement techniques without addition of any materials viz. surface compaction & deep compaction
2. Explain different methods of ground improvement techniques with addition of other materials viz. grouting and lime stabilization

Course Outcome 3 (CO3):

1. List various types of Geosynthetics
2. List functions of Geosynthetics
3. List practical applications of Geosynthetics

Course Outcome 4 (CO4):

1. Explain reinforced earth retaining walls
2. Explain Gabions
3. Explain Soil Nailing

Course Outcome 5 (CO5):

1. Explain solutions of suitable ground improvement techniques for various practical situations

SYLLABUS

Module 1
Site investigation and soil exploration: Introduction and practical importance – objectives Planning of a sub-surface exploration program – Reconnaissance – Preliminary investigation - Detailed investigation - methods of subsurface exploration – direct methods - Open pits and trenches - Semi direct methods – Borings - Auger boring – Shell and Auger Boring - Wash boring, percussion drilling and rotary drilling – advantages and disadvantages -Guidelines for choosing spacing and depth of borings [I.S. guidelines only] - Sampling - disturbed samples, undisturbed samples and chunk samples - Types of samplers – Split spoon sampler – Thin-walled sampler – Piston sampler - Rotary sampler – Core Recovery and Rock Quality Designation
Module 2
Sounding and Penetration Tests - Standard Penetration Test – Procedure - Corrections to be applied to observed N values – Numerical examples - Factors influencing the SPT results and precautions to obtain reliable results – Merits and drawbacks of the test - Correlations of N value with various engineering and index properties of soils - Static Cone Penetration Test (SCPT) and Dynamic Cone Penetration Test (DCPT) – Brief Procedure - Merits/drawbacks - Boring log - soil profile- Location of Water table - Geophysical methods : Seismic Refraction method and Electrical Resistivity method – Brief Procedure - Merits/drawbacks
Module 3
Ground Improvement Techniques : Introduction – Objectives - Soil improvement without the addition of any material : Shallow and Deep Compaction - Shallow compaction – Rollers - Deep Compaction - Dynamic compaction - Compaction piles - Blasting technique - Vibro compaction– Vibroflotation - Terra probe method - Vibro replacement - sand piles and stone columns - Preloading techniques – sand drains
Module 4
Soil improvement by adding materials : Grouting – materials - Grouting systems : One shot and two shot systems - Modes of grouting - Main types of grouting : Permeation Grouting, Compaction Grouting and Jet Grouting – Practical Applications - Grouting Plant and equipment - Grouted columns – Curtain and blanket grouting – Practical applications - Lime stabilization –Mechanism-optimum lime content-lime fixation point
Module 5
Soil improvement using Geosynthetics : Materials of Geosynthetics - Types of Geosynthetics - Types of Geotextiles and Geogrids - Functions of Geosynthetics - Practical applications - Introduction to reinforced earth – principles – reinforcing materials - Reinforced earth retaining walls – components – construction sequence – practical applications - Gabions – Introduction - practical applications - Soil Nailing – Introduction – practical applications

Text Books:

1. Ranjan G. and A. S. R. Rao, Basic and Applied Soil Mechanics, New Age International, 2002.
2. Purushotham S. Raju, Ground Improvement Technique, Laxmi Publications

References:

1. Shashi K. Gulhati and Manoj Dutta, Geotechnical Engineering, Tata McGraw-Hill Publishing Compay Limited,New Delhi, 2008
2. Venkatramaiah, Geotechnical Engg, Universities Press, 2000.
3. Arora K. R., Geotechnical Engineering, Standard Publishers, 2006.
4. Moseley, Text Book on Ground Improvement, Blackie Academic Professional, Chapman & Hall, 2004
5. Boweven R., Grouting in Engineering Practice, Applied Science Publishers Ltd
6. Sivakumar Babu, G. L., An introduction to Soil Reinforcement and Geosynthetics, Universities Press (India) Private Limited, 2006
7. Jewell R.A., Soil Reinforcement with Geotextiles, CIRIA Special Publication, Thomas Telford
8. Donald .H. Gray & Robbin B. Sotir, Bio Technical & Soil Engineering Slope Stabilization, John Wiley
9. Rao G.V. & Rao G.V.S., Engineering with Geotextiles, Tata McGraw Hill
10. Korener, Construction & Geotechnical Methods In Foundation Engineering, McGraw Hill

Course Contents and Lecture Schedule:

Module	Contents	Outcomes Addressed	Hours
1	**Module 1**		**9**
1.1	**Site investigation and soil exploration**: Introduction and practical importance – objectives	CO 1	1
1.2	Planning of a sub-surface exploration program – Reconnaissance – Preliminary investigation	CO 1	1
1.3	Detailed investigation - methods of subsurface exploration – direct methods - Open pits and trenches	CO 1	1
1.4	Semi direct methods – Borings - Auger boring – Shell and Auger Boring - Wash boring, percussion drilling and rotary drilling – advantages and disadvantages	CO 1	2
1.5	Guidelines for choosing spacing and depth of borings [I.S. guidelines only]	CO 1	1
1.6	Sampling - disturbed samples, undisturbed samples and chunk samples	CO 1	1
1.7	Types of samplers – Split spoon sampler – Thin-walled sampler – Piston sampler - Rotary sampler – Core Recovery and Rock Quality Designation	CO 1	2
2	**Module 2**		**9**
2.1	Sounding and Penetration Tests - Standard Penetration Test – Procedure	CO 1	1
2.2	Corrections to be applied to observed N values – Numerical examples	CO 1	1
2.3	Factors influencing the SPT results and precautions to obtain reliable results – Merits and drawbacks of the test	CO 1	1
2.4	Correlations of N value with various engineering and index properties of soils	CO 1	1
2.5	Static Cone Penetration Test (SCPT) and Dynamic Cone Penetration Test (DCPT) – Brief Procedure - Merits/drawbacks	CO 1	2
2.6	Boring log - soil profile- Location of Water table	CO 1	1
2.7	Geophysical methods : Seismic Refraction method and Electrical Resistivity method – Brief Procedure - Merits/drawbacks	CO 1	2
3	**Module 3**		**9**
3.1	Ground Improvement Techniques : Introduction - Objectives	CO 2	1
3.2	Soil improvement without the addition of any material : Shallow and Deep Compaction	CO 2	1

3.3	Shallow compaction – Rollers	CO 2	1
3.4	Deep Compaction - Dynamic compaction	CO 2	1
3.5	Compaction piles	CO 2	1
3.6	Blasting technique	CO 2	1
3.7	Vibro compaction– Vibroflotation - Terra probe method	CO 2	1
3.8	Vibro replacement - sand piles and stone columns - Preloading techniques – sand drains	CO 2	2
4	**Module 4**		**9**
4.1	Soil improvement by adding materials : Grouting - materials	CO 2	1
4.2	Grouting systems : One shot and two shot systems - Modes of grouting	CO 2	1
4.3	Main types of grouting : Permeation Grouting, Compaction Grouting and Jet Grouting – Practical Applications	CO 2 & CO 5	3
4.4	Grouting Plant and equipment	CO 2	1
4.5	Grouted columns – Curtain and blanket grouting – Practical applications	CO 2 & CO 5	1
4.6	Lime stabilization –Mechanism-optimum lime content-lime fixation point	CO 2	1
5	**Module 5**		**9**
5.1	Soil improvement using Geosynthetics : Materials of Geosynthetics	CO 3	1
5.2	Types of Geosynthetics - Types of Geotextiles and Geogrids	CO 3	1
5.3	Functions of Geosynthetics - Practical applications	CO 3 & CO5	1
5.4	Introduction to reinforced earth – principles – reinforcing materials	CO 4	1
5.5	Reinforced earth retaining walls – components – construction sequence – practical applications	CO 4 & CO5	2
5.6	Gabions – Introduction - practical applications	CO 4 & CO5	1
5.7	Soil Nailing – Introduction – practical applications	CO 4 & CO5	1

Model Question Paper

QP CODE:

Reg No.:_______________ **Name:__________________________**

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEMR609.2

Course Name : GEOTECHNICAL INVESTIGATION & GROUND IMPROVEMENT TECHNIQUES

Max. Marks: 100 Duration: 3 hours

Part A

(***Answer all questions; each question carries 3 marks***)

46. Explain Objectives of soil exploration
47. List out the factors, which affect the spacing between the bore holes
48. Discuss the merits and demerits of SPT in the sub-surface investigation
49. Discuss any one method of determining the ground water table.
50. Explain Compaction piles in sand
51. Explain Significant depth of influence in Deep compaction.
52. Explain One Shot system and two shot system in grouting
53. Explain optimum lime content and lime fixation point
54. Differentiate between Woven and Non-woven geotextiles.
55. Explain the principle of reinforced earth.

PART B

(Answer one full question from each module, each question carries 14 marks)

Module – 1

56. (a) Give guidelines, which enable the determination of the depth of exploration (5 Marks)

(b) Explain Wash boring methods of site exploration with neat sketch. What are the advantages and disadvantages of this method. (9 Marks)

57. (a) Distinguish between thin-wall and thick-wall samplers (5 Marks)

(b) Explain Auger boring and Shell & Auger boring methods of site exploration with neat sketches. What are the advantages of these methods. (9 Marks)

Module – 2

58. (a) Explain Static Cone Penetration Test. (5 Marks)

(b) What is Standard Penetration Test? Explain the test setup and the procedure of conducting the test. What are the corrections to the observed SPT (N) value? (9 Marks)

59. (a) Explain Dynamic Cone Penetration Test. (5 Marks)

(b) Explain Seismic Refraction Method of exploration. What are its limitations? (9 Marks)

Module – 3

60. (a) Explain the dynamic compaction process for granular soils. (7 Marks)
(b) Explain Vibroflotation with neat sketch. What are the practical applications? (7 Marks)

16. (a) Explain Sand Piles and Stone Columns. (7 Marks)
(b) Explain Preloading Techniques with neat sketch. What are the advantages and disadvantages? (7 Marks)

Module – 4

29. (a) Explain Grouting Plant and Equipment (5 Marks)
(b) Explain Compaction Grouting. What are its practical applications? (9 Marks)

30. (a) Explain Lime stabilization method. (5 Marks)
(b) Explain jet grouting method. What are its practical applications? (9 Marks)

Module – 5

31. (a) What are the functions of geosynthetics? (5 Marks)
(b) Explain Gabions and Soil Nailing. What are its practical applications? (9 Marks)

32. (a) List different types of geosynthetics. (5 Marks)
(b) Explain the components of Reinforced Earth Retaining Walls with neat sketch. What are the practical applications of reinforced earth? (9 Marks)

22CEO 703.5	Environmental Health And Safety	Category	L	T	P	Credit	Year of Introduction
		MINOR	3	1	0	3	2019

Preamble: The course is designed to build environmental health literacy among students and encourages them to take safety measures against various environmental hazards. It motivates the students in maintaining and improving the quality of the environment and empower learners to take appropriate actions to reduce the environment pollution.

Pre-requisite: Nil

Course outcome

After the course, the student will able to:

CO1	Understand the Toxicology and Occupational Health associated with industries.
CO2	Identify chemical and microbial agents that originate in the environment and can impact human health.
CO3	Describe various measures to ensure safety in Construction industry.
CO4	Explain the effect of air and water pollution on environment.
CO5	Describe the safety measures against various environmental hazards.

CET 386 Environmental Health And Safety		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	CO1	3					2	2							1	
	CO2	3					2	1								
	CO3	3					2	2								
	CO4	3					2	2								
	CO5	3					2	2								

Assessment pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	20	20	40
Apply			
Analyze	15	15	30
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment Test (2 numbers)	:	25 marks
Assignment/Quiz/Course project	:	15 marks
Total	**:**	**50 marks**

End semester examination pattern – There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment

Qn. No	Question	Marks	Course outcome (CO) Assessed
	Part A		
1	What are the socio- economic reasons in safety?	3	CO1
2	Define industrial hygiene.	3	CO1
3	Define noise. What are the compensation aspects of noise?	3	CO2
4	Explain about the biohazard control program.	3	CO2
5	Discuss the possible electrical injuries in a construction industry.	3	CO3

6	What are the hazards due to radiation?	3	CO3
7	What are the criteria air pollutants?	3	CO4
8	Describe the Depletion of Ozone Layer.	3	CO4
9	What are the benefits of safety inspection?	3	CO5
10	Discuss the role of an individual in conservation of natural resources.	3	CO5
	Part B **(Answer ANY ONE FULL question from each module)**		
	Module I		
11	Briefly explain about occupational related diseases found in the industries.	14	CO1
12	Write the short notes on : (i) Silicosis (ii) Asbestosis (iii) Anthracosis (iv) Anthrax.	14	CO1
	Module II		
13(a)	Write briefly about the classification of bio hazardous agents.	7	CO2
13(b)	What are the precautionary measures for chemical hazards?	7	CO2
14	Write short notes on : (i) Vapour (ii) Fog (iii) Dust (iv) Fumes.	14	CO2
	Module III		
15	Explain effects of radiation on human body and the methods of radioactive waste disposal.	14	CO3
16(a)	What are the requirements for safe work platform?	7	CO3
16(b)	Discuss about the scaffolding inspections.	7	CO3
	Module IV		
17	Describe the effect of air pollution on environment.	14	CO4
18	Describe the effect of water pollution on environment.	14	CO4

Module V			
19 (a)	What is First aid? Explain CPR.	7	CO5
19 (b)	What are the important points to be considered in carrying out workplace inspection?	7	CO5
20 (a)	Explain the first aid measure to be taken during i)gas poisoning, ii)heart attack, iii)chemical splash and iv)electric shock.	10	CO5
20 (b)	Briefly explain the elementary first aid	4	CO5

Model Question Paper

Reg. No.:………………….. **QP CODE:………………..**

Name:………………………

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEO 703.5

Environment Health and Safety

Max. Marks: 100 **Duration: 3 hours**

Part A

(Answer all questions; each question carries 3 marks)

1. What are the socio- economic reasons in safety?
2. Define industrial hygiene.
3. Define noise. What are the compensation aspects of noise?
4. Explain about the biohazard control program.
5. Discuss the possible electrical injuries in a construction industry.
6. What are the hazards due to radiation?
7. What are the criteria air pollutants?
8. Describe the Depletion of Ozone Layer.
9. What are the benefits of safety inspection?
10. Discuss the role of an individual in conservation of natural resources.

Part B

(Answer one full question from each module; each question carries 14 marks)

Module I

11. Briefly explain about occupational related diseases found in the industries. (14 Marks)

OR

12. Write the short notes on : (14 Marks)
    (i) Silicosis
    (ii) Asbestosis
    (iii) Anthracosis
    (iv) Anthrax.

Module II

13. (a) Write briefly about the classification of bio hazardous agents. (7 Marks)

(b) What are the precautionary measures for chemical hazards? (7 Marks)

OR

14. Write short notes on : (14 Marks)

(i) Vapour (ii) Fog (iii) Dust (iv) Fumes.

Module III

15. Explain effects of radiation on human body and the methods of radioactive waste disposal. (14 Marks)

OR

16. (a) What are the requirements for safe work platform? (7 Marks)

(b) Discuss about the scaffolding inspections. (7 Marks)

Module IV

17. Describe the effect of air pollution on environment. (14 Marks)

OR

18. Describe the effect of water pollution on environment. (14 Marks)

Module V

19. (a) What are the important points in carrying out workplace inspection? (7 Marks)

(b) What is First aid? Explain CPR. (7 Marks)

OR

20. (a) Explain the first aid measure to be taken during gas poisoning, heart attack, chemical splash and electric shock. (10 Marks)

(b) Briefly explain the elementary first aid (4 Marks)

Course Code: 22CEO 703.5
Environmental Health And Safety

Module I

Introduction to Occupational Health And Toxicology : Safety at work – Socio – Economic reasons. Introduction to health and safety at various industries. occupational related diseases- Musculoskeletal disorders, hearing impairment, carcinogens, silicosis, asbestosis, pneumoconiosis – Toxic materials and substances used in work, exposure limits, toxicological investigation, Industrial Hygiene, Arrangements by organisations to protect the workers.

Module II

Chemical hazards- dust, fumes, vapour, fog, gases, Methods of Control. **Biological hazards**- Classification of Biohazardous agents– bacterial agents, viral agents, fungal, parasitic agents, infectious diseases, control of biological agents at workplaces. Noise, noise exposure regulation and control.

Module III

Safety in Construction industry - Scaffolding and Working platform, Welding and Cutting, Excavation Work, Concreting, control measures to reduce the risk. Electrical Hazards, Protection against voltage fluctuations, Effects of shock on human body. Radiation Hazards, Types and effects of radiation on human body, disposal of radioactive waste.

Module IV

Air Pollution - air pollutants from industries, effect on human health, animals, Plants and Materials - depletion of ozone layer-concept of clean coal combustion technology.
Water Pollution - water pollutants-health hazards - effluent quality standards. Waste Management -waste identification, characterization and classification, recycling and reuse.

Module V

Safe working environment - The basic purpose and benefits of safety inspection, First-aid appliances, Shelters, rest rooms and lunch rooms, use of personal protective equipment, Role of an individual in conservation of natural resources, Methods for controlling water pollution, role of individual in prevention of pollution.

Text Books :

1. Environmental and Health and Safety Management by By Nicholas P. Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995.
2. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services 2005.
3. The Facility Managers Guide to Environmental Health And Safety by Brian Gallant, Government Inst Publ., 2007.

4. R.K.Jain and Sunil S.Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers , New Delhi (2006).
5. Mackenzie L Davis, Introduction to Environmental Engineering, McGrawhill Education (India).

References:

1. Slote. L, Handbook of Occupational Safety and Health, JohnWilleyand Sons, NewYork.
2. Heinrich H.W, Industrial Accident Prevention, McGrawHill Company,NewYork,1980.
3. S.P.Mahajan, "Pollution control in process industries", Tata McGraw Hill Publishing Company, New Delhi, 1993.

Course Code: 22CEO 703.5

Environmental Health And Safety

Course content and Schedule of Lecture (sample)

Module	Topic	Course outcome addressed	No of Hours
Module I (9 Hours)			
1.1	Introduction to Occupational Health And Toxicology.	CO1	1
1.2	Safety at work – Socio – Economic reasons.	CO1	1
1.3	Introduction to health and safety at various industries.	CO1	1
1.4	Occupational related diseases- Musculoskeletal disorders, hearing impairment	CO1	1
1.5	Occupational related diseases - carcinogens, silicosis, asbestosis, pneumoconiosis.	CO1	1
1.6	Toxic materials and substances used in work.	CO1	1
1.7	Exposure limits, toxicological investigation.	CO1	1
1.8	Industrial Hygiene.	CO1	1
1.9	Arrangements by organisations to protect the workers.	CO1	1
Module II (9 Hours)			
2.1	Chemical hazards.	CO2	1
2.2	Dust, fumes, vapour, fog, gases.	CO2	1
2.3	Methods of Control.	CO2	1
2.4	Biological hazards.	CO2	1
2.5	Classification of Biohazardous agents.	CO2	1
2.6	Bacterial agents, viral agents, fungal, parasitic agents, infectious diseases.	CO2	1
2.7	Control of biological agents at workplaces.	CO2	1
2.8	Noise.	CO2	1
2.9	Noise exposure regulation and control.	CO2	1

Module III (8 Hours)			
3.1	Safety in Construction industry- Scaffolding and Working platform.	CO3	1
3.2	Welding and Cutting, Excavation Work, Concreting.	CO3	1
3.3	Control measures to reduce the risk.	CO3	1
3.4	Electrical Hazards.	CO3	1
3.5	Protection against voltage fluctuations.	CO3	1
3.6	Effects of shock on human body, Radiation Hazards	CO3	1
3.7	Types and effects of radiation on human body.	CO3	1
3.8	Disposal of radioactive waste.	CO3	1
Module IV (9 Hours)			
4.1	Air Pollution - air pollutants from industries.	CO4	1
4.2	Effect on human health, animals.	CO4	1
4.3	Plants and Materials - depletion of ozone layer.	CO4	1
4.4	Concept of clean coal combustion technology.	CO4	1
4.5	Water Pollution - water pollutants.	CO4	1
4.6	Health hazards - effluent quality standards.	CO4	1
4.7	Waste Management-waste identification.	CO4	1
4.8	Characterization and classification.	CO4	1
4.9	Recycling and reuse.	CO4	1
Module V (8 Hours)			
5.1	Safe working environment.	CO5	1
5.2	The basic purpose and benefits of safety inspection.	CO5	1
5.3	First-aid appliances.	CO5	1
5.4	Shelters, rest rooms and lunch rooms.	CO5	1
5.5	Use of personal protective equipment.	CO5	1

5.6	Role of an individual in conservation of natural resources.	CO5	1
5.7	Methods for controlling water pollution.	CO5	1
5.8	Role of individual in prevention of pollution.	CO5	1

<table>
<tr><td rowspan="2">22MEE 702.3</td><td rowspan="2">FINITE ELEMENT METHOD</td><td>CATEGORY</td><td>L</td><td>T</td><td>P</td><td>CREDIT</td><td>Year of Introduction</td></tr>
<tr><td>HONOURS</td><td>3</td><td>1</td><td>0</td><td>4</td><td>2019</td></tr>
</table>

Preamble:

This course provides the fundamental concepts of finite element method and its applications in structural engineering. As a natural development from matrix analysis of structures learnt earlier, the student is encouraged to appreciate the versatility of this method across various domains, also as the basis of many structural analysis softwares. This course introduces the basic mathematical concepts of the method and its application to simple analysis problems.

Prerequisite: CET302 Structural Analysis II

Course Outcomes: After the completion of the course the student will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Understand the basic features of boundary value problems and methods to solve them.	Remembering, Understanding
CO2	Understand the fundamental concept of the finite element method and develop the ability to generate the governing FE equations for systems governed by partial differential equations.	Understanding, Applying
CO3	Get familiar with the basic element types and shape functions so as to identify and choose suitable elements to solve a particular problem.	Analysing, Applying
CO4	Understand the concept of isoparametric elements and apply it for problems in structural engineering.	Understanding, Applying
CO5	Apply numerical integration procedures as a tool to solve mathematical models in FEM.	Understanding, Applying

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	-	-	-	-	-	-	-	-
CO2	3	3	2	1	-	-	-	-	-	-	-	-
CO3	3	3	1	1	-	-	-	-	-	-	-	-
CO4	3	3	1	-	-	-	-	-	-	-	-	-
CO5	3	3	1	1	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	05	05	10
Understand	10	10	20
Apply	20	20	40
Analyse	15	15	30
Evaluate			
Create			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

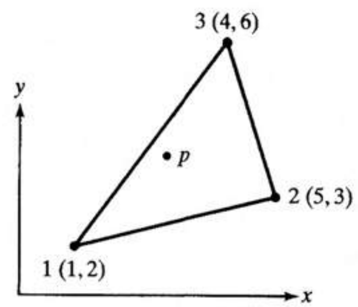
Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

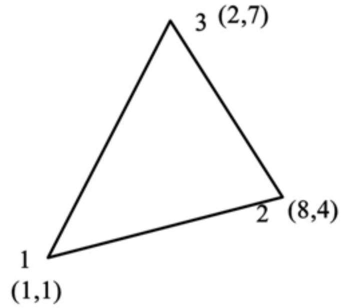
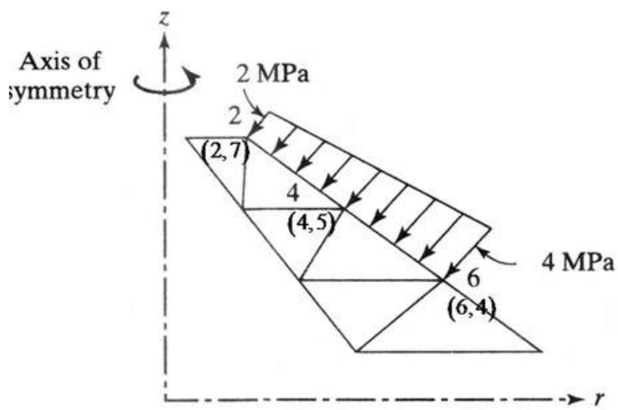
Course Level Assessment Questions

CO1:	**Understand the basic features of boundary value problems and methods to solve them.**
1.	What are boundary value problems? What are the physical and mathematical significances of boundary conditions in structural mechanics problems?
2.	Using the Galerkin method obtain an approximate solution to the following boundary value problem. $u''(x)+u(x)+x=0 \quad 0<x<1$ $u(0)=0 \qquad u(1)=0$ (a) Assume a quadratic polynomial as a trial solution. (b) Assume a cubic polynomial as a trial solution.
3.	Find a one-parameter approximate solution of the nonlinear equation $$-2u\frac{d^2u}{dx^2}+\left(\frac{du}{dx}\right)^2=4 \quad \text{for} \quad 0<x<1,$$ subject to the boundary conditions u(0) = 1 and u(1) = 0, and compare it with the exact solution $u = 1 - x^2$. Use the least-squares method.

CO2:	**Understand the fundamental concept of the finite element method and develop the ability to generate the governing FE equations for systems governed by partial differential equations.**
1.	Derive the governing differential equation of a uniform bar subjected to axial vibrations.
2.	What are field variables and forcing vectors in finite element analysis? Give examples from various applications.
3.	Derive the element stiffness equations for an axial deformation problem, using variational approach.
4.	(a) Obtain the weak form of the following boundary value problem. $$x^2\frac{d^2u}{dx^2}+2x\frac{du}{dx}-xu+4=0 \qquad 1<x<3$$ $$u(1)=1 \qquad \frac{du(3)}{dx}-2u(3)=2$$ (b) With the weak form obtained in (a), use Rayleigh-Ritz method to obtain an approximate solution of the above BVP. Use a linear polynomial trial solution.

CO3:	**Get familiar with the basic element types and shape functions so as to identify and choose suitable elements to solve a particular problem.**
1.	What are shape functions? What are their advantages in finite element analysis?
2.	Obtain the shape functions for a 4-noded bar element using Lagrange polynomials.
3.	Write the elasticity relations for axisymmetric elements.
4.	For the CST element in figure, x-coordinate at P is 3 and N2 is 0.4 at P. Determine: (a) the y-coordinate at P (b) N1 and N3 at P. 
5.	Get the explicit shape functions for the rectangular element shown in Figure 3, using Lagrange formulae. 

CO4:	**Understand the concept of isoparametric elements and apply it for problems in structural engineering.**
1.	Find the axial deformation of a mild steel square bar of side 3cm and length 2m, using two linear isoparametric axial elements.
2.	Derive the shape functions for an isoparametric Constant Strain Triangle element.
3.	Find the isoparametric mapping for the CST element shown.

	
4.	What are the advantages of coordinate mapping?
5.	What are superparametric, subparametric and isoparametric elements?
6.	Illustrate the influence of node numbering on Jacobian, by using a linear triangular isoparametric element.
7.	For the axisymmetric triangular elements in Figure, for the loaded edge,  (a) determine the nodal surface traction vector in x-direction. (b) determine the nodal surface traction vector in y-direction

CO5:	**Apply numerical integration procedures as a tool to solve mathematical models in FEM.**
1.	Evaluate the following integrals using Gauss quadrature: $(a)\ \ I=\int_{0.2}^{0.8} e^{-2x}\tan x dx \quad (b)\ \ I=\int_{-2}^{2}\frac{dx}{1+x^2}$ $(c)\ \ I=\int_{-1}^{1}\int_{-1}^{1}\left(t^3+s^2\right)dsdt \quad (d)\ \ I=\int_{-1}^{1}\int_{-1}^{1}x\sin\left(x+y^2\right)dxdy$
2.	What are the essential features of numerical integration using Gauss quadrature?
3.	Obtain the two-point Gauss quadrature points and weights from first principles
4.	How to determine the number of Gauss points to evaluate an integral exactly?

SYLLABUS

MODULE I – 9 hrs.
Introduction - Boundary value problems; Introduction to approximate numerical solutions for solving differential equations.

MODULE II – 9 hrs.
Formulation techniques: Element equations using variational approach - Element equations using weighted residual approach - the axial element example.

MODULE III – 9 hrs.
Basic elements: Interpolation and shape functions – convergence requirements; CST, LST, bilinear rectangular elements, solid elements.

MODULE IV – 9 hrs.
Isoparametric Formulation: coordinate mapping - One dimensional bar element; Two dimensional isoparametric elements - CST, LST, bilinear quadrilateral elements - Plain stress, plain strain problems.

MODULE V – 9 hrs.
Development of stiffness matrix for *beam elements*; Introduction to *higher order* elements; Introduction to *axisymmetric* elements.
Numerical Integration: Gauss quadrature

Text Books:

2. Desai, C.S., Elementary Finite Element Method, Prentice Hall of India.
3. Chandrupatla, T.R., and Belegundu, A.D., Introduction to Finite Elements in Engineering, Prentice Hall of India.

References:

1. Cook, R.D., et al, Concepts and Applications of Finite Element Analysis, John Wiley.
2. Bathe, K.J., Finite Element Procedures in Engineering Analysis, Prentice Hall of India.
3. Gallaghar, R.H., Finite Element Analysis: Fundamentals, Prentice Hall Inc.
4. Rajasekaran, S., Finite Element Analysis in Engineering Design, Wheeler Pub.
5. Krishnamoorthy, C.S., Finite Element Analysis Theory and Programming, Tata McGraw Hill.
6. Zienkiewicz, O.C., and Taylor, R.L., The Finite Element Method, Vol. I and II, McGraw Hill.
7. Bhatti, Asghar, Fundamental Finite Element Analysis and Applications: with Mathematica and Matlab Computations

Lecture Plan – Structural Analysis II

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module I: Total lecture hours: 9**		
1.1	General introduction – brief review of matrix methods, applications and versatility of FEM	CO1	1
1.2	Introduction to Boundary value problems; approximate numerical solutions for solving differential equations - Least squares method	CO1	3
1.3	Collocation method, Galerkin method - examples	CO1	5
2	**Module II: Total lecture hours: 9**		
2.1	**Formulation techniques:** Variational approach and weighted residual approach – initial concepts and differences	CO2	1
	Element equations using variational approach		3
2.2	Element equations using weighted residual approach	CO2	3
2.3	The axial element example in detail	CO2, CO3	2
3	**Module III: Total lecture hours: 9**		
3.1	**Basic elements:** Interpolation and shape functions	CO3	2
3.2	Convergence requirements; CST element	CO3	3
3.3	LST, bilinear rectangular elements, solid elements.	CO3	4
4	**Module IV: Total lecture hours: 9**		
4.1	**Isoparametric Formulation:** coordinate mapping - One dimensional bar element	CO4	2
4.2	Two dimensional isoparametric elements – CST element	CO4	3
4.3	LST, bilinear quadrilateral elements - Plain stress, plain strain problems.	CO4	4
5	**Module V: Total lecture hours: 9**		
5.1	Development of stiffness matrix for beam elements	CO3, CO4	2
5.2	Introduction to higher order elements	CO3, CO4	2
5.3	Introduction to axisymmetric elements.	CO3, CO4	2
5.4	**Numerical Integration:** Gauss quadrature	CO5	3

MODEL QUESTION PAPER

Reg. No.:_______________		Name:___________________________

SIXTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: 22MEE702.3

Course Name: FINITE ELEMENT METHOD

Max. Marks: 100		Duration: 3 Hours

PART A

Answer all questions; each question carries 3 marks.

1.	a)	What are field variables and forcing vectors in finite element analysis? Give examples from various applications.
	b)	What are boundary value problems? What are the physical and mathematical significances of boundary conditions in structural mechanics problems?
	c)	List the essential properties of shape functions.
	d)	Briefly explain the essential features of weighted residual methods to solve partial differential equations.
	e)	Write down the brief general procedure in finite element analysis.
	f)	What are shape functions? What are their advantages in finite element analysis?
	g)	What are the advantages of coordinate mapping?
	h)	What are superparametric, subparametric and isoparametric elements?
	i)	What are axisymmetric elements? Explain.
	j)	How to determine the number of Gauss points to evaluate an integral exactly?

(10×3 marks = 30 marks)

PART B

Answer one full question from each module; each full question carries 14 marks.

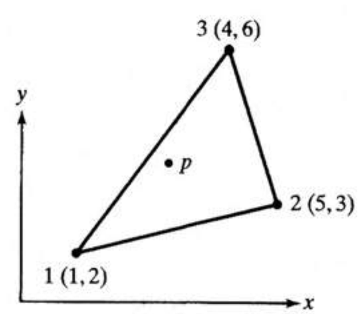
Module I

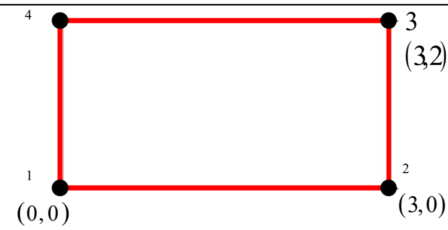
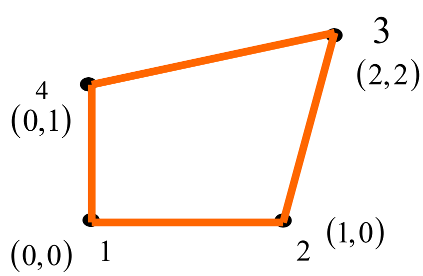
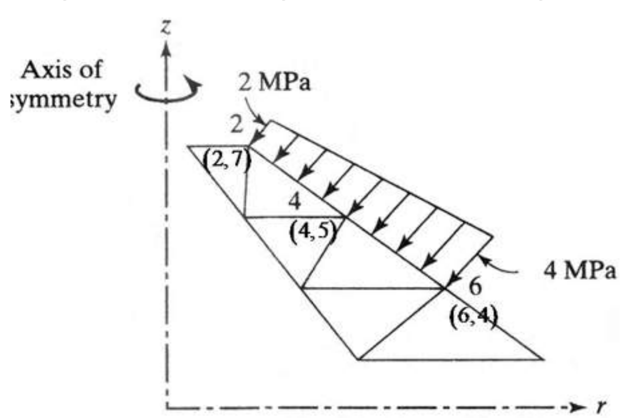
2. Using the Galerkin method obtain an approximate solution to the following boundary value problem.

$$u''(x)+u(x)+x=0 \quad 0<x<1$$
$$u(0)=0 \qquad u(1)=0$$

(a) Assume a quadratic polynomial as a trial solution.
(b) Assume a cubic polynomial as a trial solution.

(2×7=14 marks)

3.	Find a one-parameter approximate solution of the nonlinear equation $$-2u\frac{d^2u}{dx^2}+\left(\frac{du}{dx}\right)^2=4 \quad \text{for} \quad 0<x<1,$$ subject to the boundary conditions u(0) = 1 and u(1) = 0, and compare it with the exact solution $u = 1 - x^2$. Use the least-squares method. (14 marks)
	Module II
4.	Derive the element stiffness equations for an axial deformation problem, using variational approach. (14 marks)
5	(a) Obtain the weak form of the following boundary value problem. $$x^2\frac{d^2u}{dx^2}+2x\frac{du}{dx}-xu+4=0 \qquad 1<x<3$$ $$u(1)=1 \qquad \frac{du(3)}{dx}-2u(3)=2$$ (b) With the weak form obtained in (a), use Rayleigh-Ritz method to obtain an approximate solution of the above BVP. Use a linear polynomial trial solution. (2×7=14 marks)
	Module III
6.	For the CST element in figure, x-coordinate at P is 3 and N2 is 0.4 at P. Determine: (a) the y-coordinate at P (b) N1 and N3 at P.  (2×7=14 marks)
7.	Get the explicit shape functions for the rectangular element shown in Figure 3, using Lagrange formulae.

	 (14 marks)
Module IV	
8.	Illustrate the influence of node numbering on Jacobian, by using a linear triangular isoparametric element. (14 marks)
9.	Get the explicit isoparametric shape functions for the quadrilateral element shown in Figure 4. Check the validity of isoparametric mapping.  (14 marks)
Module V	
10.	For the axisymmetric triangular elements in Figure, for the loaded edge,  (a) determine the nodal surface traction vector in x-direction. (b) determine the nodal surface traction vector in y-direction.

	(2×7=14 marks)
11.	Evaluate the following integrals using two-point Gauss quadrature: $(a)\ I=\int_{1}^{2}\int_{4}^{6} xy\,e^{\left(x^2+y^2\right)}dxdy \quad (b)\ I=\int_{-2}^{2}\frac{dx}{1+x^2}$ (2×7=14 marks)
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22CEHR610.2	EARTH DAMS AND EARTH RETAINING STRUCTURES	CATEGORY	L	T	P	CREDIT	Year of Introduction
		HONOURS	4	0	0	4	2019

Preamble: Goal of this course is to impart to the students, in-depth knowledge about the fundamentals of earth dams and Earth pressure theories. After this course, students will be able to analyze stability of earth dams and various types of retaining structures.

Prerequisite : CET 305 : GEOTECHNICAL ENGINEERING II

Course Outcomes: After completion of the course the student will be able to:

CO 1	Understand the fundamentals of earth dams
CO 2	Analyze slope stability of earth dams
CO 3	Explain the basic concepts & theories of Earth pressure
CO 4	Calculate earth pressure for different types of retaining structures
CO 5	Design Rigid and Flexible Retaining Walls applying the earth pressure theories

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	3	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	3	-	-	-	-	-	-	-	-	-	-
CO 5	2	2	3	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	20
Understand	15	15	30
Apply	25	25	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation (CIE) Pattern :

Attendance : 10 Marks

Continuous Assessment Test (2 numbers) : 25 Marks

Assignment/Quiz/Course project : 15 Marks

End Semester Examination (ESE) Pattern : There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

Course Outcome 1 (CO1):

1. Understand the fundamentals of earth dams
2. Understand the types of earth dams
3. Understand the parts of earth dams like central and inclined cores, filters
4. Understand the seepage analysis of earth dams

Course Outcome 2 (CO2):

1. Analyze slope stability of earth dams

Course Outcome 3 (CO3):

1. Explain the basic concepts of Earth pressure
2. Explain Rankine's and Coulomb's theories of Earth pressure
3. Explain Graphical method using Rebhan's method

Course Outcome 4 (CO4):

1. Calculate earth pressure for different types of retaining structures using Rankine's and Coulomb's theories, Graphical Method, Trial wedge method
2. Calculate earth pressure for rigid and flexible retaining walls
3. Calculate earth pressure on Braced cuts and coffer dams

Course Outcome 5 (CO5):

1. Design of gravity retaining wall & cantilever retaining walls applying the earth pressure theories
2. Design of cantilever sheet piles
3. Design of anchored sheet piles
4. Design of Coffer Dams

SYLLABUS

Module 1
Earth dams – types of dams - Selection of type of dam based on material availability - Foundation conditions and topography - Design details – crest, free board, upstream and downstream slopes, upstream and downstream slope protection – central and inclined cores - Types and design of filters - Seepage analysis and control – seepage through dam and foundations – control of seepage in earth dam and foundation
Module 2
Construction techniques of earth dams – methods of construction - Quality control Instrumentation – measurement of pore pressures - Determination of phreatic line - Stability analysis – critical stability conditions - Desired values of factor of safety for different loading conditions of dam - Evaluation of stability by Swedish Slip Circle Method and sliding wedge method under critical conditions
Module 3
Earth pressure theories – Rankine‘s and Coulomb’s earth pressure theories for cohesionless and cohesive backfills – Computation of earth pressures for various cases – inclined – with surcharge – submerged and partly submerged – stratified backfills - Rigid retaining structures – active and passive earth pressures against gravity retaining walls – Numerical Problems - Computation of earth pressures by Trial wedge method –A mathematical approach for completely submerged and partly submerged backfills - Numerical Problems - Importance of capillarity tension in earth pressure
Module 4
Graphical methods of earth pressure computation – trial wedge method for coulomb‘s and Rankine‘s conditions, for regular and irregular ground and wall conditions - Rebhan‘s construction for active pressure - Friction circle method - Logarithmic spiral method - Design of gravity retaining wall – cantilever retaining walls - Numerical Problems - Flexible retaining structure – type and methods of construction – design strength parameters
Module 5
Safety factor for sheet pile walls – Computation of earth pressures against cantilever sheet piles in cohesionless and cohesive soils – Numerical Problems - Anchored sheet piles – free earth method – fixed earth method – Rowe‘s moment reduction method - Stability of sheet piling - Diaphragm walls and coffer dams – types of diaphragm walls and their construction techniques in various soil types - Earth pressure on braced cuts and coffer dams – Design of coffer dams

Text Books :

1. Tschebotarioff G P, Foundations, Retaining and earth structures, 2nd edition, Mcgraw Hill Pub., 1973

References:

1. Clayton, Milititsky and Woods, Earth Pressure And Earth-Retaining Structures, Taylor and Francis, 1996
2. Huntington, Earth pressure on retaining walls, John Wiley and Sons, 1957
3. Prakash, Ranjan and Saran, Analysis and Design of Foundations and Retaining structures,Saritha Prakashan, Meerut, 1977
4. Bowles, Foundation Analysis and Design, 1968.

5. Jones, Earth Reinforcements and Soil structures, 1996
7. IS : 7894 – 1975, Indian Standard Code of Practice for Stability Analysis of Earth Dams

Course Contents and Lecture Schedule:

Module	Contents		Hours
1	**Module 1**		**9**
1.1	Earth dams – types of dams	CO 1	1
1.2	Selection of type of dam based on material availability	CO 1	1
1.3	Foundation conditions and topography	CO 1	1
1.4	Design details – crest, free board, upstream and downstream slopes, upstream and downstream slope protection – central and inclined cores	CO 1	2
1.5	Types and design of filters	CO 1	2
1.6	Seepage analysis and control – seepage through dam and foundations – control of seepage in earth dam and foundation	CO 1	2
2	**Module 2**		**9**
2.1	Construction techniques of earth dams – methods of construction	CO 1	1
2.2	Quality control Instrumentation – measurement of pore pressures	CO 1	1
2.3	Determination of phreatic line	CO 1	1
2.4	Stability analysis – critical stability conditions	CO 1, CO 2	2
2.5	Desired values of factor of safety for different loading conditions of dam	CO 1, CO 2	1
2.6	Evaluation of stability by Swedish Slip Circle Method and sliding wedge method under critical conditions	CO 1, CO 2	3
3	**Module 3**		**9**
3.1	Earth pressure theories – Rankine's and Coulomb's earth pressure theories for cohesionless and cohesive backfills – Computation of earth pressures for various cases – inclined – with surcharge – submerged and partly submerged – stratified backfills	CO 3	2
3.2	Rigid retaining structures – active and passive earth pressures against gravity retaining walls – Numerical Problems	CO 3, CO 4	2
3.3	Computation of earth pressures by Trial wedge method – A mathematical approach for completely submerged and partly submerged backfills	CO 3	2
3.4	Numerical Problems	CO 3, CO 4	2

3.5	Importance of capillarity tension in earth pressure	CO 3	1

4	**Module 4**		**9**
4.1	Graphical methods of earth pressure computation – trial wedge method for coulomb‘s and Rankine‘s conditions, for regular and irregular ground and wall conditions - Rebhan‘s construction for active pressure	CO 3, CO 4	2
4.2	Friction circle method - Logarithmic spiral method	CO 3	2
4.3	Design of gravity retaining wall – cantilever retaining walls - Numerical Problems	CO 5	3
4.4	Flexible retaining structure – type and methods of construction – design strength parameters	CO 3	2
5	**Module 5**		**9**
5.1	Safety factor for sheet pile walls – Computation of earth pressures against cantilever sheet piles in cohesionless and cohesive soils – Numerical Problems	CO3, CO 4	2
5.2	Anchored sheet piles – free earth method – fixed earth method – Rowe‘s moment reduction method	CO 3, CO 4	2
5.3	Stability of sheet piling	CO 3, CO 5	1
5.4	Diaphragm walls and coffer dams – type of diaphragm walls and their construction techniques in various soil types	CO 3	2
5.5	Earth pressure on braced cuts and coffer dams – Design of coffer dams	CO 3, CO 5	2

Model Question Paper

QP CODE:

Reg No.:_______________ **Name:__________________________**

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEHR610.2

Course Name : EARTH DAMS AND EARTH RETAINING STRUCTURES

Max. Marks: 100 Duration: 3 hours

Part A

(***Answer all questions; each question carries 3 marks***)

61. Explain types of dams
62. Explain downstream slope protection measures
63. Explain the instrumentation for quality control of dams
64. Explain critical stability conditions of dams
65. Explain critical depth for an unsupported cut in cohesive soil.
66. List the assumptions of Coulomb's theory of earth pressure
67. Differentiate between rigid and flexible retaining structures
68. Explain the methods of construction of flexible retaining structures
69. How to check the stability of sheet piling?
70. List the types of Diaphragm walls

PART B

(Answer one full question from each module, each question carries 14 marks)

Module – 1

71. (a) Explain the basic design studies necessary for design of an earth dam. (7 Marks)
    (b) Explain about the seepage through Dam and foundation. (7 Marks)

12. (a) Discuss in detail the Terzgahi's filter criteria for its design. (7 Marks)
    (b) Explain the control of seepage in earth dam. (7 Marks)

Module – 2

13. (a) Explain construction techniques of an earth dam. (7 Marks)
    (b) Explain Swedish Slip Circle method of stability analysis. (7 Marks)

14. (a) Explain methods of construction of an earth dam. (7 Marks)

(b) Explain Sliding Wedge method of stability analysis. (7 Marks)

Module – 3

15. (a) Explain Trial wedge method of earth pressure. (5 Marks)

(b) Compute the total lateral earth thrust exerted by a layered backfill of height 10m if the wall has a tendency to move away from the backfill. The upper layer of thickness 4 m has angle of internal friction 32° and unit weight 19 kN/m^3. The lower layer has angle of internal friction 28°, cohesion 20 kPa, and unit weight 18 kN/m^3. The backfill also supports a uniform surcharge of intensity $10kN/m^2$. Also find the point of application. (9 Marks)

16. (a) Explain the importance of capillary tension in computation of earth pressure (5 Marks)

(b) For a layered backfill behind a 10m high retaining wall with a smooth vertical backfill, Draw the active earth pressure distribution and its magnitude and point of application : (9 Marks)

Sl. No.	Depth	Backfill Properties
1.	0 – 3 m	$c = 30\ kN/m^2$, $\phi = 0°$, $\gamma = 19kN/m^3$
2.	3 – 6 m	$c = 0\ kN/m^2$, $\phi = 32°$, $\gamma = 18\ kN/m^3$
3.	6 – 10 m	$c = 50kN/m^2$, $\phi = 0°$, $\gamma = 17\ kN/m^3$

Module – 4

17. (a) Explain design strength parameters of a flexible retaining wall. (5 Marks)

(b) The retaining wall having 6m height having back of wall is inclined at +ve batter angle of 15° and ground surface has an upward inclination of 20° retains a backfill with following properties : γ= 19kN/m3, ϕ = 34°, δ = 20°.

(i) Determine the total active thrust by Rebann's graphical construction.

(ii) A surcharge of $50kN/m^2$ is acting on the backfill. What is the magnitude of total active thrust? (9 Marks)

18. (a) Explain Logarithmic Spiral method. (5 Marks)

(b) A trapezoidal masonry retaining wall 1.5m wide at the top and 5m wide at its bottom is 5m high. The vertical face is retaining soil (ϕ = 30°) at a surcharge angle of 15° with the horizontal. Unit weights of soil and masonry are 20 kN/m^3 and 24 kN/m^3.The coefficient of friction at the base of the wall is 0.40. Check the stability of the retaining by applying necessary checks if the soil bearing capacity is $90kN/m^2$. (9 Marks)

Module – 5

19. (a) Explain the step by step procedure for design of a diaphragm wall. (7 Marks)

(b) Describe the stability checking of sheet pile wall using fixed and free earth support methods. (7 Marks)

20. (a) What are different types of coffer dams? (5 Marks)

(b) An anchored sheet pile is to support a mass of cohesion less soil up to height of 6m above ground level with horizontal anchor toes spaced at 1m intervals and located at 1.0m below the ground surface. If the unit weight of the soil is 21 kN/m^3 and its angle of internal friction is 30°, determine the minimum depth of embedment of the sheet pile for stability. (9 Marks)

22CEHR610.3	ENVIRONMENTAL POLLUTION MODELLING	CATEGORY	L	T	P	CREDIT	Year of Introduction
		HONOURS	3	1	0	4	2019

Preamble

This course introduces various approaches for environmental pollution modeling. Students will learn how to develop a verified and validated model. The mathematics behind various environmental pollution models with their uncertainties will be discussed.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	To appreciate the mathematical modelling approach	Understanding
CO2	To learn how to build a model to represent physical transport of pollutants in environment	Understanding, Applying
CO 3	To simulate pollution transport scenarios in water, air and noise environment	Applying , Analysing
CO 4	To interpret the modelling results for decision support	Analysing

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	2	-	2	-	-	-	-	-	-	-	-
CO4	-	2	-	2	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	15
Understand	10	10	15
Apply	15	15	35
Analyse	15	15	35
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

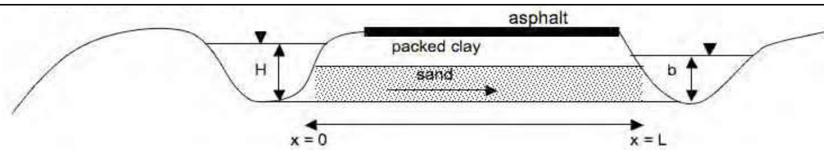
Course Level Assessment Questions

CO1: To appreciate the mathematical modelling approach

1	Discuss the classification of mathematical models
2	Explain how advection-diffusion equation is useful for modelling contaminant transport in ground water
3	How gaussian dispersion model is useful for air pollution modelling of point sources?

CO 2: To learn how to build a model to represent physical transport of pollutants in environment

1	Explain model building procedure
2	What is the flow equation for the following situation?

	
3	Discuss how salinity intrusion is modeled

CO3: To simulate pollution transport scenarios in water, air and noise environment

1	The SO2 concentration from 700 MW coal fired power plant has to be estimated. It burns 5% sulphur coal at the rate of 350KG / MW H. Stack height is 150m and plume rise is 50m.The wind speed at stack height is 6 m/s and neutral stability condition exists. Calculate the ground level concentration at 2 km downwind distance, given that σy= 80m and σz= 120m.
2	The initial BOD of a river just below a sewage outfall is 25 mg/L. The oxygen deficit just upstream from the outfall is 2 mg/L. The deoxygenation rate coefficient kd is 0.4/day, and the reaeration rate coefficient kr is 0.7/day. The river is flowing at a speed of 30 km /day. (a) Find the critical distance downstream at which DO is a minimum (b) Find the minimum DO
3	Water levels in two wells far from shoreline are 50 cm and 1.0 m respectively. The wells are separated by a distance of 1 km. Hydraulic conductivity of the aquifer is 10m/d. Thickness of aquifer is 50m. Calculate the length of saltwater wedge and position of interface. Density of salt water can be taken as 1.025 g/cm 3

CO4: To interpret the modelling results for decision support

1	Explain how gaussian dispersion model help in predicting the impact of a proposed coal power plant in a locality
2	A chemical spill occurs above a sloping, shallow unconfined aquifer consisting of medium sand with K=1 m/d and a porosity of 30%. Several monitoring wells are drilled in order to determine the regional hydraulic gradient. The hydraulic head from a well drilled near the spill location yielded a value of 5m. At a distance of 200m down the slope another well yielded a hydraulic head of 1m. Do you need to worry about safe drinking water availability in the well 200 m down the slope?
3	The distance from the base of a pumping well to the freshwater-saltwater interface is 100 m, the pumping rate is 3000 m3/day, and the hydraulic

	conductivity is 10 m/d. What's the maximum permitted pumping rate for the well?

SYLLABUS

Module1

Role of models in environmental pollution studies- objectives of modelling-modelling principles-types of models-classification of mathematical models-deterministic, stochastic, continuous, discreet, static, dynamic, linear and non-linear-model building framework- model calibration, validation, verification and sensitivity analysis- model scales, error and uncertainty -distributions in modelling data of environmental pollutant concentrations- log-normal, Weibull, and gamma

Module 2

Air pollution modelling: Transport and dispersion of air pollutants- estimating concentrations from point sources –Dispersion Modelling- Gaussian Plume Model – determination of dispersion parameters, atmospheric stability- box models- line source model-area source model-puff model

Module 3

Water quality modeling: historical development of water quality models; rivers and streams water quality modelling– low flow analysis – pollutant transport-advection, diffusion and dispersion— Modelling lake water quality-mass balance for well mixed lakes-models for dissolved oxygen; Streeter Phelps model- sediment transport modelling

Module4

Groundwater modelling: use of ground water models-ground water flow modeling-Darcy's law-ground water flow equations for homogenous, heterogenous, isotropic and anisotropic conditions-mass transport of solutes, advection diffusion equation, favorable conditions for contaminant transport-modelling parameters and boundary conditions, seawater intrusion – basic concepts and modeling- Ghyben–Herzberg formula -popular ground water models

Module5

Environmental noise - noise generation mechanisms- need for noise modelling- modelling inputs-sound propagation factors - Equivalent Continuous Sound Pressure Level (Leq)- noise mapping methodology-modelling traffic noise-CoRTN and RLS90 models

Text Books

1. Gilbert M Masters Wendell P Ela, Introduction to Environmental Engineering & Science, Pearson,2013
2. Steven C.Chapra, Surface Water Quality Modeling, The McGraw-Hill Companies,Inc., New York, 1997.

3. Todd David Keith, Ground water Hydrology, Fourth edition, John Wiley and Sons, New York, 2004..
4. C.P Kumar, Ground water assessment and modelling, Createspace Independent Pub, 2015

References

1. Seinfeld and Pandis, Atmospheric chemistry and physics, Wiley 2016
2. Marcello Benedini, George Tsakiris, Water quality modelling for rivers and streams,Springer 2013
3. Mary Anderson William Woessner Randall Hunt, Applied ground water modelling, Academic Press, 2015
4. Enda Murphy Eoin King, Environmental Noise Pollution, Elsevier, 2014

Lecture Plan- Environmental Impact Assessment

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module 1: Total Lecture Hours -9**		
1.1	Role of models in environmental pollution studies-objectives of modelling-modelling principles-	CO1	1
1.2	types of models-classification of mathematical models-deterministic, stochastic, continuous, discreet, static, dynamic, linear and non-linear-	CO1	2
1.3	model building framework- model calibration, validation, verification and sensitivity analysis-model scales, error and uncertainty -	CO2	3
1.4	distributions in modelling data of environmental pollutant concentrations- log-normal, Weibull, and gamma	CO1,CO2	3
2	**Module II: Total Lecture Hours- 9**		
2.1	Air pollution modelling: Transport and dispersion of air pollutants	CO2	1
2.2	estimating concentrations from point sources – dispersion modelling- Gaussian Plume Model – determination of dispersion parameters, atmospheric stability	CO2, CO3, CO4	4
2.3	box models- line source model-area source model-puff model	CO2, CO3, CO4	4
3	**Module III: Total Lecture Hours-9**		

3.1	Water quality modeling: historical development of water quality models	CO1,CO2	1
3.2	Rivers and streams water quality modelling– low flow analysis – pollutant transport-advection, diffusion and dispersion	CO2, CO3	2
3.3	Modelling lake water quality-mass balance for well mixed lakes	CO2, CO3	2
3.4	models for dissolved oxygen; Streeter Phelps model-	CO2, CO3,CO4	3
3.5	sediment transport modelling	CO2, CO3,CO4	1
4	**Module IV: Total Lecture Hours- 9**		
4.1	Groundwater modelling: use of ground water models-ground water flow modeling-Darcy's law-ground water flow equations for homogenous, heterogenous, isotropic and anisotropic conditions-	CO1,CO2	3
4.2	mass transport of solutes, advection dispersion equation, favorable conditions for contaminant transport-modelling parameters and boundary conditions	CO2,CO3,CO4	3
4.3	seawater intrusion – basic concepts and modeling-Ghyben–Herzberg formula**,** popular ground water models	CO2,CO3,CO4	3
5	**Module V: Total Lecture Hours- 9**		
5.1	Environmental noise - noise generation mechanisms- need for noise modelling noise mapping methodology-	CO2	3
5.2	modelling inputs-sound propagation factors - Equivalent Continuous Sound Pressure Level (Leq)-	CO2	3
5.3	modelling traffic noise-CoRTN and RLS90 models	CO3	3

Model Question Paper

Reg No.:_______________ **Name:__________________________**

SIXTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: 22CEHR610.3
Course Name: ENVIRONMENTAL POLLUTION MODELLING

Max. Marks: 100 Duration: 3 Hours

Part A
(***Answer all questions; each question carries 3 marks***)

72. Why do we need models in environmental studies?
73. A model can never represent the reality. Explain
74. What are the assumptions used in a box model?
75. Explain how atmospheric stability influence dispersion of air pollutants?
76. Explain Streeter-Phelps model
77. How modeling lake water quality is different from modeling river water quality?
78. Explain the role of Darcy's law in ground water modelling
79. Explain Ghyben-Herzberg relation
80. What are the parameters influencing propagation of environmental noise?
81. What you mean by Equivalent Continuous Sound Pressure Level ?

PART B
(Answer one full question from each module, each question carries 14 marks)

82. (a) Why do we need models? Explain with an example (5 Marks)
    (b) Discuss various types of models used in environmental science (9 Marks)

OR

83. (a) Reliability of a model does not necessarily increase with model complexity. Why? (5 Marks)
    (b) Discuss the model building framework (9 Marks)

84. (a) An air sampling station is located at an azimuth of 203° from a cement plant at a distance of 1500 meters. The cement plant releases fine particulate matter at the rate of 94.5 g/s from a 30

meter high stack. What is the contribution from the cement plant to the ambient particulate matter concentration at the sampling station when the wind is from 30 ^{o} at 3 m/s. Given that σy= 150m and σz= 87m (9 Marks)

(d) What is plume rise? How it influences air quality modelling? (5 Marks)

OR

85. (a) How stability parameters used in Gaussian model are determined? (5 Marks)
(b) Discuss in detail various air quality models and their use (9 Marks)

86. (a) Briefly discuss the historical development of water quality models (9 Marks)
(b) What input data are needed for sediment transport modelling (4 Marks)

OR

16. (a) The initial BOD of a river just below a sewage outfall is 25 mg/L. The oxygen deficit just upstream from the outfall is 2 mg/L. The deoxygenation rate coefficient k_d is 0.4/day, and the reaeration rate coefficient k_r is 0.7/day. The river is flowing at a speed of 30 km /day.
(i) Find the critical distance downstream at which DO is a minimum
(ii) Find the minimum DO (9Marks)
(b) Explain low flow analysis (5 Marks)

33. (a) An aquifer has a cross section with a horizontal width of 265m, and a vertical thickness below the water table of 42m. The water table is 36 m below the ground surface. Each day 3340 m3 of water is discharged through the cross section. The aquifer rock has an effective porosity of 27.1%. Find the Seepage velocity through the aquifer (5 Marks)
(b) Discuss the basic mechanisms that drives the contaminant transport in ground water (9 marks)

OR

34. (a) What are the contaminant, soil and site properties and their combinations that are critical in the transport of contaminants to ground water (5 Marks)
(b) The distance from the base of a pumping well to the freshwater-saltwater interface is 100 m, the pumping rate is 3000 m3/day, and the hydraulic conductivity is 10 m/d.
(i) What will be the position of the interface?
(ii) What's the maximum permitted pumping rate for the well? (9 Marks)

35. (a) Discuss the need for environmental noise modelling (5 Marks)
(b) Explain noise mapping methodology (9 Marks)

OR

36. (a) Explain the noise generation mechanisms (5Marks)
(b) Discuss how traffic noise can be modelled? (9 Marks)

SEMESTER 7

SEMESTER VII

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	22CET 701	DESIGN OF STEEL STRUCTURES	3-0-0	3	3
B	22CEE 702	PROGRAM ELECTIVE II	3-0-0	3	3
C	22CEO 703	OPEN ELECTIVE	3-0-0	3	3
D	22MNC 704	INDUSTRIAL SAFETY ENGINEERING	2-1-0	3	---
S	22CEL 705	ENVIRONMENTAL ENGINEERING LAB	0-0-3	3	2
T	22CES 706	SEMINAR	0-0-3	3	2
U	22CEP 707	PROJECT PHASE I	0-0-6	6	2
R/M/H	22CEMR708 22CEHR709.1/2/3	Remedial/Minor/Honours course	3-1-0	4*	4
TOTAL				**24/28**	**15/19**

PROGRAM ELECTIVE II

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
B	22CEE 702.1	PRESTRESSED CONCRETE	3-0-0	3	3
	22CEE 702.2	GROUND IMPROVEMENT TECHNIQUES	3-0-0		
	22CEE 702.3	HIGHWAY MATERIALS AND DESIGN	3-0-0		
	22CEE 702.4	APPLIED HYDROLOGY	3-0-0		
	22CEE 702.5	CONSTRUCTION PLANNING & MANAGEMENT	3-0-0		
	22CEE 702.6	ADVANCED ENVIRONMENTAL ENGINEERING	3-0-0		
	22CEE 702.7	OPTIMISATION TECHNIQUES IN CIVIL ENGINEERING	3-0-0		

OPEN ELECTIVE

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
C	22CEO 703.1	ENVIRONMENTAL IMPACT ASSESSMENT	2-1-0	3	3
	22CEO 703.2	APPLIED EARTH SYSTEMS	2-1-0		
	22CEO 703.3	INFORMATICS FOR INFRASTRUCTURE MANAGEMENT	2-1-0		
	22CEO 703.4	NATURAL DISASTERS AND MITIGATION	2-1-0		
	22CEO 703.5	ENVIRONMENTAL HEALTH AND SAFETY	2-1-0		
	22CEO 703.6	GEOINFORMATICS	2-1-0		

MINOR

SEMESTER	BASKET I				BASKET II				BASKET III			
	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT
S7	22CEMR708	MINI PROJECT	4	4	22CEMR708	MINI PROJECT	4	4	22CEMR708	MINI PROJECT	4	4

HONOURS

SEMESTER	GROUP I				GROUP II				GROUP III			
	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT
S 7	22CEHR709.1	MODERN CONSTRUCTION MATERIALS	4	4	22CEHR709.2	SOIL DYNAMICS AND MACHINE FOUNDATIONS	4	4	22CEHR709.3	ENVIRONMENTAL POLLUTION CONTROL TECHNIQUES	4	4

<table>
<tr><td rowspan="2">22CT 701</td><td rowspan="2">DESIGN OF STEEL STRUCTURES</td><td>CATEGORY</td><td>L</td><td>T</td><td>P</td><td>CREDIT</td><td>Year of Introduction</td></tr>
<tr><td>PCC</td><td>3</td><td>0</td><td>0</td><td>3</td><td>2019</td></tr>
</table>

Preamble: Goal of this course is to expose the students to the fundamental concepts of DESIGN OF STEEL STRUCTURES. After this course, students will be able to design steel structures and to recognize practical problems in real-world situations and respond accordingly.

Prerequisite: CE302 Structural Analysis II

Course Outcomes: After the completion of the course the student will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO 1	Explain the behavior and properties of structural steel members to resist various structural forces and actions and apply the relevant codes of practice	Understanding and analysing
CO 2	Analyses the behavior of structural steel members and undertake design at both serviceability and ultimate limit states	Analysing and applying
CO 3	Explain the theoretical and practical aspects of Design of composite Steel Structure along with the planning and design aspects	Understanding and applying
CO 4	Apply a diverse knowledge of Design of Steel engineering practices applied to real life problems	Applying
CO5	Demonstrate experience in the implementation of design of structures on engineering concepts which are applied in field Structural Engineering	Applying

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	3	2	-	-	-	-	-	-	-	-	-
CO 3	2	3	2	-	-	-	-	-	-	-	-	-
CO 4	2	3	3	-	-	-	-	-	-	-	-	-
CO5	2	3	3	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember			
Understand	25	10	20
Apply		40	50
Analyse	25		30
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation (CIE) Pattern :

Attendance : 10 Marks

Continuous Assessment Test (2 numbers) : 25 Marks

Assignment/Quiz/Course project : 15 Marks

End Semester Examination (ESE) Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

Course Outcome 1 (CO1): Explain the behavior and properties of structural steel members to resist various structural forces and actions and apply the relevant codes of practice

1. The fundamental concepts of basic structural behavior in steel structures
2. Basic theories of steel structural members and its analysis.

Course Outcome 2 (CO2): Analyses the behavior of structural steel members and undertake design at both serviceability and ultimate limit states

1. The fundamental concepts of different structural members
2. Design of simple structural members

Course Outcome 3 (CO3): Explain the theoretical and practical aspects of Design of composite Steel Structure along with the planning and design aspects

Design of composite beams and columns

Course Outcome 4 (CO4): Apply a diverse knowledge of Design of Steel engineering practices applied to real life problems

Design of different structural elements considering application aspects

Course Outcome 5 (CO5): Demonstrate experience in the implementation of Design of Structures on engineering concepts which are applied in field Structural Engineering

1. Design engineering problems giving importance to field application

SYLLABUS

Module	Contents
1	Introduction to steel and steel structures, properties of steel, structural steel sections. Introduction to design: Design loads and load combinations, limit state design concepts. Connections bolted and welded (direct loads)
2	Tension members-Types of sections – net area- design of tension members- concept of shear lag-use of lug angle-connections in tension members
3	Compression members- design of struts- solid and built up columns for axial loads-- design of lacings and battens-column bases- slab base – gusseted base
4	Design of beams- laterally restrained and unrestrained – simple and compound beams- plate girders subjected to uniformly distributed loads – design of stiffeners.
5	Design of roof trusses- types-design loads and load combinations- assessment of wind loads-design of purlins. Moment resistant/Eccentric connections (in plane and out of plane) Fire resistant design-criterion-fire resistance assessment-material property-design approach-passive protection for steel work-fire resistant steel-fire performance assessment

Text Books:

1. Punmia B. C., Jain A. K. and Jain A. K., Design of Steel Structures, Laxmi Publications (P) Ltd, 2017

2. Ramchandra S and Virendra Gehlot, Design of Steel Structures Vol. II, Standard Book House, 2007

References:

1. N.Subramanian; Steel Structures, Oxford Publication
2. P. Dayaratnam., Design of Steel Structures ,Wheeler Publishing, 2003
3. Raghupathi, Steel Structures, Tata McGraw Hill, 2006
4. V L Shah & Veena Gore, Limit State Design of steel Structures , Structures Publications, 2009
5. William T Segui., Steel Design , Cenage Learning, 6e, 2017
6. IS 800 – 2007, Code of practice for Structural steel design, BIS

7. IS:875-Part 3-2015 Design loads for buildings Part 3: Wind loads , BIS

Model Question Paper

QP CODE:

Reg No.:_______________ **Name:__________________________**

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CET 701

Course Name: DESIGN OF STEEL STRUCTURES

(Use of Codes IS 800, IS 875, IS 883 is permitted. Assume suitable data wherever necessary)

Max. Marks: 100 Duration: 3 hours

Part A

(***Answer all questions; each question carries 3 marks***)

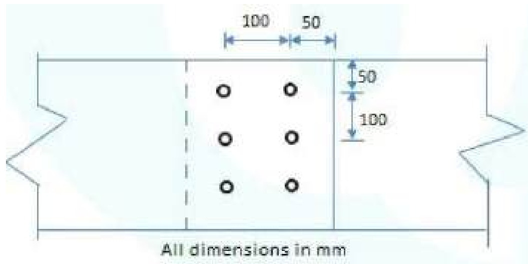
1. Explain the failures of bolted joints.
2. What do you mean by prying forces?
3. Under what circumstances do we use slot welds and plug welds?
4. With the help of suitable diagram, explain the concept of shear lag
5. What are the main purposes of lacings and battens?
6. Explain the failure modes of axially loaded columns
7. Distinguish between laterally restrained and unrestrained beams.
8. What is lateral torsional buckling of beams?
9. List the different fire resistance criterion.
10. List the various passive protection methods for steel structures against fire.

Part B

(Answer ANY ONE full question from each module, each question carries 14 marks)

Module – 1

11. Determine the strength and efficiency of a bolted lap joint shown I the figure. The bolts are of 20mm diameter, grade 4:6. The plates are of 12mm thick and grade F2410



12. An ISMC 250 @ 298kg/m is used as a tie member to transmit a factored load of 800kN. The channel section is connected to a gusset plate of 10mm thickness Design a fillet weld if the lap length is limited to 300mm Provide slot welds if required.

Module – 2

13. Design a tension member to carry an axial factored load of 500kN Use a double angle rolled steel section connected (at site) to each side of a gusset plate of10mm thick using 20mm diameter bolts of grade 4.6.
14. A tie member consisting of an angle section ISA100x75x8 designed to transfer a factored axial load of 280kN, is to be welded to a gusset plate of 10mm thick using 6mm fillet weld. Design the weld if the weld is provided on three sides by overlapping the angle on the gusset plate at a shop. Also sketch the connection showing the weld lengths.

Module – 3

15. Determine the design compressive load capacity of a column. made of a rolledsteel section ISMC200@217N/m if length of the column is 3m, with both ends fixed.
16. Design a column 10 m long to carry a factored axial load of 1100kN The column is restrained in position but not in direction at both ends. Design a batten system for the column Assume that the two channels are kept back to back

Module – 4

17. Design a simply supported beam of 10m effective span carrying a total factored load of 60kN/m. The depth of beam should not exceed 500mm. The compression flange of beam is laterally supported by floor construction. Assume stiff end bearing is 75mm

18. A conference hall 8mx12m is provided with a 120 mm RCC slab over rolled steel I beams spaced 4m centre-to-centre. The super imposed load is 4kN/m2 and floor finish of 1.5 kN/m2. Design one of the beam as laterally supported.

Module – 5

19. A purlin is to be designed to support a GI sheet as roofing material for a truss spaced at 3.5m c/c. purlin along the principal rafters are arranged at a distance of 1.35mc/c. The pitch of truss is 0.2m. Design a section for the purlin. Assume basic wind speed as 44m/s
20. Explain the different fire-resistant design approaches used in steel structures.

Course Contents and Lecture Schedule:

Module	Contents	Course Outcomes Addressed	Hours
1	**Module 1**		**7**
1.1	Introduction to steel and steel structures	CO 1	1
1.2	Properties of structural steel and types of Structural steel sections	CO 1	1
1.3	Introduction to design-design philosophies- Design loads and load combinations	CO 1	1
1.4	Connections: Bolted-different types-joints(lap joint, butt joint) -eccentric loaded connections-beam to beam connections	CO 1,CO2	2
1.5	Connections : Welded-different types-joints(lap joint, butt joint) -eccentric loaded connections-beam to beam connections	CO1,CO 2	2
2	**Module 2**		**7**
2.1	Introduction- Types of tension members	CO 1	1
2.2	Modes of failure	CO 1	1
2.3	Factors affecting strength of tension members	CO 1	1
2.4	Design of tension members	CO 1 ,CO2	1
2.5	Concept of shear lag	CO 1	1
2.6	Application of lug angle	CO1,CO 3	1
2.7	Connections in tension members	CO 1 & CO 3	1
3	**Module 3**		**7**
3.1	Introduction-compression members-classification-Behavior (theory only-No equations)	CO 1	1
3.2	Design of struts	CO 1,CO2	1
3.3	Solid and built up columns for axial loads alone	CO1,CO2, CO 3	1
3.4	Design of lacing system	CO 1,CO3	1
3.5	Design of battening system	CO 1,CO3	1

3.6	Column base plate introduction- Simple slab base plate-only axial load	CO 1,CO2	1
3.7	Gusseted base-only axial load	CO1,CO2, CO 4	1
4	**Module 4**		**7**
4.1	Introduction- Beams, design of Laterally restrained beams	CO 1	1
4.2	Laterally Unrestrained beams	CO 1	1
4.3	Design of simple beams	CO 1,CO2	1
4.4	Design of compound beams	CO 1,CO3	1
4.5	Plate girder design for welded connection	CO 1,CO2	1
4.6	Design of stiffeners-end bearing and intermediate stiffeners	CO2,CO 4	1
4.7	Gantry girders AND beam-column (introduction only-No design)	CO 1 & CO 4	1
5	**Module 5**		**7**
5.1	Type of roof truss-design loads and load combinations	CO 1	1
5.2	Calculation of wind loads	CO 1 & CO 4	1
5.3	Design of purlins	CO 1, CO2	1
5.4	Moment resistant and eccentric connections-in plane and out of plane-(No design)	CO 1	1
5.5	Introduction –Fire resistance criterion	CO 1	1
5.6	Fire resistance assessment of steel structure-material property at elevated temperature-design approaches and tools-different models-methods-procedures	CO 1, CO2	1
5.7	Passive protection-fire performance assessment	CO1, CO3	1

22CEE 702.1	Prestressed concrete	Category	L	T	P	Credit	Year of Introduction
		PEC	3	0	0	3	2019

Preamble: The general objective of this course is to expose the students the fundamental concepts of prestressed concrete as well as the analysis and design of various prestressed concrete elements using IS Code provisions

Pre-requisite: Structural analysis, Design of reinforced concrete structures

Course outcome

After the course, the student will be able to:

Course Outcome	Description	Prescribed learning level
CO1	Explain the concepts of prestressing and analyze prestressed concrete members for stresses and losses.	Analyze
CO2	Analyze for flexure, shear and torsional resistance of PSC members.	Analyze
CO3	Design pre-tensioned and post-tensioned members symmetrical about vertical axis.	Apply/Create
CO4	Analyse the deflections of prestressed concrete members.	Analyze
CO5	Analyze the transfer of prestress in pretensioned members, anchorage zone stresses in post tensioned members.	Analyze
CO6	Analyze prestressing of statically indeterminate structures and design continuous members.	Apply
CO7	Analyze composite construction of prestressed and in situ concrete.	Apply
CO8	Analyze and design PSC slabs.	Apply/ Create

CET413 Prestressed Concrete		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	3	2										
	CO2	3	3	3									
	CO3	3	3	3									
	CO4	3	2	3									
	CO5	3	3	3									
	CO6	3	3	3									
	CO7	3	2	3									
	CO8	3	2	3									

Assessment pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	5	5	10
Understand	10	10	20
Apply	15	15	30
Analyze	20	20	40
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment Test (2 numbers)	:	25 marks
Assignment/Course project	:	15 marks
Total	**:**	**50 marks**

End semester examination pattern – There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry

14 marks.

Course Level Assessment (Sample) Questions

CO1: Explain the concepts of prestressing and analyze prestressed concrete members for stresses and losses.

1. What are the advantages of prestressed concrete members?
2. What is the need of high strength concrete and steel?
3. Explain different prestressing systems with figures.
4. What do you mean by stress concept while analyzing prestressed systems?
5. Explain the load balancing concept for extreme fiber stresses for parabolic tendon profile.
6. Explain the losses of prestress in prestressed concrete
7. A rectangular concrete beam, 100 mm wide by 250 mm deep spanning over 8 m is prestressed by a straight cable carrying an effective prestressing force of 250 kN located at an eccentricity of 40 mm. The beam supports a live load of 1.2 kN/m. Calculate the resultant stress distributing for the central cross section of the beam. The density of concrete is 24 kN/m^3.

CO2: Analyze for flexure, shear and torsional resistance of PSC members.

1. A concrete beam of rectangular section, 300 mm wide and 800 mm deep is subjected to a twisting moment of 30 kNm and a prestressing force of 150 kN acting at an eccentricity of 220 mm. Calculate the maximum principal tensile stress. If the beam is subjected to a bending moment of 100 kNm in addition to the twisting moment, calculate the maximum principal tensile stress.
2. Explain with neat sketches the types of shear cracks in structural concrete members.
3. A concrete beam of rectangular section, 300 mm wide and 800 mm deep is subjected to a twisting moment of 30 kNm and a prestressing force of 150 kN acting at an eccentricity of 220 mm. i) Calculate the maximum principal tensile stress. ii) If the beam is subjected to a maximum bending moment of 100 kNm in addition to the twisting moment, calculate the maximum principal tensile stress

CO3: Design pre-tensioned and post-tensioned members symmetrical about vertical axis.

1. A post tenstioned prestressed concrete beam for the roof of an industrial structure has a simply supported span of 25 m. The beam has to support a dead load of 2 kN/m together with an imposed load of 15 kN/m in addition to the self-weight. The grade of concrete is M40 and the compressive strength of concrete at transfer is 35 N/mm^2. The loss ratio is 0.80. The 64 mm cables containing 7-15 mm strands with an ultimate load capacity of 1750 kN are available. Use IS 1343 provisions, design the cross section of the girder to comply

with various limit states. Sketch the details of cables in the cross-section and the profile of cables along the depth and length of the beam.

2. A prestressed concrete beam of rectangular cross-section is subjected to an effective prestressing force of 500 kN provided by 5 numbers of 12.5 mm diameter strands of cross-sectional area 506 mm^2. The cross-sectional dimension of the beam is 450 mm × 600 mm. The eccentricity of the posttensioned tendon is 150 mm. A service load Bending Moment of 176 kNm, Torsional Moment of 56 kNm and Shear Force of 75kN are acting at the section of the beam. Take the cube strength of concrete as 40N/mm^2 and the ultimate tensile strength of tendons as 1820 N/mm^2. Using IS 1343 codal provisions design the longitudinal and transverse reinforcements of the beam.

CO4: Analyse the deflections of prestressed concrete members.

1. A prestressed concrete beam spanning over 8 m is of rectangular section, 150 mm wide and 300 mm deep. The beam is prestressed by a parabolic cable having an eccentricity of 75 mm below the centroidal axis at the centre of span and an eccentricity of 25 mm above the centroidal axis at the support sections. The initial force in the cable is 350 kN. The beam supports 3 concentrated loads of 10 kN each at intervals of 2m. Assume any missing values. a) Neglecting losses of prestress, estimate the short-term deflection due to (Prestress + self-weight) and b) Allowing for 20 percent loss in prestress, estimate the long-term deflection under (prestress + self-weight +live load) assuming creep coefficient at 1.80.
2. A PSC beam of breadth 240 mm and depth 300 mm is S.S. on an effective span of 6 m. It is prestressed by parabolic cable with an eccentricity of 75mm below the centroid at the mid span section and 45 mm above centroid at the support section. Prestressing force is 480 kN. Calculate the initial mid-span deflection. Assume the unit weight of concrete as 25 kN/m^2 and modulus of elasticity of concrete as 2.5 x 10^4 MPa.
3. A PSC beam of span 8m has the following data: Area =32×103 mm^2, E=38 kN/m^2, width of gyration 72 mm Cable: parabolic, 6 wires of 7 mm HTS, concentric at supports and eccentric by 50mm at mid span. Fpe= 1000 N/mm2 Determine the deflection for the following cases: i) Self-weight+ Prestress ii) Self-weight +Prestress +Live load of 3 kN/m.

CO5: Analyze the transfer of prestress in pretensioned members, anchorage zone stresses in post tensioned members.

1. Explain the process of transferring of prestress in pretensioned members.
2. What are anchorage zones in post tensioned member?
3. What do you mean by bursting force?
4. Explain the end block designing.

5. Design the bearing plate and the end zone reinforcement for the following bonded post-tensioned beam. The strength of concrete at transfer is 50 MPa. A pre-stressing force of 1055 kN is applied by a single tendon. There is no eccentricity of the tendon at the ends.

CO6: Analyze prestressing of statically indeterminate structures and design continuous members.

1. What are the advantages of using continuous members in prestressed concrete structures?
2. Distinguish between primary moment and secondary moment in the context of prestressing of statically indeterminate structures.
3. A two-span continuous beam ABC (AB=BC=10 m) is of rectangular section 200 mm wide and 500 mm deep. The beam is prestressed by a parabolic cable, concentric at end supports and having an eccentricity of 100 mm towards the soffit of the ebam at centre of spans and 200 mm towards the top of beam at mid support B. The effective force in the cable is 500 kN. a) Show that the cable is concordant. b) Locate the pressure line in the beam when it supports an imposed load of 5.6 kN/m in addition to its self-weight.

CO7: Analyze composite construction of prestressed and in situ concrete.

1. What are the advantages of using precast prestressed units in association with the in-situ concrete?
2. Distinguish between propped and unpropped construction methods in composite construction using stress diagrams at various stages of construction.
3. A rectangular pretensioned concrete beam has a breadth of 100 mm and depth 230 mm and the prestress after all losses have occurred is 12 N/sq.mm at the soffit and zero at the top. The beam is incorporated in a composite I beam by casting a top flange of breadth 300 mm and depth 50 mm. Calculate the maximum uniformly distributed live load that can be supported on a simply supported span of 4.5m, without any tensile stresses occurring, a) if the slab is externally supported while casting and b) if the pretensioned beam supports the weight of the slab while casting.
4. Specify the various steps involved in the design of composite sections.

CO8: Analyze and design PSC slabs.

1. What are the different types of Prestressed concrete slabs?
2. Design a post-tensioned prestressed concrete two-way slab 6 m by 8 m in size to support a live load of 3 kN/m^2. If cables of four wires of 5 mm diameter stressed to 1000 n/mm^2 are available for use, determine the number of cables in the two principal directions. The stresses in concrete not to exceed 14 N/mm^2 in compression and tensile stresses are not permitted under service loads. The loss ratio is 0.8. Check for the limit state of serviceability and collapse.

Course Code: 22CEE 702.1

PRESTRESSED CONCRTE

Syllabus

Module I

Basic concept and principles of pre-stressed concrete; Prestressing: - Pre tensioning and Post tensioning, Thermo elastic and Chemical prestressing. Need of high strength concrete and steel, Advantages of prestressed concrete over reinforced concrete, Different prestressing systems; Analysis of prestress and bending stress: - Stress concept, Strength concept: - Pressure line and internal resisting couple and Load balancing concept for extreme fiber stresses for various tendon profile.

Losses of Prestress: Stages of losses, Types of losses in pre-tensioning and post-tensioning due to Elastic shortening, Shrinkage, Creep, Relaxation, Anchorage Slip, Friction and Sudden changes in temperature; Loss of pre-stress Stresses at transfer and service loads.

Module II

Flexural strength: - Codal provision for Limit state design, Design stress strain curve for concrete. Design of sections for flexure: - Expressions for minimum section modulus, Prestressing force, and Eccentricity. Limiting zone for prestressing force.

Shear Resistance of PSC members: - Shear and Principal stresses, Ultimate shear resistance of PSC members: - Section cracked and uncracked, Design for shear using IS code.

Torsional Resistance of PSC members: - Pure torsion, Combined bending moment and torsion, Combined bending moment, shear and torsion, Design of reinforcement using IS code provision.

Module III

Design of Pretensioned and Post-Tensioned Flexural Members:
Dimensioning of Flexural members, Estimation of Self Weight of Beams, Design of Pre tensioned and Post tensioned members symmetrical about vertical axis;

Deflections of prestressed concrete members: Importance, factors, short term and long term deflection. Codal provisions.

Module IV

Transfer of Prestress in Pretensioned members : Transmission length, Bond stresses, Transverse Tensile Stresses, End-Zone reinforcement, Flexural bond stresses, Code Provisions

Anchorage zone Stresses in post tensioned members : Stress distribution in end block, Methods of investigation, Anchorage zone reinforcements, Design (IS Code method only).

Module V

Prestressing of statically indeterminate structures: Advantages, Effect, Method of achieving continuity, Primary, Secondary and Resultant moments, Pressure line, Concept of Linear transformation, Guyon's theorem, Concordant cable profile and its determination. Design of Continuous Prestressed beams

Composite construction of Prestressed and in situ Concrete:

Types of composite construction, Analysis of stresses, Flexural strength.

PSC Slabs - Types**,** Design and analysis of PSC One-way and two way slabs.

Text Books

1. Krishna Raju.N,(2012) "*Prestressed Concrete*", 4th Edition, Tata McGraw Hill Publishing Co. New Delhi.
2. Dayaratnam.P.(2012), "*Prestressed Concrete*", Tata McGraw Hill Publishing Co. New Delhi
3. Sinha .N.C & S.K. Roy,(1985) "*Fundamentals of Prestressed Concrete*, S.Chand & Co.
4. Rajagopalan.N.(2010) "*Prestressed Concrete*", Narosa Publishing House, New Delhi.

References:

1. Lin .T.Y. (2010)"*Design of Prestressed Concrete Structures*", John Wiley and Sons - Inc
2. Leonhardt.F. (1964),"*Prestressed Concrete Design and Construction*", - Second Edition Wilhelm Ernst & Sohn, Berlin.
3. Guyon .V.(1995), "*Limit State Design of Prestressed Concrete*", - Vol - 1 & 2, Applied Science Publishers, London
4. Mallick and Rangaswamy., (2014),"*Mechanics of Prestressed Concrete Design* ", Khanna Publishers.
5. Pandit & Gupta., " *Prestressed Concrete* ", CBS Publishers
6. F.K. Hong & R.H. Evans., (2007),*"Reinforced and Prestressed Concrete* " Tata McGraw Hill Co.
7. Abeles, P. W., *"The Principles and Practice of Prestressed Concrete"*, Crosby Lockwood and Sons, 1949.
8. Collins, M. P. and Mitchell, D., "*Prestressed Concrete Structures"*, Prentice-Hall, Inc., 1991.
9. Magnel, G., "*Prestressed Concrete",* Concrete Publications, 1948.
10. Nawy, E. G., "*Prestressed Concrete – A Fundamental Approach"*, 5th Edition, Prentice-Hall, Inc., 2006.
11. Nilson, A.,"*Design of Prestressed Concrete"*, 2nd Edition, John Wiley & Sons, 1987.

Reference codes

Codes The codes related with prestressed concrete are listed below according to the publishing agencies.

Bureau of Indian Standards

IS:784 - 2001 Prestressed Concrete Pipes (Including Fittings) - Specification

IS:1343 - 1980 Code of Practice for Prestressed Concrete

IS:1678 - 1998 Specification for Prestressed Concrete Poles for Overhead Power, Traction and Telecommunication Lines

IS:1785 - 1983 Specification for Plain Hard Drawn Steel Wire for Prestressed Concrete

Part-1: Cold-drawn Stress-relieved wire

Part-2: As-drawn wire

IS: 2090 - 1983 Specification for High Tensile Steel Bars Used in Prestressed Concrete

IS:2193 - 1986 Specification for Precast Prestressed Concrete Steel Lighting Poles

IS:3370 - 1967 Code of Practice for Concrete Structures for Storage of Liquids

Part-3: Prestressed Concrete Structures

IS:6003 - 1983 Specification for Indented Wire for Prestressed Concrete

IS:6006 - 1983 Specification for Uncoated Stress Relieved Strand for Prestressed Concrete IS:6461 - 1973 Glossary of Terms Relating to Cement Concrete

Part 11: Prestressed Concrete

IS:10790 - 1984 Methods of Sampling of Steel for Prestressed and Reinforced Concrete

Part-1: Prestressing Steel

Part-2: Reinforcing Steel Prestressed Concrete Structures Dr. Amlan K Sengupta and Prof. Devdas Menon Indian Institute of Technology Madras

IS:13158 - 1991 Specification for Prestressed Concrete Circular Spun Poles for Overhead Power, Traction and Telecommunication Lines

IS: 14268 - 1995 Specification for Uncoated Stress Relieved Low Relaxation Seven Ply Strand for Prestressed Concrete

American Concrete Institute, USA

ACI 318M-05, Building Code Requirements for Structural Concrete and Commentary.

British Standard Institution, UK

BS 8110: Part 1 : 1997, Structural Use of Concrete : Part 1 Code of Practice for Design and Construction.

Council of Standards Australia

AS 3600 Concrete Structures 2001.

European Committee for Standardisation

EN 1992 Design of Concrete Structures, 2005.

Handbook

PCI Design Handbook, 5th Edition published by the Precast/Prestressed Concrete Institute, USA

Course Plan: Prestressed concrete

Module	Topic	Course outcome addressed	No of Hours
Module I (7 Hours)			
1.1	Basic concept and principles of pre-stressed concrete; Prestressing: - Pre tensioning and Post tensioning, Thermo elastic and Chemical prestressing. Need of high strength concrete and steel	CO1	1
1.2	Advantages of prestressed concrete over reinforced concrete, Different prestressing systems	CO1	1
1.3	Analysis of prestress and bending stress: - Stress concept, Strength concept: - Pressure line and internal resisting couple	CO1	1
1.4	Load balancing concept for extreme fiber stresses for various tendon profile	CO1	1
1.5	Losses of Prestress: Stages of losses, Types of losses in pre-tensioning and post-tensioning	CO1	1
1.6	Losses due to Elastic shortening, Shrinkage, Creep, Relaxation, Anchorage Slip, Friction and Sudden changes in temperature	CO1	1
1.7	Loss of pre-stress Stresses at transfer and service loads	CO1	1
Module II (7 Hours)			
2.1	Flexural strength: - Codal provision for Limit state design, Design stress strain curve for concrete. Design of sections for flexure: - Expressions for minimum section modulus,	CO2	2
2.2	Prestressing force, and Eccentricity. Limiting zone for prestressing force.	CO2	1
2.3	Shear Resistance of PSC members: - Shear and Principal stresses, Ultimate shear resistance of PSC members: - Section cracked and uncracked	CO2	1
2.4	Design for shear using IS code. Torsional Resistance of PSC members: - Pure torsion, Combined bending moment and torsion	CO2	1

2.5	Combined bending moment, shear and torsion modes of failure	CO2	1
2.6	Design of torsion reinforcement using IS code provision	CO2	1
Module III (7 Hours)			
3.1	Design of Pretensioned and Post-Tensioned Flexural Members: Dimensioning of Flexural members, Estimation of Self Weight of Beams	CO3	1.5
3.2	Design of Pre tensioned and Post tensioned members symmetrical about vertical axis	CO3	1.5
3.3	Deflections of prestressed concrete members: Importance, factors	CO4	1
3.4	Short term deflections	CO4	1.5
3.5	Long term deflection. Codal provisions	CO4	1.5
Module IV (7 Hours)			
4.1	Transfer of Prestress in Pretensioned members - Introduction	CO5	1
4.2	Transmission length, Bond stresses	CO5	1
4.3	Transverse Tensile Stresses, End-Zone reinforcement,	CO5	1
4.4	Flexural bond stresses, Code Provisions	CO5	1
4.5	Anchorage zone Stresses in post tensioned members : Stress distribution in end block, Methods of investigation	CO5	1
4.6	Anchorage zone reinforcements, Design (IS Code method only)	CO5	2
Module V (7 Hours)			

5.1	Prestressing of statically indeterminate structures: Advantages, Effect, Method of achieving continuity, Primary, Secondary and Resultant moments	CO6	1
5.2	Pressure line, Concept of Linear transformation, Guyon's theorem, Concordant cable profile and its determination	CO6	1
5.3	Design of Continuous Prestressed beams	CO6	1
5.4	Composite construction of Prestressed and in situ Concrete: Types of composite construction	CO7	1
5.5	Composite construction: Analysis of stresses, Flexural strength	CO7	1
5.6	PSC Slabs - Types, Design and analysis of PSC One-way slabs	CO8	1
5.7	Design and analysis of PSC two-way slabs	CO8	1

Course Code: 22CEE 702.1
Prestressed Concrete
(Model question paper)

Qn No	**Question**	**Marks**	**Course outcome (CO) Assessed**
	Part A **(Answer ALL Questions)**		
1	Discuss the merits and demerits of prestressed concrete	3	CO1
2	Distinguish between pretensioned and post-tensioned members	3	CO1
3	List the various types of losses of prestress in pretensioned and post-tensioned members	3	CO1
4	What are the various modes of failures in prestressed concrete beams due to shear and torsion?	3	CO2
5	What do you mean by concordant cable profile	3	CO6
6	List the various factors which influence the deflection in prestressed concrete members.	3	CO4
7	What are the different types of composite structures?	3	CO7
8	What is the necessity of providing reinforcements in the anchorage zone of a prestressed concrete beam? Give the supporting figures	3	CO5
9	Briefly explain the importance of creep and shrinkage of concrete in long-term deflections of prestressed members.	3	CO4
10	How does the prestress gets transferred to the member in pretensioned members.	3	CO5
	Part B **(Answer ANY ONE FULL question from each module)**		
	Module I		
11	a) A pretensioned beam 250 mm wide and 360 mm deep is prestressed by 10 wires of 8mm dia. Initial stress to	8	CO1

	1000N/mm^2. The centroid of the steel wires is located at 105mm from the soffit. Determine the max.stress in concrete immediately after transfer allowing elastic shortening of concrete only at the level of centroid of the steel. If however, the concrete is subjected to additional shortening due to the creep and shrinkage and the steel is subjected to relaxation of stress of 5% of initial stress. Find the final percentage of loss of stress in steel wires. Take Es=210kN/mm2 , Ec=36.85kN/mm2 , ϕ=1.60, take residual shrinkage strain =3X10-4 b) Derive the loss due to elastic shortening of concrete.	6	CO1
12	A rectangular concrete beam, 100 mm wide by 250 mm deep, spanning over 8 m is prestressed by a straight cable carrying an effective prestressing force of 250 kN located at an eccentricity of 40 mm. The beam supports a live load of 1.2 kN/m. a) Calculate the resultant stress distribution for the central cross section of the beam. The density of concrete is 24 kN/m^3. b) Find the magnitude of the prestressing force with an eccentricity of 40 mm which can balance the stresses due to dead and live loads at the bottom fibre of the central section of the beam.	14	CO1
	Module II		
13	a) A prestressed girder of rectangular section 150 mm wide by 300 mm deep is to be designed to support an ultimate shear force of 130 kN. The uniform prestress across the section is 5 N/mm2 . Given the characteristic cube strength of concrete as 40 N/mm2 and Fe-415 HYSD bars of 8 mm diameter, design suitable spacing for the stirrups conforming to the Indian standard code IS: 1343 recommendations. Assume cover to the reinforcement as 50 mm. b) A pretensioned girder having a T-section is made up of a flange 200 mm wide and 60 mm thick. The overall depth of	7 7	CO2

	the girder is 600 mm. The thickness of the web is 60 mm. The horizontal prestress at a point 300 mm from the soffit is 10 N/mm^2. The shear stress due to transverse load acting at the same point is 2.5 N/mm^2. Determine the increase in the principal tensile stress at this point if the T-section is subjected to a torque of 2 kN-m		CO2
14	a) The horizontal prestress at the centroid of a concrete beam of rectangular cross section 340mm by 600mm, is 10N/mm2 and maximum shearing force on the beam is 90kN.Calculate the maximum principal tensile stress b) A concrete beam of rectangular section, 300 mm wide and 800 mm deep is subjected to a twisting moment of 30 kNm and a prestressing force of 150 kN acting at an eccentricity of 220 mm. i) Calculate the maximum principal tensile stress. ii) If the beam is subjected to a maximum bending moment of 100 kNm in addition to the twisting moment, calculate the maximum principal tensile stress.	6 8	CO2 CO2
	Module III		
15	a) A beam of size 200 mm × 350 mm is prestressed with 12 wires of 7 mm diameter straight tendons located at a distance of 75 mm from the soffit of the beam. The wires are stressed to 750 N/mm^2. The beam supports an imposed load of 7 kN/m over a span of 8 m. The modulus of elasticity of concrete is 38 kN/mm^2, and density of concrete is 24 kN/m^3. Estimate the central deflection of the beam under the action of prestress, self-weight and live load. Compare this value with IS 1343 codal provisions b) A concrete beam is prestressed by a sloping tendon having an eccentricity of e1 towards the soffit at centre of span and an eccentricity of e2 towards the top at supports. Find the ratio of these eccentricities for zero deflection at the centre of span due to prestress only.	9 5	CO4 CO4
16	A prestressed concrete beam of rectangular cross-section is subjected to an effective prestressing force of 500 kN provided by 5 numbers of 12.5 mm diameter strands of cross-sectional area 506 mm2 . The cross-sectional dimension of the beam is 450 mm × 600 mm. The eccentricity of the posttensioned tendon is 150 mm. A	14	CO3

	service load Bending Moment of 176 kNm, Torsional Moment of 56 kNm and Shear Force of 75kN are acting at the section of the beam. Take the cube strength of concrete as 40N/mm2 and the ultimate tensile strength of tendons as 1820 N/mm^2 . Using IS 1343 codal provisions design the longitudinal and transverse reinforcements of the beam.		
	Module IV		
17	a) Estimate the transmission length at the ends of a pretensioned beam prestressed by 7-mm diameter wires. Assume the cube strength of concrete at transfer as 42 N/mm^2 . b) A pretensioned beam is prestressed using 5 mm diameter wires with an initial stress of 80 percent of the ultimate tensile strength of steel (fpu = 1600 N/mm2). The cube strength of concrete at transfer is 30 N/mm^2 . (a) Calculate the transmission length (b) compute the bond stress at ¼ and ½ the transmission length from the end and (c) Calculate the overall average bond stress.	9 5	CO5 CO5
18	The end block of a post tensioned concrete beam 300 mm×300 mm is subjected to a concentric anchorage force of 800 kN by a freyssinet anchorage system of area 1100mm$^{2.}$ Design, Discuss and detail the anchorage reinforcement for the end block.	14	CO5
	Module V		
19	The floor slab of an industrial structure, spanning over 8 m is to be designed as a one-way prestressed concrete slab with parallel post-tensioned cables. The slab is required to support a live load of 10 kN/sq.m with the compressive and tensile stress in concrete at any stage not exceeding 14 and zero 14 kN/sq.m respectively. Design a suitable thickness for the slab and estimate the maximum horizontal spacing of the Freysinet cables (12 of 5 mm diameter initially stressed to 1200 N/sq.mm) and their position at mid span section. The loss ratio is 0.8.	14	CO8

20	a) A PSC beam of 230 mm wide and 450 mm deep is used over a span of 4m is pre stressed by a cable carrying a force of 650 kN & located at an eccentricity of 75mm. The beam supports three concentrated loads of 25 kN at each quarter span points. Determine the location of the pressure line in beam at center, quarter & support sections. Neglect the moment due to self-weight of the beam.	7	CO6
	b) A two-span continuous prestressed concrete beam ABC (AB=BC = 15 m) has a uniform cross section with a width of 250 mm and a depth of 600 mm. The cable carrying an effective prestressing force of 500 kN is parallel to the axis of the beam and located at an eccentricity of 200 mm. Determine the secondary and resultant moment developed at mid support section B.	7	CO6

22CEE 702.2	GROUND IMPROVEMENT TECHNIQUES	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PEC	3	0	0	3	2019

Preamble:
The course introduces the various types ground improvement techniques that can be adopted in different site conditions. It enables the students to choose the suitable ground improvement techniques to be adopted depends on the site condition and requirements.

Prerequisite: Geotechnical Engineering-I, Geotechnical Engineering-II

Course Outcomes: After the completion of the course the student will be able to

Course Outcome	Description of Course Outcome
CO1	Classify different ground improvement methods based on the soil suitability
CO2	Outline the basic concept/ design aspects of various ground improvement methods
CO3	Identify the construction procedure of different ground improvement methods
C04	Choose different application of geosynthetics and soil stabilization in Ground improvement

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10		10
Understand	10	10	30

Apply	30	40	60
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10marks

Continuous Assessment Test(2numbers) : 25 marks

Assignment/Quiz/Course project : 15marks

End Semester Examination Pattern: There will be two parts; Part A and Part B.

Part A contain 10 questions with 2 questions from each module having 3 marks for each question. Students should answer all questions.

Part B contains 2 questions from each Module of which student should answer any one question form each Module. Each question should have a maximum if two subdivision and carry 14marks.

Course Level Assessment Questions

CO1: Classify different ground improvement methods based on the soil suitability

1. Explain the relevance of Ground improvement techniques.
2. Summarize different method of in-situ ground improvement techniques and its applications.

CO2: Outline the basic concept/ design aspects of various ground improvement methods

1. Explain the basic concept used in blasting technique
2. Explain the design consideration of soil nailing

CO3: Identify the construction procedure of different ground improvement methods

1. Explain Grouting technique used for Ground Improvement.
2. Explain the installation procedure of PVD

CO4: Choose different application of geosynthetics and soil stabilization in Ground improvement

1. Illustrate the application of geo-textile as (a) Filtration (b) Drainage (c) Erosion control**.**
2. Explain the chemical aspects of lime stabilization

SYLLABUS

MODULE 1.
Roll of ground improvement in foundation engineering- Classification of ground improvement methods-different problematic soil -selection of suitable ground improvement based on the soil condition-Emerging trends in ground improvement-Different materials used for ground improvement and its property
Brief introduction to sustainable method of ground improvement, Microbial methods

MODULE 2.
In situ Densification-Deep compaction and shallow compaction, Properties of compacted soil and compaction control.
Dynamic Compaction-Procedure-design considerations, soil suitability, Merit and demerit.
Vibration methods-Vibro compaction techniques-Blasting, Vibrating compactors
Vibro displacement methods-Vibro-flotation. Sand pile, Stone column, Lime pile-principle, installation procedure, basic design considerations, soil suitability, Merit and demerits

MODULE 3.
Drainage methods- Methods of dewatering systems-Open sump, Well points, Vaccuum and electroosmotic methods
Drains-type-drainage facility after construction-Foundation drain, Blanket drain, Interceptor drains
Precompression and Vertical Drain – Preloading, Vertical drain-General principle, Soil suitability, Type-sand drain, PVD-Installation procedure

MODULE 4.
Earth Reinforcement-Reinforcement materials-reinforced earth wall-design considerations-construction procedure
Soil nailing & Micro pile-basic concept-construction sequence-areas of application-design considerations-merit and demerit
Geosynthetics - use, type-function- filtration, drainage, separation-Application of geotextile in different works

MODULE 5.
Grouting Techniques- Grouting material-groutability-stabilization with cement, lime and chemicals
Classification of grouting techniques-particulate grouting, Compaction grouting, penetration grouting, jet grouting, displacement grouting-Procedure-soil suitability-merit and demerit.
Thermal method-stabilization by heating, stabilization by cooling
Soil stabilization- Fundamental concept of soil-cement stabilisation, Mechanism of lime stabilisation

Text Books:

1. P. Purushothama Raj, Ground Improvement Techniques , Laxmi Publications (P) Ltd.
2. Manfred. R. Hausmann, Engineering Principles of Ground Modification, McGraw Hill, 1989

References:

1. M.P. Moseley and K. Kirsch (Edited), Ground improvement, Second edition, Spon Press, Taylor and Francis group

Lecture Plan

Module	*Topic*	*CO addressed*	*No. of Lectures*
1	**Module I: Total lecture hours:6**		
1.1	Roll of ground improvement in foundation engineering-	1	1
1.2	Classification of ground improvement methods	1	1
1.3	Different problematic soil -selection of suitable ground improvement based on the soil condition-	1	1
1.4	Emerging trends in ground improvement	1	1
1.5	Different materials used for ground improvement and its property	1	1
1.6	Brief introduction to sustainable method of ground improvement, Microbial methods	1	1
2	**Module II: Total lecture hours-8**		
2.1	In situ Densification-Deep compaction and shallow compaction, Properties of compacted soil and compaction control.	2	1
2.2	Dynamic Compaction-Procedure-design considerations, soil suitability, Merit and demerit.	2	1
2.3	Vibration methods-Vibro compaction techniques-	3	1
2.4	Blasting, Vibrating compactors	3	1

2.5	Vibro displacement methods-Vibro-flotation.	3	1
2.6	Sand pile, Stone column, principle, installation procedure, basic design considerations, soil suitability, Merit and demerits	2,3	2
2.7	Lime pile-principle, installation procedure, basic design considerations, soil suitability, Merit and demerit	2,3	1
3	**Module III: Total lecture hours: 7**		
3.1	Drainage methods- Methods of dewatering systems-Open sump, Well points, Vaccuum	2,3	1
3.2	Vaccuum and electroosmotic methods	2,3	2
3.3	Drains-type-drainage facility after construction-Foundation drain, Blanket drain, Interceptor drains	2	1
3.4	Precompression and Vertical Drain – Preloading, General principle, Soil suitability	2,3	1
3.5	Vertical drain-General principle, Soil suitability, Type-sand drain, PVD-Installation procedure	2,3	2
4	**Module IV: Total lecture hours: 7**		
4.1	Earth Reinforcement-Reinforcement materials-reinforced earth wall, construction procedure	2,3	2
4.2	Soil nailing -basic concept-construction sequence-areas of application-design considerations-merit and demeri	3	1
4.3	Micro pile-basic concept-construction sequence-areas of application-design considerations-merit and demerit	2,3	1
4.4	Geosynthetics - use, type-function- filtration, drainage, separation-Application of geotextile in different works	4	3
5	**Module V: Total lecture hours: 8**		

5.1	Grouting Techniques- Grouting material-groutability-stabilization with cement, lime and chemicals	2,3	2
5.2	Classification of grouting techniques-particulate grouting, Compaction grouting, penetration grouting, jet grouting, displacement grouting-Procedure-soil suitability-merit and demerit.	2,3	3
5.3	Thermal method-stabilization by heating , stabilization by cooling	1,2	1
5.4	Soil stabilization- Fundamental concept of soil-cement stabilisation, Mechanism of lime stabilisation	4	2

MODEL QUESTION PAPER

Reg.No.:____________ Name:_________________

SEVENTH SEMESTER B. TECH DEGREE EXAMINATION

Course Code: 22CEE 702.2

Course Name: GROUND IMPROVEMENT TECHNIQUES

Max.Marks:100 Duration: 3Hours

PART A

Answer all questions; each question carries 3 marks.

(10×3 marks = 30 marks)

1. Explain the importance of Ground improvement in foundation engineering.
2. Name any five-material used for ground improvement.
3. Explain the blasting method used for Ground improvement.
4. Write note on Column techniques for Ground improvement.
5. How Electro osmotic method is applied for Ground Improvement.
6. Write note on the importance of lowering the ground water in a construction site.
7. Outline the use of micro pile as ground improvement choice.
8. List different type of geosynthetics.
9. list the different type of grouting material used for ground improvement?
10. Explain method of stabilisation using cement.

PART B

Answer one full question from each module

(14 × 5 = 70 Marks)

Module I

11. (a) Categories different ground improvement methods based on the soil suitability (7)

    (b) Explain the property of material suitable for ground improvement (7)

12. (a) List the different method of insitu ground improvement techniques and its applications (10)

    (b) Explain the properties of material used for ground improvement (4)

Module II

13. (a) Explain the Dynamic Compaction for Ground improvement. (10)
    (b) Explain about the compaction control (4)
14. (a) Outline how the ground improvement are achieved by vibration techniques. (7)
    (b) What is Stone column? Explain its method of construction (7)

Module III

15. (a) Explain the application of vertical drain. (7)
    (b) What is PVD? Explain its advantage over other drains. (7)
16. (a) Illustrate the well point system of dewatering. (7)
    (b) Explain about different drains facility (7)

Module IV

17. Illustrate the application of geo-textile as (a) Filtration (b) Drainage (c) Erosion control.
18. Explain the design considerations of a) Reinforced Earth wall (b) Soil nailing

Module V

19. (a) Explain Grouting technique used for Ground Improvement. (10)
    (b) Explain the principle of ground freezing (4)
20. Describe the chemical aspects of lime stabilisation and its effects on adjacent soil.

CEE 702.3	HIGHWAY MATERIALS AND DESIGN	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	3	0	0	3	2019

Preamble

The course aims to impart in-depth knowledge pertinent to characteristics of various highway materials, tests on highway materials, design of bituminous mixes, analysis and design of highway pavements etc.

Prerequisite: CET 206 Geo Technical Engineering

Course Outcomes: After the completion of the course the students will be able to

CO 1	Identify suitable materials for different types of pavements (K2, K3)
CO 2	Interpret material test results with respect to field conditions and standards (K2, K3)
CO 3	Apply the pavement material properties to analysis of pavements (K2,K3)
CO 4	Evaluate material properties and design pavement mixes.(K3,K4)
CO 5	Analyse and design the pavement, flexible or rigid, for the conditions prevailing at site (K3, K4)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3											
CO 2	3		2			2						
CO 3	3	2		2								2
CO 4	3	3	3	2		2						2
CO 5	3	3	3	3		3						2

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (marks)
	Test 1 Marks	Test 2 Marks	
Remember	**5**	**5**	**10**
Understand	**10**	**10**	**40**
Apply	**5**	**5**	**20**
Analyse	**5**	**5**	**30**
Evaluate			
Create			

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern:

The question consists of two parts- Part A and Part B. Part A consists of 10 questions with 3marks for each (two questions from each module). Part B consists of two questions from each module, out of which one has to be answered. Each question carries 14 marks and can have maximum 2 subdivisions.

Sample Course Level Assessment Questions:

Course Outcome 1 (CO1

Identify the suitable materials for different types of pavement constructions?

Course Outcome 2 (CO2)

Assess the suitability of pavement materials with respect to field conditions of any site known to you.

Course Outcome 3 (CO3)

Explain the various properties of materials used in the analysis of pavements, why are they significant?

Course Outcome 4 (CO4)

1) What are the desirable properties of bituminous mixes?
2) Explain the steps involved in the bituminous mix design?
3) What are the techniques used?

Course Outcome 5 (CO5)

1) Design a flexible pavement for the conditions prevailing at a specific site(rural road through marshy land).
2) Analyse the various stresses developed in a rigid pavement, for the specified requirements?

Syllabus

Module 1	**Pavements and materials: Desirable properties and testing of road aggregates** Introduction to highway pavements, Types and component parts of pavements, Factors affecting design and performance of pavements, Pavement Materials-Road aggregates, Tests on aggregates and specifications for flexible and rigid pavements, Principles and methods of Gradation for soil – Aggregate mixes. Alternate Materials for durable pavements -Artificial aggregates.
Module 2	**Desirable properties and testing of bitumen** Properties and tests on Bituminous binders –Methods of grading, Emulsions – Properties and tests, Cut backs and Modified binders-Types, characteristics and uses, aging of bitumen and aging tests.
Module 3	**Testing of subgrade soil and pavement mixes** Functions and significance of sub grade properties, Various methods of assessment of sub grade soil strength for pavement design. Testing of sub base, base course and interlayer materials. Mix design procedures in mechanical stabilisation of soils, Design of bituminous mixes by Marshall, Hubbard - field and Hveem's methods
Module 4	**Design of flexible pavements** Introduction to analysis and design of flexible pavements, Stresses and deflections in homogeneous masses, Burmister's 2 layer and 3 layer theories, Wheel load stresses, ESWL of multiple wheels, Repeated loads and EWL factors, Empirical, semi - empirical and theoretical approaches for flexible pavement design, Group index, CBR, Triaxial, Mcleod and Burmister layered system methods
Module 5	**Design of rigid pavements** Introduction to analysis and design of rigid pavements, Types of stresses and causes, Factors influencing stresses, General conditions in rigid pavement analysis, Warping stresses, Frictional stresses, Combined stresses Joints in cement concrete pavements, Joint spacings, Design of slab thickness, Design and detailing of longitudinal, contraction and expansion joints, IRC methods of Design

Text Books:

1. Justo C.E.G , Veeraragavan A and Khanna S.K; Highway Engineering, Nem Chand Publishers, Revised 10th Ed, 2018.
2. Yoder E J and Witezak, M W Principles of Pavement Design, John Wiley and sons, 2nd Edition 2011.
3. Kadiyali L R: Highway Engineering, Khanna publication Revised Edition, 2017

References

1. Yang, H H Design of functional pavements, McGraw-Hill, 1973.

2.Atkins, H.N Highway Materials, Soils, and Concrete, Prentice Hall, 2002

3. Krebs, R.D. Highway Materials, McGraw Hill Text, 1971.
4. Relevant IRC codes
5. MoRTH specifications

Course Content and lecture Schedule:

No.	Topic	Course Outcome	No. of Hrs
1	**Module 1**		Total:6
1.1	Introduction to highway pavements, Types and component parts of pavements	CO1	1
1.2	Road aggregates, Tests and specifications on aggregates for flexible and rigid pavements	CO1	2
1.3	Principles and methods of Gradation for soil – Aggregate mixes	CO1	2
1.4	Alternate Materials for durable pavements: artificial aggregates		1
2	**Module 2**		Total: 6
2.1	Properties and tests on bitumen -Bituminous binders –Methods of grading,	CO2	2
2.2	Emulsions –Properties and tests, Cut backs and Modified binders-Types, characteristics and uses,	CO2	2
2.3	Aging of bitumen and aging tests		2
3	**Module 3**		Total: 8
3.1	Functions and significance of sub grade properties, Various methods of assessment of sub grade soil strength for pavement design	CO3	2
3.2	Soil stabilization -Mix design procedures in mechanical stabilization of soils,	CO4	3
3.3	Sub base, base course mixes and interlayers. Design of bituminous mixes by Marshall, Hubbard - field and Hveem's methods	CO4	3
4	**Module 4**		Total: 8
4.1	Introduction to analysis and design of flexible pavements, Stresses and deflections in homogeneous masses, Burmister's 2 layer and 3 layer theories,	CO5	2
4.2	Wheel load stresses, ESWL of multiple wheels, Repeated loads and EWL factors,	CO5	2
4.3	Empirical and semi - empirical approaches for flexible pavement design, Group index, CBR, Triaxial and Mcleod methods	CO5	2
4.4	Theoretical approaches for flexible pavement design- Burmister layered system methods of design	CO5	2

5	**Module 5**		Total: 8
5.1	Introduction to analysis and design of rigid pavements, Types of stresses and causes, Factors influencing stresses, General conditions in rigid pavement analysis,	CO5	2
5.2	Warping stresses, Frictional stresses, Combined stresses	CO5	2
5.3	Joints in cement concrete pavements, Joint spacings, Design and detailing of longitudinal, contraction and expansion joints,	CO5	2
5.4	Design of slab thickness and IRC methods of Design	CO5	2

Model Question Paper

SEVENTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEE 702.3

Course Name: **HIGHWAY MATERIALS AND DESIGN**

Max. Marks:100 Duration: 3 hrs

PART A

(Answer all Questions: Each question carries 3 marks)

1 Differentiate between flexible and rigid pavements?

2 Explain the term Combined Flakiness and Elongation index?

3 What are the different methods of grading of bituminous binders?

4 Explain the aging of bitumen?

5 What are the desirable properties of subgrade soil?

6 What are the factors in design of mix for mechanical stabilization?

7 Mention the effects of repeated applications of loads on pavements?

8 Explain the concept of Equivalent single wheel load?

9 How the warping stresses in rigid pavements calculated?

10 The width of expansion joint gap is 2.5cm in a cement concrete pavement. If the laying temperature is 10^{o}C and the maximum slab temperature in summer is 54^{o}C, Calculate the spacing between expansion joints. coefficient of thermal expansion of concrete as $10*10^{-6}$per^{o}C.

(3 x 10=30 marks)

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PART B

(Answer one full question from each module)

11	a.	Explain the principles of various tests for judging the suitability of road aggregates? Specify the desirable values of the test results	14
		OR	
12	a.	Explain the Principles and methods of Gradation for soil – Aggregate mixes	10
	b.	Write short notes on the alternate Materials for durable pavements	4

13	a.	Explain the uses of emulsion and how are they prepared?	7
	b.	List the different types of cutbacks and explain the various tests carried out on cutback bitumen?	7
		OR	
14		What are the various tests carried out on bitumen? Briefly mention the principles and uses of each test	14
15	a.	With the help of graphs, explain the procedure for the Marshall method of design of bituminous mixes?	8
	b.	Explain the various methods to evaluate the soil strength for pavement design?	6
		OR	
16	a.	Explain the principles of soil stabilization	4
	b.	Explain the mix design procedures in mechanical soil stabilization	10
17	a.	State the advantages and disadvantages of group index method for design of flexible pavements.	6
	b.	Explain the concept of CBR and give the step-by-step procedure for design of flexible pavements as per IRC recommendations.	8
		OR	
18	a.	Illustrate the application of Burmister's 2 layer theory in pavement design?	6
	b.	Estimate the thickness of sub base, base and wearing surface course of a flexible pavement system from following data, using Kansas triaxial test method. Moduli values of subgrade, sub base, base and wearing course are 100kg/cm^2, 200kg/cm^2, 400kg/cm^2 and 1000kg/cm^2 respectively. Given that radius of contact = 15cm, Design deflection = 0.25cm, assume saturation coefficient based on rainfall as 0.5 and traffic coefficient as 2. Wheel load = 4080kg.	8
19	a.	Calculate the stresses at interior, edge and corner regions of a C.C. pavement using Wester Gaard's stress equation for the following data: Wheel load=5100 kg, Modulus of elasticity of concrete=3x10^5 kg/cm^2, poisson's ratio=0.15, pavement thickness=24cm, modulus of subgrade reaction =6 kg/cm^3, radius of contact area=15cm	7
	b.	Define 1) Modulus of Subgrade reaction 2) Radius of relative stiffness 3) Equivalent radius of resisting section	7
		OR	
20	a.	Estimate the thickness of cement concrete pavement using the method suggested by Indian Roads Congress Modulus of elasticity of concrete -3 *10^5 kg/cm^2 Modulus of rupture of concrete – 40 kg/cm^2 Poissons ratio of concrete – 0.15 Modulus of subgrade reaction - 6 kg/cm^2 Wheel load =5100kg	14

Radius of contact area =15cm

22CEE 702.4	APPLIED HYDROLOGY	Category	L	T	P	Credit	Year of Introduction
		PEC	3	0	0	3	2019

Preamble: The general objective of this course is to expose the students to the advanced concepts of hydrology and hydrologic systems. The course aim to impart the knowledge on the availability of water on hydrosphere, scientific methods quantifying the components of hydrologic cycle, statistical analysis of hydrologic datasets etc.

Pre-requisite: Hydrology and Water Resources Engineering

Course outcome

After the course, the student will be able to:

CO1	Describe or estimate the different components of hydrologic cycle
CO2	Explain the behavior of catchments and quantify the response of the catchment
CO3	Apply the concept of hydrograph for runoff computation
CO4	Apply hydrological and statistical principles for estimation of flood discharge
CO5	Determine the aquifer parameters and assess the groundwater quality

CO - PO Mapping

CET443 Applied Hydrology		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	3	3										
	CO2	3	3										
	CO3	3	3										
	CO4	3	3										
	CO5	3	3										

Assessment pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	5	5	15
Understand	10	10	15
Apply	20	20	40
Analyze	15	15	30

Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance	:	10 Marks
Continuous Assessment Test (2 numbers)	:	25 Marks
Assignment/Quiz/Course project	:	15 Marks
Total	**:**	**50 Marks**

End semester examination pattern – There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 Marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 Marks.

Course Code: 22CEE 702.4

Applied Hydrology

(Course Level Assessment Questions)

Qn No	Question	Marks	Course outcome (CO) Assessed
	Part A **(Answer ALL Questions)**		
1	Explain probable maximum precipitation	3	CO1
2	Explain Green Ampt model for estimation of infiltration	3	CO1
3	What are the factors to be considered in selection of site for a stream gauging station ?	3	CO2
4	Explain the concept of stream ordering	3	CO2
5	Explain linear reservoir model	3	CO3
6	State the limitations of rational method of runoff computation	3	CO1, CO2

<table>
<tr><td>7</td><td>Differentiate hydrologic routing and hydraulic routing</td><td>3</td><td>CO4</td></tr>
<tr><td>8</td><td>Explain different methods of flood control</td><td>3</td><td>CO4</td></tr>
<tr><td>9</td><td>Explain Electrical resistivity method</td><td>3</td><td>CO5</td></tr>
<tr><td>10</td><td>Explain Method of images</td><td>3</td><td>CO5</td></tr>
<tr><td></td><td>Part B
(Answer ANY ONE FULL question from each module)</td><td></td><td></td></tr>
<tr><td></td><td>Module I</td><td></td><td></td></tr>
<tr><td>11 (a)</td><td>What are IDF curves? Explain its practical use</td><td>5</td><td>CO1</td></tr>
<tr><td>11 (b)</td><td>Estimate the PET of an area for the season November to February in which wheat is grown. The area is in North India at a latitude of 30^{o} N with mean monthly temperatures and % daytime hours as below:
<table>
<tr><td>Month</td><td>November</td><td>December</td><td>January</td><td>February</td></tr>
<tr><td>Monthly day time hours</td><td>7.19</td><td>7.15</td><td>7.30</td><td>7.03</td></tr>
<tr><td></td><td>16.5</td><td>13</td><td>11</td><td>14.5</td></tr>
</table></td><td>9</td><td>CO1</td></tr>
<tr><td>12 (a)</td><td>Explain Penmann-Montieth method of evapotranspiration estimation</td><td>3</td><td>CO1</td></tr>
<tr><td>12 (b)</td><td>The annual rainfall data of a station A and the annual rainfall values of 6 neighboring stations are given below. Check the consistency of rainfall record of station A, by double mass curve method
<table>
<tr><td>Year</td><td>Annual rainfall of Station A (cm)</td><td>6 station average (cm)</td></tr>
<tr><td>1969</td><td>177</td><td>143</td></tr>
<tr><td>1970</td><td>144</td><td>132</td></tr>
<tr><td>1971</td><td>178</td><td>146</td></tr>
<tr><td>1972</td><td>162</td><td>147</td></tr>
<tr><td>1973</td><td>194</td><td>161</td></tr>
<tr><td>1974</td><td>168</td><td>155</td></tr>
</table></td><td>11</td><td>CO1</td></tr>
</table>

	<table><tr><td>1975</td><td>196</td><td>152</td></tr><tr><td>1976</td><td>144</td><td>117</td></tr><tr><td>1977</td><td>160</td><td>128</td></tr><tr><td>1978</td><td>196</td><td>193</td></tr><tr><td>1979</td><td>141</td><td>156</td></tr><tr><td>1980</td><td>158</td><td>164</td></tr><tr><td>1981</td><td>145</td><td>155</td></tr><tr><td>1982</td><td>132</td><td>143</td></tr><tr><td>1983</td><td>95</td><td>115</td></tr><tr><td>1984</td><td>148</td><td>135</td></tr><tr><td>1985</td><td>142</td><td>163</td></tr><tr><td>1986</td><td>140</td><td>135</td></tr><tr><td>1987</td><td>130</td><td>143</td></tr><tr><td>1988</td><td>137</td><td>130</td></tr><tr><td>1989</td><td>130</td><td>146</td></tr><tr><td>1990</td><td>163</td><td>161</td></tr></table>		
	Module II		
13 (a)	Explain area-velocity method of stream gauging	4	CO2
13 (b)	Three points on a rating curve of a stream gauging station obtained from an eye-fit for the stage discharge data have the following coordinates : (100 m^3/s; 121.67 m) (200 m^3/s,122.23 m) and (400 m^3/s,123.04). Determine the equation of the rating curve and compute the discharge in the stream corresponding to a stage of 124.5 m	10	CO2
14 (a)	Define (i) form factor (ii) Compactness coefficient (iii) drainage density (iv) time of concentration	8	CO2
14 (b)	Explain the method of extrapolation of stage discharge curve	6	CO2
	Module III		
15 (a)	What are instantaneous Unit hydrographs ? Explain Nash's conceptual model	5	CO3

<table>
<tr><td>15 (b)</td><td>The effective rainfall hyetograph of a complex storm has duration of 12 h with rainfall intensity 2, 0.75 and 4 cm/h respectively in successive 4 h periods. The ordinates of the corresponding DRH read at 4 h intervals are 160, 300, 570, 636, 404, 234, 105 and 48 m^3/sec. Determine the ordinates of 4 hr unit hydrograph using the deconvolution method</td><td>9</td><td>CO3</td></tr>
<tr><td>16</td><td>From the topographical map of a drainage basin, the following quantities are measured. A=3480 km^2; Length of the main stream (L) is 148 km and distance from the centroid of the basin to the catchment outlet (Lc) is 74 km. The 12-hr. unit hydrograph derived for the basin has a peak ordinate of 155 m^3/s occurring at 40 hrs. Derive the 4-hr. synthetic unit hydrograph of sub- basin of the catchment, having drainage area 2500 km^2, L=100km and Lc=50 km using Snyder's method</td><td>14</td><td>CO3</td></tr>
<tr><td>17 (a)</td><td>Data of monthly rainfall and runoff available for a basin are shown in Table. Develop a linear regression model between rainfall (P) and runoff (Q) and plot the relation.
<table>
<tr><td>Month</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td>P(cm)</td><td>4</td><td>40</td><td>30</td><td>25</td><td>20</td><td>15</td><td>10</td><td>5</td><td>50</td></tr>
<tr><td>Q (cm)</td><td>0.2</td><td>9</td><td>5</td><td>4.5</td><td>2.5</td><td>2</td><td>1</td><td>0.5</td><td>14</td></tr>
</table></td><td>8</td><td>CO3</td></tr>
<tr><td>17 (b)</td><td>Explain the deconvolution method of derivation of unit hydrograph from complex storms</td><td>6</td><td>CO3</td></tr>
<tr><td></td><td>Module IV</td><td></td><td></td></tr>
<tr><td>18 (a)</td><td>Flood frequency computations for a river by using Gumbel's method, yielded the following results:
<table>
<tr><td>Return period (T)(Years)</td><td>Peak flood (m^3/sec)</td></tr>
<tr><td>40</td><td>27000</td></tr>
<tr><td>80</td><td>31000</td></tr>
</table>
Estimate the flood magnitude in the river with the return period of 240 years.</td><td>7</td><td>CO4</td></tr>
<tr><td>18 (b)</td><td>Explain how you will you determine the Muskingum parameters</td><td>7</td><td>CO4</td></tr>
<tr><td>19 (a)</td><td>Route the flood hydrograph given below through a channel reach and derive the outflow hydrograph. The values of Muskingum parameters K and x are 12 h and 0.278 respectively</td><td>10</td><td>CO4</td></tr>
</table>

Time(h)	0	4	8	12	16	20	24	28	32	36	40	44	48	52	56
Flow (m^3/s)	42	68	116	164	194	200	192	170	150	128	106	88	74	62	54

19 (b)	Explain Flood routing and its importance	4	CO4
	Module V		
20 (a)	Derive partial differential equation for unsteady flow in a confined aquifer	10	CO5
20 (b)	Explain method of images	4	CO5
21 (a)	Explain the methods of artificial recharge of groundwater	7	CO5
21 (b)	Explain the methods of control of seawater intrusion	7	CO5
22 (a)	Derive Ghyben-Herzberg relationship	6	CO5
22 (b)	In an artesian aquifer, the drawdown is 1.2 m at a radial distance of 10 m from a well after two hours of pumping. On the basis of Thies' non- equilibrium equation determine the pumping time for the same drawdown at a radial distance of 30 m from the well	8	CO5

Course Code: 22CEE 702.4

Applied Hydrology
Syllabus

Module I (7 Hours)

Hydrology and Hydrologic cycle -Test for consistency of rainfall records – Double mass curve method. Analysis of rainfall data – intensity, duration, frequency (IDF) curves; depth area duration (DAD) curve. Frequency analysis-probable maximum precipitation, Hydrologic abstractions- Infiltration- Green Ampt method, Evapotranspiration- methods of estimation-Blaney Criddle method (problem)- penman method, Penmann-Montieth method

Module II (7 hours)

Catchment characteristics, classification of streams - stream pattern and stream order; Stream gauging – methods- rating of current meter; Extension of stage discharge curve, Adjustment of stage discharge curve; selection of site for stream gauging stations.

Module III (7 Hours)

Runoff - Computation of runoff– Hydrograph analysis- S-hydrograph, unit hydrograph from complex storm, synthetic unit hydrograph, Instantaneous unit hydrograph (Brief description only), linear reservoir model. Application of linear regression in hydrologic modeling

Module IV (7 Hours)

Design flood and their Estimation - Different methods; Flood frequency studies -Gumbel’s method; Flood routing-Hydrologic and Hydraulic routing, Flood routing through reservoirs – concept only. Flood routing through channels - Muskingum method, determination of Muskingum parameters. Flood control methods - Flood forecasting and warning (Brief descriptions only)

Module V (7 Hours)

Partial differential equation governing unsteady groundwater flow- Evaluation of aquifer parameters - Theis method -Jacob’sapproximation method. Well flow near aquifer boundaries - Method of images, Surface investigation of groundwater -Electrical resistivity method. Graphical representation of hydrochemical data, Pollution of groundwater- sources; Seawater intrusion-Ghyben-Herzberg relationship, Method of control of seawater intrusion; Artificial recharge of groundwater.

Text Books:

1. Raghunath H.M. Hydrology: Principles, Analysis and Design. New Age International New Delhi 2006.
2. VenTe Chow. Hand book of Applied Hydrology, Tata McGraw Hill, 1988
3. Subramanya K. Engineering Hydrology, Tata McGraw Hill, 2013.
4. Reddy JR, A text book of Hydrology, Laxmi Publishers

References:

- Ojha, C.S.P, R. Berndtsson, P.Bhunya, Engineering Hydrology, Oxford University Press
- Todd D. K. Ground Water Hydrology, Wiley, 2005.
- H.M Raghunath. Groundwater. New Age International New Delhi 2007
- Garg S. K. Hydrology and Water Resources Engineering, Khanna Publishers New Delhi 2005.
- Punmia B.C. Ashok K Jain, Arun K Jain, B. B. L Pande, Irrigation and Water Power Engineering, Laxmi Publications (P) Ltd. 2009

Course Code: 22CEE 702.4

Applied Hydrology
Lecture Plan

Module	Topic	COs Mapped	Hours
	Module I		
1	Hydrology and Hydrologic cycles	CO1	1
2	Test for consistency of rainfall data – Double Mass Curve	CO1	1
3	Analysis of rainfall data intensity, duration, frequency (IDF) curves	CO1	1
4	Depth area duration (DAD) curve. Frequency analysis-probable maximum precipitation	CO1	1
5	Hydrologic abstractions- Infiltration- Green Ampt method	CO1	1
6	Evapotranspiration- methods of estimation- Blaney Criddle method	CO1	1
7	Penman method, Penmann-Montieth method	CO1	1
	Module II		
8	Catchment Characteristics	CO2	1
9	Classification of streams – Stream pattern and stream order.	CO2	1
10	Stream gauging- different methods	CO2	1
11	Selection of site for stream gauging stations	CO2	1
12	Stage Discharge Curve	CO2	1
13	Extension of stage discharge curve	CO2	1
14	Adjustment of stage discharge curve	CO2	1
	Module III		
15	Runoff - Computation of runoff	CO1,CO2	1
16	Hydrograph analysis and S- Hydrograph	CO3	2
17	Unit hydrograph from complex storm	CO3	1
18	Synthetic unit hydrograph	CO3	1
19	Instantaneous unit hydrograph, Linear reservoir model	CO3	1
20	Application of linear regression in hydrologic modeling	CO1, CO3	1
	Module IV		

21	Design flood and their Estimation - Different methods	CO4	1
22	Flood frequency studies -Gumbel's method	CO4	1
23	Flood routing-Hydrologic and Hydraulic routing	CO4	1
24	Flood routing through reservoirs – concept and approaches	CO4	1
25	Flood routing through channels - Muskingum method	CO4	2
26	Flood control methods , Flood forecasting and warning	CO1, CO4	1
	Module V		
27	Partial differential equation governing unsteady groundwaterflow; Evaluation of aquifer parameters - Theis method	CO5	1
28	Jacob'sapproximation method	CO5	1
29	Well flow near aquifer boundaries - Method of images	CO5	1
30	Surface investigation of groundwater -Electrical resistivity method.	CO5	1
31	Graphical representation of hydro chemical data, Pollution of groundwater- sources;	CO5	1
32	Seawater intrusion- Ghyben-Herzberg relationship, Method of control of seawater intrusion; Artificial recharge of groundwater.	CO5	2

Model Question Paper

Reg No.:...................... **Name:..**

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CET 443
Course Name: Applied Hydrology

Max. Marks: 100 **Duration: 3 hours**

PART A

(Answer all questions; each question carries 3 Marks)

1 Explain Probable maximum precipitation

2 Explain Green Ampt model for estimation of infiltration

3 What are the factors to be considered in selection of site for a stream gauging station?

4 Explain the concept of stream ordering

5 Explain S-hydrograph and its use

6 State the limitations of rational method of runoff computation

7 Differentiate hydrologic routing and hydraulic routing

8 Explain different methods of flood control

9 Explain Electrical resistivity method for subsurface investigations

10 Explain Method of images 10*3=30

PART B

(Answer one full question from each module, each question carries 14 Marks)

Module I

11 a. What are the causes of inconsistency of rainfall records? Explain double mass curve method for checking the consistency of rainfall records (5 Marks)

b. Determine the yearly consumptive use ofwater for sugarcane for the following data by Blaney-criddle method (9 Marks)

Month	Monthly mean Temperature (°C)	Monthly Crop coefficient k	Percent sunshine hours, P
January	13.1	19.05	7.38
February	15.7	20.32	7.02
March	20.7	21.59	8.39
April	27.0	21.59	8.69
May	31.1	22.86	9.48
June	33.0	24.13	9.41
July	30.6	25.40	9.60
August	29.0	25.40	9.60
September	28.2	24.13	8.33
October	24.7	22.86	8.01
November	18.8	21.59	7.25
December	13.7	19.05	7.06

OR

12 a. Explain any three methods for determination of evapotranspiration (9 Marks)

b. What are IDF curves? Explain its practical use? (5 Marks)

Module II

13 a. Define (i) compactness coefficient (ii) Ordering of streams (iii) stream patterns (7 Marks)

b. Three points on a rating curve of a stream gauging station obtained from an eye-fit for the stage discharge data have the following coordinates : (100 m^3/s; 121.67 m) (200 m^3/s,122.23 m) and (400 m^3/s,123.04). Determine the equation (7 Marks) of the rating curve and compute the discharge in the stream corresponding to a stage of 124.5 m

OR

14 a. Explain current meter rating curve and its use. How it is different from stage discharge curve? (10 Marks)

b. Explain the classification of streams (4 Marks)

Module III

15 a. What are instantaneous Unit hydrographs? Explain Nash's conceptual model (5 Marks)

b. The effective rainfall hyetograph of a complex storm has duration of 12 h with rainfall intensity 2, 0.75 and 4 cm/h respectively in successive 4 h periods. The ordinates of the corresponding DRH read at 4 h intervals are 160, 300, 570, 636, 404, 234, 105 and 48 m^3/sec. Determine the ordinates of 4 hr unit hydrograph using the deconvolution method (9 Marks)

OR

16 . From the topographical map of a drainage basin, the following quantities are measured. A=3480 km^2; Length of the main stream (L) is 148 km and distance from the centroid of the basin to the catchment outlet (Lc) is 74 km. The 12 hr unit hydrograph derived for the basin has a peak ordinate of 155 m^3/s occurring at 40 hrs. Derive the 4 hr synthetic unit hydrograph of sub- basin of the catchment, having drainage area 2500 km^2, L=100km and Lc=50 km using Snyder's method (14 Marks)

(10 Marks)

Module IV

17 a. Explain any two empirical methods for computation of flood discharge. (4 Marks)

b. .Flood frequency computations for a river by using Gumbel's method, yielded the following results: (10 Marks)

Return period T (years)	Peak flood (m^3/s)
50	40,809
100	46,300

Estimate the flood magnitude in the river with the return period of 500 years.

OR

18 a. Explain flood warning and its importance (4 Marks)

b. Route the flood hydrograph given below through a channel reach and derive the outflow hydrograph. The values of Muskingum parameters K and x are 12 h and 0.278 respectively (10 Marks)

Time(h)	0	4	8	12	16	20	24	28	32	36	40	44	48	52	56
Flow (m^3/s)	42	68	116	164	194	200	192	170	150	128	106	88	74	62	54

Module V

19 a. Derive Ghyben-Herzberg relationship (6 Marks)

b. In an artesian aquifer, the drawdown is 1.2 m at a radial distance of 10 m from a well after two hours of pumping. On the basis of Thies' non- equilibrium equation determine the pumping time for the same drawdown at a radial distance of 30 m from the well (8Marks)

OR

20 a. Derive partial differential equation for unsteady flow in a confined aquifer (8 Marks)

b. Explain the methods of artificial recharge of groundwater (6 Marks)

22CEE 702.5	CONSTRUCTION PLANNING AND MANAGEMENT	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PEC	3	0	0	3	2019

Preamble:

Construction Planning and Management is an elective course designed to provide in-depth knowledge in the planning and management of construction projects. The course details various operations encountered in a construction project in different phases throughout the lifecycle of a project, from planning, design, construction and operations. The course also helps students to develop the required skills to plan and manage various types of construction projects effectively and efficiently using the latest technologies like BIM.

Prerequisite: Construction Technology and Management

Course Outcomes: After the completion of this course the student will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Apply knowledge of Planning and Management for planning and execution of Construction Projects	Applying
CO2	Explain techniques for Project Planning, Scheduling, Construction Administration and Management	Understanding
CO3	Identify the criteria for selecting the appropriate method and tools as per the requirement of each project or site.	Understanding
CO4	Discuss the latest industry standards and technologies used in construction projects for planning and management.	Understanding
CO5	Explain the financial and legal aspects involved in a construction project.	Understanding

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2				2				2		3	2
CO2	2	2		2			1		2		3	2
CO3	2	2	2		2	2	1		2	1	3	2
CO4	2	1		1	1	2	1		2	3	3	2
CO5	2	2	2	1	2		1	3	2		3	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	30	30	70
Apply	10	10	20
Evaluate			
Analyse			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers): 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Course Level Assessment (Sample) Questions

CO1: Apply knowledge of Planning and Management for planning and execution of Construction Projects

1. How do you structure a team for a project? What do you consider?
2. What are the functions of construction management and give its applications?
3. What actions would you take if a project is falling behind schedule or exceeding the project's budget?
4. What would you do if some of your workers were not using the necessary safety equipment?

CO2: Explain techniques for Project Planning, Scheduling, Construction Administration and Management

1. List out the various network techniques in construction management.
2. Name the resource allocation methods and give the steps involved in any one of the resource allocation methods.
3. Explain the different costs involved in material management for material, labour and expenses.

CO3: Identify the criteria for selecting the appropriate method and tools as per the requirement of each project or site.

1. What methods do you use to monitor and track the progress of your construction project?
2. Elucidate the methods to prioritize the necessary tasks for a project.
3. How do you know when a construction project is well-executed and what do you look for in quality control?

CO4: Discuss the latest industry standards and technologies used in construction projects for planning and management.

1. What are some of the major uses of BIM?
2. What is the difference between Retained Logic & Override Logic in progress update?
3. What is Clash Detection? How does it help in Construction Projects?

CO5: Explain the financial and legal aspects involved in a construction project.

1. What factors would you consider before negotiating contracts or rates?
2. Explain the different laws relating to wages.
3. Explain legal and financial aspects of accidents in construction projects.

SYLLABUS

Module 1

Introduction: Objectives of construction planning and management. Importance of Management in Construction, Construction team- Roles, responsibilities and skills.

Organization and Hierarchy in Construction Projects – Types, Characteristics, Functions and Flow charts.

Construction scheduling: Review of CPM and PERT (AoN network), Time-cost trade-off – Cost optimization through the crashing of a network, Resource smoothing and resources levelling – concept only.

Module 2

Introduction to BIM Technology: Define BIM and BIM model, Describe workflow in using BIM in the building lifecycle, Model-Based cost estimating, Perform Simulations, Apply BIM to reduce error and change orders in projects, Evaluate and communicate ideas related to the use of BIM in the building life cycle, BIM Benefits: Case Studies, Organizational Maturity and Dimensions, Construction Management and Planning using BIM

Labour Legislations pertaining to the construction industry, Payment of Wages Act, Minimum Wages Act, Contract Labour Act, Labour Welfare Fund Act, Workmen's Compensation Act.

Module 3

Human Resource Management: manpower estimation at various stages, recruitment, training, under and overmanning.

Materials Management: Materials of construction, classification codification, ABC analysis, estimation of materials procurement, inventory/stock control, Economic Order Quantity, purchase procedure, stores management

Quality control in Construction: Importance of quality, elements of quality, organization for quality control, quality assurance technique.

Construction Safety Management: Important causes of accidents on construction sites, safety measures, safety benefits to employees, employees and customers.

Module 4

Economics of Project Management: Economic analysis of projects – NPV, Rate of return analysis, cost-benefit analysis.

Tendering – E Tendering / Electronic Process.

Contract – Contract documents and conditions of Contract, Contract agreement

Technical terms only - Administrative approval, Technical Sanction, Secured Advance, Mobilization Advance, Heads of accounts in government organization, Earnest money deposit (EMD) and Security deposit (SD). Accounting- Terms only- Work Abstract, Cash book, Work register, Accounting for the materials, Measurement book, Muster roll and Record of Bills

Module 5

Budgetary Control Systems: Types of budgets, new approaches for budgeting, responsibility of accounting, profit centre approach.

Financial Management: Meaning and scope, financial statement analysis, financial ratio analysis, funds flow analysis.

Working Capital Management: Meaning, policy for working capital, estimating working capital needs. Capital investment decision, long term financing working of financial institutions in India and abroad, self-financing, financing mechanisms.

Text Books:

1. Srinath, L.S. PERT and CPM Principles and Applications, 3rd ed. Affiliated East-West Press, New Delhi 2015.
2. Kumar Neeraj Jha, Construction Project Management, 2nd ed Pearson, Dorling Kindersley (India) pvt. Ltd 2015
3. K. K. Chitkara, Construction Project Management Planning Scheduling & Controlling, Tata McGraw Hill, New Delhi 2014.

References:

1. Gupta, B.L. and Gupta, Amit. Construction Management, Machinery and Accounts, 3rd ed. Standard Pub, 2005.
2. Loraine, R.K. Construction Management in Developing Countries. Thomas Telford, London, 1993.
3. Singh, Harpal. Construction Management and Accounts 14th ed. Tata McGraw-Hill Pub., New Delhi, 1981.
4. Gould, E. Frederick and Joyce, E. Nancy. Construction Project Management. Prentice Hall, New Jersey, 2000.
5. Shrivastava, U.K. Construction Planning and Management, 3rd ed. Galgotia Pub., New Delhi, 2004
6. Brad Hardin, Dave McCool . BIM and Construction Management: Proven Tools, Methods, and Workflows Paperback – 2017 .

LECTURE PLAN - CONSTRUCTION PLANNING AND MANAGEMENT

Module	*Topic Course*	*Course Outcomes Addressed*	*No. of Lectures*
1	**Module I : Total lecture hours : 7**		
1.1	Introduction: Objectives of construction planning and management. Importance of Management in Construction, Construction team- Roles, responsibilities and skills.	CO2	1
1.2	Organization and Hierarchy in Construction Projects -Types, Characteristics, Functions and Flow charts.	CO1, CO2	2
1.3	Review of CPM and PERT, Time-cost trade-off – Cost optimization through the crashing of a network, Resource smoothing and resources levelling – concept only.	CO1, CO2	4
2	**Module II: Total lecture hours: 7**		
2.1	Introduction to BIM Technology: Define BIM and BIM model, Describe workflow in using BIM in the building lifecycle, Model-Based cost estimating, Apply BIM to reduce error and change orders in projects	CO2, CO3, CO4	3
2.2	Evaluate and communicate ideas related to the use of BIM in the building life cycle, BIM Benefits: Case Studies, Organizational Maturity and Dimensions, Construction Management and Planning using BIM	CO1, CO3, CO4	2
2.3	Labour Legislations pertaining to the construction industry, Payment of Wages Act, Minimum Wages Act, Contract Labour Act, Labour Welfare Fund Act, Workmen's Compensation Act.	CO2, CO5	2
3	**Module III: Total lecture hours: 6**		
3.1	Human Resource Management: manpower estimation at various stages, recruitment, training, under and overmanning.	CO1	1
3.2	Materials Management: Materials of construction, classification codification, ABC analysis, Estimation of materials procurement, inventory/stock control, Economic Order Quantity, purchase procedure, stores management.	CO1	2

3.3	Quality control in Construction: Importance of quality, elements of quality, organization for quality control, quality assurance technique.	CO1	1
3.4	Construction Safety Management: Important causes of accidents, safety measures, safety benefits to employees, employees and customers.	CO2	2
4	**Module IV: Total lecture hours: 7**		
4.1	Economics of Project Management: Economic analysis of projects, – NPV, Rate of return analysis, cost-benefit analysis.	CO2, CO4	2
4.2	Tendering – E Tendering / Electronic Process.	CO2, CO4	1
4.3	Contract – Contract documents and conditions of Contract, Contract agreement	CO2	2
4.4	Technical terms only - Administrative approval, Technical Sanction, Secured Advance, Mobilization Advance, Heads of accounts in government organization, Earnest money deposit (EMD) and Security deposit (SD). Accounting- Terms only- Work Abstract, Cash book, Work register, Accounting for the materials, Measurement book, Muster roll and Record of Bills	CO2	2
5	**Module V: Total lecture hours: 8**		
5.1	Budgetary Control Systems: Types of budgets, new approaches for budgeting, responsibility of accounting, profit centre approach.	CO2, CO5	2
5.2	Financial Management: Meaning and scope, financial statement analysis, financial ratio analysis, fund flow analysis.	CO2, CO5	2
5.3	Working Capital Management: Meaning, policy for working capital, estimating working capital needs. Capital investment decision	CO2, CO5	2
5.4	Long term financing working of financial institutions in India and abroad, self-financing, financing mechanisms.	CO2, CO5	2

Model Question Paper

SEVENTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEE 702.5

Course Name: CONSTRUCTION PLANNING AND MANAGEMENT

Model Question Paper

Marks: 100 Duration : 3 hrs

PART A

(Answer all Questions. Each Question carries 3 Marks)

1. Differentiate between resource smoothing and resource levelling.
2. List out members of the construction team and write the responsibilities.
3. Explain BIM Technology.
4. What is meant by Organizational Maturity of BIM?
5. Explain Economic Order Quantity.
6. List the important causes of accidents on construction sites.
7. Explain rate of return analysis.
8. What is meant by administrative approval?
9. Discuss any two types of construction budgets.
10. Explain the sources of long-term financing of construction projects.

PART B

(Answer one full question from each module, each question carries 14 marks)

Module 1

11. a) Explain the Functions of construction project management.
    b) Describe any two types of organization structures for construction projects.
12. With an example, explain the procedure for the time-cost tradeoff.

Module 2

13. Explain any two labour legislations pertaining to the construction industry.

14. Explain the following
    i) BIM Model
    ii) Clash Detection
    iii) Model Based Cost Estimating
    iv) Dimensions of BIM

Module 3

15. Explain the need for Quality assurance and Quality control in construction projects.
16. Discuss in detail ABC analysis for Material Management

Module 4

17. a) Give the salient features of the contract document.
    b) Explain any two important conditions of the contract.
18. Discuss the major steps involved in E Tendering and the process of awarding the contract.

Module 5

19. Analyse the important benefits of the following:

    i) Fund Flow Analysis
    ii) Financial Ratio Analysis
20. Explain, with examples, the different Methods for Estimating Working Capital Requirement.

22CEE 702.6	ADVANCED ENVIRONMENTAL ENGINEERING	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PEC	3	0	0	3	2019

Preamble

This course introduces students to the state of technologies that exist for treating water and air. They will learn basic engineering principles that govern these technologies and develop the capacity to select appropriate technologies for solving environmental problems related to water and air pollution.

Prerequisite: 22CET 602 Environmental Engineering

Course Outcomes: After the completion of the course the student will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Explain various secondary treatment technologies for waste water	Understand
CO2	Explain various tertiary treatment technologies and their applications	Understand
CO3	Explain engineering principles to dimension various treatment units	Analyse
CO4	Identify appropriate technology for controlling air pollution	Understand

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	3	-	-	-	-	-	-	-	-	-
CO 2	3	-	3	-	-	-	-	-	-	-	-	-
CO 3	3	-	3	-	-	-	-	-	-	-	-	-
CO4	3	-	3	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	15
Understand	10	10	15
Apply	15	15	35
Analyse	15	15	35
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Course Level Assessment Questions

CO1: Explain various secondary treatment technologies for waste water

1.Explain the working principle of a Rotating Biological Contactor.

2. What are the sequential steps of sequencing batch reactor (SBR) operation?

3. Moving bed biofilm reactor (MBBR) is an advanced wastewater treatment technology, which employs the benefits of both biofilm and activated sludge processes. Explain

CO 2: Explain various tertiary treatment technologies and their applications

1. What is Fenton process?

2. Discuss the biological removal of phosphorous in waste water.

3. What are the various configurations available for MBR?

CO3: Explain engineering principles to dimension various treatment units

1. Calculate the maximum efficiency for a RO plant, which is operated with a inlet pressure of 45 bar and under the condition that effective driving fource Δp_{eff} min = 15 bar is maintained. The permeate pressure is 1 bar, pressure loss is 3 bar and mass fraction of salt in permeate (Wp) = 0. Feed is a NaCl solution with mass fraction(Wf) = 0.03 and the osmotic coefficient is 790 bar. How big is the membrane area if 10 m^3/h of permeate are to be produced and a membrane with A = 1,2.10-7 m/(s.bar) was chosen?

2. A design wastewater flow 7571 m^3/d is to be treated with an MBR treatment system. The design membrane module properties are, average membrane flux= 12 L/hr/m^2; module packing density= 120m^2/m^3; specific aeration demand= 0.3 m^3 air/hr/m^2 membrane area. Calculate the required membrane area, membrane module volume and scouring air flow rate.

3. An ESP is collecting 95% of the particles in the waste gas. A salesperson now offers us an additive to add to the gas that will change the resistivity of the collected cake of particles, thus doubling the effective drift velocity. If we use this additive, what will be the improvement in collection efficiency?

CO4: Identify appropriate technology for controlling air pollution

1. Compare baghouse filters with cyclone separators in terms of the efficiency of particulate removal from a gas stream.

2. How sulfur oxides can be controlled?

3.Wet scrubbing is useful for the removal of both particulate and gaseous pollutants. Explain

SYLLABUS

Module 1

Advances in waste water treatment –Process for biological nitrogen removal –Process for biological phosphorus removal - anoxic-aerobic process design – sequencing batch reactor (SBR)

Module 2

Aerobic attached growth Process – Rotating Biological Contactor (RBC), Moving Bed Biofilm Reactor (MBBR)
Advanced Oxidation Processes- Fenton process, Wet Air Oxidation process, Photo-Oxidation process

Module 3

Adsorption- Removal of organic and inorganic contaminants- Popular adsorbents-Adsorption Isotherms-Breakthrough Curves in Continuous Adsorption Processes- Adsorption in a Batch Contactor-Adsorption kinetics-Regeneration of spent adsorbents

Ion Exchange-method of purification-Applications in water treatment

Module 4

Membrane Technology- Reverse Osmosis (RO)- Ultra Filtration(UF)- Nano Filtration(NF)-Micro Filtration(MF)- Electro Dialysis (ED)-Dimensioning of RO units for desalination.
Tertiary filtration of waste water- design of Membrane Bio Reactors (MBR), MBR configurations.

Module 5

Air Pollution Control- Control devices for Particulate pollutants –Cyclone separators, baghouse filters, wet scrubbers, electrostatic precipitators (ESP)- Design of an ESP
Gaseous pollutant control-technologies for the control of sulfur oxides, nitrogen oxides and carbon monoxide- wet scrubbing, process modification.

Text Books:

1. Howard S Peavy, Donald R Rowe and George Tchobanoglous, Environmental Engineering, Mc Graw Hill Education , 2013

2. Mackenzie L Davis, David A Cornwell, Introduction to Environmental Engineering, Mc Graw Hill Education, 2014
3. Gilbert M Masters, Introduction to Environmental Engineering and Science, Pearson Education India; 3rd edition, 2015
4. J. Arceivala, Shyam R. Asolekar, Wastewater Treatment for Pollution Control and Reuse, McGrawhill Education, 2007
5. S.K. Garg, Sewage disposal and air pollution engineering, Khanna Publishers. 2008

References:

1. Metcalf and Eddy, Waste Water Engineering, Tata McGraw Hill publishing Co Ltd, 2003
2. Syed R Qasim, Wastewater Treatment Plants-Planning, Design & Operation, CRC Press,1999
3. Baker, Membrane Technology and Applications, 3rd ed., Wiley-Blackwell 2012
4. Fane, Schaefer, Waite, Nanoflitration, Principles and applications, Elsevier 2004
5. Peinemann, Nunez, Membrane Technology, 6 vols, Wiley-vch 2007 – 2010

Lecture Plan- Environmental Engineering

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module 1: Total Lecture Hours -7**		
1.1	Process for biological nitrogen removal-design criteria	CO2	2
1.2	Process for biological phosphorus removal-design criteria	CO2	2
1.3	anoxic-aerobic process design – sequencing batch reactor (SBR)	CO1	3
2	**Module II: Total Lecture Hours- 7**		
2.1	Aerobic attached growth Process – Rotating Biological Contactor (RBC)	CO1	2
2.2	Moving Bed Biofilm Reactor (MBBR)	CO1	2
2.3	Advanced Oxidation Processes- Fenton process, Wet Air Oxidation process, Photo-Oxidation process	CO2	3
3	**Module III: Total Lecture Hours-7**		
3.1	Adsorption- Removal of organic and inorganic contaminants- Popular adsorbents	CO2	1
3.2	Adsorption Isotherms	CO2	2
3.3	Breakthrough Curves in Continuous Adsorption Processes- Adsorption in a Batch Contactor- Adsorption kinetics	CO2	2
	Regeneration of spent adsorbents	CO2	1
	Ion Exchange-method of purification-Applications in water treatment	CO2	1
4	**Module IV: Total Lecture Hours- 7**		
4.1	Membrane Technology- Reverse Osmosis (RO)- Ultra Filtration(UF)- Nano Filtration(NF)- Micro Filtration(MF)- Electro Dialysis (ED)	CO3	2
4.2	Dimensioning of RO units for desalination	CO3	2
4.3	Tertiary filtration of waste water- design of Membrane Bio Reactors (MBR), MBR configurations.	CO2, CO3	3
5	**Module V: Total Lecture Hours- 7**		
5.1	Air Pollution Control- Control devices for Particulate pollutants –Cyclone separators, baghouse filters, wet scrubbers, electrostatic precipitators (ESP)	CO4	3
5.2	Design of an ESP	CO3, CO4	1

5.3	Gaseous pollutant control-technologies for the control of sulfur oxides, nitrogen oxides and carbon monoxide- wet scrubbing, process modification	CO4	3

Model Question Paper

Reg No.: _______________ **Name: ___________________________**

SEVENTH SEMESTER B. TECH DEGREE EXAMINATION

Course Code: 22CEE 702.6

Course Name: ADVANCED ENVIRONMENTAL ENGINEERING

Max. Marks: 100 Duration: 3 Hours

Part A

(***Answer all questions; each question carries 3 marks***)

16. Explain denitrification.
17. What are the sequences of operation in an SBR?
18. How advanced oxidation processes (AOP) helps in treating waste water?
19. What is the difference in the biological process of an RBC and MBBR?
20. What are adsorption isotherms?
21. How ion exchange can soften water?
22. What is Ultra filtration?
23. Explain the benefits of MBR treatment system.
24. How cyclones remove particles from a gas stream.
25. what is desulfurization?

PART B

(Answer one full question from each module, each question carries 14 marks)

26. (a) Explain the process for biological nitrogen removal (9 Marks)

(b) How anoxic process is different from anaerobic process? (5 Marks)

OR

27. (a) Explain the working of an SBR (6 Marks)

(b) Explain the treatment technologies available for phosphorous removal in waste water (8 Marks)

28. (a) Explain the working principle of an MBBR (6 Marks)

(b) Discuss Advanced Oxidation Processes (8 Marks)

OR

29. (a) How aerobic attached process compare with aerobic suspended process (5 Marks)

(b) What is the application of Wet Air Oxidation process (5 Marks)

(c)How biological process in RBC is different from that in MBBR (4 Marks)

30. (a) List some popular adsorbents. How they are regenerated after use? (4 Marks)

(b) Explain breakthrough curve in continuous adsorption process. (5Marks)

(c) What are the applications of ion exchange process in water treatment? (5 Marks)

OR

16. (a) Explain the significance of adsorption processes in environmental engineering (7 Marks)

(b) Explain various adsorption kinetics models (7 Marks)

21. (a) Explain the working principle of Electro Dialysis (6Marks)

(b) Calculate the maximum efficiency for a RO plant, which is operated with a inlet pressure of 45 bar and under the condition that effective driving fource Δp_{eff} min = 15 bar is maintained. The permeate pressure is 1 bar, pressure loss is 3 bar and mass fraction of salt in permeate (Wp) = 0. Feed is a NaCl solution with mass fraction(Wf) = 0.03 and the osmotic coefficient is 790 bar. How big is the membrane area if 10 m^3/h of permeate are to be produced and a membrane with A = 1,2.10-7 m/(s.bar) was chosen? (8 marks)

OR

22. (a)Explain the working of Membrane Bio Reactors. What are the different configurations available for MBRs? (6 Marks)

(b) A design wastewater flow 7571 m^3/d is to be treated with an MBR treatment system. The design membrane module properties are, average membrane flux= 12 $L/hr/m^2$; module packing density= $120 m^2/m^3$; specific aeration demand= 0.3 m^3 air/hr/m^2 membrane area. Calculate the required membrane area, membrane module volume and scouring air flow rate. (8 Marks)

23. (a) Wet scrubbing is useful for the removal of both particulate and gaseous pollutants. Explain (6 Marks)
    (b) As an air pollution control engineer, explain what air pollution control measures you will adopt at a Coal fired thermal power plant and why? (8 Marks)

OR

24. (a) Discuss the source reduction measures for oxides of nitrogen (6 Marks)
    (b) Explain the principle of electrostatic precipitator. Discuss the advantages and limitations of electrostatic precipitators. (8 Marks)

22CEE 702.7	OPTIMIZATION TECHNIQUES IN CIVIL ENGINEERING	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PEC	3	0	0	3	2019

Preamble:

Optimization techniques in civil engineering is a subject which provide the basic concepts of optimization problem formulation in various civil engineering fields. Optimization has application in all fields of engineering. This course introduces different algorithms for solving structural optimization problems. After this course the students will be able to identify the type of the real-world optimization problems and design the corresponding optimization techniques.

Course Outcomes: After the completion of the course the students will be able to:

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Formulate engineering design problem as an optimization problem.	Applying
CO2	Apply suitable optimization technique to the design problem at hand.	Applying
CO3	Evaluate the problem as linear or nonlinear optimization problem and design the optimization technique.	Evaluate
CO4	Evaluate the problem as single variable or multi-variable optimization problem and design the corresponding optimization technique	Evaluate
CO5	Formulate linear programming problem for engineering applications and evaluate the solution.	Evaluate
CO6	Familiarise with transportation and assignment problems and genetic algorithm.	Applying

Mapping of course outcomes with programme outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	2	-	-	-	-	-	2	2
CO 2	3	3	3	3	3	-	-	-	-	-	2	2
CO 3	3	3	3	3	3	-	-	-	-	-	2	2
CO 4	3	3	3	3	3	-	-	-	-	-	2	2
CO 5	3	3	3	3	3	3	2	-	-	-	2	2
CO 6	3	3	3	3	3	3	2	-	-	-	2	2

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination Marks
	Test 1 Marks	Test 2 Marks	
Remember	-	-	
Understand	10	-	10
Apply	10	10	20
Analysis	10	20	30
Evaluate	20	20	40
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:
Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern:
There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Course Level Assessment Questions

(Questions may be framed based on the outline given under each course outcome)

Course Outcome 1 (CO1): Formulate engineering design problem as an optimization problem.

1. Formulate a optimization problem with constraints for determining the optimum dimensions of a simply supported beam of span 6 m subjected to a uniformly distributed load of 30 kN/m. Allowable stress in bending is 10N/mm^2 and allowable stress in shear is 1N/mm^2. Allowable deflection is span/300.

2. Formulate an optimization problem with constraints for determining the optimal slope and dimensions for the members of the truss if the shape, loads and span are given.

Course Outcome 2 (CO2): Apply suitable optimization technique to the design problem at hand.

1. Find the optimum dimensions of a simply supported beam of span 6 m subjected to a uniformly distributed load of 30 kN/m. Allowable stress in bending is 10N/mm^2 and allowable stress in shear is 1N/mm^2. Allowable deflection is span/300.

2. Find the optimal slope and dimensions for the members of the truss if the shape, loads and span are given.

Course Outcome 3 (CO3): Evaluate the problem as linear or nonlinear optimization problem and design the optimization technique.

1. Calculate the minimum of the given function by unrestricted search, exhaustive search and interval halving methods.

$$f(x) = 0.65 - 0.75/(1+x^2) - 0.65x\tan^{-1}(1/x)$$

2. Using Newton Raphson method find the minimum of the function $f(x) = xe^x - Cosx$

3. Minimize the function by Golden section method and Fibonacci method

$$f(x) = 2Sinx - x^2/10 \text{ in the interval } (0,10)$$

Course Outcome 4 (CO4): Evaluate the problem as single variable or multi-variable optimization problem and design the corresponding optimization technique.

1. Minimize the function by univariate method
$$f(x_1,x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$$
2. Write down the algorithm for Powell's conjugate direction method

3. Write down the algorithm for Hooke and Jeeve's pattern search method

Course Outcome 5 (CO5): Formulate linear programming problem for engineering applications and evaluate the solution.

1. Express the given problem in the standard form

$$\text{Maximize } z = 3x_1 + 5x_2 + 7x_3 \text{ subject to}$$

$$6x_1 - 4x_2 \leq 5;\ 3x_1 + 2x_2 + 5x_3 \geq 11;\ 4x_1 + 2x_2 \geq 2;\ x_1, x_2 \geq 0$$

2. Determine the minimum value of the objective function

$$Z = -50x + 20y \text{ subject to the constraints}$$

$$2x - y \geq -5;\ 3x + y \geq 3;\ 2x - 3y \leq 12;\ x \geq 0, y \geq 0$$

3. A dietician has to develop a special diet using two foods P and Q. Each packet (containing 30 g) of food P contains 12 units of calcium, 4 units of iron, 6 units of cholesterol and 6 units of vitamin A. Each packet of the same quantity of food Q contains 3 units of calcium, 20 units of iron, 4 units of cholesterol and 3 units of vitamin A. The diet requires atleast 240 units of calcium, atleast 460 units of iron and at most 300 units of cholesterol. How many packets of each food should be used to minimise the amount of vitamin A in the diet? What is the minimum amount of vitamin A?

Course Outcome 6 (CO6): Familiarise with transportation and assignment problems and genetic algorithm

1. There are two factories located one at place P and the other at place Q. From these locations, a certain commodity is to be delivered to each of the three depots situated at A, B and C. The weekly requirements of the depots are respectively 5, 5 and 4 units of the commodity while the production capacity of the factories at P and Q are respectively 8 and 6 units. The cost of transportation per unit is given below:

From/To	Cost in (Rs)		
	A	B	C
P	160	100	150
Q	100	120	100

How many units should be transported from each factory to each depot in order that the transportation cost is minimum. What will be the minimum transportation cost?

2. A company manufactures two products P1 and P2. The company has two types of machines A and B. Product P1 take 2 hours on machine A and 4 hours on machine B, whereas product P2 takes 5 hours on machine A and 2 hours on machine B. The profit realised on the sale of one unit of product P1 is Rs.3 and that of product P2 is Rs. 4. If machine A and B can operate 24 and 16 hours per day respectively, determine the weekly output for each product in order to maximise the profit. (Assume a 5day week).

SYLLABUS

Module -1

Introduction to optimization methods- optimization problem formulation - objective function, constraints. Classification of optimization problems. Geometric, graphical, analytical methods of optimization. Application examples from engineering.

Module -2

Single Variable Unconstrained Optimisation Techniques- Optimality Criteria. Bracketing methods: Unrestricted search, Exhaustive search. Region Elimination methods: Interval Halving methods, Dichotomous search, Fibonacci method, Golden section method. Interpolation methods: Quadratic Interpolation method, Cubic Interpolation method. Gradient Based methods: Newton-Raphson method, Secant method, Bisection method.

Module -3

Multivariable Unconstrained Optimisation Techniques- Optimality Criteria- Unidirectional Search. Direct Search methods: Random search, Grid search, Univariate method, Hooke's and Jeeves' pattern search method, Powell's conjugate direction method, Simplex method. Gradient based methods: Cauchy's (Steepest descent) method, Conjugate gradient (Fletcher Reeves) method, Newton's method, Variable metric (DFP)method, BFGS method.

Module -4

Linear programming, simplex method- dual problem, weak duality theorem, optimality criterion theorem, main duality theorem, complementary slackness theorem, primal-dual relationship, economic interpretation of dual solution, introduction to sensitivity analysis examples of applications of linear programming in engineering.

Module -5

Transportation problem- Assignment problem- applications of linear programming problems in Civil Engineering- Introduction to Genetic Algorithms- basic concept- problem formulation - operations- convergence criteria.

Text Books:

1. Rajasekharan S. "Numerical Methods in Science and Engineering" S Chand & company 2003.
2. S.S. Rao, Optimisation Theory and applications, Wiley Eastern.
3. Belegundu., Optimisation concepts and Applications Engineering.
4. S. S. Rao, Engineering Optimization, New Age International (P) Ltd. Publishers.
5. J. S. Arora, Introduction to Optimum Design, McGraw-Hill Book Company.
6. K. Deb, Multiobjective Optimization using Evolutionary Algorithms, John Wiley and Sons.

Reference Books:

1. Grewal B.S. "Numerical Methods in Engineering and Science" Khanna Publishers.
2. Chapra S.C. and Canale R.P. "Numerical Methods for Engineers" Mc Graw Hill 2006.
3. Ketter and Prawel "Modern Methods for Engineering Computations" Mc Graw Hill
4. Terrence. J. Akai "Applied Numerical Methods for Engineers", Wiley publishers 1994.
5. R.L. Fox, Optimisation methods in Engineering Design, Addison Wesely
6. Ravindran, D. T. Phillips, J. J. Solberg, Operations Research – Principles and Practice, John Wiley and Sons.
7. Ravindran, K. M. Ragsdell, G. V. Reklaitis, Engineering Optimization – Methods and Applications, John Wiley and Sons.
8. M. S. Bazaraa, H. D. Sherali, and C. M. Shetty, Nonlinear Programming: Theory and Algorithms, Wiley-Interscience.
9. Rajasekharan S. "Numerical Methods for Initial and Boundary value problems," Khanna publishers 1989.

COURSE PLAN			
Module	Contents	Course Outcomes addressed	No. of Lectures
1	**Module 1: Total lecture hours:7**		
1.1	Introduction to optimization methods	1	1
1.2	Problem formulation, objective function, constraints	1	1
1.3	Classification of optimization problems.	1	1
1.4	Geometric methods of optimization	2	1
1.5	Graphical methods of optimization	2	1
1.6	Analytical methods of optimization	2	1
1.7	Application examples from engineering.	1	1
2	**Module 2: Total lecture hours: 6**		
2.1	Single Variable Unconstrained Optimisation Techniques, Optimality Criteria.	3, 4	1
2.2	Bracketing methods: Unrestricted search, Exhaustive search.	3, 4	1
2.3	Region Elimination methods: Interval Halving methods, Dichotomous search	3, 4	1
2.4	Fibonacci method, Golden section method	3, 4	1
2.5	Interpolation methods: Quadratic Interpolation method, Cubic Interpolation method.	3, 4	1
2.6	Gradient Based methods: Newton-Raphson method, Secant method, Bisection method	3, 4	1
3	**Module 3: Total lecture hours: 8**		
3.1	Multivariable Unconstrained Optimisation Techniques	3, 4	1
3.2	Optimality Criteria- Unidirectional Search.	3, 4	1
3.3	Direct Search methods: Random search, Grid search	3, 4	1
3.4	Univariate method, Hooke’s and Jeeves’ pattern search method	3, 4	1
3.5	Powell’s conjugate direction method, Simplex method	3, 4	1
3.6	Gradient base methods: Cauchy’s (Steepest descent) method,	3, 4	1

3.7	Conjugate gradient (Fletcher Reeves) method	3, 4	1
3.8	Newton's method, Variable metric (DFP)method, BFGS method.	3, 4	1
4	**Module 4: Total lecture hours: 8**		
4.1	Linear programming, simplex method	5	1
4.2	Dual problem, weak duality theorem	5	1
4.3	Optimality criterion theorem, main duality theorem	5	1
4.4	Complementary slackness theorem	5	1
4.5	Primal-dual relationship, economic interpretation of dual solution	5	1
4.6	Introduction to sensitivity analysis	5	1
4.7	Examples of applications of linear programming in engineering.	5	1
4.8	Numerical Examples	5	1
5	**Module 5: Total lecture hours: 6**		
5.1	Transportation problem	6	1
5.2	Assignment problem	6	1
5.3	Numerical Examples	6	1
5.4	Applications of linear programming problems in Civil Engineering	6	1
5.5	Introduction to Genetic Algorithms, Basic concept - problem formulation	6	1
5.6	Operations- convergence criteria.	6	1

Model Question Paper

Reg No.:__________ **Name:___________________**

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEE 702.7

Course Name: OPTIMIZATION TECHNIQUES IN CIVIL ENGINEERING

Max. Marks: 100 Duration: 3 hours

Part A

(***Answer all questions; each question carries 3 marks***)

31. What is the difference between a bound point and a free point in the design space?
32. What is graphical optimisation and what are its limitations?
33. What is the basis of the interval halving method?
34. What is the difference between quadratic and cubic interpolation methods?
35. Give three reasons why the study of unconstrained minimization methods is important.
36. Why is Powell's method called a pattern search method?
37. State an LPP problem in standard form.
38. Why is linear programming important in several types of industries?
39. How can we represent a standard genetic algorithm?
40. Explain the cycle of genetic algorithm.

PART B

(Answer one full question from each module, each question carries 14 marks)

41. (a) . Explain the general steps involved in formulation of optimisation model (6 Marks)

    (b) A uniform column of rectangular cross section is to be constructed for supporting a water tank of mass M. It is required (1) to minimize the mass of the column for economy, and (2) to maximize the natural frequency of transverse vibration of the system for avoiding possible resonance due to wind. Formulate the problem of designing the column to avoid failure due to direct compression and buckling. Assume the permissible compressive stress to be σ_{max}. (8 Marks)

OR

42. (a) State any six engineering applications of optimization. (6 Marks)

    (b) Formulate a optimization problem with constraints for determining the optimum dimensions of a simply supported beam of span 6 m subjected to a uniformly distributed load of 30 kN/m. Allowable stress in bending is 10N/mm2 and allowable stress in shear is 1N/mm2. Allowable deflection is span/300. (8 Marks)

43. Find the minimum of the following function using Newton Raphson method with the starting point $x_1 = 0.1$. $f(x) = 0.65 - 0.75/(1+x^2) - 0.65x\tan^{-1}(1/x)$ (14 marks)

OR

44. (a) What is the difference between Fibonacci and golden section methods? (6 Marks)
(b) Find the minimum of $f = x(x - 1.5)$ in the interval (0.0,1.00) to within 10% of the exact value by exhaustive search method (8 Marks)

45. (a) Minimize $f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ with the starting point (0,0) by Hooke and Jeeves method (14 Marks)

OR

16. (a) Show that the DFP method is a conjugate gradient method. (7 Marks)
(b) Prove that the gradient vector represents the direction of steepest ascent. (7 marks)

25. (a) Maximise $F = x_1 + 2x_2 + x_3$ subject to

$$2x_1 + x_2 - x_3 \leqslant 2$$
$$-2x_1 + x_2 - 5x_3 \geqslant 6$$
$$4x_1 + x_2 + x_3 \leqslant 6$$
$$x_i \geqslant 0,\ i = 1,2,3$$

(14 Marks)

OR

26. A dietician has to develop a special diet using two foods P and Q. Each packet (containing 30 g) of food P contains 12 units of calcium, 4 units of iron, 6 units of cholesterol and 6 units of vitamin A. Each packet of the same quantity of food Q contains 3 units of calcium, 20 units of iron, 4 units of cholesterol and 3 units of vitamin A. The diet requires atleast 240 units of calcium, atleast 460 units of iron and at most 300 units of cholesterol. How many packets of each food should be used to minimise the amount of vitamin A in the diet? What is the minimum amount of vitamin A?
(14 Marks)

27. There are two factories located one at place P and the other at place Q. From these locations, a certain commodity is to be delivered to each of the three depots situated at A, B and C. The weekly requirements of the depots are respectively 5, 5 and 4 units of the commodity while the production capacity of the factories at P and Q are respectively 8 and 6 units. The cost of transportation per unit is given below:

From/To	Cost in (Rs)		
	A	B	C
P	160	100	150
Q	100	120	100

How many units should be transported from each factory to each depot in order that the transportation cost is minimum. What will be the minimum transportation cost? (14 marks)

OR

28. A company manufactures two products P1 and P2. The company has two types of machines A and B. Product P1 take 2 hours on machine A and 4 hours on machine B, whereas product P2 takes 5 hours on machine A and 2 hours on machine B. The profit realised on the sale of one unit of product P1 is Rs.3 and that of product P2 is Rs. 4. If machine A and B can operate 24 and 16 hours per day respectively, determine the weekly out put for each product in order to maximise the profit. (Assume a 5day week). (14 marks)

22CEO 703.1	Environmental Impact Assessment	Category	L	T	P	Credit	Year of Introduction
		OEC	2	1	0	3	2021

Preamble

This course introduces the methodologies for identifying, predicting, evaluating and mitigating the impacts on environment due to any developmental project or activities. Students will learn how to prepare an impact assessment report and devise an environment management plan. Sufficient background will be provided on the environmental clearance procedures in India.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Explain the need for minimizing the environmental impacts of developmental activities	Understand
CO2	Outline environmental legislation & clearance procedure in the country	Remember, Understand
CO 3	Apply various methodologies for assessing the environmental impacts of any developmental activity	Apply & Analyse
CO 4	Prepare an environmental impact assessment report	Analyse & Evaluate
CO 5	Conduct an environmental audit	Analyse & Evaluate

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	2	2	-	-	-	-	-
CO 2	-	-	-	-	-	2	-	-	-	-	-	-
CO 3	2	-	-	3	2	-	3	-	-	-	-	-
CO4	-	-	-	2	-	2	2	3	-	3	-	-
CO5	-	-	-	2	1	-	2	2	-	2	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	15
Understand	10	10	15
Apply	15	15	35
Analyse	15	15	35
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

<u>Course Level Assessment Questions</u>

CO1: Explain the need for minimizing the environmental impacts of developmental activities

1.Explain the evolution of EIA in India

2.Explain why EIA is needed for developmental projects.

3. What are the different ways in which development projects impact the water quality and quantity?

CO 2: Outline the environmental legislation & clearance procedure in the country

1. Two municipalities in Kerala plan to set up a Common Municipal Solid Waste Management Facility (CMSWMF). Explain the procedure required for the Environmental Clearance (EC) for the project as per the EIA Notification of 2006. (All CMSWMFs are category B projects)

2. Describe the procedure for obtaining environmental clearance according to EIA notification 2006.

3. The Environment (Protection) Act, 1986 is called an umbrella legislation. Substantiate the statement.

CO3: Apply various methodologies for assessing the environmental impacts of any developmental activity

1. Prepare a simple checklist for assessment of socio economic impact due to the development of a highway.

2. Explain overlay mapping as an EIA method

3. Explain how to predict the impact of a highway project on air quality

CO4: Prepare an environmental impact assessment report

1.Explain the Terms of Reference (ToR) for EIA report of a highway project

2.Explain the structure of EIA report

3.Explain the importance of an environmental management plan.

CO5: Conduct an environmental audit

1. Explain the need for environmental auditing

2.What are the different types of environmental audits?

3. Explain the importance of ISO 14001 standard.

SYLLABUS

Module 1

Definition, Need for EIA, Evolution of EIA: Global & Indian scenario -Environmental legislations in India- The Water (Prevention & Control of Pollution) Act 1974, The Air (Prevention & Control of Pollution) Act 1981, The Environmental (Protection) Act 1986- Environmental standards for water, air and noise quality- EIA Notification 2006

Module 2

Environmental clearance process in India: Screening, Scoping, Public Consultation, Appraisal- Form1- Category of projects- Generic structure of EIA report- Terms of Reference (ToR) -Types of EIA: strategic, regional, sectoral, project level- Rapid EIA and Comprehensive EIA- Initial Environmental Examination (IEE)

Module 3

EIA methodologies: Ad hoc, checklist, matrix, network and overlay- Impact Prediction, Evaluation and Mitigation-Prediction and assessment of the impact on water (surface water and groundwater), air, and noise environment- assessment of ecological impacts and Socio economic Impacts.

Module 4

Environmental Management Plan (EMP): Goal and purpose- Importance of EMP- Content of an EMP- Role of environmental monitoring program
Environment Audit: need for audit- audit types and benefits- environmental audit procedure
ISO 14001 standards: Importance, salient features - Stages in implementation- Benefits

Module 5

EIA case studies (Indian)- a highway project, a hydro electric power plant, an air port project, a quarry mining project and a solid waste management project

Text Books:

6. Larry W Canter, “Environmental Impact Assessment”, McGraw Hill Inc. , New York, 1995
7. Betty Bowers Marriott, Environmental Impact Assessment: A Practical Guide, McGraw-Hill Professional, 1997
8. Environmental Impact Assessment, 2003, Y.Anjaneyulu, B.S Publications

References:

6. Lawrence, David P., Environmental Impact Assessment (Practical Solutions to Recurrent Problems), Wiley International, New Jersey.
7. Ministry of Environment & Forests, Govt. of India 2006 EIA Notification

8. Jain, R.K., Urban, L.V. and Stacey, G.S., Environment Impact Analysis, Von Nostrand Reinhold Company.

Lecture Plan- Environmental Impact Assessment

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module 1: Total Lecture Hours -7**		
1.1	Definition, Need for EIA, Evolution of EIA: Global & Indian scenario	CO1	1
1.2	Environmental legislations in India- The Water (Prevention & Control of Pollution) Act 1974, The Air (Prevention & Control of Pollution) Act 1981, The Environmental (Protection) Act 1986	CO2	3
1.3	Environmental standards for water, air and noise quality	CO2	1
1.4	EIA Notification 2006	CO2	2
2	**Module II: Total Lecture Hours- 7**		
2.1	Environmental clearance process in India: Screening, Scoping, Public Consultation, Appraisal-Form1-Category of projects	CO2	3
2.2	Generic structure of EIA report- Terms of Reference (ToR)	CO4	1
2.3	Types of EIA: strategic, regional, sectoral, project level-	CO3	1
2.4	Rapid EIA and Comprehensive EIA	CO3	1
2.5	Initial Environmental Examination (IEE)	CO3	1
3	**Module III: Total Lecture Hours-7**		
3.1	EIA methodologies: Ad hoc, checklist, matrix, network and overlay	CO3	3
3.2	Impact Prediction, Evaluation and Mitigation-Prediction and assessment of the impact on water (surface water and groundwater), air, and noise environment	CO3	2
3.3	assessment of ecological impacts and Socio economic Impacts	CO3	2
4	**Module IV: Total Lecture Hours- 7**		

4.1	Environmental Management Plan (EMP): Goal and purpose- Importance of EMP- Content of an EMP	CO4	2
4.2	Role of environmental monitoring program	CO4	1
4.3	Environment Audit: need for audit- audit types and benefits- environmental audit procedure	CO5	2
4.4	ISO 14001 standards: Importance, salient features - Stages in implementation- Benefits	CO5	2
5	**Module V: Total Lecture Hours- 7**		
5.1	EIA case studies (Indian)- a highway project	CO1, CO4	2
5.2	Hydroelectric power plant, airport project	CO1, CO4	3
5.3	Quarry mining project, solid waste management project	CO1, CO4	3

Model Question Paper

Reg No.:_______________ **Name:__________________________**

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: 22CEO 703.1

Course Name: ENVIRONMENTAL IMPACT ASSESSMENT

Max. Marks: 100 Duration: 3 Hours

Part A

(***Answer all questions; each question carries 3 marks***)

46. Explain the need for EIA
47. Why environmental (protection) act, 1986 is called an umbrella act?
48. Discuss screening of projects
49. What is rapid EIA?
50. What is ad hoc method for impact assessment?
51. How to predict the impact of a proposed food industry on the water quality of a nearby river
52. Explain the benefits of an environmental audit
53. What is ISO 14001 standard?
54. What are the impacts of a highway project on local air quality
55. Discuss the environment monitoring program for a quarry mining industry.

PART B

(Answer one full question from each module, each question carries 14 marks)

56. (a) Discuss environmental standards for water, air and noise (6 Marks)
    (b) Discuss evolution of EIA in India (8 Marks)

OR

57. (a) Discuss Air (Prevention & Control of Pollution) Act 1981 (5 Marks)
    (b) Explain salient features of EIA notification 2006 (9 Marks)

58. (a) Discuss environmental clearance process in India (10 Marks)
    (c) What is Form-1? (4 Marks)

OR

59. (a) What is Initial Environmental Examination? (5 Marks)
(b) Explain different types of EIA (9 Marks)

60. (a) Discuss in detail EIA methodologies (10 Marks)
(b) How can air quality modelling help in assessing the impact on air (4 Marks)

OR

16. (a) Explain the steps to assess the impacts on the ecological environment due to a project (7Marks)
(b) Explain the steps involved in assessment of impacts on the water environment. (7 Marks)

29. (a) What are the different types of Environmental Audit? (5 Marks)
(b) Discuss the content of an environment management plan .(9 marks)

OR

30. (a) Discuss the salient features of an Environmental Monitoring Plan (5 Marks)
(b) Explain in detail the procedure for conducting an environmental audit (9 Marks)

31. Explain environmental clearance procedure for an airport (14 Marks)

OR

32. Discuss how to assess the impacts of a hydro electric project (14 Marks)

22CEO 703.2	APPLIED EARTH SYSTEMS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		OEC	2	1	0	3	2019

Preamble

Objective of the course is to appreciate the concept of earth system and it interrelated components, the processes and mechanisms thereof.

Prerequisite: Nil

Course Outcomes:

Mapping of course outcomes with program outcomes

	Description
	At the end of the course, students will be able to:
CO 1	Explain the concept of earth as a system of interrelated components and associated exogenic/endogenic processes.
CO 2	Appraise geological agents and their respective erosion, transportation and deposition regimes and landforms formed.
CO 3	Contemplate constraints and processes that continuously affect earth's surface and its stability and consistency.
CO 4	Evaluate/investigate the significance of Plate tectonics theory to explain the geodynamic features and processes of earth's surface.
CO 5	Develop an understanding of oceanographic and atmospheric regimes and their sway on other subsystems and process thereof.
CO 6	Understand implications of human interaction with the Earth system.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	2		2		3	3	2				3		
CO 2	3	3		3		3	3		1			3		
CO 3	3	3		3		3	3	2	1		3	3		
CO 4	3	3		3		3	3					3		
CO 5	3	3	2	3		3	3					3		

CO 6	2	3		2		3	3	3				3		

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (marks)
	Test 1 Marks	Test 2 Marks	
Remember	**3**	**3**	**10**
Understand	**4**	**4**	**15**
Apply	**-**	**-**	**-**
Analyse	**9**	**9**	**37**
Evaluate	**9**	**9**	**38**
Create			

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern:

The question consists of two parts- Part A and Part B. Part A consists of 10 questions with 3 marks for each (two questions from each module). Part B consists of two questions from each module, out of which one has to be answered. Each question carries 14 marks and can have maximum 2 subdivisions.

Sample Course Level Assessment Questions:

1 **Course Outcome 1 (CO1):**

Explain, citing examples the subsystems of earth interact with each other.

2 Course Outcome 2 (CO2):

Appraise the processes involved in any erosional or depositional feature of rivers.

3 Course Outcome 3 (CO3):

Discuss the controls that give rise to mass movements.

4 Course Outcome 4 (CO4):

Analyse the distribution of seismicity and volcanism with respect to plate dynamics.

5 Course Outcome 5 (CO5):

Examine ecological significance of coral reefs and implications of global warming on them.

6 Course Outcome 6 (CO6):

Assess the effect of human activities enhance the vulnerability of environment.

Syllabus

Module	Contents	Hours
I	Fundamental concepts of equilibrium. Geomorphic agents and processes. Basic concept of Earth as a system and its component sub systems. Climate Change vis-a-vis the interrelationships of the subsystems	5
II	Weathering- relevance, influence of and on earth systems, types and controlling factors Fluvial processes-hydrological cycle, fluvial erosion, transportation and deposition, fluvial landforms. Stages of stream development; Drainage patterns.	6
III	Soil- formation and controls, soil profile, soil erosion and conservation methods. Deserts-distribution and controls.	7
IV	Wagner's ideas of continental drift, Plate Tectonics- seafloor spreading. Plate boundaries and their features, mechanisms of plate movements.	6
V	Basics of oceanography: coastal upwelling and downwelling. Outlines of ocean floor topography, Brief account of marine sediments, turbidity currents, basic outlines of origin and circulation of deep-sea surface currents (Atlantic and Pacific Oceans), coral reefs- types and concepts about their formation. Basics of atmosphere and atmospheric processes: Structure and composition of the atmosphere. Heat budget, factors affecting solar radiation. Green House Effect and Global warming, basic ideas about their causes and effects	12 (6+6)

References

1. Critchfield H. General Climatology Prentice Hall, New Delhi, 1983

2. Fetter C. Applied Hydrogeology CBS New Delhi, 1990

3. Carlson, DH, Plummer, CC and McGreary, D Physical geology: Earth Revealed McGraw Hill New York, 2006

4. Pinet PR Oceanography – An Introduction to the Planet Oceanus, West Publishing Co, 1992

5. Ritter, DF, Kochel, RC and Miller, JR. Process Geomorphology Wm.C. Brown Publishers New York, 1995

6. Soman K Geology of Kerala Geological Society of India, Bangalore, 2001

Course Content and lecture Schedule:

No.	Topic	Course Outcome	Hours
Module I			
1.1	Basic concept of Earth as a system, interactions between its component sub systems.	CO1, CO5, CO6	1
1.2	Fundamental concepts of equilibrium	CO1, CO3	2
1.3	Geomorphic agents and processes	CO1, CO2, CO3	2
Module II			
2.1	Weathering- relevance, influence of and on earth systems Types and controlling factors	CO1, CO2, CO3	2
2.2	River as a system, Fluvial processes-hydrological cycle, fluvial erosion, transportation and deposition and landforms	CO1, CO2, CO3	2
2.3	Stages of stream development	CO1, CO2, CO3	1
2.4	Drainage patterns and implications	CO1, CO2, CO3, CO4	1
Module III			
3.1	Soil- significance and controls, soil profile	CO1, CO2, CO3, CO6	2
3.2	Soil erosion and conservation methods	CO1, CO2, CO3, CO6	3
3.3	Deserts-distribution and controls	CO2, CO3	2
Module IV			
4.1	Wagner’s ideas of continental drift, limitations	CO2, CO3, CO4	2
4.2	Plate Tectonics- background of the theory, evidences	CO2, CO3, CO4	1
4.3	Plate boundaries and their features, seismicity and volcanism vis-à-vis plates	CO2, CO3, CO4	2
4.4	Mechanisms of plate movements	CO2, CO3, CO4	1
Module V			
5.1	Importance of marine environment	CO1, CO2, CO3	1
5.2	Circulation in oceans- surface circulation in deep sea (Atlantic and Pacific Oceans), coastal upwelling and downwelling	CO1, CO2, CO3	2
5.3	Outlines of ocean floor topography, brief account of marine sediments	CO1, CO2, CO3	2
5.4	Turbidity currents	CO1, CO2, CO3	1
5.5	Coral reefs- types and concepts about their formation.	CO1, CO2, CO3	2
5.6	Structure and composition of the atmosphere	CO1, CO2, CO3, CO6	2

5.7	Heat budget, radiation balance of earth, Green House Effect and Global warming, basic ideas about their causes and effects	CO1, CO2, CO3, CO6	2

Model Question Paper

SEVENTH SEMESTER B. TECH DEGREE EXAMINATION

Course Code: 22CEO 703.2

APPLIED EARTH SYSTEMS

Marks:100 Duration: 3 hours

PART A

(Answer all questions. Each question carries three marks)

1. Natural slopes are in dynamic equilibrium. Appraise.
2. Assess the significance of different soil horizons.
3. Examine the conditions that give rise to parallel drainage pattern.
4. Describe features associated with convergent plate boundaries.
5. Assess the fossil evidences that support the idea of continental drift.
6. Compare creep and solifluction.
7. Assess the conditions of coral bleaching.
8. Appraise the increasing temperature with elevation in stratosphere.
9. Evaluate the role of latitudinal distribution in the formation of Hadley cells.
10. Explain the role of ocean currents in the formation of deserts.

PART B

(Answer one full question from each module)

11. There are mass and energy interactions between the subsystems of earth. Justify with two examples. (14)

OR

12. Assess the feedback mechanisms involved in controlling the mean sea-level. (14)

13. Evaluate the controls (any four) on chemical weathering. (14)

OR

14. Examine the processes of fluvial erosion and transportation. (14)

15. Evaluate the factors giving rise to aridity. (14)

OR

16. Discuss the influence of climate, slope and rock structure on occurrence on soil genesis. (14)

17. a) Examine any two evidences put forth by Wagner that support continental drift. (8)

    b) Relate convection currents in mantle to plate movements. (6)

OR

18. Appraise the significance of plate boundaries on seismicity and volcanism. (14)

19. a) Explain the implications of ozone, water vapour and carbon dioxide in troposphere. (7)

    b) How are turbidity currents formed? (7)

OR

20. a) Examine the heat budget of earth. (7)

    b) Assess the significance of zooxanthellae in the maintenance of coral reefs. (7)

22CEO 703.3	Informatics for infrastructure management	Category	L	T	P	Credit	Year of Introduction
		OEC	2	1	0	3	2019

Preamble: This course is aimed at exposing the students to the scope of Informatics and Internet of Things (IoT) in Civil Engineering. It introduces students to the fundamentals of data analytics, informatics &IoT as it is applicable to civil engineering field. After this course, students will be in a position to appreciate the use of informatics & IoT in civil engineering projects and follow the future developments in this sector.

Prerequisite: NIL

Course Outcomes:

After the completion of the course the students will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO 1	Explain the fundamental concepts of data science, informatics & internet of things	Remembering, Understanding
CO 2	Identify the use of geomatics in planning and site selection of infrastructure projects	Applying & Analysing
CO 3	Apply building informatics in construction, monitoring and project management	Applying& Analysing
CO4	Utilize IoT technology in infrastructure management	Applying& Analysing

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	-	-	-	2	-	-	-	-	-	-	2
CO 3	2	-	-	-	2	-	-	-	-	-	-	2
CO4	2	-	-	-	2	-	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	15

Understand	10	10	15
Apply	15	15	35
Analyse	15	15	35
Evaluate			
Create			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

Course Outcome 1 (CO1):

Explain the fundamental concepts of data science, informatics & internet of things.

1. Explain DIKW pyramid.
2. Explain the data mining techniques
3. Discuss different data models
4. Discuss the vector data analysis techniques
5. Explain COBie standard
6. List IoT protocols
7. What are the elements of BIM?

Course Outcome 2 (CO2):

Identify the use of geomatics for planning and site selection of infrastructure projects.

1. Discuss how geomatics help in site selection of a solid waste management facility
2. Discuss how terrain modeling is an important geographic information for project planning

Course Outcome 3 (CO3):

Apply building informatics in construction, monitoring and project management.

1. How BIM helps in reducing the cost of construction?
2. Discuss the steps in developing a BIM for an infrastructure project.

Course Outcome 4 (CO4):

Utilise IoT technology in infrastructure management.

1. How a water supply system could benefit by IoT technology?
2. Monitoring infrastructure projects could leverage from IoT technologies! Discuss.

Syllabus

Module 1

Data to Information

History of informatics, DIKW pyramid, data management- data types, Meta data, database management systems; Data analysis techniques-spatial and non-spatial data, trends and patterns

Module 2

Geoinformatics

Fundamental concepts in Geo-informatics- Components, Spatial data and attributes, vector and raster data models, Vector data analysis-buffering, overlay; Raster data analysis- local operations, neighbourhood operations, zonal operations

Module 3

Planning and Site selection

Application of geoinformatics systems: Site suitability analysis- Residential area, Industrial area and a Reservoir. Zoning- Ground water potential zonation, Hazard zonation
Network Analysis- Water supply line, Power line and a Road network

Module 4

Building Informatics

Building Information Modelling- Definition, Elements of BIM, steps in BIM development, COBie standard, potential and applications of BIM

Module 5

Internet of Things (IoT) in Civil Infrastructure

IoT Standards & Protocols, Concept of IoT in civil engineering- Applications in construction, product monitoring and project Management
Management Applications- Traffic Regulation, Water Supply and Smart Buildings

Text Books

1. J. Campbell, Essentials of Geographic Information Systems, Saylor Foundation, 2011.
2. RamezElmasri, ShamkantB.Navathe, "Fundamental of Database Systems", Pearson Addison Wesley, 2003.

3. BIM Handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers, Publisher: John Wiley & Sons; 2nd edition (1 July 2011), Language: English, ISBN-10: 9780470541371

Reference Books

1. Raja R. A. Issa and Svetlana Olbina, Building Information Modeling: Applications and Practices, ASCE, 2015.
2. Samuel Greengard, The internet of things, The MIT Press Essential Knowledge Series, 2015, ISBN: 978-0-262-52773-6.
3. ShashiShekhar and Sanjay Chawla,"Spatial Databases: A Tour", Prentice Hall, 2003.
4. Building Information Modeling: BIM in Current and Future Practice, Publisher: John Wiley & Sons; 1 edition (15 August 2014), Language: English, ISBN-10: 9781118766309

Lecture Plan – Informatics for Infrastructure Management

Module	*Topic*	*Course outcomes addressed*	*No. of Lectures*
1	**Module I : Total lecture hours : 7**		
1.1	History of informatics	CO1	Lecture 1
1.2	DIKW pyramid& Meta data	CO1	Lecture 2
1.3	Data management	CO1	Lecture 3
1.4	Data types & Meta data	CO1	Lecture 4
1.5	Database management systems	CO1	Lecture 5
1.6	Data analysis techniques	CO1	Lecture 6
1.7	Trends & Patterns in data analysis	CO1	Lecture 7
2	**Module II : Total lecture hours : 7**		
2.1	Fundamental concepts in Geo-informatics-	CO1	Lecture 1
2.2	Components of GIS	CO1	Lecture 2
2.3	Spatial data and attributes	CO1	Lecture 3
2.4	Data models- vector & raster	CO1	Lecture 4
2.5	Vector data analysis	CO1	Lecture 5

2.6	Raster data analysis- local & neighbourhood analysis	CO1	Lecture 6
2.7	Raster data analysis- zonal analysis	CO1	Lecture 7
3	**Module III : Total lecture hours : 7**		
3.1	Site suitability analysis for Residential area	CO2	Lecture 1
3.2	Site suitability analysis for Industrial area	CO2	Lecture 2
3.3	Site suitability analysis for reservoir	CO2	Lecture 3
3.4	Ground water potential zonation& Hazard zonation mapping	CO2	Lecture 4
3.5	Network analysis for water supply	CO2	Lecture 5
3.6	Network analysis for power line	CO2	Lecture 6
3.7	Network analysis for road network	CO2	Lecture 7
4	**Module IV : Total lecture hours : 7**		
4.1	Building Information Modelling- Definition	CO3	Lecture 1
4.2	Elements of BIM	CO3	Lecture 2& 3
4.3	Steps in BIM development	CO3	Lecture 4 & 5
4.4	COBie standard	CO3	Lecture 6
4.5	Potential & applications of BIM	CO3	Lecture 7
5	**Module V: Total lecture hours: 7**		
5.1	IoT Standards & Protocols, Concept of IoT in civil engineering	CO4	Lecture 1
5.2	Application of IoT in construction, product monitoring & project management	CO4	Lecture 2,3 & 4
5.3	Management applications of IoT- Traffic, water supply, smart buildings	CO4	Lecture5,6 & 7

Question Paper

Reg No.:_______________ **Name:__________________________**

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEO 703.3

Course Name: INFORMATICS FOR INFRASTRUCTURE MANAGEMENT

Max. Marks: 100 Duration: 3 hours

Part A

(***Answer all questions; each question carries 3 marks***)

61. Explain different data types.
62. Explain DIKW pyramid.
63. Compare vector & raster model.
64. What are the components of GIS?
65. Explain network analysis.
66. What is the importance of terrain modeling?
67. Define BIM.
68. What is COBie standard?
69. List the IoT protocols.
70. Explain the concept of smart buildings.

PART B

(Answer one full question from each module, each question carries 14 marks)

71. (a) Discuss data analysis techniques for spatial data. (5 Marks)

    (b) Explain the steps in processing data into information. (9 Marks)

OR

72. (a) Briefly describe the history of informatics (5 Marks)

    (b) Explain various data analysis techniques. (9 Marks)

73. (a) Discuss various components of GIS (5 Marks)

    (d) Explain various vector analysis techniques. (9 Marks)

OR

74. (a) Explain buffering analysis. What is its application? (5 Marks)
    (b) Explain various raster data analysis techniques. (9 Marks)
75. (a) How the site suitability analysis is carried out for a reservoir? (7 Marks)
    (b) Explain how geomatics is useful for mapping hazard zones. (7 Marks)

OR

16. (a) Explain the methodology for road network analysis. (7 Marks)
    (b) Explain the process of converting data to information for an industrial area selection. (8 Marks)
33. (a) What are the applications of BIM? (5 Marks)
    (b) Discuss the steps in developing a BIM for an infrastructure project. (9 marks)

OR

34. (a) Explain the elements of BIM. (5 Marks)
    (b) How BIM helps in reducing the cost of construction? (9 Marks)

35. (a) What sensors & devices would help in monitoring water distribution network. (5 Marks)
    (b) Infrastructure management could leverage from IoT technologies! Discuss. (9 Marks)

OR

36. (a) What are the selection criteria for sensors & devices used in IoT technologies. (7 Marks)
    (b) Discuss how IoT technologies could help in traffic management. (7 Marks)

22CEO 703.4	Natural Disasters & Mitigation	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		OEC	2	1	0	3	2019

Preamble

Objective of the course is to introduce the concept of disasters, their causes and their mitigation and management.

Prerequisite: Nil

	At the end of the course, students will be able to:
CO 1	Explain interaction between subsystems of earth that give rise to hazards and their potential for disasters
CO 2	Explain the evolving concepts and thoughts of management of hazards and disasters
CO 3	Analyse the causes behind natural disasters and evaluate their magnitude and impacts
CO 4	Create management plans for hazards and disasters, and understand the roles of agencies involved.
CO 5	Explain the concept of sustainable development and EIA and their role in mitigating disasters

Course Outcomes:

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	1	-	2	1	2	3	1	-	1	1	3
CO 2	2	1	-	2	1	2	3	1	-	1	1	3
CO 3	1	2	2	3	3	3	2	2	2	2	1	3
CO 4	2	1	3	2	3	2	3	2	2	1	3	3
CO 5	2	2	3	2	1	3	3	2	1	2	2	3

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (marks)
	Test 1 Marks	Test 2 Marks	
Remember	5	5	20
Understand	5	5	20
Apply	-	-	-
Analyse	5.5	5.5	22
Evaluate	5.5	5.5	22
Create	4	4	16

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern:
The question consists of two parts- Part A and Part B. Part A consists of 10 questions with 3marks for each (two questions from each module). Part B consists of two questions from each module, out of which one has to be answered. Each question carries 14 marks and can have maximum 2 subdivisions.

Sample Course Level Assessment Questions:
Course Outcome 1:
Citing a few examples known to you, discuss how disaster differs from a hazard.

Course Outcome 2:
Compare a few earthquakes in history based on their magnitude and degree of damage.

Course Outcome 3:
Discuss how the potentiality for volcanic eruption may be assessed.

Course Outcome 4:
Based on any disaster in an infrastructure project, prepare a report on how following EIA rules could have abated the disaster.

Course Outcome 5:
Prepare a disaster management plan in case of a landslide on a Railway track near to a station.

Module	Contents	Hours
1	Hazards and disasters: Introduction to key concepts and terminology: hazard, disasters and types of classifications, vulnerability, exposure, risk, crisis, emergency, capacity, resilience, Carbon footprint. Effect of subsystems of earth. Urbanization, hazards and disasters.	3
2	Extent and nature of natural hazards, implications of climate change: Earth quakes, Volcanoes, Floods. Coastal disasters- Storm surges, Tsunamis, mitigation methods.	8
3	Landslides, Soil and soil degradation, erosion and Desertification, Forest fires, their mitigation methods.	7
4	Impacts and assessment: Risk Management and Assessment and Disaster Management cycle. SWOT Analysis- basic concepts, uses, limitations and advantages. Disaster management plan and reports, participation of community in disaster management.	8
5	Hazard and disaster management plans for floods, storm surges, landslides, earthquakes, forest fires: pre-disaster phase, actual disaster phase, post-disaster phase- Relief and Amenities, Relief camps, organization, individual and community participation, camp layout, food requirement, water needs, sanitation, security, information administration. Concepts of EIA and sustainable development. Technology in disaster management.	9

Text Books

1. Ariyabandu, M. and Sahni P. “Disaster Risk Reduction in South Asia”, Prentice-Hall (India), 2003.

2. Valdiya, K.S. “Environmental Geology - Ecology, Resource and Hazard Management”. McGraw-Hill Education (India) Private Limited. 2013
3. Shaw, R and Krishnamurthy, RR (Ed.) “Disaster Management: Global Problems and Local Solutions”. Universities Press (India) Ltd. 2009
4. Gupta, H.K. (Ed.), “Disaster management”. Universities Press (India) Ltd. 20038.
5. Jha, M.K. (Ed.) “Natural and Anthropogenic Disasters- Vulnerability, Preparedness and Mitigation”. Springer, Amsterdam. 2010
6. Nick Carter. W., “Disaster Management - A Disaster Manager's Handbook”. Asian Development Bank, Philippines. 1991
7. U.N.O, “Mitigating Natural Disasters, Phenomena, Effects and options, A Manual for policy makers and planners”, United Nations. New York, 1991

References

1. Andrew, S., “Environmental Modeling with GIS and Remote Sensing”, John Willey, 2002
2. Bell, F.G., “Geological Hazards: Their assessment, avoidance and mitigation”, E & FN SPON Routledge, London. 1999
3. Bossler, J.D., “Manual of Geospatial Science and Technology”, Taylor and Francis, 2001
4. Alexander, D., “Natural Disasters”, Research Press, New Delhi, 1993
5. Girard, J. “Principles of Environmental Chemistry”. Jones & Bartlett Publishers,New York. 2013
6. Khorram-Manesh, A. (Ed.). “Handbook of Disaster and Emergency Management”. Kompendiet (Gothenburg). 2017
7. Mason, I., McGuire, B., and Kilburn, C., “Natural Hazards and Environmental Change (Key Issues in Environmental Change)”. Routledge, London. 2002

LECTURE SCHEDULE

No.	Topic	Course Outcome	No. of Hrs
1	**Module 1**		Total: 3
1.1	Introduction, Hazard, disaster, their characteristics and effects, interaction between subsystems of earth that bring about hazards and their intensification. Classification, how development is connected to disasters. Disaster cycle	CO1, CO2	2
1.2	Hazard and disaster Terminology: vulnerability and types, exposure, risk, capacity, crisis, emergencies, resilience etc. basic concepts of carbon footprint	CO1, CO4	1
2	**Module 2**		Total: 8
2.1	Natural Disasters: General classification, Causes, types, impact of: Earth quakes, volcanoes, floods, storm surges, tsunamis	CO1, CO2, CO3	3
2.2	Assessment and mitigation of: Floods, types Coastal disasters: Earth quakes, volcanoes, floods, storm surges, tsunamis.	CO1, CO2, CO3	5
3	**Module 3**		Total: 7
3.1	Soil, formation, significance and characteristics. Soil degradation, engineering and agricultural methods of prevention	CO1, CO3, CO4	2
3.2	Desertification: nature and mechanisms, mitigation	CO2, CO3, CO4	1
3.3	Landslides: processes, controlling factors, classification and impact and alleviation	CO2, CO3, CO4	2
3.4	Forest fires: incidence and means and deterrence	CO1, CO3, CO4	2
4	**Module 4**		Total: 8
4.1	Steps in Risk Management and Assessment, Disaster management cycle-Prevention, Preparedness, Response, and Recovery	CO1, CO3, CO4	3
4.2	SWOT Analysis- concepts, uses, limitations and advantages	CO2, CO3, CO4	3

4.3	Disaster management plan and reports, participation of community in disaster management	CO3, CO4, CO5	2
5	**Module 5**		Total: 9
5.1	Hazard and Disaster Management: relief camps, organisation and amenities. Behavioral aspects of management- psychological considerations, training in human professionalism, individual and community empowerment	CO1, CO2, CO4	2
5.2	Management of floods, storm surges, landslides, earthquakes, forest fires: pre-disaster phase, actual disaster phase, post-disaster phase. Relief and Amenities, Relief camps, organization, camp layout, food requirement, water needs, sanitation, security.	CO3, CO4, CO5	5
5.3	Concepts of EIA and sustainable development.	CO5	2

Model Question Paper

SEVENTH SEMESTER B. TECH DEGREE EXAMINATION

Course Code: 22CEO 703.4
Course Name: **NATURAL DISASTERS & MITIGATION**

Marks:100 Duration: 3 hours

PART A
(Answer all questions. Each question carries three marks)

21. With a typical example explain how a hazard differs from a disaster
22. Explain the terms: vulnerability and risk and how they contribute to disasters
23. Enumerate natural disasters, and mention their impacts.
24. How are earthquakes caused? What is the connection between earthquake and tsunami?
25. How is soil formed? Why do soils differ in characteristics?
26. Compare creep and solifluction.
27. What is meant by a pre-disaster plan? Give an example.
28. How is environmental impact connected to disasters?
29. Evaluate the pre-disaster measures for landslides.
30. Compare risk and vulnerability assessment.

PART B
(Answer one full question from each module)

31. a) Describe how an infrastructure project could trigger disaster. (6)
    b) How does resilience influence the recovery from a disaster? Illustrate with examples. (8)

OR

32. Bring out the differences between emergency and disaster. How is the risk for a disaster assessed? (14)
33. What are the causes of floods? How do they decide the magnitude of impact? (14)

OR

34. Discuss the triggering factors for landslides. Illustrate how they could become disastrous in the case of an infrastructure project. (14)

35. Evaluate the factors giving rise to forest fires. Analyse the influence of climate change on them. (14)

OR

36. How does desertification occur? Discuss the mitigation measures. (14)

37. Compare and contrast the concepts of disaster response and recovery with suitable examples. (14)

OR

38. Appraise (with suitable examples) the significance of ideas of relief, rehabilitation, reconstruction and recovery in disaster management. (14)

39. Prepare a disaster management plan for a landslide scenario in a hilly terrain. Discuss the organisational set up needed for the same. (14)

OR

40. Discuss the various factor to be considered in conducting environmental impact assessment of a highway project, keeping in mind the probable hazards/disasters. (14)

22CEO 703.5	**Environmental Health And Safety**	Category	L	T	P	Credit	Year of Introduction
		OEC	2	1	0	3	2019

Preamble: The course is designed to build environmental health literacy among students and encourages them to take safety measures against various environmental hazards. It motivates the students in maintaining and improving the quality of the environment and empower learners to take appropriate actions to reduce the environment pollution.

Pre-requisite: Nil

Course outcome

After the course, the student will able to:

CO1	Explain the Toxicology and Occupational Health associated with industries.
CO2	Identify chemical and microbial agents that originate in the environment and can impact human health.
CO3	Describe various measures to ensure safety in Construction industry.
CO4	Explain the effect of air and water pollution on environment.
CO5	Describe the safety measures against various environmental hazards.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					2	2					
CO2	3					2	1					
CO3	3					2	2					
CO4	3					3	2					
CO5	3					2	2					

Assessment pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (Marks)**
	Test 1 (Marks)	**Test 2 (Marks)**	
Remember	15	15	30
Understand	20	20	40

Apply			
Analyze	15	15	30
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment Test (2 numbers)	:	25 marks
Assignment/Quiz/Course project	:	15 marks
Total	**:**	**50 marks**

End semester examination pattern – There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment

Qn. No	Question	Marks	Course outcome (CO) Assessed
	Part A		
1	What are the socio- economic reasons in safety?	3	CO1
2	Define industrial hygiene.	3	CO1
3	Define noise. What are the compensation aspects of noise?	3	CO2
4	Explain about the biohazard control program.	3	CO2
5	Discuss the possible electrical injuries in a construction industry.	3	CO3
6	What are the hazards due to radiation?	3	CO3
7	What are the criteria air pollutants?	3	CO4
8	Describe the Depletion of Ozone Layer.	3	CO4
9	What are the benefits of safety inspection?	3	CO5
10	Discuss the role of an individual in conservation of natural resources.	3	CO5
	Part B **(Answer ANY ONE FULL question from each module)**		
Module I			
11	Briefly explain about occupational related diseases found in the industries.	14	CO1
12	Write the short notes on : (i) Silicosis (ii) Asbestosis (iii) Anthracosis (iv) Anthrax.	14	CO1

Module II			
13(a)	Write briefly about the classification of bio hazardous agents.	7	CO2
13(b)	What are the precautionary measures for chemical hazards?	7	CO2
14	Write short notes on : (i) Vapour (ii) Fog (iii) Dust (iv) Fumes.	14	CO2
Module III			
15	Explain effects of radiation on human body and the methods of radioactive waste disposal.	14	CO3
16(a)	What are the requirements for safe work platform?	7	CO3
16(b)	Discuss about the scaffolding inspections.	7	CO3
Module IV			
17	Describe the effect of air pollution on environment.	14	CO4
18	Describe the effect of water pollution on environment.	14	CO4
Module V			
19 (a)	What is First aid? Explain CPR.	7	CO5
19 (b)	What are the important points to be considered in carrying out workplace inspection?	7	CO5
20 (a)	Explain the first aid measure to be taken during i)gas poisoning, ii)heart attack, iii)chemical splash and iv)electric shock.	10	CO5
20 (b)	Briefly explain the elementary first aid.	4	CO5

Course Code: 22CEO 703.5
Environmental Health and Safety

Module I

Introduction to Occupational Health And Toxicology: Safety at work – Socio – Economic reasons. Introduction to health and safety at various industries. occupational related diseases- Musculoskeletal disorders, hearing impairment, carcinogens, silicosis, asbestosis, pneumoconiosis – Toxic materials and substances used in work, exposure limits, toxicological investigation, Industrial Hygiene, Arrangements by organisations to protect the workers.

Module II

Chemical hazards- Dust, fumes, vapour, fog, gases; Methods of Control. **Biological hazards**- Classification of Biohazardous agents– bacterial agents, viral agents, fungal, parasitic agents, infectious diseases, control of biological agents at workplaces. Noise, noise exposure regulation and control.

Module III

Safety in Construction industry - Scaffolding and Working platform, Welding and Cutting, Excavation Work, Concreting, control measures to reduce the risk. Electrical Hazards, Protection against voltage fluctuations, Effects of shock on human body. Radiation Hazards, Types and effects of radiation on human body, disposal of radioactive waste.

Module IV

Air Pollution - air pollutants from industries, effect on human health, animals, plants and materials - depletion of ozone layer-concept of clean coal combustion technology.
Water Pollution - water pollutants-health hazards - effluent quality standards. Waste Management -waste identification, characterization and classification, recycling and reuse.

Module V

Safe working environment - The basic purpose and benefits of safety inspection, First-aid appliances, shelters, rest rooms and lunch rooms, use of personal protective equipment, Role of an individual in conservation of natural resources, Methods for controlling water pollution, role of individual in prevention of pollution.

Text Books:

1. Environmental and Health and Safety Management by By Nicholas P. Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995.
2. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services 2005.
3. The Facility Managers Guide to Environmental Health And Safety by Brian Gallant, Government Inst Publ., 2007.
4. R.K.Jain and Sunil S.Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers , New Delhi (2006).
5. Mackenzie L Davis, Introduction to Environmental Engineering, McGrawhill Education (India).

References:

1. Slote. L, Handbook of Occupational Safety and Health, JohnWilleyand Sons, NewYork.
2. Heinrich H.W, Industrial Accident Prevention, McGrawHill Company,NewYork,1980.
3. S.P.Mahajan, "Pollution control in process industries", Tata McGraw Hill Publishing Company, New Delhi, 1993.

Course Code: 22CEO 703.5

Environmental Health And Safety

Course content and Schedule of Lecture (sample)

Module	Topic	Course outcome addressed	No of Hours
Module I (7 Hours)			
1.1	Introduction to Occupational Health And Toxicology.	CO1	1
1.2	Safety at work – Socio – Economic reasons.	CO1	
1.3	Introduction to health and safety at various industries.	CO1	1
1.4	Occupational related diseases- Musculoskeletal disorders, hearing impairment	CO1	1
1.5	Occupational related diseases - carcinogens, silicosis, asbestosis, pneumoconiosis.	CO1	1
1.6	Toxic materials and substances used in work.	CO1	1

1.7	Exposure limits, toxicological investigation.	CO1	1
1.8	Industrial Hygiene.	CO1	1
1.9	Arrangements by organisations to protect the workers.	CO1	
Module II (7 Hours)			
2.1	Chemical hazards.	CO2	1
2.2	Dust, fumes, vapour, fog, gases.	CO2	
2.3	Methods of Control.	CO2	1
2.4	Biological hazards.	CO2	1
2.5	Classification of Biohazardous agents.	CO2	
2.6	Bacterial agents, viral agents, fungal, parasitic agents, infectious diseases.	CO2	1
2.7	Control of biological agents at workplaces.	CO2	1
2.8	Noise.	CO2	1
2.9	Noise exposure regulation and control.	CO2	1

Module III (7 Hours)			
3.1	Safety in Construction industry- Scaffolding and Working platform.	CO3	1
3.2	Welding and Cutting, Excavation Work, Concreting.	CO3	
3.3	Control measures to reduce the risk.	CO3	1
3.4	Electrical Hazards.	CO3	1
3.5	Protection against voltage fluctuations.	CO3	1
3.6	Effects of shock on human body, Radiation Hazards	CO3	1
3.7	Types and effects of radiation on human body.	CO3	1
3.8	Disposal of radioactive waste.	CO3	1
Module IV (7 Hours)			
4.1	Air Pollution - air pollutants from industries.	CO4	1
4.2	Effect on human health, animals.	CO4	
4.3	Plants and Materials - depletion of ozone layer.	CO4	1
4.4	Concept of clean coal combustion technology.	CO4	1
4.5	Water Pollution - water pollutants.	CO4	1
4.6	Health hazards - effluent quality standards.	CO4	1
4.7	Waste Management-waste identification.	CO4	1
4.8	Characterization and classification.	CO4	1
4.9	Recycling and reuse.	CO4	
Module V (7 Hours)			
5.1	Safe working environment.	CO5	1
5.2	The basic purpose and benefits of safety inspection.	CO5	
5.3	First-aid appliances.	CO5	1
5.4	Shelters, rest rooms and lunch rooms.	CO5	1

5.6	Role of an individual in conservation of natural resources.	CO5	1
5.7	Methods for controlling water pollution.	CO5	1
5.8	Role of individual in prevention of pollution.	CO5	1

Model Question Paper

Reg. No.:………………….. **QP CODE:………………..**

Name:………………………

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CET 455

Environmental Health and Safety

Max. Marks: 100 **Duration: 3 hours**

Part A

(Answer all questions; each question carries 3 marks)

1. What are the socio- economic reasons in safety?
2. Define industrial hygiene.
3. Define noise. What are the compensation aspects of noise?
4. Explain about the biohazard control program.
5. Discuss the possible electrical injuries in a construction industry.
6. What are the hazards due to radiation?
7. What are the criteria air pollutants?
8. Describe the Depletion of Ozone Layer.
9. What are the benefits of safety inspection?
10. Discuss the role of an individual in conservation of natural resources.

Part B

(Answer one full question from each module; each question carries 14 marks)

Module I

11. Briefly explain about occupational related diseases found in the industries. (14 Marks)

OR

12. Write the short notes on : (14 Marks)
    (i) Silicosis
    (ii) Asbestosis
    (iii) Anthracosis
    (iv) Anthrax.

Module II

13. (a) Write briefly about the classification of bio hazardous agents. (7 Marks)

    (b) What are the precautionary measures for chemical hazards? (7 Marks)

OR

14. Write short notes on : (14 Marks)
    (i) Vapour (ii) Fog (iii) Dust (iv) Fumes.

Module III

15. Explain effects of radiation on human body and the methods of radioactive waste disposal. (14 Marks)

OR

16. (a) What are the requirements for safe work platform? (7 Marks)
    (b) Discuss about the scaffolding inspections. (7 Marks)

Module IV

17. Describe the effect of air pollution on environment. (14 Marks)

OR

18. Describe the effect of water pollution on environment. (14 Marks)

Module V

19. (a) What are the important points in carrying out workplace inspection? (7 Marks)

    (b) What is First aid? Explain CPR. (7 Marks)

OR

20. (a) Explain the first aid measure to be taken during gas poisoning, heart attack, chemical splash and electric shock. (10 Marks)

(b) Briefly explain the elementary first aid. (4 Marks)

22CEO 703.6	GEOINFORMATICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		OEC	2	1	0	3	2019

Preamble

This course introduces students to the basics of geographical information system. They will learn basic concepts in geospatial data handling and analysis. They will learn various steps involved in developing a geographical information system. Course will also explore different use cases of GIS applications.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Explain basic concepts of GIS and spatial data	Understand
CO2	Explain various datatypes and database management	Understand
CO3	Choose various spatial data collection technologies & analysis techniques	Apply
CO4	Demonstrate the use of GIS in various applications	Apply

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	3	-	-	-	-	-	-	-
CO 2	3	-	-	-	3	-	-	-	-	-	-	-
CO 3	3	-	-	-	3	-	-	-	-	-	-	-
CO4	3	-	-	-	3	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	15
Understand	10	10	15
Apply	15	15	35
Analyse	15	15	35
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

<u>Course Level Assessment Questions</u>

CO1: Explain basic concepts of GIS and spatial data

1.What are the basic components of GIS?

2. How datum and projection are important in representing spatial data?

3. What is georeferencing?

4.What are various map elements?

CO2: Explain various datatypes and database management

1. Explain the difference between spatial and attribute data used in GIS.

2. How relational database management systems (RDBMS) are useful?

3. What are the various data models used in GIS?

CO3: Choose various spatial data collection technologies & analysis techniques

1. Layers (or levels) are a fundamental means of organizing geographic data in almost all GIS, why?

2. Explain in detail various spatial data analysis techniques used in GIS.

3. Explain how DEMs are built. What are their applications?

4. What is the use of DGPS?

CO4: Demonstrate on the use of GIS in various applications

1. Discuss with examples how GIS can be useful in disaster management.

2. GIS is a useful tool in environmental science. Discuss?

3. How geospatial information helps in forest management?

SYLLABUS

Module 1

Introduction to GIS, History and development of GIS, Spatial data concepts, Coordinate reference systems, datum and projections, map scales, georeferencing, components of GIS, data sources in GIS, data input methods, file formats for GIS, standard GIS packages

Module 2

Type of data, Spatial and attribute data, Data models- vector and raster, Spatial data structure- Vector data structure and raster data structure, Database management systems (DBMS), Relational database management systems (RDBMS)

Module 3

Spatial data analysis, single layer operations- spatial and attribute query, buffer analysis, point pattern analysis, network analysis, surface analysis, interpolation; multi-layer operations-topological overlays, point in polygon, line in polygon, polygon in polygon, logical operators-AND, OR, NOT, XOR, vector overlay operations-Clip, erase, split, union, identity and intersect; raster calculators; GIS Modeling

Module 4

Digital elevation model (DEM), digital terrain model (DTM), triangular irregular network (TIN) Global navigation satellite systems- types, Global positioning system- components and principle, satellite ranging- calculating position, GPS errors and biases, Differential GPS (DGPS)

Module 5

Application of GIS in various fields- Urban planning, agriculture, disaster management, forest management, site suitability analysis for infra projects, environmental science, sales and marketing.

A mini project on application of GIS.

Text Books:

9. Anji Reddy, M. Remote Sensing and Geographical Information System, BSP Publications., 2001.
10. Chang, K (2005). Introduction to Geographic Information Systems, Tata McGraw Hills Edition, New Delhi.

References:

9. Geo Information Systems – Applications of GIS and Related Spatial Information Technologies, ASTER Publication Co., Chestern (England), 1992.
10. Burrough P.A., Principles of GIS for Land Resources Assessment, Oxford Publication, 1980.
11. Jeffrey Star and John Estes, Geographical Information System – An Introduction, Prentice – Hall Inc., 1990.
12. Marble D.F., Galkhs H.W. and Pequest, Basic Readings in Geographic Information System, Sped System Ltd., New York, 1984.
13. Clarke, K.C. Parks B.O., and Crane M.P. (2006) Geographic Information systems and environmental modeling- PHI of India, New Delhi.

Lecture Plan- Geoinformatics

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module 1: Total Lecture Hours -7**		
1.1	Introduction to GIS, History and development of GIS, Spatial data concepts	CO1	2
1.2	Coordinate reference systems, datum and projections, map scales, georeferencing	CO1	2
1.3	Components of GIS, data sources in GIS	CO1	1
1.4	Data input methods, file formats for GIS, standard GIS packages	CO1	2
2	**Module II: Total Lecture Hours- 7**		
2.1	Type of data, Spatial and attribute data	CO2	1
2.2	Data models- vector and raster, Spatial data structure- Vector data structure and raster data structure	CO2	3
2.3	Database management systems (DBMS), Relational database management systems (RDBMS)	CO2	3
3	**Module III: Total Lecture Hours-7**		
3.1	Spatial data analysis, single layer operations-spatial and attribute query, buffer analysis, point pattern analysis, network analysis, surface analysis, interpolation	CO3	3
3.2	multi-layer operations-topological overlays, point in polygon, line in polygon, polygon in polygon, logical operators-AND, OR, NOT, XOR	CO2	2
3.3	Vector overlay operations-Clip, erase, split, union, identity and intersect; raster calculators; GIS Modeling	CO2	2

4	**Module IV: Total Lecture Hours- 7**		
4.1	Digital elevation model (DEM), digital terrain model (DTM), triangular irregular network (TIN)	CO3	2
4.2	Global navigation satellite systems- types, Global positioning system- components and principle	CO3	2
4.3	Satellite ranging- calculating position, GPS errors and biases	CO3	2
4.4	Differential GPS (DGPS)	CO3	1
5	**Module V: Total Lecture Hours- 7**		
5.1	Application of GIS in various fields- Urban planning, agriculture, disaster management	CO4	3
5.2	GIS application in forest management, site suitability analysis for infra projects	CO4	2
5.3	GIS application in environmental science, sales and marketing	CO4	2

Model Question Paper

Reg No.:_______________ **Name:__________________________**

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: 22CEO 703.6
Course Name: GEOINFORMATICS

Max. Marks: 100 Duration: 3 Hours

Part A
(***Answer all questions; each question carries 3 marks***)

76. Explain georeferencing.
77. What is datum?
78. What is attribute data?
79. Raster is faster but vector is corrector. Discuss
80. What is the application of buffer analysis?
81. What is the use of line in polygon overlay?
82. What is TIN?
83. What are the components of a global positioning system?
84. List the data layers needed for identifying a landslide hazard zone?
85. Water quality analysis was carried out on the samples collected from various public wells within a Panchayat. How will you create a water quality map of the Panchayat?

PART B
(Answer one full question from each module, each question carries 14 marks)

86. (a) Why is it useful to view GIS as a process rather than merely software of hardware? (8 Marks)
    (b) What are the data input methods in GIS? (6 Marks)

OR

87. (a) Explain components of GIS (8 Marks)

(b) Discuss evolution of GIS. (6 Marks)

88. (a) Explain the difference between attribute and spatial data, give examples (6 Marks)

(e) How relational database management systems (RDBMS) are useful? (8 Marks)

OR

89. (a) Compare vector and raster data models. (8 Marks)

(b) What is a vector data structure? (6 Marks)

90. (a) Explain modelling in GIS with examples. (9 Marks)

(b) What is a raster calculator? (5Marks)

OR

16. (a) Explain network analysis. How it is useful explain with example. (7 Marks)

(b) Discuss vector overlay operations. (7 Marks)

37. (a) What is DEM? How is it developed? What are its applications? (9 Marks)

(b) Explain the principle of Global positioning. (5 marks)

OR

38. (a)Discuss the possible errors in global positioning and their causes. (7 Marks)

(b) Explain the principle of DGPS. What is its application? (7 Marks)

19. (a) Write a note on importance of geospatial technology in natural hazard management. (7 Marks)

(b) What are the applications of GIS in environmental studies. (7 Marks)

OR

39. (a) Explain the process to develop a GIS for suitability analysis of a reservoir site. (7 Marks)

(b) How sales and marketing is benefitted by GIS? Explain with example. (7 Marks)

22MNC 704	**INDUSTRIAL SAFETY ENGINERING**	**Category**	**L**	**T**	**P**	**CREDIT**
		OEC	**2**	**1**	**0**	**3**

Preamble: The course is intended to give knowledge of various safety management principles, various safety systems, various machine guarding devices, hazard identification techniques, energy sources, systems & applications and the need in the present context. Learners will be able to compare different hazard identification tools and choose the most appropriate based on the nature of industry. It aims to equip students in working with projects and to take up research work in connected areas

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Describe the theories of accident causation and preventive measures of industrial accidents. (Cognitive Knowledge level: **Understand**)
CO2	Explain about personal protective equipment, its selection, safety performance & indicators and importance of housekeeping. (Cognitive Knowledge level: **Understand**)
CO3	Explain different issues in construction industries. (Cognitive Knowledge level: **Understand**)
CO4	Describe various hazards associated with different machines and mechanical material handling. (Cognitive Knowledge level: **Understand**)
CO5	Utilise different hazard identification tools in different industries with the knowledge of different types of chemical hazards. (Cognitive Knowledge level: **Apply**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2				2	2	2				1
CO2	2	1	2		1	1	1	1				1
CO3	2	2	2		1	1	1	1	1	1		1
CO4	2	2	2		1	1	1	1	1	1		1
CO5	2	2	2	1	1	1	1	1	1	1		1

Abstract POs defined by National Board of Accreditation			
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

	Continuous Assessment Tests		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment - Test : 25 marks

Continuous Assessment - Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

MCN401- Industrial Safety Engineering (35 hrs)

Module I (safety introduction- 5 hrs)

Need for safety. Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Theories of accident causation. Safety organization- objectives, types, functions, Role of management, supervisors, workmen, unions, government and voluntary agencies in safety. Safety policy. Safety Officer-responsibilities, authority. Safety committee-need, types, advantages.

Module II (Personal protection in work environment- 7 hrs)

Personal protection in the work environment, Types of PPEs, Personal protective equipment- respiratory and non-respiratory equipment. Standards related to PPEs. Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate. Housekeeping: Responsibility of management and employees. Advantages of good housekeeping. 5 s of housekeeping. Work permit system- objectives, hot work and cold work permits. Typical industrial models and methodology. Entry into confined spaces.

Module III (safety issues in construction- 7 hrs)

Introduction to construction industry and safety issues in construction Safety in various construction operations – Excavation and filling – Under-water works – Under-pinning & Shoring – Ladders & Scaffolds – Tunneling – Blasting – Demolition – Confined space – Temporary Structures. Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety. Relevance of ergonomics in construction safety. Ergonomics Hazards - Musculoskeletal Disorders and Cumulative Trauma Disorders.

Module IV (safety hazards in machines- 8 hrs)

Machinery safeguard-Point-of-Operation, Principle of machine guarding -types of guards and devices. Safety in turning, and grinding. Welding and Cutting-Safety Precautions of Gas welding and Arc Welding. Material Handling-Classification-safety consideration- manual and mechanical handling. Handling assessments and techniques- lifting, carrying, pulling, pushing, palletizing and stocking. Material Handling equipment-operation & maintenance. Maintenance of common elements-wire rope, chains slings, hooks, clamps. Hearing Conservation Program in Production industries.

Module V (hazard identification and analysis- 8 hrs)

Hazard and risk, Types of hazards –Classification of Fire, Types of Fire extinguishers, fire explosion and toxic gas release, Structure of hazard identification and risk assessment. Identification of hazards: Inventory analysis, Fire and explosion hazard rating of process plants - The Dow Fire and Explosion Hazard Index, Preliminary hazard analysis, Hazard and Operability study (HAZOP)) – methodology, criticality analysis, corrective action and follow-up.Control of Chemical Hazards, Hazardous properties of chemicals, Material Safety Data Sheets (MSDS).

Text Books:

1. R.K Jain (2000) Industrial Safety, Health and Environment management systems, Khanna Publications.
2. Paul S V (2000), Safety management System and Documentation training Programme handbook, CBS Publication.
3. Krishnan, N.V. (1997). *Safety management in Industry*. Jaico Publishing House, New Delhi.
4. John V. Grimaldi and Rollin H.Simonds. (1989) *Safety management*. All India Traveller Book Seller, Delhi.
5. Ronald P. Blake. (1973). *Industrial safety.* Prentice Hall, New Delhi.
6. Alan Waring. (1996). *Safety management system*. Chapman & Hall, England.
7. Vaid, K.N., (1988). Construction safety management. National Institute of Construction Management and Research, Mumbai.

8. AIChE/CCPS. (1992). *Guidelines for Hazard Evaluation Proce*dures. (second edition). Centre for Chemical Process Safety, American Institute of Chemical Engineers, New York.

Course Level Assessment Questions:

Course Outcome 1 (CO1):

1. Which are the various accident causation theories? Explain.
2. Define terms: Accident, Reportable accident, Dangerous occurrence.

Course Outcome 2 (CO2):

1. Discuss different types of personal protective equipment
2. Discuss about how to compare the safety performance of two industries.
3. Discuss the significance of work permit system in accident prevention.

Course Outcome 3 (CO3):

1. Distinguish ladders and scaffolds along with their safety features.
2. Discuss the safety requirement for a confined space entry.
3. Explain the important provision in the National Building Code.

Course Outcome 4 (CO4):

1. Explain the various principles used in machine guarding.
2. Explain the issues in mechanical material handling.

Course Outcome 5 (CO5):

1. Selection of different types of fire extinguishers accordance to type of fire.
2. Conduct a HAZOP study for a batch rector of your choice.
3. Determine different types of Chemical hazards associated with industries

MODEL QUESTION PAPER

VII SEMESTER B. TECH DEGREE EXAMINATION

22MNC704- INDUSTRIAL SAFETY ENGINEERING

Maximum: 100 Marks **Duration: 3 hours**

PART A

Answer all questions, each question carries 3 marks

1. Differentiate Unsafe act and Unsafe conditions with suitable examples
2. Discuss the significance of a safety committee in improving the safety performance of an industry
3. Which are the different types of permit? Highlight its suitability.
4. Which are five 'S' used in housekeeping?
5. List the various safety features of ladders.
6. How safety of the workers can be ensured during a demolition operations.
7. Which are the hazards associated with manual material handling?
8. Discuss the safety issues of Gas welding operations.
9. Differentiate Hazard and Risk.
10. Why MSDS is mandatory for chemical products.

(10 X 3 = 30 Marks)

PART B

Answer one full question from each module

Module 1

11. List the various accident causation theories and explain any one in details. (14 Marks)
12. a) Discuss the significance of safety policy in reducing the accidents. (4 Marks)

    b) Safety and productivity are the two sides of a coin'. Are you agreeing with this statement? Explain with your arguments. (10 Marks)

Module 2

13. a) Classify the personal protective equipment. List the suitability of at least fifteen types of PPEs. (10 Marks)

b) How will you calculate the frequency rate? Explain with an example. (4 Marks)

14. a) How will you compare the safety performance of two industries? Explain with suitable example. (10 Marks)

    b) Which are the steps to be followed in confined space entry to protect the life a worker. (4 Marks)

Module 3

15. Discuss the safety and fire protection facilities required for a high rise building as per National building code. (14 Marks)

16. a) Identify the various hazards during the different stages of building construction. (7 Marks)

    b) Discuss the important types of ergonomic hazards associated with industries.(7 Marks)

Module 4

17. Which are the various types of machine guarding devices used industries. Discuss the suitability of each machine guarding devices. (14 Marks)

18. With suitable sketches briefly explain seven defects of wire ropes. (14 Marks)

Module 5

19. What is Hazard and Operability Analysis? How do you conduct a HAZOP analysis? (14 Marks)

20. Discuss about different types of chemical hazards. (14 Marks)

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures/ Tutorials L-T
1	**Introduction to Industrial safety Engineering**	
1.1	Need for safety. Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence. Reportable accidents	1
1.2	Theories of accident causation. Safety organization.	2
1.3	Role of management, supervisors, workmen, unions, government and voluntary agencies in safety.	3
1.4	Safety Officer-responsibilities, authority.	4
1.5	Safety committee-need, types, advantages.	5
2	**Personal protection in the work environment**	
2.1	Types of PPEs, respiratory and non-respiratory equipment.	6
2.2	Standards related to PPEs	7
2.3	Monitoring Safety Performance: Frequency rate, severity rate	8,
2.4	Monitoring Safety Performance: incidence rate, activity rate.	9
2.5	Housekeeping: Responsibility of management and employees. Advantages of good housekeeping. 5 s of housekeeping.	10
2.6	Work permit system- objectives, hot work and cold work permits.	11
2.7	Typical industrial models and methodology. Entry into confined spaces.	12
3	**Introduction to construction industry and safety**	
3.1	Excavation and filling – Under-water works – Under-pinning & Shoring	13
3.2	Ladders & Scaffolds – Tunneling	14
3.3	Blasting –Demolition – Confined space	15
3.4	Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety.	16
3.5	Relevance of ergonomics in construction safety.	17
3.6	Ergonomics Hazards	18
3.7	Musculoskeletal Disorders and Cumulative Trauma Disorders.	19
4	**Machinery safeguard**	

4.1	Point-of-Operation, Principle of machine guarding -	20
4.2	Types of guards and devices.	21
4.3	Safety in Power Presses, primary & secondary operations - shearing -bending - rolling – drawing.	22
4.4	Safety in turning, boring, milling, planning and grinding.	23
4.5	Welding and Cutting-Safety Precautions of Gas welding and Arc Welding,	24
4.6	Cutting and Finishing.	25
4.7	Material Handling-Classification-safety consideration- manual and mechanical handling. Handling assessments and techniques- lifting, carrying, pulling, pushing, palletizing and stocking.	26
4.8	Material Handling equipment-operation & maintenance. Maintenance of common elements-wire rope, chains slings, hooks, clamps	27
5	**Hazard identification**	
5.1	Hazard and risk, Types of hazards – Classification of Fire	28
5.2	Types of Fire extinguishers fire, explosion and toxic gas release.	29
5.3	Inventory analysis, Fire and explosion hazard rating of process plants -	30
5.4	The Dow Fire and Explosion Hazard Index.	31
5.5	Preliminary hazard analysis, Hazard and Operability study (HAZOP)	32
5.6	Chemical hazard- Classifications, Control of Chemical Hazards.	33
5.7	Hazardous properties of chemicals	34
5.8	Material Safety Data Sheets (MSDS).	35

22CEL 705	Environmental Engineering Lab	Category	L	T	P	CREDIT	Year of Introduction
		PCC	0	0	3	2	2019

Preamble: This lab provides the knowledge on tests used to analyse the physio-chemical and bacteriological properties of water and explains the various method followed in the test along with its suitability as a drinking water.

Prerequisite: Environmental Engineering

Course Outcomes:
After the completion of the course, the student will be able to:

Course outcome	Description
CO1	Analyse various physico-chemical and biological parameters of water
CO2	Compare the quality of water with drinking water standards and recommend its suitability for drinking purposes

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	-	3	3	-	-	-	-	3
CO2	3	3	3	1	-	3	3	-	-	-	-	3

Assessment Pattern:

Mark distribution

Total marks	CIE	ESE	ESE Duration
150	75	75	3 Hrs

Continuous Internal Evaluation (CIE) Pattern:

Attendance	:15 marks
Continuous Assessment	:30 marks
Internal Test	:30 marks

End Semester Examination (ESE) Pattern:
The following guidelines should be followed regarding award of marks

(a) Preliminary work	: 15 Marks
(b) Implementing the work/Conducting the experiment	: 10 Marks
(c) Performance, result and inference (usage of equipment and trouble shooting)	: 25 Marks
(d) Viva voce	: 20 Marks
(e) Record	: 5 Marks

Instructions:

- Any 12 of the 18 experiments included in the list of experiments need to be performed mandatorily.
- Virtual Lab facility cannot be used to substitute the conduct of these mandatory experiments.
- Periodic maintenance and calibration of various testing instruments needs to be made.
- Practical examination to be conducted covering entire syllabus given below. Evaluation is to be conducted under the equal responsibility of both the internal and external examiners. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

References

1. Standard Methods for the Examination of Water and Wastewater, 23rd edition, American Public Health Association, American Water Works Association, Water Environment Federation, 2017.
2. Water Supply Engineering, 33rd edition, Santhosh Kumar Garg, Khanna publishers.
3. Sewage Disposal and Air Pollution Engineering, 39th edition, Santhosh Kumar Garg, Khanna publishers.
4. IS: 10500:2012 Drinking Water - Specification, Second revision, Bureau of Indian Standards, 2012.

SYLLABUS

1. Determination of pH, Electrical Conductivity and Turbidity*
2. Determination of TS, TDS and TSS, TVS *
3. Determination of Alkalinity and Acidity *
4. Determination of Hardness *
5. Determination of Chlorides
6. Determination of Total Iron
7. Determination of Biochemical Oxygen Demand*
8. Determination of Chemical Oxygen Demand*
9. Optimum Coagulant dosage*
10. Break point Chlorination *
11. Determination of Available Chlorine in a sample of bleaching powder
12. Determination of Sulphates
13. Determination of Fluoride
14. Determination of Dissolved Oxygen*
15. Determination of nitrates
16. Determination of phosphates
17. Determination of any two Heavy Metal concentration
18. Total coliforms *

Note: * mandatory

22CES 706	SEMINAR	CATEGORY	L	T	P	CREDIT
		PWS	0	0	3	2

Preamble: The course 'Seminar' is intended to enable a B.Tech graduate to read, understand, present and prepare report about an academic document. The learner shall search in the literature including peer reviewed journals, conference, books, project reports etc., and identify an appropriate paper/thesis/report in her/his area of interest, in consultation with her/his seminar guide. This course can help the learner to experience how a presentation can be made about a selected academic document and also empower her/him to prepare a technical report.

Course Objectives:

- To do literature survey in a selected area ofstudy.
- To understand an academic document from the literate and to give a presentation about it.
- To prepare a technical report.

Course Outcomes [COs] : After successful completion of the course, the students will be able to:

CO1	Identify academic documents from the literature which are related to her/his areas of interest (Cognitive knowledge level: **Apply**).
CO2	Read and apprehend an academic document from the literature which is related to her/ his areas of interest (Cognitive knowledge level: **Analyze**).
CO3	Prepare a presentation about an academic document (Cognitive knowledge level: **Create**).
CO4	Give a presentation about an academic document (Cognitive knowledge level: **Apply**).
CO5	Prepare a technical report (Cognitive knowledge level: **Create**).

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1		2	1					3
CO2	3	3	2	3		2	1					3
CO3	3	2			3			1		2		3
CO4	3				2			1		3		3
CO5	3	3	3	3	2	2		2		3		3

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

General Guidelines

- The Department shall form an Internal Evaluation Committee (IEC) for the seminar with academic coordinator for that program as the Chairperson/Chairman and seminar coordinator & seminar guide as members. During the seminar presentation of a student, all members of IEC shall be present.

- Formation of IEC and guide allotment shall be completed within a week after the University examination (or last working day) of the previous semester.

- Guide shall provide required input to their students regarding the selection of topic/ paper.

- Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than a very specific research work. It's advisable to choose a topic for the Seminar to be closely linked to the final year project area. Every member of the projectteam could choose or be assigned Seminar topics that covers various aspects linked to the Project area.

- A topic/paper relevant to the discipline shall be selected by the student during the semester break.

- Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IEC.

- The IEC shall approve the selected topic/paper by the second week of the semester.

- Accurate references from genuine peer reviewed published material to be given in the report and to be verified.

Evaluation pattern

Total marks: 100, only CIE, minimum required to pass 50

Seminar Guide: 20 marks (Background Knowledge – 10 (The guide shall give deserving marks for a candidate based on the candidate's background knowledge about the topic selected), Relevance of the paper/topic selected – 10).

Seminar Coordinator: 20 marks (Seminar Diary – 10 (Each student shall maintain a seminar diary and the guide shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 10).

Presentation: 40 marks to be awarded by the IEC (Clarity of presentation – 10, Interactions – 10 (to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 10 (to be given based onher/his involvement during interactive sessions of presentations by other students), Quality of the slides – 10).

Report: 20 marks to be awarded by the IEC (check for technical content, overall quality, templates followed, adequacy of references etc.).

22CEP 707	PROJECT PHASE I	CATEGORY	L	T	P	CREDIT
		PWS	0	0	6	2

Preamble: The course 'Project Work' is mainly intended to evoke the innovation and invention skills in a student. The course will provide an opportunity to synthesize and apply the knowledge and analytical skills learned, to be developed as a prototype or simulation. The project extends to 2 semesters and will be evaluated in the 7th and 8th semester separately, based on the achieved objectives. One third of the project credits shall be completed in 7th semester and two third in 8th semester. It is recommended that the projects may be finalized in the thrust areas of the respective engineering stream or as interdisciplinary projects. Importance should be given to address societal problems and developing indigenous technologies.

Course Objectives

- To apply engineering knowledge in practical problem solving.
- To foster innovation in design of products, processes or systems.
- To develop creative thinking in finding viable solutions to engineering problems.

Course Outcomes [COs] : After successful completion of the course, the students will be able to:

CO1	Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: **Apply**).
CO2	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: **Apply**).
CO3	Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: **Apply**).
CO4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: **Apply**).
CO5	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: **Analyze**).
CO6	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: **Apply**).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	2	2	2	1	1	1	1	2
CO2	2	2	2		1	3	3	1	1		1	1
CO3									3	2	2	1
CO4					2			3	2	2	3	2
CO5	2	3	3	1	2							1
CO6					2			2	2	3	1	1

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

G

PROJECT PHASE I

Phase 1 Target

- Literature study/survey of published literature on the assigned topic
- Formulation of objectives
- Formulation of hypothesis/ design/ methodology
- Formulation of work plan and task allocation.
- Block level design documentation
- Seeking project funds from various agencies
- Preliminary Analysis/Modeling/Simulation/Experiment/Design/Feasibility study
- Preparation of Phase 1 report

Evaluation Guidelines & Rubrics

Total: 100 marks (Minimum required to pass: 50 marks).

- Project progress evaluation by guide: 30 Marks.
- Interim evaluation by the Evaluation Committee: 20 Marks.
- Final Evaluation by the Evaluation Committee: 30 Marks.
- Project Phase - I Report (By Evaluation Committee): 20 Marks.

(The evaluation committee comprises HoD or a senior faculty member, Project coordinator and project supervisor).

Evaluation by the Guide

The guide/supervisor shall monitor the progress being carried out by the project groups on a regular basis. In case it is found that progress is unsatisfactory it shall be reported to the Department Evaluation Committee for necessary action. The presence of each student in the groupand their involvement in all stages of execution of the project shall be ensured by the guide.Project evaluation by the guide: 30 Marks. This mark shall be awarded to the students in his/her group by considering the following aspects:

Topic Selection: innovativeness, social relevance etc. (2)

Problem definition: Identification of the social, environmental and ethical issues of the project problem. (2)

Purpose and need of the project: Detailed and extensive explanation of the purpose and need of the project. (3)

Project Objectives: All objectives of the proposed work are well defined; Steps to be followed to solve the defined problem are clearly specified. (2)

Project Scheduling & Distribution of Work among Team members: Detailed and extensive Scheduling with timelines provided for each phase of project. Work breakdown structure well defined. (3)

Literature survey: Outstanding investigation in all aspects. (4)

Student's Diary/ Daily Log: The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily/weekly activity diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily/weekly activity diary shall be signed after every day/week by the guide. (7)

Individual Contribution: The contribution of each student at various stages. (7)

EVALUATION RUBRICS for PROJECT Phase I: Interim Evaluation

No.	Parameters	Marks	Poor	Fair	Very Good	Outstanding
1-a	Topic identification, selection, formulation of objectives and/or literature survey. (Group assessment) [CO1]	10	The team has failed to come with a relevant topic in time. Needed full assistance to finda topic from the guide. Theydo not respond to suggestions from the evaluation committee and/or the guide. No literature review was conducted. The team tried to gather easy information without verifying the authenticity. No objectives formed yet.	The team has identified a topic. The originally selected topic lacks substance and needs to be revised. There weresuggestions given to improve the relevance and quality of the project topic. Only a few relevant references were consulted/ studied and there is no clear evidence to show the team's understanding on the same. Some objectives identified, but not clear enough.	Good evidence of the group thinking and brainstorming on what they are going to build. The results of the brainstorming are documented and the selection of topic is relevant. The review of related references was good, but there is scope of improvement. Objectives formed with good clarity, however some objectives are not realistic enough.	The group has brainstormed in an excellent manner on what they were going to build. The topic selected is highly relevant, real world problem and is potentially innovative. The group shows extreme interest in the topic and has conducted extensive literature survey in connection with the topic. The team has come up with clear objectives which are feasible.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
1-b	Project Planning, Scheduling and Resource/ Tasks Identification and allocation. (Group assessment) [CO4]	10	No evidence of planning or scheduling of the project. The students did not plan what they were going to build or plan on what materials / resources to use in the project. The students do not have any idea on the budget required. The team has not yet decided on who does what. No project journal kept.	Some evidence of a primary plan. There were some ideas on the materials /resources required, but not really thought out. The students have some idea on the finances required, but they have not formalized a budget plan. Schedules were not prepared. The project journal has no details. Some evidence on task allocation among the team members.	Good evidence of planning done. Materials were listed and thought out, but the planwasn't quite complete. Schedules were prepared, but not detailed, and needs improvement. Project journal is presented but it is not complete in all respect / detailed. There is better task allocation and individual members understand about their tasks. There is room for improvement.	Excellent evidence of enterprising and extensive project planning.Gantt charts were used to depict detailed project scheduling. A project management/version control tool is used to track the project, which shows familiarity with modern tools. All materials / resources were identified and listed and anticipation of procuring time is done. Detailed budgeting is done. All tasks were identified and incorporated in the schedule. A well-kept project journal shows evidence for all the above, in addition to the interaction with the project guide. Each member knows well about their individual tasks.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
Phase 1 Interim Evaluation Total Marks: 20						

EVALUATION RUBRICS for PROJECT Phase I: Final Evaluation

Sl. No.	Parameters	Marks	Poor	Fair	Very Good	Outstanding
1-c	Formulation of Design and/or Methodology and Progress. (Group assessment) [CO1]	5	None of the team members show any evidence of knowledge about the design and the methodology adopted till now/ to be adopted in the later stages. The team has not progressed from the previous stage of evaluation.	The students have some knowledge on the design procedure to be adopted, and the methodologies. However, the team has not made much progress in the design, and yet to catch up with the project plan.	The students are comfortable with design methods adopted, and they have made some progress as per the plan. The methodologies are understood to a large extent.	Shows clear evidence of having a well-defined design methodology and adherence to it. Excellent knowledge in design procedure and its adaptation. Adherence to project plan is commendable.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
1-d	Individual and Teamwork Leadership (Individual assessment) [CO3]	10	The student does not show any interest in the project activities, and is a passive member.	The student show some interest and participates in some of the activities. However, the activities are mostly easy and superficial in nature.	The student shows very good interest in project, and takes up tasks and attempts to complete them. Shows excellent responsibility and team skills. Supports the other members well.	The student takes a leadership position and supports the other team members and leads the project. Shows clear evidence of leadership.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
1-e	Preliminary Analysis/ Modeling / Simulation/ Experiment / Design/ Feasibility study [CO1]	10	The team has not done any preliminary work with respect to the analysis/modeling/ simulation/experiment/design/feasibility study/ algorithm development.	The team has started doing some preliminary work with respect to the project. The students however are not prepared enough for the work and they need to improve a lot.	There is some evidence to show that the team has done good amount of preliminary investigation and design/ analysis/ modeling etc. They can improve further.	Strong evidence for excellent progress in the project. The team has completed the required preliminary work already and are poised to finish the phase I in an excellent manner. They have shown results to prove their progress.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)

1-f	Documentation and presentation. (Individual & group assessment). [CO6]	5	The team did not document the work at all. The project journal/diary is not presented. The presentation was shallow in content and dull in appearance. The individual student has no idea on the presentation of his/her part.	Some documentation is done, but not extensive. Interaction with the guide is minimal. Presentation include some points of interest, but overall quality needs to be improved. Individual performance to be improved.	Most of the project details were documented well enough. There is scope for improvement. The presentation is satisfactory. Individual performance is good.	The project stages are extensively documented in the report Professional documentation tools like LaTeX were used to document the progress of the project along with the project journal. The documentation structure is well-planned and can easily grow into the project report. The presentation is done professionally and with great clarity. The individual's performance is excellent.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
Total		**30**	**Phase - I Final Evaluation Marks: 30**			

EVALUATION RUBRICS for PROJECT Phase I: Report Evaluation

Sl. No.	Parameters	Marks	Poor	Fair	Very Good	Outstanding
1-g	Report [CO6]	20	The prepared report is shallow and not as perstandard format. It does not follow proper organization.Contains mostly Unacknowledged content.Lack of effort in preparation is evident.	Project report follows the standard format to some extent. However, its organization is not very good. Language needs to be improved. All references are not cited properly in the report.	Project report shows evidence of systematic documentation. Report is following the standardformat and there are only a few issues. Organization of the report is good. Most of references are cited properly.	The report is exceptionally good. Neatly organized. All references cited properly. Diagrams/Figures, Tables and equations are properly numbered, and listed and clearly shown. Language is excellent and follows standard styles.
			(0 - 7 Marks)	(8 - 12 Marks)	(13 - 19 Marks)	(20 Marks)
Phase - I Project Report Marks: 20						

22CEMR 708	MINI PROJECT	CATEGORY	L	T	P	CREDIT
		PWS	0	0	3	4

Preamble: Mini Project Phase I: A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The object of Project Work I is to enable the student to take up investigative study in the broad field of Civil Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on a group of three/four students, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

- Survey and study of published literature on the assigned topic;
- Preparing an Action Plan for conducting the investigation, including team work;
- Working out a preliminary Approach to the Problem relating to the assigned topic;
- Block level design documentation
- Conducting preliminary Analysis/ Modelling/ Simulation/ Experiment/ Design/ Feasibility;
- Preparing a Written Report on the Study conducted for presentation to the Department;

CO1	Identify and synthesize problems and propose solutions to them.
CO2	Prepare work plan and liaison with the team in completing as per schedule.
CO3	Validate the above solutions by theoretical calculations and through experimental
CO4	Write technical reports and develop proper communication skills.
CO5	Present the data and defend ideas.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3					3	3		2
CO2	3			3				3	3	3	3	
CO3	3	3	3	3	3					3		
CO4					3			3	3	3		1
CO5	3	3	3	3				3		3	3	1

*1-slight/low mapping, 2- moderate/medium mapping, 3-substantial/high mapping

Continuous Internal Evaluation Pattern:

Sl. No.	Level of Evaluation	Marks
1	Interim evaluation by the committee	**20**
2	Project Guide	**30**
3	Final Seminar evaluation by the committee	**30**
4	The report evaluated by the evaluation committee	**20**
	Total	**100**
	Minimum required to pass	**50**

The evaluation committee comprises a panel of HoD or a senior faculty member, Project coordinator and project supervisor.

22CEHR 709.1	MODERN CONSTRUCTION MATERIALS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		VAC	3	1	0	4	2019

Preamble: Goal of this course is to expose the students to the recent developments in the modern construction materials, and to introduce the conventional construction materials and their modern use. After this course, students will be able to identify and decide the material most suited for the construction, considering the durability, sustainability and economy in the material selection.

Prerequisite : CET309 Construction Technology and Management

Course Outcomes: After completion of the course the student will be able to:

CO 1	Identify and select suitable concrete type for a specific construction
CO 2	Characterize various structural materials for construction
CO 3	Select suitable non-structural materials for buildings
CO 4	Ascertain sustainable materials for construction
CO 5	Outline various smart materials suitable for structures

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1				2	3					3
CO 2	3	1				2	3					3
CO 3	3	1				2	3					3
CO 4	3	1				2	3					3
CO 5	3	1				2	3					3

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	20	20	40
Understand	20	20	50
Apply	10	10	10
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation (CIE) Pattern :

Attendance : 10 Marks

Continuous Assessment Test (2 numbers) : 25 Marks

Assignment/Quiz/Course project : 15 Marks

End Semester Examination (ESE) Pattern : There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

Course Outcome 1 (CO1):

1. Explain the mix composition, properties and uses of high strength concrete.
2. Enumerate the various advantages of using high strength concrete.
3. Describe the properties and uses of fibre reinforced concrete.
4. Write a short note on ready mixed concrete. What are its advantages?

Course Outcome 2 (CO2):

1. Explain the types and properties of structural materials
2. Describe the manufacturing process of various structural materials
3. Enumerate the applications of various structural materials in construction

Course Outcome 3 (CO3):

1. Explain the types and properties of non-structural materials
2. Describe the manufacturing process of various non-structural materials
3. Enumerate the uses and applications of various non-structural materials in construction

Course Outcome 4 (CO4):

1. Explain the pros and cons of various sustainable materials
2. Enumerate the uses and applications of various sustainable materials in construction
3. Define the concepts of life cycle assessment

Course Outcome 5 (CO5):

1. Explain the pros and cons of various smart materials
2. Enumerate the applications of smart materials in construction

SYLLABUS

Module 1 (Advanced Concrete)

Concrete - special concretes for specific purposes like lightweight concrete, ready mixed concrete, high strength concrete, high performance concrete, self compacting concrete, fibre reinforced concrete, polymer concrete, geopolymer concrete, textile reinforced concrete, ferrocement (brief description of composition, properties, and applications of the above).

Module 2 (Structural Materials)

Bricks, fly ash bricks - Stone; Stabilised mud blocks, soil - cement blocks, calcium silicate bricks, red mud - Wood, Industrial Products which can substitute wood ; particle board, fibre board, hard board, Glulam - Polymers; Fibre reinforced polymers - Metals; Steel ; Aluminium - Bituminous materials – Glass, glass reinforced gypsum – Plastics - jute fibre polymer composite (RFPC)

Module 3 (Non-structural Materials)

Properties and use of conventional and modern waterproofing materials, Conventional and modern insulating materials (thermal, sound and electrical insulating materials). Concept of polymer floor finishes, Paints, tiles, Acoustic Treatment, Dry walls, anchors

Module 4 (Sustainable Materials)

Sustainable Construction Materials - Wood, bamboo, straw bales, earthen materials, glass cullet, copper slag, municipal incinerated bottom ash, recycled aggregates, recycled plastic products, sustainable concretes, biocomposites, thatched roofing, linoleum flooring.

Energy - Definition, Types of Unit Energy Values, Assessment of Energy. (brief discussion only)

Introduction to Life Cycle Assessment (brief discussion only)

Module 5 (Smart and Intelligent Materials)

Types- Neoprene, Bridge pads, thermocole- Smart and Intelligent Materials, Special features:- Shape Memory Alloys (SMAs), Magnetostrictive Materials, Piezoelectric Materials, Electrochromic materials, Green materials including biomaterials, biopolymers, bioplastics– – Case studies showing the applications of smart and Intelligent Materials.

References:

1. Building Materials, P. C. Varghese, Prentice-Hall India, 2005.
2. Construction materials: Their nature and behaviour, Eds. J.M. Illston and P.L.J. Domone, 3rd ed., Spon Press, 2001.

3. The Science and Technology of Civil Engineering Materials, J.F. Young, S. Mindess, R.J. Gray & A. Bentur, Prentice Hall, 1998
4. Michel S. Mamlouk and John P. Zaniewski, Materials for Civil and Construction Engineers, Prentice Hall.
5. L. Reed Brantley and Ruth T Brantley, Building Materials Technology, McGraw-Hill Publishers
6. Neil Jackson and Ravindra K. Dhir, Civil Engineering Materials, Palgrave Foundations
7. Don A Watson, Construction Materials and Processes, Career Education
8. Gandhi M. V. and B. S. Thompson, Smart Materials and Structures, Chapmann & Hall, London
9. Concrete: Microstructure, properties and materials, P.K. Mehta and P.J.M. Monteiro, McGraw Hill, 2006
10. Properties of concrete, A.M. Neville, Pearson, 2004
11. Shetty M. S., Concrete Technology‟‟, S. Chand & Co., 2006
12. Ganapathy, C., Modern Construction Materials, Eswar Press, 2015.
13. Deucher, K.N, Korfiatis, G.P and Ezeldin, A.S, Materials for civil and Highway Engineers, Prentice Hall Inc., 1998.
14. Mamlouk, M.S. and Zaniewski, J.P., Materials for Civil and Construction Engineers, Prentice Hall Inc., 1999.
15. Brain Culshaw – Smart Structure and Materials Artech House – Borton. London-1996.
16. Materials Science and Engineering, V. Raghavan, Prentice Hall, 1990
17. Sandy Halliday, Sustainable Construction, Butterworth-Heinemann, 2008.

Course Contents and Lecture Schedule:

Module	Contents	Outcomes Addressed	Hours
1	**Module 1**		**8**
1.1	Review of properties of concrete, uses of concrete	CO1	1
1.2	lightweight concrete (types, properties and uses)	CO1	1
1.3	ready mixed concrete, high strength concrete, high performance concrete	CO1	1
1.4	self compacting concrete (properties, tests and uses)	CO1	2
1.5	fibre reinforced concrete (properties and applications)	CO1	1
1.6	polymer concrete (types, properties and uses)	CO1	1
1.7	geopolymer concrete (brief description of one part and two part geopolymer concrete, composition, properties, and uses)	CO1	1
1.8	textile reinforced concrete (properties and uses), ferrocement (construction, properties and applications)	CO1	1
2	**Module 2**		**9**
2.1	Bricks, fly ash bricks	CO2	1
2.2	Stone; Stabilised mud blocks, soil - cement blocks, calcium silicate bricks, red mud	CO2	1
2.3	Wood, Industrial Products which can substitute wood ; particle board, fibre board, hard board, Glulam	CO2	1
2.4	Polymers; Fibre reinforced polymers	CO2	1
2.5	Metals; Steel , Aluminium	CO2	1
2.6	Bituminous materials	CO2	1
2.7	Glass, glass reinforced gypsum	CO2	1
2.8	Plastics	CO2	1
2.9	Jute fibre polymer composite (RFPC)	CO2	1
3	**Module 3**		**9**
3.1	Properties and use of conventional and modern waterproofing materials	CO3	1
3.2	Conventional and modern insulating materials (thermal)	CO3	1
3.3	sound and electrical insulating materials	CO3	1
3.4	Concept of polymer floor finishes	CO3	1
3.5	Paints	CO3	1
3.6	Tiles	CO3	1
3.7	Acoustic Treatment	CO3	1
3.8	Dry walls	CO3	1
3.9	Anchors	CO3	1

4	**Module 4**		**9**
4.1	Susainable Construction Materials - Wood, bamboo, straw bales (characteristics, types and uses)	CO4	1
4.2	Earthen materials- rammed earth, earthen bags, mudbrick, adobe, cob, compressed earth block, (characteristics, types and uses)	CO4	1
4.3	Earth shelter technique	CO4	1
4.4	Glass cullet, copper slag, municipal incinerated bottom ash (characteristics and uses)	CO4	1
4.5	Recycled aggregates, recycled plastic products (characteristics, types and uses)	CO4	1
4.6	Sustainable concretes, thatched roofing, linoleum flooring. (characteristics, types and uses)	CO4	1
4.7	Emergy - Definition, Types of Unit Emergy Values	CO4	1
4.8	Assessment of emergy	CO4	1
4.9	Introduction to Life Cycle Assessment (brief discussion)	CO4	1
5	**Module 5**		**9**
5.1	Types- Neoprene	CO5	1
5.2	Bridge pads	CO5	1
5.3	Thermocole	CO5	1
5.4	Smart and Intelligent Materials	CO5	1
5.5	Shape Memory Alloys (SMAs), Magnetostrictive Materials	CO5	1
5.6	Piezoelectric Materials, Electrochromic materials	CO5	1
5.7	Green materials including biomaterials, biopolymers, bioplastics	CO5	2
5.8	Case studies showing the applications of smart and Intelligent Materials.	CO5	2

Model Question Paper

QP CODE:

Reg No.:_______________ **Name:___________________________**

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEHR709.1
Course Name : MODERN CONSTRUCTION MATERIALS

Max. Marks: 100 Duration: 3 hours

Part A
(***Answer all questions; each question carries 3 marks***)

1. Enumerate the various advantages of using high strength concrete.
2. State the advantages of self compacting concrete.
3. What is the use of gypsum board in construction?
4. Define dressing of stones
5. Name few commercially available water proofing compounds
6. What is meant by façade material?
7. Explain about linoleum flooring and its sustainability aspects.
8. Enlist the pros and cons of bamboo as a construction material
9. List out the recent smart materials used in building construction
10. What is shape memory alloys?

PART B

(Answer one full question from each module, each question carries 14 marks)

Module – 1

11. (a) Explain the mix composition, properties and uses of self compacting concrete. (8)

    (b) Write a short note on ready mixed concrete. What are its advantages? (6)

12. (a) Explain the different types, properties and uses of light weight concrete. (8)

    (b) Explain the typical composition of a geopolymer concrete and its advantages. (6)

Module – 2

13. (a) Describe corrosion of steel and the measures adopted for its prevention. (8)

(b) Explain the different types of glass and its applications in buildings. (6)

14. (a) Detail the types of plastics, its manufacturing process and uses. (8)

(b) Explore the possibilities of stabilized mud block as a construction material (6)

Module – 3

15. (a) Explain the functions, types and properties of water proofing compounds. (8)

(b) Critically compare different modern flooring materials. (6)

16. 16. (a) Describe various modern thermal and sound insulating materials. (8)

(b) Compare "breathing" and "non-breathing" types of paints. What are the considerations in application of these paints to the ceiling under the wet areas and wall surfaces? (6)

Module – 4

17. (a) What are the various eco-friendly materials for green building? (8)

(b) Discuss the uses of glass cullet in the construction industry. (6)

18. (a) Explain the uses of copper slag as sustainable aggregate. (6)

(b) How will you improve low-cost rural houses using modern construction materials? (8)

Module – 5

19. (a) Compare Smart and intelligent materials (6)

(b) Explain the various types of smart materials based on their properties (8)

20. (a) Write an explanatory note on the special features and application of intelligent and smart modern materials (8)

(b) Evaluate the effects of smart materials on green buildings (6)

22CEHR709.2	SOIL DYNAMICS AND MACHINE FOUNDATION	CATEGORY	L	T	P	CREDIT	Year of Introduction
		VAC	3	1	0	4	2019

Preamble: Goal of this course is to impart to the students, in-depth knowledge about the basic concepts and theories of soil dynamics and machine foundation.

Prerequisite: Geotechnical Engineering - II

Course Outcomes: After completion of the course the student will be able to:

CO 1	Analyze single degree of freedom systems under vibration using theory of vibrations
CO 2	Evaluate dynamic soil properties using IS procedures
CO 3	Analyze the response of machine foundations
CO 4	Design machine foundation with reciprocating and Impact type of machines
CO 5	Design of wave barriers

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	3	-	-	-	-	-	-	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	3	-	-	-	-	-	-	-	-	-	-
CO 4	2	2	3	-	-	-	-	-	-	-	-	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation (CIE) Pattern :

Attendance	: 10 Marks
Continuous Assessment Test (2 numbers)	: 25 Marks
Assignment/Quiz/Course project	: 15 Marks

End Semester Examination (ESE) Pattern : There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

SYLLABUS

Module 1

Theory of vibrations: Definitions, Single degree freedom system - Free vibration of a spring mass system. Free vibration with viscous damping- Critically damped system, Over damped system, Under damped system. Logarithmic decrement. Forced vibration with damping. Frequency dependent excitation.

Dynamic soil properties: Definition and factors affecting. Determination of dynamic soil properties -Cross hole test, Cyclic plate load test, Block vibration test, Correlations of dynamic soil properties with SPT N value.

Module 2

Analysis of Machine Foundations: Modes of vibrations of a rigid foundation block. Linear Elastic Weightless Spring method of analysis for all modes of vibration- Numerical problems. Concept of elastic Half-space method of analysis.

Module 3

Design of foundation for reciprocating machines: Design of foundations for reciprocating machines (IS method of Design) -design requirements and design procedure for block type foundation-Necessary data, design criteria, permissible amplitude.

Module 4

Design of foundation for Impact type machines-Design criteria and design procedure for block type foundation (IS method). Properties and requirements of cushion pad, Construction criteria of foundations for impact type of machines.

Module 5

Vibration isolation for Machine Foundations: Choice of vibration isolation -IS Guidelines, Active and passive isolation, Transmissibility, Design of wave barriers (open trench), dynamic properties of vibration isolators- coil springs, rubber springs, cork pads, Design procedure for foundations on absorbers .

Text Books:

1. Ranjan G. and A. S. R. Rao, Basic and Applied Soil Mechanics, New Age International, 2002.
2. Arora K. R., Geotechnical Engineering, Standard Publishers, 2006.

References:

1. Das B. M., Principles of Geotechnical Engineering, Cengage India Pvt. Ltd., 2010.
2. Venkatramaiah, Geotechnical Engg, Universities Press, 2000.
3. Terzaghi K. and R. B. Peck, Soil Mechanics in Engineering Practice, John Wiley, 1967.

4. A V Narasimha Rao and C Venkatramaiah, Numerical Problems, Examples and Objective questions in Geotechnical Engineering, Universities Press (India) Ltd., 2000
5. Purushothamaraj P., Soil Mechanics and Foundation Engineering, Dorling Indersley (India) Pvt. Ltd., 2013
6. Taylor D.W., Fundamentals of Soil Mechanics, Asia Publishing House, 1948.

Course Plan:

Module	Contents	Hours
1		
1.1	**Theory of vibrations:** Definitions, Single degree freedom system	1
1.2	Free vibration of a spring mass system.	1
1.3	Free vibration with viscous damping- Critically damped system, Over damped system, Under damped system	1
1.4	Logarithmic decrement. Forced vibration with damping	1
1.5	Frequency dependent excitation.	1
1.6	**Dynamic soil properties**: Definition and factors affecting	1
1.7	Determination of dynamic soil properties -Cross hole test, Cyclic plate load test, Block vibration test	2
1.8	Correlations of dynamic soil properties with SPT N value.	1
2		
2.1	**Analysis of Machine Foundations**: Modes of vibrations of a rigid foundation block	1
2.2	Linear Elastic Weightless Spring method of analysis for all modes of vibration	2
2.3	Numerical problems	3
2.4	Concept of elastic Half-space method of analysis.	3
3		
3.1	**Design of foundation for reciprocating machines** -Design of foundations for reciprocating machines (IS method of Design)	4
3.2	Design requirements	3
3.3	Design procedure for block type foundation-Necessary data, design criteria, permissible amplitude	4
4		
4.1	**Design of foundation for Impact type machines-**Design criteria and design procedure for block type foundation (IS method)	5

4.2	Properties and requirements of cushion pad	2
4.3	Construction criteria of foundations for impact type of machines.	2
5		
5.1	**Vibration isolation for Machine Foundations**: Choice of vibration isolation	1
5.2	IS Guidelines	1
5.3	Active and passive isolation, Transmissibility, Design of wave barriers (open trench)	2
5.4	Dynamic properties of vibration isolators- coil springs, rubber springs, cork pads	1
5.5	Design procedure for foundations on absorbers	2

22CEHR 709.3	**Environmental Pollution Control Techniques**	Category	L	T	P	Credit	Year of Introduction
		VAC	3	1	0	4	2019

Preamble: The course is designed to impart knowledge on the fundamental aspects of environmental pollution and its control techniques among students. It helps the learners to understand the sources of environmental pollution, characteristics of pollutants, waste treatment techniques and empower the learners to adopt appropriate strategies to control the environmental pollution.

Pre-requisite: Nil

Course outcome

After the course, the student will able to:

CO1	Explain the basic concepts of Air pollution and Water pollution
CO2	List the environmental protection laws and acts implemented in India to abate the Environmental Pollution
CO3	Describe various treatment techniques used to control the Environmental Pollution
CO4	Differentiate the treatment techniques for domestic sewage and industrial wastewater
CO5	Explain the different practices adopted for solid waste management of a community

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					2	2					
CO2	3					2	1					
CO3	3					3	2					
CO4	3					2	2					
CO5	3					3	2					

Assessment pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	20	20	40
Apply			
Analyze	15	15	30
Evaluate			
Create			

Continuous Internal Evaluation Pattern: -

Attendance	:	10marks
Continuous Assessment Test (2numbers)	:	25 marks
Assignment/Quiz	:	15marks
Total	**:**	**50 marks**

End semester examination pattern – There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which students should answer anyone. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment

Qn. No	Question	Marks	Course outcome (CO) Assessed
	Part A(Answer all questions)		
1	What are the different sources of air pollutants?	3	CO1

2	What are the various approaches to minimize exhaust emissions from automobiles?	3	CO1
3	Write a short note on skimming tanks.	3	CO3
4	Give a general layout of a waste treatment plant.	3	CO3
5	Explain the biological characteristics of Industrial wastes.	3	CO4
6	Explain the significance of pre-treatment of industrial waste and briefly describe any one method.	3	CO4
7	What are the drawbacks of incineration?	3	CO5
8	What are the different waste minimization strategies?	3	CO5
9	Enumerate the different environmental rules and regulations in India.	3	CO2
10	What are the different methods for the identification of environmental impacts of a project?	3	CO2
	Part B **(Answer ANY ONE FULL question from each module)**		
Module I			
11	What do you mean by particulate pollutants? Explain the various means to control them.	14	CO1
12	Explain in detail, the different means to control gaseous pollutants	14	CO1
Module II			
13	Explain with a neat sketch, the working of an activated sludge process. State the merits and demerits of the process as well.	14	CO3

14	Explain with a neat sketch, the working of a trickling filter. Also state its merits and demerits.	14	CO3
Module III			
15	Explain High Rate Anaerobic Treatment method for treating industrial wastes.	14	CO4
16	Explain equalization and proportioning for treating industrial wastes.	14	CO4
Module IV			
17	How do the waste matters are stabilized during Sanitary Land Filling? Explain.	14	CO5
18	What is composting? Explain various types of composting.	14	CO5
Module V			
19	Explain Environmental Management Plan.	14	CO2
20	Discuss the different Environmental protection laws and acts in India with respect to Air Pollution.	14	CO2

Course Code: 22CEHR709.3
Environmental Pollution Control Techniques

Module 1 (9hrs)

Introduction to environmental pollution-Air pollution – Sources – Primary pollutants, Secondary pollutants - Criteria pollutants – Effects - Control of gaseous pollutants (adsorption, absorption, reaction and other methods) – Control of particulate pollutants (settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators)– Automobile pollution control, Air Pollution Mitigation Measures - Ambient air quality standards.

Module 2 (9hrs)

Water pollution – Sources – Various Pollutants – Effects - Treatment and control methods – Physico-chemical and Biological Treatments – Screening, skimming, sedimentation, coagulation, Filtration, Trickling Filters, Activated sludge process, Oxidation ponds,

Module 3 (9hrs)

Industrial Pollution - Characteristics of industrial wastes: physical, chemical and biological. Pretreatment of industrial wastes: waste volume reduction, waste strength reduction neutralization, equalization and proportioning. High rate anaerobic methods (design not needed). Essential elements of an Environmental Management System (EMS)

Module 4 (9hrs)

Solid waste management: Type and source of solid waste, characteristics, collection, segregation, transportation and processing- Waste minimization strategies – Reduction - Recycling – Reuse; Disposal - composting, sanitary landfill, incineration; Hazardous Waste Treatment and Disposal - Biological and chemical treatment of hazardous wastes, Landfill disposal of hazardous waste; Bioremediation of hazardous waste disposal sites.

Module 5 (8hrs)

Administrative and Legislative control of environmental pollution. Important Environmental rules and regulations, environmental protection acts and rules. Environmental Management Plan, identification and mitigation of environmental impacts.

Text Books

1. Peavy, Rowe, Tchobanoglous, Environmental Engineering, Mc Graw Hill International Editions.

2. M.N. Rao & H.V.N. Rao, Air Pollution, Tata Mc Graw Hill Pvt. Ltd., New Delhi.

3. S. K. Garg, Environmental Engineering Vol. l & ll, Khanna Publishers, New Delhi.

4. B.C. Punmia, Waste water Engineering, Arihant Publications, Jodpur.

5. C.S. Rao, Environmental Pollution Control Engineering, New Age International (P)Ltd, New Delhi.

References

1. Nelson Leonard Nemerow, Theories and practices of industrial waste treatment, Addison-Wesley Publishing Co., Inc.

2. W Wesley Eckenfelder Jr., Industrial water pollution control, International Edition, Mc Graw Hill Inc, New Delhi.

3. M Narayana Rao, Waste water treatment, Rational methods of design and Industrial practice, Oxford & IBH Publishing Co. Pvt. Ltd, Bombay.

4. Warren Viessman and mark J Hammer, Water Supply and Pollution Control, Pearson Education, Inc.

5. Gilbert M.Masters, Kurian Joseph and R. Nagendran, Introduction to Environmental Engineering and Science.

6. Ruth F. Weiner and Robin Matthews, Environmental Engineering, Butterworth-Heinemann, Elsevier.

Course Code: 22CEHR709.3

Environmental Pollution Control Techniques

Course content and Schedule of Lecture (sample)

Module	Topic	Course outcome addressed	No of Hours
Module I (9 Hours)			
1.1	Introduction to environmental pollution	CO1	1
1.2	Air pollution – Sources – Primary pollutants, Secondary pollutants Criteria pollutants– Effects	CO1	2
1.3	Control of gaseous pollutants	CO1	2
1.4	Control of particulate pollutants	CO1	2
1.5	Automobile pollution control	CO1	1
1.6	Air Pollution Mitigation Measures- Ambient air quality standards.	CO1	1
Module II (9 Hours)			
2.1	Water pollution – Sources – Various Pollutants – Effects	CO3	1
2.2	Physico-chemical and Biological Treatments – Screening, Skimming	CO3	1
2.3	Sedimentation	CO3	1
2.4	Coagulation	CO3	1
2.5	Filtration	CO3	1
2.6	Trickling Filters	CO3	1
2.7	Activated sludge process	CO3	2
2.8	Oxidation ponds	CO3	1

Module III (9 Hours)			
3.1	Industrial Pollution - Characteristics of industrial wastes: physical, chemical and biological	CO4	2
3.2	Pretreatment of industrial wastes: waste volume reduction	CO4	2
3.3	Waste strength reduction neutralization	CO4	1
3.4	Equalization and proportioning, High rate anaerobic methods	CO4	2
3.5	Essential elements of an Environmental Management System (EMS)	CO4	2
Module IV (8 Hours)			
4.1	Solid waste management: Type and source of solid waste, characteristics	CO5	1
4.2	Collection, segregation, transportation and processing	CO5	1
4.3	Waste minimization strategies – Reduction - Recycling – Reuse	CO5	1
4.4	Disposal - composting, sanitary landfill, incineration	CO5	2
4.5	Hazardous Waste Treatment and Disposal	CO5	1
4.6	Biological and chemical treatment of hazardous wastes	CO5	1
4.7	Landfill disposal of hazardous waste	CO5	1
4.8	Bioremediation of hazardous waste disposal sites	CO5	1
Module V (8 Hours)			
5.1	Administrative and Legislative control of environmental pollution	CO2	2
5.2	Important Environmental rules and regulations	CO2	2
5.3	Environmental protection acts and rules	CO2	2
5.4	Environmental Management Plan, identification and mitigation of environmental impacts	CO2	2

Model Question Paper

Reg.No.:………………….. **QP CODE:………………..**

Name:………………………

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEHR709.3

Environmental Pollution Control Techniques

Max. Marks: 100 **Duration: 3 hours**

Part A

(Answer all questions; each question carries 3 marks)

1. What are the different sources of air pollutants?
2. What are the various approaches to minimize exhaust emissions from automobiles?
3. Write a short note on skimming tanks.
4. Give a general layout of a waste treatment plant.
5. Explain the biological characteristics of Industrial wastes.
6. Explain the significance of pre-treatment of industrial waste and briefly describe any one method.
7. What are the drawbacks of incineration?
8. What are the different waste minimization strategies?
9. Enumerate the different environmental rules and regulations in India.Explain the significance of pre-treatment of industrial waste and briefly describe any one method.
10. What are the different methods for the identification of environmental impacts of a project?

Part B

(Answer any one question from each module; each question carries 14 marks)

MODULE 1

11. What do you mean by particulate pollutants? Explain the various means to control control them.

OR

12. Explain in detail, the different means to control gaseous pollutants.

MODULE 2

13. Explain with a neat sketch, the working of an activated sludge process. State the merits and demerits of the process as well.

OR

14. Explain with a neat sketch, the working of a trickling filter. Also state its merits and demerits.

MODULE 3

15. Explain High Rate Anaerobic Treatment method for treating industrial wastes.

OR

16. Explain Equalisation and Proportioning for treating industrial wastes.

MODULE 4

17. How do the waste matters are stabilized during Sanitary Land Filling? Explain.

OR

18. What is composting? Explain various types of composting.

MODULE 5

19. Explain Environmental Management Plan.

OR

20. Discuss the different Environmental protection laws and acts in India with respect to air pollution.

SEMESTER 8

SEMESTER VIII

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	22CET 801	QUANTITY SURVEYING & VALUATION	3-0-0	3	3
B	22CEE 802	PROGRAM ELECTIVE III	3-0-0	3	3
C	22CEE 803	PROGRAM ELECTIVE IV	3-0-0	3	3
D	22CEE 804	PROGRAM ELECTIVE V	3-0-0	3	3
E	22CEV 805	COMPREHENSIVE VIVA VOCE	1-0-0	1	1
U	22CEP 806	PROJECT PHASE II	0-0-12	12	4
R/M/H	22CEMR807 22CEHR808	Remedial/Minor/Honours course	3-1-0	4*	4
TOTAL				**25/29**	**17/21**

PROGRAM ELECTIVE III

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
B	22CEE 802.1	ADVANCED STRUCTURAL DESIGN	3-0-0	3	3
	22CEE 802.2	GEO ENVIRONMENTAL ENGINEERING	3-0-0		
	22CEE 802.3	RAILWAY AND TUNNEL ENGINEERING	3-0-0		
	22CEE 802.4	IRRIGATION & DRAINAGE ENGINEERING	3-0-0		
	22CEE 802.5	CONSTRUCTION METHODS & EQUIPMENT	3-0-0		
	22CEE 802.6	AIRQUALITY MANAGEMENT	3-0-0		
	22CEE 802.7	URBAN PLANNING & ARCHITECTURE	3-0-0		

PROGRAM ELECTIVE IV

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
C	22CEE 803.1	BRIDGE ENGINEERING	3-0-0	3	3
	22CEE 803.2	ADVANCED FOUNDATION DESIGN	3-0-0		
	22CEE 803.3	TRANSPORTATION PLANNING	3-0-0		
	22CEE 803.4	INFORMATICS FOR INFRASTRUCTURE MANAGEMENT	3-0-0		
	22CEE 803.5	REPAIR AND REHABILITATION OF BUILDINGS	3-0-0		
	22CEE 803.6	ENVIRONMENTAL REMOTE SENSING	3-0-0		
	22CEE 803.7	BULDING SERVICES	3-0-0		

PROGRAM ELECTIVE V

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
D	22CEE 804.1	EARTHQUAKE RESISTANT DESIGN	3-0-0	3	3
	22CEE 804.2	SOIL STRUCTURE INTERACTION	3-0-0		
	22CEE 804.3	AIRPORT, SEAPORT AND HARBOUR ENGINEERING	3-0-0		
	22CEE 804.4	HYDROCLIMATOLOGY	3-0-0		
	22CEE 804.5	SUSTAINABLE CONSTRUCTION	3-0-0		
	22CEE 804.6	CLIMATE CHANGE & SUSTAINABILITY	3-0-0		
	22CEE 804.7	BUILDING INFORMATION MODELLING	3-0-0		

MINOR

SEMESTER	BASKET I				BASKET II				BASKET III			
	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT
S8	22CEMR807	MINI PROJECT	4	4	22CEMR807	MINI PROJECT	4	4	22CEMR807	MINI PROJECT	4	4

HONOURS

SEMESTER	GROUP I				GROUP II				GROUP III			
	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT	Course No.	Course Name	HOURS	CREDIT
S 8	22CEHR808	MINI PROJECT	4	4	22CEHR808	MINI PROJECT	4	4	22CEHR808	MINI PROJECT	4	4

22CET 801	QUANTITY SURVEYING AND VALUATION	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PCC	3	0	0	3	2019

Preamble:
The course provides the knowledge about various types of estimation and specification of different civil engineering works. It equips students to analyze the rate of various items of work with reference to the standard data and schedule of rate. This course develops capability of students to prepare the detailed estimate of various items of work related to civil engineering construction and also preparation of the valuation of land and buildings.

Prerequisite: Building drawing

Course Outcomes: After the completion of the course the student will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Define basic terms related to estimation, quantity surveying and contract document	Remembering
CO2	Interpret the item of work from drawings and explain its general specification and unit of measurement.	Understanding
CO3	Make use of given data from CPWD DAR/DSR for calculating the unit rate of different items of work associated with building construction	Applying
CO4	Develop detailed measurement (including BBS) and BoQ of a various work like buildings, earthwork for road, sanitary and water supply work	Applying
C05	Explain various basic terms related to valuation of land and building	Understanding
CO6	Develop valuation of buildings using different methods of valuation.	Applying

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10		10
Understand	10	10	30
Apply	30	40	60
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10marks

Continuous Assessment Test(2numbers) : 25 marks

Assignment/Quiz/Course project : 15marks

End Semester Examination Pattern: There will be two parts; Part A and Part B.

Part A contain 3 questions from module-I & II. Answer any 2 question, each question caries 10marks.

Part B contains 3 questions from Module III of which student should answer any 2 questions. Each full question carries 25 marks.

Part C contains 3 questions from Module IV of which student should answer any 2 questions. Each question carries 15 marks.

Note:

For analysis of rate and cost estimation, unit rate and labour requirement should be given along with the questions in the question paper. No other charts, tables, codes are permitted in the Examination Hall. If necessary, relevant data shall be given along with the question paper.

Sample Course Level Assessment Questions

CO1: Define basic terms related to estimation, quantity surveying and contract document

1.	What is mean by the term (a) Work charge establishment (b) Provisional quantity
2.	List different type of estimate. Explain any two in detail.

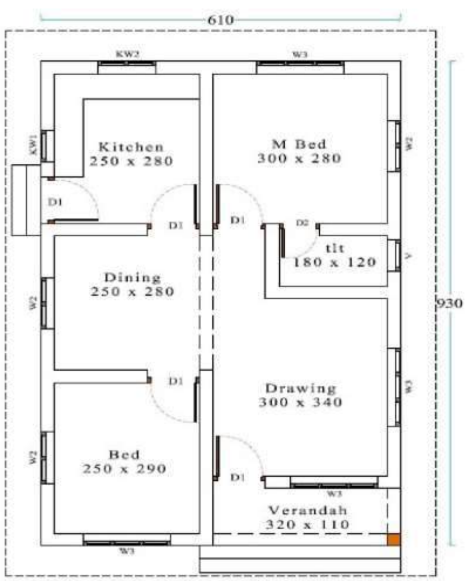
CO2: Interpret the item of work from drawings and explain its general specification and unit of measurement.

1	Give the units of following work (a) Carpentry fitting (b) Pointing (c) Plastering
2	Explain the general rule of measurement as per Indian Standards

CO3: Make use of given data from CPWD DAR/DSR for calculating the unit rate of different items of work associated with building construction

1.	Develop rate analysis for DSR item No.5.3, Reinforced cement concrete work with 1:1.5:3 (3 graded stone aggregate 20 mm nominal size) in beams, suspended floors, roofs having slope up to 15° landings, above plinth level up to floor five level, excluding the cost of centering, shuttering, finishing and reinforcement. **Material** : 20mm Aggregate 0.57m^3@₹1300/m^3, 10mm 0.28m^3@ ₹1300/m^3, coarse sand (Zone III) 0.425m^3@₹1200/m^3, Portland cement 400kg@₹5700/tonne. **Labour :** Mason 0.24@₹467/day, Beldar 2.75@₹368/day, Bhisti 0.90@₹407/day, Coolie 1.88@₹368/day **Carriage provisions** : Stone aggregate below 40mm 0.85m^3@₹103.77 , Portland cement 0.40tonne@₹5700/tonne. **Hire Charges** for concrete mixer 0.08@₹800/day, Vibrator needle type ₹0.08@350/day **Sundries** (LS) 14.30@₹1.73. Adopt water charges, contractor profit and overheads as per the CPWD DSR2018 provisions.

CO4: Develop detailed measurement (including BBS) and BoQ of a various work like buildings, earthwork for road, sanitary and water supply work

<table>
<tr><td>1.</td><td>List the any four items of work in plumbing work of residential building</td></tr>
<tr><td>2.</td><td>Write the unit of measurement of (i) Carpentry fittings (ii) Pointing of Brick Wall</td></tr>
<tr><td>3.</td><td>Prepare a bar bending schedule and quantities of RCC and reinforcement of a simply supported beam of length 6.5 m , depth 50 cm, and width 30 cm reinforced with 3 Nos of 20 mm dia at bottom as straight bar, 2 Nos of 20 mm dia cranked at 45o , 2 Nos 16 Φ at top of beam and 8 mm Φ 2 legged stirrups @ 15 cm c/c</td></tr>
<tr><td>4.</td><td>Prepare detailed measurement for the following items of work for the construction of residential building shown below using Centre line method
(a) RRM for foundation (75cm x 75cm) and basement50cm x 50cm , Wall thickness 20cm
(b) Brick work for superstructure
(c) RCC works for slab (12cm thick), lintel (15cm thick), and sun shade (60cm projection)
(d) Painting for walls, doors(D1-100x210; D2 80x210) and windows (W2-100x150; W3-150x150;KW1-50x100;KW2-100x100); V(90x60).


Also Calculate No. of brick, cement & sand required for Brick wall</td></tr>
</table>

CO5: Explain various basic terms related to valuation of land and building

1.	Explain how depreciation in building is worked out.
2.	Discuss about the different types of values and the term obsolescence
3	Discuss the importance of valuation in civil engineering.
4	Differentiate the terms Value, Cost and Price

CO6: Develop valuation of buildings using different methods of valuation.

1.	A building is situated by the side of a main road of Mumbai city on a land of 500sq m. The built up portion is 20m x 15 m.The building is first class type and provided

	with water supply, sanitary and electrical fittings, and the age of the building is 30 years. Workout the valuation of the property.
2.	Workout the valuation of a commercial building with the following data: Cost of land for life-time period of building is ₹.5,20,000/-. Gross income per year is ₹.8,50,000/-Expenses required per year: (a) staff salary, electric charges, municipal taxes including licenses fees, stationery and printing etc. is 20% of the gross income. (b) For repair and maintenance of lift, furniture etc. @ 5% of their capital cost of ₹.10,50,000/- (c) sinking fund for the items considered in capital cost, whose life is 25years @4% after allowing 10% scrap value. (d) Insurance premium is ₹.25,000/- per year. Take year's purchase @8% and annual repair of the building @2% on gross income.

SYLLABUS

MODULE 1.

Introduction- Quantity Surveying- Basic principles, Role/responsibility of Quantity surveyor at various stages of construction

Estimate-Details required, Type of estimate, purposes.

Contingencies, Work-charge establishment, Tools and Plant, centage charge, Day work, Prime cost, Provisional sum & provisional Quantity, Overhead charges, Cost index, Contract documents (Brief description only)

Bill of Quantity -Typical format-use

Item of works- Identify various item of work from the drawings-units of measurement of various materials and works (focus may give to RCC residential building)

General rule & method of measurement with reference to Indian Standard Specifications-IS1200.

MODULE 2.

Introduction to the use of CPWD schedule of rates as per latest DSR and Analysis of rate as per latest DAR

Specifications-General specification of all items of a residential building.

Detailed specification (CPWD specifications) of major item of work like Earth work excavation in foundation, masonry, Reinforced cement concrete, finishing of building work

Analysis of rates for Earth work in excavation for foundation, mortars, reinforced cement concrete Works, finishing work, masonry work, stone works, flooring with reference to latest DSR and latest DAR (Data should be given).

MODULE 3.

Detailed Estimate- Preparation of detailed measurement using Centre line method & Short wall long wall (separate wall) method for RCC single storied building (Flat roof) including stair cabin- Residential/office/school building.

BOQ preparation of a single storied RCC building work.

Material quantity calculation of the items of work (Rubble, Brick work, Concrete work, Plastering) in detailed estimate prepared for building work. (Data for unit quantity should be provided from DAR)

Bar Bending Schedule- Preparation of BBS of RCC beams, slabs, Column footings, Retaining wall.
Road estimation-Estimation of earthwork from longitudinal section-metaled road.

Estimation of sanitary and water supply work -Water tank, Septic tank, Manhole *(No Detailed estimate needed-concept of item of work, its general specification and unit of measurement*).

MODULE 4.

Valuation – purpose, factor affecting, introduction to terms-Value, Cost, Price, kinds of values Income- Gross income, net income, outgoings, annuity, sinking fund, Year's purchase, Depreciation, obsolescence -Free hold and leasehold properties.

Methods of calculating depreciation – straight line method – constant percentage method, sinking fund method and quantity survey method.

Methods of valuation– rental method, direct comparison of capital cost, valuation based on profit, depreciation method.

Various method of valuation of land (Brief description only)

Text Books:

1. B. N. Dutta, Estimation and costing in civil engineering, UBS publishers
2. Rangwala, Estimation Costing and Valuation,Charotar publishing house pvt. ltd
3. Dr. S. Seetha Raman, M.Chinna swami, Estimation and quantity surveying, Anuradha publications Chennai.
4. M Chakraborthy, Estimating, Costing, Specification and valuation, published by the author, 21 B, Babanda Road, Calcutta 26

References:

1. B S Patil, Civil Engineering contracts and estimates, university press
2. V N Vazirani& S P Chandola, Civil Engineering Estimation and Costing, Khanna Publishers
3. IS 1200-1968; Methods of measurement of building & civil engineering works
4. CPWD DAR 2018 and DSR 2018 or latest
5. CPWD Specifications Vol1 & 2 (2019 or latest edition)

Course Plan

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module I: Total lecture hours:8**		
1.1	Introduction to Quantity survey, basic principle, Role/responsibility of Quantity surveyor, Estimate-List the types, Details required	CO1	1
1.2	Types of estimates, simple problems of approximate estimate, purpose	CO1	1
1.3	Contingencies, Work-charge establishment, Tools and Plant, centage charge, Day work, Prime cost, Provisional sum & provisional Quantity (Brief description only)	CO1	1
1.4	Bill of Quantity -Typical format-use	CO2	1
1.5	Units of measurement of various materials and works	CO2	2
1.6	General rule & method of measurement with reference to Indian Standard Specifications-IS1200	CO2	1
1.7	Introduction to the use of CPWD schedule of rates as per latest DSR and Analysis of rate as per latest DAR, Overhead charges, Cost index.	CO2	1
2	**Module II: Total lecture hours-5**		
2.1	Specifications-General specification of various items of building work.	CO3	1
2.2	Detailed specification of major item of work like Earth work excavation in foundation, masonry, Reinforced cement concrete, finishing of building work with reference to CPWD specifications	CO3	2
2.3	Analysis of rates for Earth work in excavation for foundation, mortars, reinforced cement concrete Works, finishing work, masonry work, stone works, flooring with reference to latest DSR and latest DAR (All data (Material, labour & machine) and rate will be given in the question paper)	CO3	2
3	**Module III: Total lecture hours: 16**		
3.1	Preparation of detailed measurement and abstract of estimate using Centre line method & Short wall long wall (separate wall) method- Explain with a single room building example	CO4	2
3.2	Preparation of detailed measurement for RCC single storey buildings with stair cabin- Excavation for foundation, Foundation and basement, DPC,	CO4	5

	Masonry in superstructure, RCC, Plastering, Painting, flooring, Woodwork, Staircase.		
3.3	Preparation of BoQ of single storied RCC building	CO4	1
3.4	Material quantity calculation of the Rubble, Brick work, Concrete work, plastering in detailed estimate of RCC building (Data for unit quantity should be provided from DAR)	CO4	1
3.5	BBS of RCC beams, slabs, Column footings, Retaining wall	CO4	4
3.6	Road estimation-Estimation of earthwork from longitudinal section-metaled road	CO4	2
3.7	Estimation of sanitary and water supply work - Water tank, Septic tank , Manhole (Concept only)	CO4	1
4	**Module IV: Total lecture hours: 7**		
4.1	Valuation –Purpose, factor affecting- Introduction to terms-Value, Cost, Price, Income- Gross income, net income, outgoings, annuity, sinking fund (Simple Examples), Year’s purchase, Depreciation, obsolescence -Free hold and leasehold properties.	CO5	2
4.2	Depreciation – methods of calculating depreciation – straight line method, constant percentage method, sinking fund method, and quantity survey method-numerical examples	C06	2
4.4	Methods of valuation of land with building – rental method, direct comparison of capital cost, valuation based on profit, depreciation method.	CO6	2
4.5	Various method of valuation of land (Brief description only)	CO6	1

MODEL QUESTION PAPER

Reg.No.:____________ Name:______________________

EIGHTH SEMESTER B. TECH DEGREE EXAMINATION

Course Code: 22CET801

Course Name: QUANTITY SURVEYING AND VALUATION

Max.Marks:100 Duration: 3Hours

General Instructions: 1. Supplement answers with illustrations, wherever necessary.
2. Assume any missing data and state the assumptions clearly. Assumptions should be realistic.

PART A

Answer Two full question

(10×2 marks = 20 marks)

Module 1 & II

1. a. Explain the terms (a) Cost index (b) Overhead charges (4)

   b. List different type of Estimate. Explain the detailed estimate (6)

2. a. What are different types of specification? (2)

   b. Reproduce the detailed specification for earthwork excavation for foundation (8)

3. Develop unit rate of the work (DSR 2018 item No. 4.1.2), providing and laying in position 1:1½:3 (1 Cement: 1½ coarse sand (zone-III) : 3 graded stone aggregate 20 mm nominal size) cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : MATERIAL : 0.57cu.m 20mm nominal size of stone aggregate @ Rs.1370/cu.m., 0.28cu.m 10mm nominal size of stone aggregate @ Rs.1350/cu.m., 0.425 cu.m of coarse sand (Zone-III) @Rs.1350/cu.m., 0.2833cu.m Portland cement @ Rs.4940/tonne, LABOUR : 0.10 Mason @ Rs.709/day; 1.63 Beldar @ Rs.558/day, 0.70 Bhisti @ Rs.617/day. CARRIAGE PROVISIONS: Stone aggregate below 40mm Rs. 103.77/cu.m.; coarse sand @Rs.103.77/cu.m. and for cement @ Rs.92.24/tonne. HIRE CHARGES of concrete mixer 0.07@Rs.800/day, Vibrator 0.07@Rs.370/day, SUNDRIES , LS, 14.30@Rs.2

   (10)

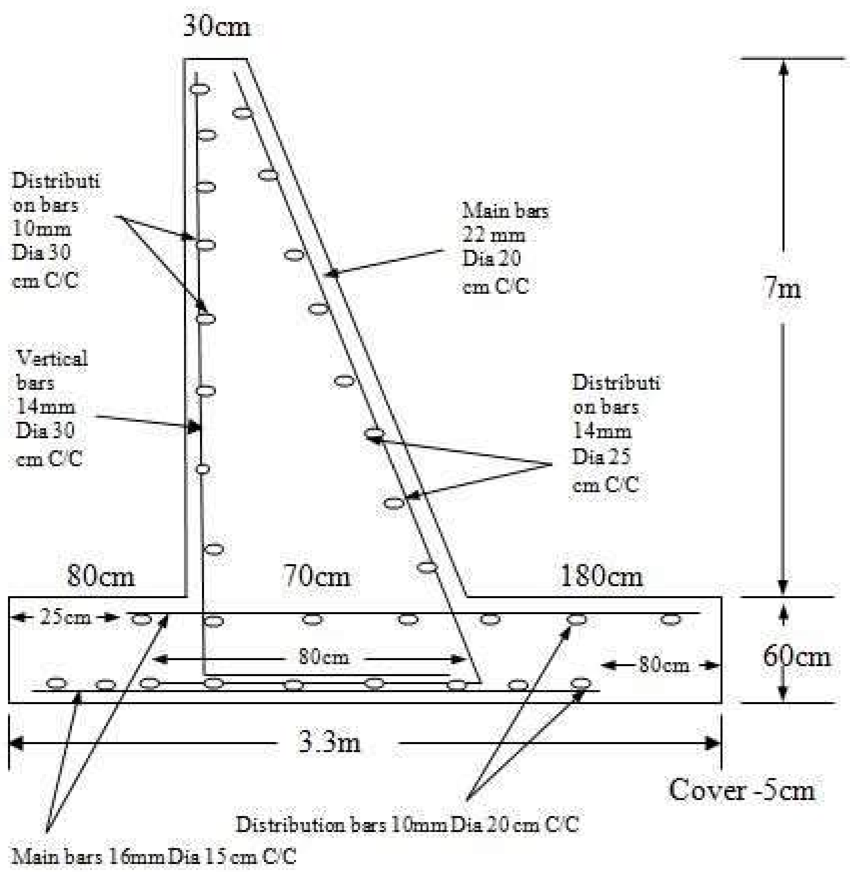
PART B

Answer Two full question

(2 x 25=50 Marks)

Module III

4. Prepare Schedule of bars and calculate the quantities of material required for constructing a retaining wall shown in figure. Length of retaining wall 20m.



5. Calculate the following quantity of the given plan using Centre line method. Assume suitable dimensions for Doors & Windows

(Door D1 -100x210; D2 -80x210; W2 -120x140; V1- 90x60; KW2- 120x90; FW1- 60x180)

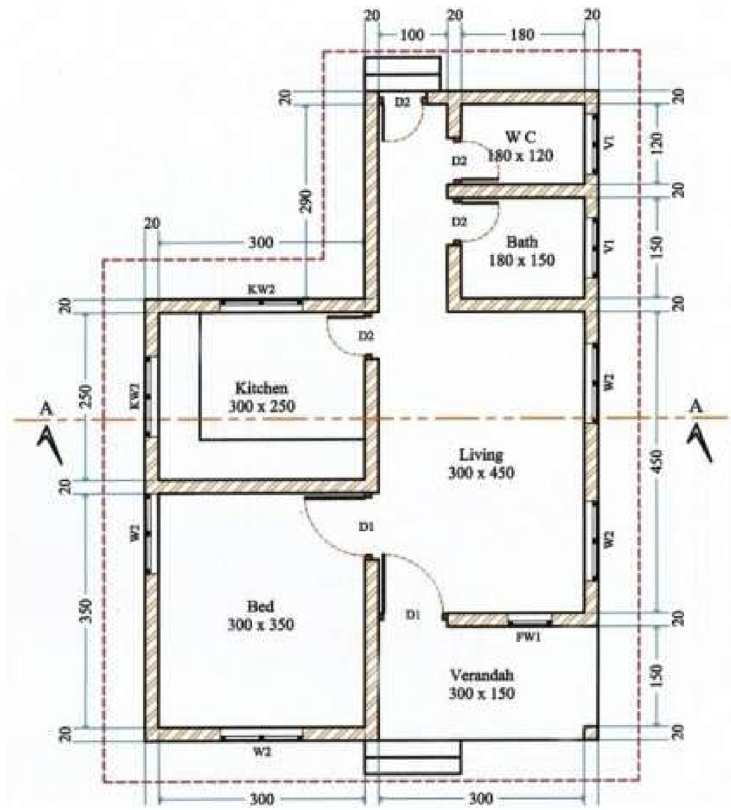
(a) Earth work excavation, Width of base Concrete 75cm

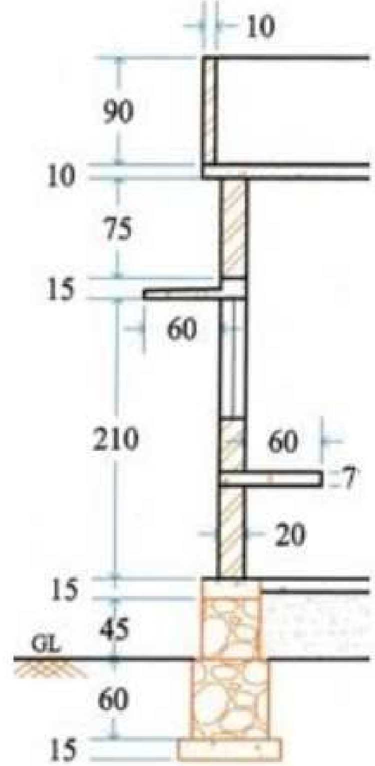
(b) Foundation (60cm x 60cm) and basement (45cm x 45cm) with RR masonry

(c) Brick work for super structures, CM1:6

(d) RCC 1:2:4 for roof

(e) Wood work for door and windows





6. **a.** A simply supported beam of size 450 x 230 having a span of 6m is supported on a 30cm wall at both ends. The stirrups of 10mm diameter are provided at a spacing of 150mm c/c. The beam have main bar of 3 no's 20mm diameter at bottom including one bend up bar and stirrup holders are of 2 no's 16mm diameter at top. Main & Stirrup holder reinforcement is provided with a cover of 25mm. Calculate the total quantity of the reinforcement required for the stirrup for this beam. Also prepare an estimate of tor steel reinforcement for stirrup including cutting, bending , placing in position and binding, adopt the rate as Rs.95/kg. (10 Marks)

b. Calculate the quantity of earth work for a portion of road of length 700m. Formation width of road is 8m, side slope in banking 2: 1 and 1:1 in cutting, road has a down gradient of 1 in 150, formation level 160 at distance 0.

Distance (m)	0	100	200	300	400	500	600	700
Reduced Level	158.9	159.10	159.20	162.20	160.80	160.70	160.30	160.40

(15 Marks)

PART C

Answer Two full question

(2 x 15=30 Marks)

7. **a.** A concrete mixer was purchased at Rs.8000/-. Assuming salvage value to be Rs.1000, after5years, calculate depreciation for each year adopting (a) Straight line method (b) Constant percentage method and (c) Sinking fund method considering 6% interest. (8 marks)

   b. A lease-hold property is to produce a net income of Rs.12,000/- per annum for the next -60years. What is the value of the property? Assume that the land lord desires a return of 6% on his capital and the sinking fund to replace the capital is also to accumulate at 6%. What will be the value of the property if the rate of interest for redemption of capital is 3%? (7 marks)

8. **a.** Explain various method of land valuation (8 marks)

   b. Workout the valuation of a commercial building with the following data: Cost of land for life-time period of building is ₹.5,20,000/-. Gross income per year is ₹.8,50,000/-Expenses required per year: (a) staff salary, electric charges, municipal taxes including licenses fees, stationery and printing etc. is 20% of the gross income. (b) For repair and maintenance of lift, furniture etc. @ 5% of their capital cost of ₹.10,50,000/- (c) sinking fund for the items considered in capital cost, whose life is 25years @4% after allowing 10% scrap value. (d) Insurance premium is ₹.25,000/- per year. Take year's purchase @8% and annual repair of the building @2% on gross income. (8 marks)

9. a. List the factors affecting valuation. (5 marks)

   b. Explain the significance of sinking fund, How it is calculated. (5 marks)

   c. A person purchased a property for Rs.50,00,000/-. Assuming its salvage value after 40 years will be Rs. 5,00,000/-, determine amount of depreciation each year considering it to be uniform. (5 marks)

22CEE 802.1	ADVANCED STRUCTURAL DESIGN	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PEC	3	0	0	3	2019

Preamble:

This course intends to brush-up the fundamentals of design of reinforced concrete and steel structures by limit state design and review the usage of relevant codes. The course offers to make students competent by covering contemporary engineering practices in the structural design. This course is also intended to develop the mixed qualities to students in structural engineering point of view - independently handling the design problems and to work in a group for team works (through assignments)

Prerequisite: CET303 Design of Concrete Structures, CET401 Design of Steel Structures

Course Outcomes: After the completion of the course the student will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Design and detail cantilever retaining wall and understand the design principles of Counter fort retaining wall. And Design and detail deep beams	Applying Understanding
CO2	Design and detail water tanks as per IS code provisions	Applying
CO3	Explain Concept of yield line theory and design of different slab using yield line theory Design of Flat slabs using IS code provisions.	Understanding Applying
CO4	Analyse and design Cold form light gauge section.	Applying
CO5	Use of latest industry standard formula, table, design aids used for design of beams and portal frames under pattern loading.	Understanding Applying

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	1	-	-	1	-	-	-	1	-	-
CO2	3	1	1	-	-	-	-	-	-	1	-	-
CO3	3	2	3	-	-	-	-	-	-	1	-	-
CO4	3	2	3	-	-	-	-	-	-	1	-	-
CO5	1	3	2	-	-	-	-	2	2	1	-	1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	5	5	10
Understand	10	10	20
Apply	25	25	50
Analyse	5	5	10
Evaluate	5	5	10
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Course Level Assessment (Sample) Questions

CO1: Design and detail cantilever retaining wall and understand the design principles of Counter fort retaining wall. And Design and detail deep beams

1. Identify the situations in which each type of retaining wall is used.
2. Design a cantilever retaining wall has to retain earth 3.5 m high above ground level. The density of earth is 17 KN/m^3 and its angle of repose is 300. The earth is horizontal at top. The safe bearing capacity of soil is 180 KN/m^2 and coefficient of friction between soil and concrete is 0.55
3. Describe the structural behavior of deep beam.
4. Design a typical interior span of a continuous deep beam using the following data:
   Span of beam = 9m
   Overall depth = 4.5m
   Width of supports = 0.9m
   Width of beam = 0.4m
   Uniformly distributed load (including self weight) = 200kN/m
   Concrete = M20 grade
   Reinforcements = Fe415 HYSD bars
   Sketch the details of reinforcements at centre of span and support sections.
5 Explain the design principles of cantilever retaining wall.

CO2: Design and detail water tanks as per IS code provisions.

1. Design a circular water tank with flexible base for a capacity of 450 KL. The depth of water is 4.5 m. Allow suitable free board
2. What are the methods of design of water tanks?
3. Design a rectangular water tank on the ground having size 10m x 4 m x 5 m. Use M30 concrete and Fe 416 steel

CO3: Explain the Concept of yield lines and design of slab using yield lines
Design of Flat slabs using IS code provisions

1. Obtain an expression for the moment carrying capacity along a yield line for isotropically reinforced square slab simply supported and uniformly loaded.
2. Discuss the following: i) Applications of flat slab ii) Components of flat slab
3. Explain the assumptions of yield line theory?
4. Discuss the yield line pattern of one way and two way slab
5. Explain in detail the steps for designing of a flat slab?

1. A RCC slab 5 m. x 5 m. in plan is simply supported along its four edges, and is reinforced with 10 mm. dia. Fe-415 grade bars at 150 mm. c/c both ways. Slab is 130

mm. thick,' with average effective depth of reinforcement as 100 mm. slab carries a floor finish weighing 2.0 kN/m.2 M-20 concrete is used. Compute the service load. on slab, from fundamentals, of yield line theory. Take load factor = 1.50.

2. Calculate the moments on column strip and middle strip of an interior panel of a flat slab for an office floor to suit the following data. Size of office floor – 25m x 25m
   Size of panel – 5m x 5m
   Loading class – 4 kN/m2
   Use M20 grade concrete and Fe415 HYSD bars.

CO4: Analyse and design Cold form light gauge section.

1. Mention where light gauge members are commonly used
2. Explain typical light gauge steel sections with the help of neat sketches
3. Differentiate behaviour of laterally supported and laterally unsupported beams
4. Explain the behaviour of stiffened and un-stiffened compression elements made up of light gauge sections
5. Two channel sections 200mm x 80mm with bent up lips are connected with webs to act as beam as shown. The thickness of the plate is 2.5mm and depth of lip is 25mm.The beam has an effective span of 4m. Determine the allowable load per meter on the beam. Take fy=235 MPa and E =200 Gpa.
6. Explain briefly about design step for a light gauge steel beam with laterally supported system.

CO5: Use latest industry standard formula, table, design aids used for design of beams and portal frames under pattern loading.

1. Design a continuous beam of two spans supported on stone masonry walls using the limit state method and allowing 15% redistribution of moments. The following data may be assumed.
   Clear span between the supports = 6m
   Width of masonry supports = 330mm
   Thickness of RC slab = 150mm
   Spacing of continuous beams = 3m c/c
   Self weight of floor finish = 0.4 kN/m^2
   LL on the floor = 4kN/m^2
   Characteristic cube strength of concrete = fck = 20N/mm^2
   Characteristic strength of steel = fy= 415N/mm^2
   Also sketch the reinforcement details .
2. Explain the portal method and cantilever method of building frame analysis. Discuss the merits and demerits.
3. What are substitute frames

4. Explain the salient features to be notes in the detailing of reinforcement for portal frames.

5. Design a typical interior portal frame of a hall 10 m wide. The frames are at 4.5 m c/c, with hase fixed. Single storey frame is of height 4.0 m. Slab thickness = 120 mm. Live Load =2.5 kN/m^2. Sketch the detailing of slab, beam and column.
6. Sketch a beam Column joint showing the detailing of reinforcements.
7 Discuss the concept of moment redistribution in continuous beams.

SYLLABUS

Module I

Retaining Structures- Introduction- Functions and types of retaining walls- Structural analysis and design of RCC cantilever type of retaining wall for various types of backfill conditions

Counterfort retaining wall- design principles of components and detailing (design not required)

Structural design of deep beams

Module II

Review of the IS code 3370 (2009)

Introduction to design of water tanks-design philosophy and requirements-joints- IS code recommendations- Design of rectangular water tanks using IS code coefficients (IS 3370-2009).

Design of circular water tanks using IS code coefficients (IS 3370-2009)

Module III

Yield line method of analysis of slabs:– Characteristic features of yield lines– analysis by virtual work method – Yield line analysis by equilibrium method

Flat slabs – Introduction–components–IS Code recommendations– IS code method of design of interior panel (with and without column drop).

Module IV

Review of the codes –IS 811(1987), IS 801(1975),SP 6-5(1980)

Light gauge sections – Types of cross sections – Local buckling and post buckling – Design of compression and Tension members – Design of flexural member-Types of connections and their design

Module V

Design of continuous beams– Redistribution of moments- Detailing

Reinforced concrete portal frames: Introduction - Analysis and design of rectangular portal frames for vertical loading

Approximate methods for structural Analysis and design for vertical loads , Pattern loading, lateral loads

Text Book:

1. Punmia, B. C, Jain A.K and, Jain A.K , R C C Designs, Laxmi Publications Ltd., 10e, 2015
2. Ramchandra S and Virendra Gehlot, Design of Steel Structures Vol. I, Standard Book House, 2007

3. N. Krishna Raju Advanced Reinforced Concrete Design (IS : 456-2000), 2e CBS Publishers & Distributors, 2008.

References:

1. Pillai S.U & Menon D – Reinforced Concrete Design, Tata McGraw Hill Book Co., 2009
2. Varghese P.C, Advanced Reinforced Concrete Design, Prentice Hall of India Pvt Ltd, 2008
3. J. Rhodes and R.M. Lawson "Design of Structures using Cold Formed Steel Sections, SCI Publication 089, The Steel Construction Institute, U.K. 1992
4. Relevant IS codes (IS 456, IS 875, IS 1893, IS 13920, SP 16, SP 34, IS 801)
5. N. Subramanian, Design of Steel Structures, Oxford University Press

Lecture Plan – 22CEE802.1-Advanced Structural Design

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module I : Total lecture hours : 6**		
1.1	Retaining Structures: Introduction, Functions and types of retaining walls	CO1	1
1.2	Analysis of RCC cantilever type of retaining	CO1	1
1.3	Design of RCC cantilever type of retaining wall for various types of backfill conditions	CO1	2
1.4	Counterfort retaining wall- design principles of components and detailing	CO1	1
1.5	Design of deep beams	CO1	1
2	**Module II : Total lecture hours : 6**		
2.1	Introduction to design of water tanks-design philosophy	CO2	1
2.2	IS code recommendations	CO2	1
2.3	Design of rectangular water tanks using IS code coefficients (IS 3370)	CO2	2
2.4	Design of circular water tanks using- IS code coefficients (IS 3370	CO2	2
3	**Module III : Total lecture hours : 7**		
3.1	Introduction to Yield line method of analysis of slabs:– Characteristic features of yield lines	CO3	1
3.2	Analysis by virtual work method.	CO3	1
3.3	Yield line analysis by equilibrium method	CO3	1
3.4	Design of flat slabs:– Introduction–components	CO3	1
3.5	IS Code recommendations	CO3	1
3.6	IS code method of design of interior panel without drop	CO3	1
3.7	IS code method of design of interior panel with drop	CO3	1
4	**Module IV : Total lecture hours : 7**		
4.4	Introduction of light gauge sections – Types of cross sections	CO4	1
4.5	Local buckling and post buckling of light gauge sections	CO4	1
4.6	Design of compression and Tension members,	CO4	2
4.7	Design of flexural member	CO4	1
4.8	Types of connections and their design procedure	CO4	2
5	**Module V : Total lecture hours : 9**		
5.1	Design of continuous beams	CO5	2

5.2	Redistribution of moments.	CO5	1
5.3	Introduction to Reinforced concrete portal frames	CO5	1
5.4	Analysis and design of rectangular portal frames for vertical loading	CO5	1
5.5	Multi-storeyed building frames: Analysis and design due to vertical loads Substitute Frame method of analysis may be followed Use of SP 16 (only Group assignments intended)	CO5	2
5.6	Multi-storeyed building frames- Analysis and design by portal method for lateral loading cantilever method and factor method (only Group assignments intended)	CO5	2

MODEL QUESTION PAPER

Reg. No.:_______________ Name:__________________________

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: 22CEE802.1

Course Name: ADVANCED STRUCTURAL DESIGN

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions; each question carries 3 marks.

1. a) Explain under what circumstances the counterfort retaining wall is preferred?

   b) Explain the arrangement of reinforcements in a simply supported deep beam across the Depth

   c) Draw the cross section of water tank showing reinforcement details.

   d) Explai:r the applications of drop walls.

   e) Explain the characteristic features of yield line.

   f) State the advantages and disadvantages of flat slab.

   g) What are the advantages of cold formed steel structural members over hot rolled Members

   h) Explain post buckling in light gauge steel members

   i) Explain the portal method of building frame analysis.

   j) Explain the effects of pattern loading on frames'

(10×3 marks = 30 marks)

PART B

Answer one full question from each module; each full question carries 14 marks.

Module I

2. A cantilever retaining wall is designed to retain earth for a height of 4.5 m. The safe bearing capacity of soil is 180 kN/m^2 and unit weight of soil is 17.8 kN/m^3 . Coefficient of friction between soil and concrete is 0.6. Proportion the retaining wall and check for stability. Also design and detail the stem slab of the retaining wall. **(14marks)**

3. Design a typical interior span of a deep beam using the following data

   Span of beam - 8m, overall depth = 4m, width of support= 0.8m., width of beam – 0.4 m

   The udl including self-weight acting on the beam is 180kN/m. Sketch the reinforcement details. Use M20 concrete and Fe415 steel. **(14 marks)**

Module II

4. Design and detail a circular tank for a capacity of 500000 litres. The depth of water is to be 5m including freeboard of 30cm. The tank is supported on ground. Design using M20 concrete and 415 grade steel. **(14 marks)**

5. Design a rectangular water tank 5 m x 4 m with depth of storage 3m, resting on ground and whose walls are rigidly joined at vertical and Base. Free at top. Assume M20 concrete and Fe415 grade steel. Sketch the details of reinforcement in the tank using IS Code method. **(14 marks)**

Module III

6. Design an interior panel of a flat slab with panel size 6m x 6m by providing drop. The size of columns is 500 x 500 mm and live load on the panel is 4 kN/m^2 Use M20 grade concrete and Fe415 steel**.** **(14 marks)**

7. (a) Discuss the assumptions in yield line method of analysis. **(4 marks)**

   (b) Obtain an expression for the moment carrying capacity along a yield line for an isotropic reinforced square slab simply supported and uniformly loaded. **(9 marks)**

Module IV

8. (a) Explain the behaviour of stiffened and un-stiffened compression elements made up of light gauge sections. **(4 marks)**

   b) A square box section 200x200x2mm is to be used as a column of effective length 4m. Find the maximum load it can carry. **(10 marks)**

9. a) Explain briefly abut design step for a light gauge steel beam with laterally supported system. **(4 marks)**

(b) Explain the following with sketches with reference to light gauge sections: (i) Stiffened and unstiffened compression elements, (ii) flat-width ratio, (iii) effective design width, (iv) torsional flexural buckling, (v) point symmetric section. **(10 marks)**

Module V

10. Design a continuous beam with 2 equal spans of 6m each. The beam being supported on masonry walls of300mm thickness. Beams are placed at 3m clc, to support a floor of self weight of 3.5 kN/m and supporting a live load of 4 kN/m^2. (Redistribution 15 % moment)

(14 marks)

11. Design a portal frame hinged at base assuming M20 grade concrete and Fe415 HYSD bars to suit the following data.- Spacing of portal frame – 4 m, Height of columns – 4m, Live load on roof – 1.5kN/m^2, Distance between column centres – 10 m. RCC slab is continuous over portal frame. **(14 marks)**

22CEE 802.2	GEO ENVIRONMENTAL ENGINEERING	Category	L	T	P	Credit	Year of Introduction
		PEC	3	0	0	3	2019

Preamble:

The course introduces the geotechnical engineering need to deal with environmental problems related to the reduction of waste, waste disposal facilities and cleanup of contaminated sites. This course is a blend of geotechnical engineering and environmental concepts and introduces multidisciplinary problem domains**.** The course aims to develop knowledge in landfill facility design.

Prerequisite: Geotechnical Engineering-I, Environmental Engineering

Course Outcomes: After the completion of the course the student will be able to

Course Outcome	Description of Course Outcome
CO1	Outline the geo-environmental considerations of waste containment
CO2	Explain the contaminant transport mechanism
CO3	Choose the suitable system for waste containment and its various components
C04	Plan suitable remediation method for contaminated site

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	20
Understand	20	10	30
Apply	20	30	50
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10marks
Continuous Assessment Test(2numbers) : 25 marks
Assignment/Quiz/Course project : 15marks

End Semester Examination Pattern: There will be two parts; Part A and Part B.
Part A contain 10 questions with 2 questions from each module having 3 marks for each question. Students should answer all questions.
Part B contains 2 questions from each Module of which student should answer any one question form each Module. Each question should have a maximum if two subdivision and carry 14marks.

SYLLABUS

MODULE 1.
Scope of geo-environmental engineering - multiphase behavior of soil – role of soil in geo-environmental applications – importance of soil physics, soil chemistry, hydrogeology, biological process – impact of ground contamination on geo-environment
Regulatory requirement -Solid waste management rules (brief introduction only) -MoeF guideline
Geochemistry-Geochemical Attenuation-Quantification of attenuation capacities-Laboratory evaluation, sequential batch-contact testing & Column percolation testing. Waste Characteristics of Municipal solid waste-Physical-Chemical & geotechnical
Identification of Hazardous and Non-Hazardous waste

MODULE 2.
Contaminant transport-Transport process- Advection, Diffusion, Dispersion – Advection-Dispersion equation-Fick’s equation.
Soil-water-contaminant interaction soil-water interaction and concepts of double layer
Evolution of waste containment facilities and disposal practices – Site selection based on environmental impact assessment –different role of soil in waste containment - Hydrological consideration in land fill design

MODULE 3.
Containment technology, Landfill-Type-site selection
Landfill Components: Landfill layout and capacity, components of landfill and its functions. Types and functions of liner-natural clay liner- compacted clay liner- selection of soil for liner, properties-effect of compaction on permeability of clay.

Geo membrane liners-Types-geosynthetics clay liners , Type- methodology of construction, testing and design aspects.

MODULE 4.
Primary and secondary leachate collection and removal systems.
Drainage, Collection, Removal and Filtration considerations of primary and secondary leachate collection and removal system. Various components and design considerations.
Cover system-Basic concept, Components-surface layer, Protection layer, Drainage layer, Barrier layer Assessment, Gas Management, Gas extraction systems-passive and active system
Closure and post closure monitoring system (brief introduction)

MODULE 5.
Site characterization – risk assessment of contaminated site - remediation methods for soil and groundwater – selection and planning of remediation methods –in-situ / exit remediation, bio remediation, thermal remediation, pump and treat method, phyto remediation and electro-kinetic remediation
Stability of landfill (brief introduction), Soil exploration at contaminated site (brief introduction)

Text Books/ References:

1. Daniel, D.E. (1993). Geotechnical Practice for Waste Disposal. Chapman, and Hall, London.
2. Koerner, R.M. (2005). Designing with Geosynthetics. Fifth Edition. Prentice Hall, New Jersey.
3. Reddi L.N and Inyang HI (2000) Geoenvironmental Engineering: Principles and Applications, Marcel Dekker Inc Publication
4. R. N. Yong (2000) Geoenvironmental Engineering: Contaminated Soils, Pollutant Fate, Mitigation Lewis Publication.
5. Dr. G V Rao and Dr. R S Sasidhar (2009) Solid waste Management and Engineered Landfills, Saimaster Geoenvironmental Services Pvt. Ltd. Publication.
6. Ayyar TSR (2000) Soil engineering in relation to environment, LBS centre for Science and Technology, Trivandrum.
7. Hari D. Sharma, Krishna R. Reddy (2004) Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies, Publisher: John Wiley & Sons Inc.
8. Donald L. Wise, Debra J. Trantolo, Hilary I. Inyang, Edward J. Cichon (2000) Remediation Engineering of Contaminated Soils, Publisher: Marcel Dekker Inc
9. Manoj Datta, Waste Disposal in Engineering landfills, Narosa Publishing House, New Delhi
10. Amalendu Badchi, Design of landfills and integrated solid waste management, John Wiley & Sons. Inc.

Lecture Plan

Module	*Topic*	*CO addressed*	*No. of Lectures*
1	**Module I: Total lecture hours:8**		
1.1	Scope of geo-environmental engineering - multiphase behavior of soil – role of soil in geo-environmental applications	CO1	1
1.2	Importance of soil physics, soil chemistry, hydrogeology, biological process – impact of ground contamination on geo-environment	CO1	1
1.3	Regulatory requirement -Solid waste management rules (brief introduction only) -MoeF guideline	CO1	1
1.4	Geochemistry-Geochemical Attenuation-Quantification of attenuation capacities	CO1	1
1.5	Laboratory evaluation, sequential batch-contact testing & Column percolation testing.	CO1	1
1.6	Waste Characteristics of Municipal solid waste-Physical-Chemical & geotechnical	CO1	2
1.7	Identification of Hazardous and Non-Hazardous waste	CO1	1
2	**Module II: Total lecture hours-7**		
2.1	Contaminant transport-Transport process- Advection, Diffusion, Dispersion – Advection-Dispersion equation-Fick's equation.	CO2	2
2.2	Soil-water-contaminant interaction soil-water interaction and concepts of double layer	CO2	1
2.3	Evolution of waste containment facilities and disposal practices	CO3	1
2.4	Site selection based on environmental impact assessment	CO3	1
2.5	Different role of soil in waste containment	CO3	1
2.6	Hydrological consideration in land fill design	CO3	1
3	**Module III: Total lecture hours: 8**		
3.1	Containment technology, Landfill-Type-site selection	CO3	1

3.2	Landfill layout and capacity, components of landfill and its functions.	CO3	1
3.3	Types and functions of liner-natural clay liner, properties	CO3	2
3.4	Compacted clay liner- selection of soil for liner, properties-effect of compaction on permeability of clay.	CO3	2
3.5	Geo membrane liners-Types-geosynthetics clay liners , Type-methodology of construction, testing and design aspects.	CO3	2
4	**Module IV: Total lecture hours: 7**		
4.1	Primary and secondary leachate collection and removal systems.	CO3	1
4.2	Drainage, Collection, Removal and Filtration considerations of primary and secondary leachate collection and removal system. Various components and design considerations.	CO3	2
4.3	Cover system-Basic concept, Components-surface layer, Protection layer, Drainage layer, Barrier layer Assessment,	CO3	2
4.4	Gas Management, Gas extraction systems-passive and active system	CO3	1
4.5	Closure and post closure monitoring system (brief introduction)	CO3	1
5	**Module V: Total lecture hours: 6**		
5.1	Site characterization – risk assessment of contaminated site	CO4	1
5.2	Remediation methods for soil and groundwater – selection and planning of remediation methods	CO4	1
5.3	In-situ / exit remediation, bio remediation, thermal remediation, pump and treat method, phyto remediation and electro-kinetic remediation	CO4	3
5.4	Stability of landfill (brief introduction), Soil exploration at contaminated site (brief introduction)	CO3	1

22CEE 802.3	RAILWAY AND TUNNEL ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	3	0	0	3	2019

Preamble

To set a solid and firm foundation in Railway and Tunnel engineering, including the history, development, modern trends, maintenance, geometric design,construction and safety of railways and tunnel.

Prerequisite: Nil

Course Outcomes:

	Description
CO No.	At the end of the course, students will be able to:
CO 1	Explain the role of railways in national development and carry out geometric design of railway track by identifying component parts of railway track
CO 2	Design railway operation and control systems
CO 3	Analyze factors affecting railway accidents and understandthe modern developments in railways and develop an awareness about the maintenance of railway system.
CO 4	Explain about the importance, types and methods of construction of tunnel
CO 5	Develop and analyze design aspects of ventilation, lining and lighting in tunnels

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	2	3	1	-	1	-	1	2	2	-	1
CO 2	2	3	3	2	1	3	3	3	2	2	2	1
CO 3	2	3	2	1	-	1	1	2	-	2	2	1
CO 4	2	2	1	2	-	2	2	2	2	-	2	-
CO 5	2	2	-	2	1	2	1	2	-	-	2	1

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (marks)
	Test 1 Marks	Test 2 Marks	
Remember	7.5	7.5	30
Understand	7.5	7.5	30
Apply	5	5	20
Analyse	5	5	20
Evaluate			
Create			

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern:

The question consists of two parts- Part A and Part B. Part A consists of 10 questions with 3marks for each (two questions from each module). Part B consists of two questions from each module, out of which one has to be answered. Each question carries 14 marks and can have maximum 2 subdivisions.

Sample Course Level Assessment Questions:

Course Outcome 1 (CO1):

Draw the typical cross section of railway in embankment and mark salient components. If the ruling gradient is 1 in 150 on a particular section of a broad gauge track and at the same time a curve of 4º is situated on a ruling gradient, what should be the allowable ruling gradient?

Course Outcome 2 (CO2):.

How are crossings classified? What is the Number of crossing? Find out the crossing angle of 1 in 16 crossing by right angle method and centre line method.

Course Outcome 3 (CO3):

Why is packing of ballast carried out? An existing track is to be attended in packing ballast under the sleepers. What measures will you suggest as an engineer?

Course Outcome 4 (CO4):

Identify and describe the relevant method of constructing the tunnel in a given situation with justification

Course Outcome 5 (CO5):

For a given tunnel cross section, identify the method adopted for lining and ventilation of tunnels

SYLLABUS

Module -I

Introduction to Railways in India: Role of Indian Railways in National Development – Railways for Urban Transportation –Alignment- basic requirements and factors affecting selection, **Permanent Way**: Typical cross-section- Component parts of a railway track -requirements and functions -Rails - Types of Rails, Rail Fastenings, Sleepers – Functions, Materials, Density, Ballast less Tracks.

Concept of Gauges, Coning of Wheels, Creeps and kinks. - Gradients - different types -Compensation of gradients, Geometric design of railway track: Horizontal curves, radius – superelevation -cant deficiency - transition curves

Module-II

Railway operation and control: Points and Crossings – Design features of a turnout – Details of station yards and marshalling yards – Signalling - Classification of signals, layout of Signals, interlocking of signals and points - Principles of track circuiting – Control systems of train movements – ATC, CTC

Module-III

Modern developments- LRT &MRTS, tube railways, high speed tracks.

Maintenance: - Introduction to track maintenance, Items of track maintenance, packing and over hauling, screening

Railway accidents: Human and system contribution to catastrophic accidents, Human Factors in Transport Safety.

Module-IV

Tunnel Engineering: Tunnel - sections - classification - tunnel surveying-alignment, transferring centre, grade into tunnel – tunnel driving procedure- shield method of tunnelling, compressed air method, tunnel boring machine.

Module-V

Tunnel lining – Necessity, materials, methods, Ventilation – natural and mechanical ventilation, drainage of tunnels, dust control methods.

Text Books

1. Mundrey J. S, Railway Track Engineering, Tata McGraw Hill, 5th edition 2017
2. Srinivasan,R., Harbour, Dock & Tunnel Engineering, Charotar Publishing House, 28e, 2016
3. Rangawala, S.C. Railway Engineering, Charotor Publishing House 27th edition 2017
4. Bindra, S.P., A course in Docks and Harbour Engineering, Dhanpat Rai& Sons

References

1. Chandra, S. and Agarwal, M.M. ,Railway Engineering, Oxford University Press, New Delhi, Second edition 2013
2. Saxena, S. C and Arora, S. P, Railway Engineering, Dhanpat Rai & Sons, 7e, 2015
3. Subhash C. Saxena, Railway Engineering, Dhanpat Rai& Sons
4. H P Oza and G H Oza, Dock and Harbour Engineering, Charotar Publishing House 8th Edition 2017

COURSE PLAN

No.	Topic	Course Outcome	No. of Hrs
1	**Module 1**		Total: 11
1.1	**Introduction to Railways in India**: Role of Indian Railways in National Development – Railways for Urban Transportation –. Alignment- basic requirements and factors affecting selection, Typical cross-section	CO1	3
1.2	**Permanent Way**: Components and their Functions: Component parts of a railway track – requirements and functions –Rails – Types of Rails, Rail Fastenings, Sleepers – Functions, Materials, Density, Ballast less Tracks.	CO1	3
1.3	Concept of Gauges, Coning of Wheels, Creeps and kinks. – Gradients – different types –Compensation of gradients, Geometric design of railway track: Horizontal curves, radius – super elevation –cant deficiency – transition curves	CO1	5
2	**Module 2**		Total: 8
2.1	**Railway operation and control:** Points and Crossings – Design features of a turnout	CO2	4
2.2	**Signalling** – Classification of signals, layout of Signals, interlocking of signals and points	CO2	2
2.3	Principles of track circuiting – Control systems of train movements – ATC, CTC	CO2	2
3	**Module 3**		Total: 5
3.1	**Modern developments-** LRT &MRTS, tube railways, high speed tracks	CO3	2
3.2	**Maintenance**:- Introduction to track maintenance, Items of track maintenance, packing and over hauling, screening, Details of station yards and marshalling yards	CO3	2
3.3	**Railway accidents:** Human and system contribution to catastrophic accidents, Human Factors in Transport Safety.		1
4	**Module 4**		Total: 6
4.1	**Tunnel Engineering: Tunnel** - sections - classification - tunnel surveying -alignment, transferring centre, grade into tunnel – tunnel driving procedure	CO4	3
4.2	Tunnelling methods - Shield method of tunnelling, compressed air method, Tunnel boring machine.	CO4	3
5	**Module 5**		Total: 6
5.1	**Tunnel lining** – Necessity, materials, methods, Ventilation – natural and mechanical ventilation.	CO5	3
5.2	Drainage of tunnels, dust control methods	CO5	3

EIGHTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: **22CEE802.3**

Course Name: **RAILWAY AND TUNNEL ENGINEERING**

Model Question Paper

Marks:100 Duration: 3 hrs

PART A
(Answer all questions. Each question carry three marks)

1 Briefly explain LRT and MRT.

2 Draw the typical cross section of railway in embankment and mark salient components.

3 What is meant by Super elevation? What are the objects of providing SE on curves?

4 Describe the advantages of transition curve.

5 With a suitable sketch illustrate a right hand turn out. Label the component parts on it.

6 What is the Number of crossing? Find out the crossing angle of 1 in 16 crossing by right angle method and centre line method.

7 Give reasons

a) In the absence of ganger, the keyman performs the duties of the ganger
b) Any occurrence, especially railway accidents, with the railway assumes a human dimension

8 Describe briefly the process of screening of ballast.

9 List different tunnel sections and identify the situation where each of them are preferred

10 Identify the sources from which water will be encountered during tunneling process and describe how management measures can be adopted.

PART B
(Answer one full question from each module)

1. (a) List and define the component parts of a railway track (4)

(b) Explain the functions and requirements of rails and sleepers(6)

(c) What are the factors affecting the alignment of a railway track. (4)

OR

2. (a) What is the equilibrium cant on a 20 curve on a BG track, if the speed of various trains are 10 trains at 50kmph., 8 trains at 55 kmph. and 4 trains at 60kmph. respectively (4)

   (b) Explain the various type of gradient used on railway track? What is grade compensation and why is it necessary? (4)

   (c) If an 7^{o} curve track diverges from a main curve of 3^{o} in opposite direction in the layout of a BG yard, calculate the super elevation and speed on the branch line, if the maximum speed permitted on the main track is 50 kmph. (6)

3. (a) Explain the following terms: Heel divergence and Flange way depth, (4)

   (b) Calculate all the necessary elements for a 1 in 12 BG turnout, taking off from a BG track with its curve, starting from the toe of the switch, Heel divergence= 12cm. (10)

OR

4. (a) How are signals classified? Explain each of them in detail. With suitable layout, show the different signals located on a section of a station.(5)

   (b) Classify and explain the various types of yards? What are the features of a marshalling yard?(5)

   (c) Illustrate the various methods adopted for the control of movement of trains. Explain ATC in detail.(4)

5. (a) Explain the operation and advantages of tube railways and high speed tracks. (7)

   (b) Discuss on conventional and advanced remedial Aids for preventing railway accidents. (7)

OR

6. (a) Explain how the accidents are classified on Indian Railways. (6)

   (b) What is a yard? What are the different types of yards? Explain the functions of a Marshalling yard and describe the points to be considered in its design. (8)

7.(a) Write down the procedure for constructing a tunnel in clayey soil. Explain its advantages. (Draw necessary diagrams). (8)

   (b) How is transferring of center line into the tunnel carried out? Explain with the help of neat diagram. (6)

OR

8. (a) List the various methods of tunneling in hard and soft rocks. Explain in detail any one tunneling method employed in hard strata and soft soil. (8)

(b) Explain the procedure of tunnel driving using tunnel boring machine indicating the advantage and disadvantages of the process. (6)

9. (a) Write notes on (i) Lighting and (ii) Lining of tunnels. (7)

(b) Explain in detail about different types of ventilation in tunnels. (7)

OR

10. (a) Explain different methods of ventilation of tunnels. (7)

(b) Explain the dust control methods in tunnel. (7)

22CEE 802.4	IRRIGATION AND DRAINAGE ENGINEERING	Category	L	T	P	Credit	Year of Introduction
		PEC	3	0	0	3	2019

Preamble: The general objective of this course is to make the students familiar with the concepts of irrigation water scheduling, distribution and system performance. The course aim to impart the knowledge on surface and sub-surface systems for drainage of irrigation lands and the principles behind the reclamation of saline soils.

Pre-requisite: NIL

Course outcome

After the course, the student will be able to:

CO1	Determine the crop water requirement and understand the design of various surface irrigation methods
CO2	Perform scheduling of irrigation and evaluate irrigation system performance
CO3	Estimate properties of soil water zone, design open drains
CO4	Perform design of various drainage systems
CO5	Compute leaching requirement and design of drainage systems considering crop water requirement and leaching requirement

CO-PO Mapping

CET444 Irrigation and Drainage Engineering		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	3	3		1			1					
	CO2	3	3					1					
	CO3	3	2					1					
	CO4	3	3					1					
	CO5	3	3					1					

Assessment pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (Marks)**
	Test 1 (Marks)	**Test 2 (Marks)**	
Remember	5	5	15
Understand	10	10	15
Apply	20	20	40
Analyze	15	15	30
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment Test (2 numbers)	:	25 marks
Assignment/Quiz/Course project	:	15 marks
Total	**:**	**50 marks**

End semester examination pattern – There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code: 22CEE 802.4

Irrigation and Drainage Engineering

(Course Level Assessment Questions)

Qn No	Question	Marks	Course outcome (CO) Assessed
	Part A **(Answer ALL Questions)**		
1	What is surface irrigation? What are different methods of surface irrigation?	3	CO1
2	Calculate the Delta for kharif crop having Duty as 2500 ha/cumec. (Base period for kharif crop=123days)	3	CO1
3	What are the factors affecting the alignment of a water course?	3	CO2
4	What do you mean by drainage? What are the objectives of drainage?	3	CO2
5	What are the assumptions of Dupuit-ForchHeimer (D-F) theory?	3	CO3
6	What do you mean by drainable porosity? How do you determine it?	3	CO3
7	Briefly explain the applications of Kraijenhoff Vande Leur Mass land equation for unsteady state drainage	3	CO4
8	Explain patterns of drainage system	3	CO4
9	Explain the terms soil salinity and water logging.	3	CO5
10	Define leaching requirement and the factors affecting it.	3	CO5
	Part B **(Answer ANY ONE FULL question from each module)**		
	Module I		
11(a)	What are the conditions favorable for selection of basin irrigation system?	5	CO1
11(b)	For a given field soil, the average infiltration rate is 45 mm per hour, and desired depth of water application corresponding to the depth of root zone is 50 mm. Determine (a) Optimum length of each border strip if	9	CO1

	the discharge of the water source entering into the border strip is 18 litres per second and width of each border strip is 9 m, and (b) The inflow rate if the length of each border strip is 150 m and its width is 9 m. What will be the time of water application in each case? Take the slope of the border strip as 0.35%.		
12(a)	What is furrow irrigation method? What are the advantages and disadvantages of the method?	6	CO1
12(b)	A stream of 135 lit/sec was delivered from a canal and 100 lit/sec was diverted to the field. An area of 1.6 ha was irrigated in 8 hrs. The effective root zone depth is 1.8 m. The runoff loss in the field was 432 m3. The depth of water penetration varied linearly from 1.8 m at the head of the field to 1.2 m at the tail end. Available moisture holding capacity of the soil is 20 cm per m depth of soil. Determine the water conveyance efficiency, water application efficiency, water storage efficiency and water distribution efficiency. Irrigation was started at a moisture extraction level of 50% of the available moisture?	8	CO1
	Module II		
13(a)	Explain different methods of irrigation water distribution	7	CO2
13(b)	Explain irrigation system performance indicators and methods of improving irrigation system performance	7	CO2
14(a)	The following data pertains to the healthy growth of a crop. (i) Field capacity of soil= 30% (ii) Permanent wilting percentage= 11% (iii)Density of soil=1300 Kg/m^3 (iv)Effective depth of root zone= 700 mm (v) Daily consumptive use= 12mm For healthy growth moisture content must not fall below 25% of the water holding capacity between the field capacity and the permanent wilting point. Determine the watering interval in days.	7	CO2
14(b)	Discuss about drainage problems in India	7	CO2
	Module III		
15 (a)	Explain about classification of soil water.	4	CO3

15(b)	Derive Ernst equation with neat sketch for steady state flow.	10	CO3
16 (a)	Explain water table fluctuation maps and its uses.	4	CO3
16 (b)	Derive Hooghoudt's equation for spacing of tile drains under steady state conditions with neat sketch. Also state assumptions.	10	CO3
	Module IV		
17(a)	Explain about the different layouts of the open drainage systems with neat sketches.	7	CO4
17(b)	Determine the size of the tile required at the end of a 300 m long tile line, if the drainage coefficient is 1.2 cm, grade is 0.2 percent and tile spacing is 60 m. Mannings roughness coefficient for tile drains is 0.04.	7	CO4
18(a)	Explain about the structures of a Pipe drainage system	8	CO4
18(b)	Derive Glover Dum equation for unsteady state flow.	6	CO4
	Module V		
19 (a)	Write salt balance equation and explain the terms in it	4	CO5
19 (b)	Estimate the leaching requirement when electrical conductivity (EC) value of a saturated extract of soil is 10 m.mho/cm at 25% reduction in the yield of a crop. The EC of irrigation water is 1.2 m.mho/cm. What will be the required depth of water to be applied to the field if the consumptive use requirement of the crop is 80 mm? EC value of the leaching water may be suitably assumed.	10	CO5
20 (a)	Explain gravity outlet structures including their types and location	7	CO5
20 (b)	Classify salt affected soils based on the values of EC, ESP and pH of the soil saturation extract. Briefly explain about any one of them	7	CO5

Course Code: 22CEE 802.4
Irrigation and Drainage Engineering
Syllabus

Module I

Surface Irrigation methods: Classification – Border irrigation: design parameters, evaluation and ideal wetting pattern – Furrow irrigation: design parameters, types of furrows, evaluation, ideal wetting pattern – Basin irrigation: types of basins, ideal wetting pattern, shapes and size – Efficiency of surface irrigation methods. **Crop Water Requirements** : Infiltration and movement of water in soil– Soil-water-plant relationship – Water requirement of crops – Evapo transpiration (ET) and consumptive use - Effective rainfall – Irrigation requirement, Soil water balance, Yield response to water, Production functions .

Module II

Irrigation Water Distribution: Canal network and canal regulation –Methods of distribution: supply based and demand based – Delivery of water to farms –Measurement of water – Scheduling of irrigation – Criteria for scheduling, constraints – Frequency and interval of irrigation. **Irrigation System Performance Indicators**: Systems classification –Rehabilitation and modernization – Performance indicators – Improving system performance –constraints. **Land Drainage systems**: necessity-types-surfaces and subsurface drainage-design considerations.

Module III

Soil Water Zone: Description, Flow through soil water zone-Physical properties of soil-hydraulic conductivity-saturated thickness-drainable pore space-storativity, hydraulic resistance, leakage factor-Ground water data-concepts of ground water hydrograph, ground water maps, Isobath map, water table fluctuation maps etc. **Drainage studies**-continuity equation, Laplace equation, relaxation method of solution-Typical boundary conditions like impervious layer, plane of symmetry, freewater surface, water at rest or slowly moving water, seepage surface- Dupit Forchheimer Theory steady flow above an impervious horizontal boundary-Dupits equation-water table subject to recharge. **Flow into open drains**-steady state equations-Hooghoudt equation, Principles, applications for design use of nomographs for homogeneous and layered soils– Earnst equation, concept of horizontal vertical and radial flow, application to layered soils.

Module IV

Unsteady state drainage equations-Glover Dum equation, application, concept of Kraijenhoff Vande Leur Mass land equation, application- analysis for constant recharge, intermittent recharge cases. **Layout of open drainage systems**: types-Field drains, design considerations of ditch drains- Mole drains, design considerations, suitability- Sub-surface drainage systems- Pipe drainage systems- design for uniform and non-uniform flow conditions-transport and dewatering situations. Patterns of drainage system- Drainage criteria formulation for off season drainage, crop season drainage, salt drainage- use of steady state and unsteady state approaches in formulation. -criteria for irrigated area. –incorporation of intentional and unavoidable losses

Module V

Salinity and drainage- cause of salinity, salt balance equation, leaching efficiency, salt equilibrium equation and leaching requirement – salt storage equation – expressing equations in electrical conductivity terms-Design of a drainage system for an irrigated area based on crop water requirement and leaching requirement- Dynamic equilibrium concept. **Gravity outlet structures**-types, location.

Text Books:

1. Michel A M, Irrigation Theory and Practice, Vikas Publishing House, New Delhi, 2008.
2. Majumdar D P, Irrigation Water Management Principles and Practices, Prentice Hall of India,New Delhi, 2000.

References:

1. Irrigation and Drainage paper 24. Crop water requirement. FAO, Rome, 1977.
2. Irrigation and Drainage paper 56. Crop water requirement. FAO, Rome, 1988.
3. Kessler J, Drainage Principles and Applications, Volumes I to IV, International Institute for Land Reclamation and Improvement (ILRI), Netherlands, 1979.
4. Ritzema H P, Drainage Principles and Applications, Publication No. 16, International Institute of Land Reclamation and Improvement, Netherlands, 1994.
5. Bhattacharya A K and Michael A M, Land Drainage Principles: Methods and Applications, Konark Publishers Pvt. Ltd., New Delhi, 2003.

Course Code: 22CEE 802.4

Irrigation and Drainage Engineering

(Course plan)

Module	Topic	Course outcome addressed	No of Hours
Module I (6 Hours)			
1.1	Surface irrigation methods-classification	CO1	1
1.2	Design parameters of border, furrow and basin irrigation	CO1	2
1.3	Infiltration, soil-water-plant relationship, evapotranspiration	CO1	1
1.4	Effective rainfall, irrigation requirement, Soil water balance	CO1	1
1.5	Yield response to water, production functions	CO1	1
Module II (7 Hours)			
2.1	Methods of irrigation water distribution	CO2	1
2.2	Measurement of water, Scheduling of irrigation	CO2	1
2.3	Criteria for scheduling, constraints-frequency and interval of irrigation	CO2	1
2.4	Irrigation systems-classification, rehabilitation and modernization	CO2	1
2.5	Irrigation system performance indicators-improving system performance-constraints	CO2	1
2.6	Land drainage systems-necessity-types	CO2	1
2.7	Surfaces and subsurface drainage-design considerations	CO2	1
Module III (9 Hours)			
3.1	Soil water zone, flow through soil water zone, hydraulic conductivity, saturated thickness, storativity, hydraulic resistance, leakage factor	CO3	1
3.2	Ground water data-ground water hydrographs, groundwater maps, Isobath maps, Water table fluctuation maps etc.	CO3	1.5
3.3	Drainage studies-continuity equation, Laplace equation, relaxation method of solution, typical boundary conditions	CO3	2
3.4	Dupit Forchheimer Theory-steady flow above an impervious horizontal boundary, Dupits equation-water table subject to recharge	CO3	2
3.5	Flow into open drains-steady state equations-Hooghoudt equation, applications for design use of nomographs	CO3	1.5
3.6	Earnst equation, concept of horizontal, vertical and radial flow, application to layered soils	CO3	1
Module IV (8 Hours)			
4.1	Unsteady state drainage equations-Glover Dum equation, application	CO4	1

4.2	Kraijenhoff Vande Leur Mass land equation, application-analysis for constant and intermittent recharge	CO4	1
4.3	Layout of open drainage systems-types and design considerations and suitability	CO4	2
4.4	Sub-surface drainage systems-pipe drainage systems-design considerations-transport and dewatering situations	CO4	2
4.5	Patterns of drainage system-drainage criteria formulation for different conditions	CO4	1
4.6	Use of steady and unsteady state approaches in formulation-criteria for irrigated area-incorporation of losses	CO4	1
Module V (5 Hours)			
5.1	Salinity-causes, salt balance equation, leaching efficiency, salt equilibrium equation and leaching requirement	CO5	1
5.2	Salt storage equation, expressing equations in electrical conductivity terms	CO5	1
5.3	Design of a drainage system for an irrigated area based on crop water requirement and leaching requirement, Dynamic equilibrium concept	CO5	2
5.4	Gravity outlet structures-types, location	CO5	1

Pages: 3

Model Question Paper

Reg No.:…………………. **QP CODE:……………….**

Name:…………………………………….

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEE 802.4
Course Name: IRRIGATION AND DRAINAGE ENGINEERING

Max. Marks: 100 **Duration: 3 hours**

PART A
(Answer all questions; each question carries 3 marks)

1	What is surface irrigation? What are different methods of surface irrigation?	(3 marks)
2	Calculate the Delta for kharif crop having Duty as 2500 ha/cumec. (Base period for kharif crop=123days)	(3 marks)
3	What are the factors affecting the alignment of a water course?	(3 marks)
4	What do you mean by drainage? What are the objectives of drainage?	(3 marks)
5	What are the assumptions of Dupuit-ForchHeimer (D-F) theory?	(3 marks)
6	What do you mean by drainable porosity? How do you determine it?	(3marks)
7	Briefly explain the applications of Kraijenhoff Vande Leur Mass land equation for unsteady state drainage	(3 marks)
8	Explain patterns of drainage system	(3 marks)
9	Explain the terms soil salinity and water logging.	(3 marks)
10	Define leaching requirement and the factors affecting it.	(3 marks)

PART B
(Answer one full question from each module, each question carries 14 marks)

Module I

11 a. What are the conditions favorable for selection of basin irrigation system? (5 marks)

b. For a given field soil, the average infiltration rate is 45 mm per hour, and desired depth of water application corresponding to the depth of root zone is 50 mm. Determine (a) Optimum length of each border strip if the discharge of the water source entering into the border strip is 18 litres per second and width of each border strip is 9 m, and (b) The inflow rate if the length of each border strip is 150 m and its width is 9 m. What will be the time of water application in each case? Take the slope of the border strip as 0.35%. (9 marks)

OR

12 a. What is furrow irrigation method? What are the advantages and disadvantages of the method? (6 marks)

b. A stream of 135 lit/sec was delivered from a canal and 100 lit/sec was diverted to the field. An area of 1.6 ha was irrigated in 8 hrs. The effective root zone depth is 1.8 m. The runoff loss in the field was 432 m^3. The depth of water penetration varied linearly from 1.8 m at the head of the field to 1.2 m at the tail end. Available moisture holding capacity of the soil is 20 cm per m depth of soil. Determine the water conveyance efficiency, water application efficiency, water storage efficiency and water distribution efficiency. Irrigation was started at a moisture extraction level of 50% of the available moisture? (8 marks)

Module II

13 a. Explain different methods of irrigation water distribution (7 marks)

b. Explain irrigation system performance indicators and methods of improving irrigation system performance (7 marks)

OR

14 a. The following data pertains to the healthy growth of a crop. (7 marks)

(i) Field capacity of soil= 30%

(ii) Permanent wilting percentage= 11%

(iii)Density of soil=1300 Kg/m3

(iv)Effective depth of root zone= 700 mm

(v) Daily consumptive use= 12mm

For healthy growth moisture content must not fall below 25% of the water holding capacity between the field capacity and the permanent wilting point. Determine the watering interval in days.

b. Discuss about drainage problems in India (7 marks)

Module III

15 a. Explain about classification of soil water. (4 marks)

b. Derive Ernst equation with neat sketch for steady state flow. (10 marks)

OR

16 a. Explain water table fluctuation maps and its uses. (4 marks)

b. Derive Hooghoudt's equation for spacing of tile drains under steady state conditions with neat sketch. Also state assumptions. (10 marks)

Module IV

17 a. Explain about the different layouts of the open drainage systems with neat sketches. (7 marks)

b. Determine the size of the tile required at the end of a 300 m long tile line, if the drainage coefficient is 1.2 cm, grade is 0.2 percent and tile spacing is 60 m. Mannings roughness coefficient for tile drains is 0.04. (7 marks)

OR

18 a. Explain about the structures of a Pipe drainage system (8 marks)

b. Derive Glover Dum equation for unsteady state flow. (6 marks)

Module V

19 a. Write salt balance equation and explain the terms in it (4 marks)

b. Estimate the leaching requirement when electrical conductivity (EC) value of a saturated extract of soil is 10 m.mho/cm at 25% reduction in the yield of a crop. The EC of irrigation water is 1.2 m.mho/cm. What will be the required depth of water to be applied to the field if the consumptive use requirement of the crop is 80 mm? EC value of the leaching water may be suitably assumed. (10 marks)

OR

20 a. Explain gravity outlet structures including their types and location (7 marks)

b. Classify salt affected soils based on the values of EC, ESP and pH of the soil saturation extract. Briefly explain about any one of them (7 marks)

22CEE 802.5	CONSTRUCTION METHODS & EQUIPMENT	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PEC	3	0	0	3	2019

Preamble:
This course introduces students to construction equipment and selected construction methods. This includes selection and technical fundamentals of common construction equipment and construction procedures for civil construction.

Prerequisite: CET309 Construction Technology & Management

Course Outcomes: After completion of the course, the student will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Explain the various construction procedures for sub structures and super structures	Remembering, Understanding
CO2	Describe the various construction activities involved in underground and under water construction	Understanding
CO3	Demonstrate basic knowledge about construction equipment and machineries	Remembering, Understanding
CO4	Explain the equipment used for production of aggregates and concreting	Understanding
CO5	Select construction equipment appropriate to tasks.	Applying

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					1	1	1		1		1
CO2	3					1	1	1		1		1
CO3	3					1		1		1		1
CO4	3					1				1		1
CO5	3	2				1				1	2	1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	40	30	76
Apply		10	14
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE(Marks)	ESE (Marks)	ESE Duration
150	50	100	3hours

Continuous Internal Evaluation Pattern:

Attendance :10marks

Continuous Assessment Test (2numbers) : 25 marks

Assignment/Quiz/Course project :15marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer anyone. Each question carries 14marks and can have maximum 2 sub-divisions.

Course Leve l Assessment (Sample) Questions

CO1: Explain the various construction procedures for sub structures and super structures

1. Explain the various types of construction joints.
2. Write short notes on vacuum dewatering of concrete flooring.
3. What is a slip form? Where they are used?
4. Discuss in detail various techniques used for launching heavy decks.
5. Discuss the construction methods of cable stayed bridges.
6. Explain the procedure involved in the construction of domes.

CO2: Describe the various activities involved in underground and under water construction.

1. Describe the procedure involved in the Piling technique.
2. What is a cofferdam? With the help of sketches explain various types of Cofferdams underground open excavation
3. What are the uses of diaphragm walls and sheet piles?
4. Write short notes on well foundation and caisson.
5. Explain the methods of dewatering foundations excavations.

CO3: Demonstrate basic knowledge about construction equipment and machineries

1. Discuss different types of earth work operations.
2. Explain the uses of various types of excavating equipment.
3. Explain the pile driving equipment in detail.
4. Describe the various equipment used for compaction in field.

CO4: Explain the equipment used for production of aggregates and concreting.

1. Explain the types of crushers used for production of aggregates.
2. Describe the uses of screening equipment.
3. Discuss different types of Mixers used for concrete mixing.
4. Explain the types of Pumps used in concrete construction.

CO5: Select construction equipment appropriate to tasks.

1. Mention the various types of earthwork equipment. Explain their uses.
2. Discuss the role of tractors in earth moving. What consideration govern selection of wheel

type or crawler type tractor on a job?

3. What are the different types of cranes? Explain them in detail.
4. What are the advantages of using belt conveyors for transporting materials?
5. Compare the applications of various equipment used for compaction.

SYLLABUS

Module1
Construction techniques
Construction joints- movement and expansion joints –Vacuum Dewatering of Concrete Flooring – Techniques of construction for continuous concreting operation in Tall buildings – Slip Form techniques—Erection techniques of Tall structures, large Span Structures - Bridge Construction-Construction sequence and methods - Bow string bridges, cable stayed bridges - Launching techniques for heavy decks. Domes- Types — Construction sequence and methods in domes

Module2
Sub structure construction
Tunneling techniques- Piling techniques - driving well and caisson - sinking cofferdam- cable anchoring and grouting. Driving diaphragm walls, sheet piles - shoring for deep cutting -well points -dewatering and stand by Plant equipment for underground open excavation.

Module3
Equipment for Earth Work
Fundamentals of earth work operations - earth moving operations - types of earth work equipment - tractors, motor graders, scrapers, front end waders – excavating and earth moving equipment- dozer, excavators, rippers, loaders - trucks and hauling equipment, compacting equipment, finishing equipment.

Module4
Equipment for production of aggregate and concrete
Equipment for production of aggregate and concreting - Crushers – Feeders - Screening Equipment – Handling Equipment- Batching and Mixing Equipment- Transit mixers - Hauling, Concrete Pouring and Pumping Equipment -Transporters

Module5
Other construction equipment
Pile driving Equipment - Erection Equipment – Cranes, Derrick Cranes, Mobile cranes, Overhead cranes, Traveller cranes, Tower cranes - Types of pumps used in Construction - Equipment for Dewatering and Grouting - Material Handling Conveyors –Industrial Trucks, Forklifts and related equipment.

Textbooks:

1. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., "Construction Planning, Equipment and Methods", McGraw Hill, Singapore, 2006.
2. Sharma S.C. "Construction Equipment and Management", Khanna Publishers, New Delhi, 1988.

3. Arora S.P. and Bindra S.P., Building Construction, Planning Techniques and Method of Construction, Dhanpat Rai and Sons, 1997

Reference books:

1. Deodhar, S.V. "Construction Equipment and Job Planning", Khanna Publishers, New Delhi, 1988.
2. Jerry Irvine, Advanced Construction Techniques, CA Rocketr, 1984
3. Dr.MaheshVarma, "Construction Equipment and its planning and Application", etropolitan Book Company, New Delhi. 1983

Lecture Plan

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module I(7hours)**		
1.1	Construction joints- movement and expansion joints –	CO1	1
1.2	Vacuum Dewatering of Concrete Flooring – Techniques of construction for continuous concreting operation in Tall buildings – Slip Form techniques	CO1	1
1.3	Erection techniques of Tall structures, large Span Structures	CO1	1
1.4	Bridge Construction- Construction sequence and methods - Bow string bridges, cable stayed bridges	CO1	2
1.5	Launching techniques for heavy decks.	CO1	1
1.6	Domes- Types — Construction sequence and methods in domes	CO1	1
2	**Module II(6hours)**		
2.1	Introduction to pile foundation- types, Piling techniques	CO2	1
2.2	Well foundation and caisson	CO2	1
2.3	Sinking cofferdam- cable anchoring and grouting	CO2	1
2.4	Driving diaphragm walls, sheet piles	CO2	1
2.5	Shoring for deep cutting	CO2	1
2.6	Well points -dewatering and stand by Plant equipment for underground open excavation.	CO2	1
3	**Module III(7hours)**		
3.1	Fundamentals of earth work operations - earth moving operations - types of earth work equipment	CO3, CO5	1

3.2	Tractors, motor graders, scrapers, front end waders	CO3, CO5	2
3.3	Excavating and earth moving equipment- dozer, excavators, rippers, loaders	CO3, CO5	2
3.4	Trucks and hauling equipment	CO3, CO5	1
3.5	Compacting equipment, finishing equipment.	CO3, CO5	1
4	**Module IV(7hours)**		
4.1	Equipment for production of aggregate and concreting - Crushers	CO4	1
4.2	Feeders - Screening Equipment – Handling Equipment	CO4	2
4.3	Batching and Mixing Equipment - Transit mixers	CO4	2
4.4	Hauling, Concrete Pouring and Pumping Equipment - Transporters	CO4	2
5	**Module V(8hours)**		
5.1	Pile driving Equipment – Types of pile hammer: Drop hammer, Single acting and double acting steam hammers, Diesel hammers, Vibratory pile drivers	CO3, CO5	2
5.2	Erection Equipment – Cranes, Derrick Cranes, Mobile cranes, Overhead cranes, Traveller cranes, Tower cranes	CO3, CO5	2
5.3	Types of pumps used in Construction	CO3, CO5	1
5.4	Equipment for Dewatering and Grouting	CO3, CO5	1
5.5	Material Handling Conveyors –Industrial Trucks, Forklifts and related equipment	CO3, CO5	2

MODELQUESTIONPAPER

Reg.No.:________________ Name:___________________________

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: 22CEE 802.5

Course Name: **CONSTRUCTION METHODS & EQUIPMENT**

Max.Marks:100 Duration:3Hours

PARTA

Answer all questions. Each question carries 3 marks.

1. What is the necessity of providing construction joints?
2. Discuss Slip form technique.
3. What is a box caisson? Where do we use it?
4. What are problems normally occur during deep excavations.
5. Discuss different types of earth work operations.
6. What are the uses of a grader?
7. What is a transit mixer? Mention its uses
8. List out the various types of hauling equipment used in concrete construction.
9. What are the equipment used for grouting?
10. Explain different types of material handling conveyors.

(10×3marks=30marks)

PARTB

Answer one full question from each module. Each full question carries14marks.

Module I

11. a) Write short notes on Vacuum Dewatering of Concrete Flooring (7 marks)

b) Explain the erection techniques involved in the construction of of Tall structures. (7marks)

OR

12. a) Discuss in detail various techniques used for launching heavy decks (7marks)

b) Explain the procedure involved in the construction of domes (7marks)

Module II

13. a) What is a cofferdam? With the help of sketches explain various types of Cofferdams. (6marks)

b) Describe in detail about the various piling techniques. (8marks)

OR

14. a) Explain the following with neat sketches. (8marks)

(i) Sheet piles

(ii) Well point

b) Explain the methods of dewatering foundations excavations. (6marks)

Module III

15. Mention the various types of excavating equipment. Explain their uses. (14marks)

OR

16. a) Describe in detail the various equipment used for compaction in field (8 marks)

b) Discuss the role of tractors in earth moving. What consideration govern selection of wheel type or crawler type tractor on a job?. (6marks)

Module IV

17. Describe the various equipment used for production of aggregates (14marks)

OR

18. Discuss different types of Mixers used for concrete mixing. (14marks)

Module V

19. Explain the pile driving equipment in detail (14 marks)

OR

20. What are the different types of cranes? Explain them in detail (14marks)

22 CEE 802.6	AIR QUALITY MANAGEMENT	Category	L	T	P	Credit	Year of Introduction
		PEC	3	0	0	3	2019

Preamble: The course is designed to provide engineering knowledge on air pollution, air quality monitoring and air pollution control strategies among students. It motivates the students in maintaining and improving the air quality of the environment and empower learners to take appropriate actions to reduce the air pollution for the benefit of the society.

Pre-requisite: Nil

Course outcome

After the course, the student will able to:

CO1	Explain the sources of air pollution and different types of air pollutant.
CO2	Describe the effect of air pollutants on vegetation, animals, materials and human health.
CO3	Discuss the different methods of ambient air quality monitoring system which supports an air quality management program.
CO4	Explain the meteorological aspects of air pollutant dispersion.
CO5	Describe the various air pollution control strategies that can be undertaken to meet the air quality goals.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					2	2					
CO2	3					2	1					
CO3	3					2	2					
CO4	3					3	2					
CO5	3					2	2					

Assessment pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	20	20	40
Apply			
Analyze	10	10	20
Evaluate	5	5	10
Create			

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment Test (2 numbers)	:	25 marks
Assignment/Quiz/Course project	:	15 marks
Total	**:**	**50 marks**

End semester examination pattern – There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment

Qn. No	**Question**	**Marks**	**Course outcome (CO) Assessed**
	Part A		
1	What are the criteria air pollutants?	3	CO1
2	Define air pollution.	3	CO1
3	Explain effect of carbon monoxide on human health.	3	CO2
4	What are the sources of indoor air pollution?	3	CO2
5	Enumerate the assumptions in Gaussian plume model.	3	CO3
6	Explain Pasquill's stability curves.	3	CO3
7	Discuss National Ambient Air Quality Standards.	3	CO4
8	Explain the devices used for sampling gases and vapours.	3	CO4
9	Write short notes on scrubbing.	3	CO5
10	List the different methods for controlling the particulate air pollutants.	3	CO5

	Part B **(Answer ANY ONE FULL question from each module)**		
	Module I		
11(a)	Explain green house effect.	7	CO1
11(b)	Give a classification of the different types of air pollutants based on different criteria with suitable examples.	7	CO1
12	Explain major air pollution episodes.	14	CO1
	Module II		
13(a)	Discuss the effects of indoor air pollutants.	7	CO2
13(b)	Discuss the effects of air pollutants on human health.	7	CO2
14(a)	Describe the effect of air pollution on environment.	9	CO2
14(b)	Write a short note on effect of air pollution on vegetation.	5	CO2
	Module III		
15(a)	Explain the effect of meteorological factors on dispersion of air pollutant.	7	CO3
15(b)	Explain temperature lapse rate.	7	CO3
16	Explain advantages and disadvantages of Gaussian plume model.	14	CO3
	Module IV		
17(a)	Briefly explain Emission Inventory.	5	CO4
17(b)	Explain the different methods for the collection of gaseous air pollutants.	9	CO4
18	Explain various methods used for the sampling of particulate air pollutants.	14	CO4
	Module V		
19 (a)	Write short note on scrubbing.	5	CO5

19 (b)	Explain the working of an Electrostatic precipitator for particulate emission control. Also explain its advantages and disadvantages.	9	CO5
20	Explain various methods used for the control of particulate air pollutants.	14	CO5

Course Code: 22 CEE 802.6

Air Quality Management

Module I

Introduction- Components of Environment- Definition –Air Pollution- History of air pollution episodes- Sources of Air pollution – Industrial Processes causing Air Pollution- Air Pollutants- Types of Air Pollutants- Criteria Pollutants.

Module II

Effect of air pollutants on health, vegetation, animals and materials and environment- Green house effect - Indoor Air Pollution- Sources of indoor air pollutants- Effects of indoor air pollution.

Module III

Meteorological aspects of Air Pollutant Dispersion - Temperature and Pressure relationships- Atmospheric Stability- Temperature Lapse Rate- Inversions- Types, Plume behaviour. Dispersion of Air pollutants-Plume dispersion theory- Gaussian plume model (Derivation not required)- Assumptions-Advantages and Disadvantages- Pasquill's stability curves.

Module IV

Air Quality monitoring - Ambient air sampling - Collection of gaseous air pollutants-Collection of particulate Pollutants- Ambient Air Quality standards- Emission Inventory.

Module V

Control of Air Pollutants- Particulate emission control-methods, Scrubbing-Cyclones- Filtration- Electrostatic Precipitation-Gaseous emission control- adsorption, absorption, thermal methods.

Text Books :

1. C.S.Rao, “Environmental Pollution Control Engineering”, New Age International Pub., 2006

2. M.N. Rao & H.V.N Rao ,Air Pollution, Tata McGraw Hill Co. Ltd, Delhi, 1990.

3. Peavy H S, Rowe, D.R. Tchobanaglous "Environmental Engineering" McGraw Hill Education, 1985

References:

1. Beat Meyer, Indoor Air Quality, Addison – Wesley Publishers.

2. Chhatwal G. R., Encyclopedia of Environmental Pollution and Control, Vol.1, 2 &3, Anmol Publications.

3. Noel de Nevers, Air Pollution Control Engineering, McGraw Hill, New York, 1995.

4. J. R. Mudakavi, Principles and Practices of Air Pollution Control and Analysis, IK International Pvt Ltd, 2012

5. Perkins H.C, "Air Pollution" McGraw Hill Publications, 2004

6. S C Bhatia, Textbook of Air Pollution and Its Control , Atlantic publishers, 2007

7. S P Mahajan, Air Pollution Control, Common Wealth of Learning, Canada,

Indian Institute of Science, Bangalore, 2006

8. Stern.A, "Air Pollution" (Volume I ,II & III) ,Academic Press New York, 1962

Course Code: 22CEE 802.6

Air Quality Management

Course content and Schedule of Lecture (sample)

Module	Topic	Course outcome addressed	No of Hours
Module I (7 Hours)			
1.1	Introduction- Components of Environment	CO1	1
1.2	Definition –Air Pollution	CO1	
1.3	History of air pollution episodes	CO1	1
1.4	Sources of Air pollution	CO1	1
1.5	Industrial Processes causing Air Pollution	CO1	1
1.6	Air Pollutants	CO1	1
1.7	Types of Air Pollutants	CO1	1

1.8	Criteria Pollutants	CO1	1
Module II (7 Hours)			
2.1	Effect of air pollutants on health	CO2	1
2.2	Effect of air pollutants on vegetation and animals	CO2	1
2.3	Effect of air pollutants on materials and environment	CO2	1
2.4	Effect of air pollutants on materials and environment	CO2	1
2.5	Green house effect	CO2	1
2.6	Indoor Air Pollution	CO2	
2.7	Sources of indoor air pollutants	CO2	1
2.8	Effects of indoor air pollution	CO2	1

Module III (7 Hours)			
3.1	Meteorological aspects of Air Pollutant Dispersion	CO3	1
3.2	Temperature and Pressure relationships	CO3	
3.3	Atmospheric Stability	CO3	1
3.4	Temperature Lapse Rate	CO3	1
3.5	Inversions- Types, Plume behaviour	CO3	1
3.6	Dispersion of Air pollutants -Plume dispersion theory	CO3	1
3.7	Gaussian plume model	CO3	1
3.8	Assumptions-Advantages and Disadvantages	CO3	
3.9	Pasquill's stability curves	CO3	1
Module IV (7 Hours)			
4.1	Air Quality monitoring	CO4	1
4.2	Ambient air sampling	CO4	1
4.3	Collection of gaseous air pollutants	CO4	1
4.4	Collection of particulate Pollutants	CO4	1
4.5	Collection of particulate Pollutants	CO4	1
4.6	Ambient Air Quality standards	CO4	1
4.7	Emission Inventory	CO4	1
Module V (7 Hours)			
5.1	Control of Air Pollutants	CO5	1
5.2	Particulate emission control-methods	CO5	1
5.3	Scrubbing-Cyclones	CO5	1
5.4	Filtration- Electrostatic Precipitation	CO5	1
5.5	Gaseous emission control	CO5	1
5.6	Adsorption, absorption, thermal methods.	CO5	1
5.7	Thermal methods.	CO5	1

Model Question Paper

Reg. No.:………………….. **QP CODE:………………..**

Name:………………………

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22 CEE 802.6

Air Quality Management

Max. Marks: 100 **Duration: 3 hours**

Part A

(Answer all questions; each question carries 3 marks)

1. What are the criteria air pollutants?
2. Define air pollution.
3. Explain effect of carbon monoxide on human health.
4. What are the sources of indoor air pollution?
5. Enumerate the assumptions in Gaussian plume model.
6. Explain Pasquill's stability curves.
7. Discuss National Ambient Air Quality Standards.
8. Explain the devices used for sampling gases and vapours.
9. Write short notes on scrubbing.
10. List the different methods for controlling the particulate air pollutants.

Part B

(Answer one full question from each module; each question carries 14 marks)

Module I

11. a) Explain green house effect. (7 Marks)

b) Give a classification of the different types of air pollutants based on different criteria with suitable examples. (7Marks)

OR

12. Explain major air pollution episodes. (14 Marks)

Module II

13. (a) Discuss the effects of indoor air pollutants. (7 Marks)

(b) Discuss the effects of air pollutants on human health. (7 Marks)

OR

14. (a) Describe the effect of air pollution on environment. (9 Marks)

(b) Write a short note on effect of air pollution on vegetation. (5 Marks)

Module III

15. (a) Explain the effect of meteorological factors on dispersion of air pollutant. (7 Marks)

(b) Explain temperature lapse rate. (7 Marks)

OR

16. Explain advantages and disadvantages of Gaussian plume model. (14 Marks)

Module IV

17. (a) Briefly explain Emission Inventory. (5 Marks)

(b) Explain the different methods for the collection of gaseous air pollutants. (9 Marks)

OR

18. Explain various methods used for the sampling of particulate air pollutants. (14 Marks)

Module V

19. (a) Write short note on scrubbing. (5 Marks)

(b) Explain the working of an Electrostatic precipitator for particulate emission control. Also explain its advantages and disadvantages. (9 Marks)

OR

20. Explain various methods used for the control of particulate air pollutants. (14 Marks)

22CEE 802.7	URBAN PLANNING AND ARCHITECTURE	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PEC	3	0	0	3	2019

Preamble: Goal of this course is to expose the students to the fundamental concepts of Architecture and Urban Planning. After this course, students will be able to understand the visual vocabulary and origin and evolution of Architecture and Urban Planning and its impact in the society.

Prerequisite : Nil

Course Outcomes: After completion of the course the student will be able to:

CO 1	Classify the elements of Architecture and fundamental principles of architectural design
CO 2	Explain the origin and evolution of World Architecture, Indian Architecture and Architecture of Kerala
CO 3	Explain the basic principles of sustainability and resource-based planning
CO 4	Explain the evolution of planning and impact of urbanization
CO 5	Evaluate and assess the planning process and its legislation in India

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	3	-	-	-	-	-	-	-	-	-	-
CO 4	2	3	-	-	-	-	-	-	-	-	-	-
CO 5	2	3	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	20
Understand	10	15	20
Apply	25	25	50
Analyse	5		10
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation (CIE)Pattern :

Attendance : 10 Marks

Continuous Assessment Test (2 numbers) : 25 Marks

Assignment/Quiz/Course project : 15 Marks

End Semester Examination (ESE)Pattern : There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Sample Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

Course Outcome 1 (CO1):

1. The relevance and impact of Architecture in human society
2. The concepts of architectural development
3. The fundamental principles of architectural design
4. Elements of architecture and its composition

Course Outcome 2 (CO2):

1. The fundamentals of styles in Architecture,World Architecture and its development
2. Understanding the classical Architecture Vocabulary- Roman
3. Concepts of structure and geometry in Greek Architecture,Orders of Architecture,
4. The development and features of Gothic and Renaissance architecture
5. The evolution and features of Indian Architecture- Budhist, Hindu and Non-Islamic period
6. Evolution and factors that influenced the development of Kerala Architecture including materials, climate and socio economic factors

Course Outcome 3 (CO3):

1. Basics of Sustainability, Sustainable Development and its influence in sustainable architecture
2. Concept of Green Buildings, various rating systems and its comparison
3. Basic principles of resource-based planning, sustainable urban planning

Course Outcome 4 (CO4):

1. Basic concepts of evolution of town planning
2. Understanding of the problems associated with uncontrolled urban growth and industrialization
3. Urban planning legislations
4. Theories of urban planning like garden city concept, new towns and conservative surgery
5. Understanding of town planning surveys including landuse surveys and socio economic analysis

Course Outcome 5 (CO5):

1. Basic concepts of regional planning, zoning and sub division regulation
2. Understanding the concepts of FSI/FAR and its relevance in town planning
3. Understanding the principles of planning
4. Introduction to town planning regulations and guidelines

SYLLABUS

Module I

Architecture: definition – factors influencing architectural development-Principles and elements of architecture: Contrast, proportion, scale, balance, rhythm, character, colour and unity- Line, space, form and shape.

Module II

Characteristic features of a style – Characteristic features and examples from world architecture. Development of Roman vocabulary of Architecture, Structural and Engineering feats - Geometry and Greek Architecture, Greek Capitals and Orders. Gothic: Characteristics of Gothic churches and cathedrals, Renaissance: development of stone vaults into groined systems. Indian architecture: A brief study of the architecture of Buddhist, Hindu and Indo-islamic period. Introduction to Kerala Architecture: Evolution of architectural style, Factors that influenced the development of Kerala architecture: Materials, Climate & Socioeconomic factors.

Module III

Basic concepts of sustainability- goals for sustainable development- Introduction to the concept and issues of Sustainable Architecture - basic concept of Green Buildings- Green Rating systems (LEED and GRIHA) - Sustainable building practices in India.

Resource based planning – urban infrastructure planning in sustainability context- socioeconomic development and sustainable planning – sustainable new towns.

Module IV

Basics of planning: Evolution of towns – problems of urban growth – Benefits of planning - urbanization, industrialization and urban development; push and pull factors; migration trends and impacts on urban and rural development – beginning of town planning acts – ideal towns – garden city movement – concept of new towns and conservative surgery - comprehensive planning of towns. Basics of town planning surveys – Land use surveys and analysis – Socio-economic surveys.

Module V

Regional planning – Zoning and subdivision regulation – FSI/FAR – Neighbourhood planning – planning principles – site planning – site selection criteria for housing development – types – site analysis. Types of plans – master plans, development plans, etc. (introduction only). Spatial standards, performance standards, benchmarks, and variable standards; URDPFI guidelines, zoning regulations/ordinances and DCR and (development control rules and regulations). New Urbanism and Public participation in planning process.

References:

1. James C. Snyder, Introduction to Architecture, McGraw-Hill, 1979
2. Francis D.K. Ching, A Visual Dictionary of Architecture
3. Leland M Roth; “Understanding Architecture: Its Elements, History and Meaning”; Craftsman House; 1994
4. Simon Unwin, Analysing Architecture; Routledge Publicaions, Taylor and Francis. 2014

5. “ A Global History of Architecture”, Francis D K ching, Mark M. Jarzombek, Vikramaditya Prakash, Wiley Pub: 2010
6. Sir Banister Fletcher, “A History of Architecture”, CBS Publications (Indian Edition),1999.
7. Vernacular Architecture: An Illustrated Handbook By R.W. Brunskill, 4th ed 2000 Faber and Faber
8. Cities in A Globalizing World – Global Report on Human Settlements 2001: by United Nations
9. John Ratcliffe, 1984,' An Introduction to Town and Country Planning'
10. Kulsreshtha, 2012, 'Urban and Regional Planning in India: A handbook for professionals'
11. Ministry of Urban Affairs, Govt. of lndia, 'Urban and Regional Development Plan Formulation and Implementation Guidelines -2014’

Course Contents and Lecture Schedule:

Module	Contents	Outcomes Addressed	Hours
1	**Module 1**		**7**
1.1	Architecture: definition	CO 1	1
1.2	Factors influencing architectural development	CO 1	1
1.3	Principles and elements of architecture: Contrast, proportion, scale, balance	CO 1	1
1.4	Principles and elements of architecture-rhythm, character, colour and unity	CO 1	2
1.5	Principles and elements of architecture -Line, space, form and shape.	CO 1	2
2	**Module 2**		**7**
2.1	Characteristic features of a style	CO 2	1
2.2	Characteristic features and examples from world architecture.	CO 2	
2.3	Development of Roman vocabulary of Architecture	CO 2	1
2.4	Structural and Engineering featsGeometry and Greek ArchitectureGreek Capitals and Orders	CO 2	1
2.5	Gothic: Characteristics of Gothic churches and cathedrals	CO 2	1
2.6	Renaissance: development of stone vaults into groined systems	CO 2	1
2.7	Indian architecture: A brief study of the architecture of Buddhist, Hindu and Indo-islamic period.	CO 2	1
2.8	Introduction to Kerala Architecture: Evolution of architectural style	CO 2	1
2.9	Factors that influenced the development of Kerala architecture: Materials, Climate & Socioeconomic factors	CO 2	
3	**Module 3**		**7**
3.1	Basic concepts of sustainability- goals for sustainable development	CO 3	1
3.2	Introduction to the concept and issues of Sustainable Architecture	CO 3	1
3.3	Basic concept of Green Buildings	CO 3	1
3.4	Green Rating systems (LEED and GRIHA)	CO 3	
3.5	Sustainable building practices in India.	CO 3	1
3.6	Resource based planning – urban infrastructure planning in sustainability context	CO 3	1
3.7	socioeconomic development and sustainable planning	CO 3	1
3.8	sustainable new towns	CO 3	1
4	**Module 4**		**7**
4.1	Basics of planning:	CO 4	1
4.2	Evolution of towns – problems of urban growth – Benefits of	CO 4	

	planning - urbanization,		
4.3	industrialization and urban development	CO 4	1
4.4	push and pull factors	CO 4	
4.5	migration trends and impacts on urban and rural development	CO 4	1
4.6	beginning of town planning acts – ideal towns	CO 4	1
4.7	garden city movement	CO 4	1
4.8	concept of new towns and conservative surgery - comprehensive planning of towns	CO 4	1
4.9	Basics of town planning surveys – Land use surveys and analysis – Socio-economic surveys	CO 4	1
5	**Module 5**		**7**
5.1	Regional planning – Zoning and subdivision regulation	CO 5	1
5.2	FSI/FAR	CO 5	
5.3	Neighbourhood planning	CO 5	1
5.4	planning principles	CO 5	
5.5	site planning – site selection criteria for housing development types – site analysis.	CO 5	1
5.6	Types of plans – master plans, development plans, etc.	CO 5	1
5.7	.Spatial standards, performance standards, benchmarks, and variable standards;	CO 5	1
5.8	URDPFI guidelines, zoning regulations/ordinances and DCR and (development control rules and regulations).	CO 5	1
5.9	New Urbanism and Public participation in planning process	CO 5	1

Model Question Paper

QP CODE:

Reg No.:_______________ **Name:__________________________**

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22 CEE 802.7

Course Name : URBAN PLANNING AND ARCHITECTURE

Max. Marks: 100 Duration: 3 hours

Part A

(***Answer all questions; each question carries 3 marks***)

1. What is a Line? what are its types.
2. Explain the term‘Contrast’
3. Describe the orders of Architecture
4. What are the different styles of Hindu temples in India.
5. What do you understand by the term ‘Global Warming’?
6. What does the term ‘Renewable and Non-renewable sources’ meant? Give Examples..
7. Describe the importance of socio economic survey in urban planning.
8. What are the planning features of ‘Garden City’?
9. Describe the contents of development Plan.
10. Explain the term ‘FAR’

PART B

(Answer one full question from each module, each question carries 14 marks)

Module – 1

11. (a) Explain the importance of ‘scale and proportion’ in Architectural Design (5 Marks)

    (b) Explain about the characteristics and functions of lines, space and form in Architecture. (9 Marks)

12. (a) Discuss the pattern of evolution in architecture and the etymology of the word ‘Architecture’.. (5 Marks)

    (b) Briefly discuss the influences of elements in architectural spaces. (9 Marks)

Module – 2

13. (a) Briefly explain salient features of Gothic and Renaissance period. (5 Marks)

(b) Explain the influence of Local materials on vernacular architecture with an example of Kerala Architecture. (9 Marks)

14. (a) What are the essential features and elements of Hindu temple Planning? (5 Marks)

(b) Describe TAJ MAHAL emphasizing on both TOMB and GARDEN. (9 Marks)

Module – 3

15. (a) Define sustainable development. Describe the 3 spheres of sustainable development.Brieflyexplain on the 3 spheres of sustainable architecture. (5 Marks)

(b) Discuss in detail the major objectives and fundamental principles in Green buildingconcept. (9 Marks)

16. (a) Discuss in detail GRIHA rating system. What are the certification levels and discuss indetail the criterions for the rating system?. (7 Marks)

(b) Explain in detail the energy consumed by a building in its life. Explain transportationenergy and its significance in sustainable architecture. (7 Marks)

Module – 4

17. (a) Discuss about the contributions of Ebenezer Howard towards town planning. (5 Marks)

(b) Principles of 'Conservative Surgery" as proposed by Patrick Geddess (9 Marks)

18. (a) Describe the importance of surveys in the urban planning process? (5 Marks)

(b) With the help of examples, relate the influence of Industrial Revolution in the process of urbanization. (9 Marks)

Module – 5

19. (a) Compare and contrast the difference between Master Plan and Development Plan (5 Marks)

(b) What are the functions and powers of District Planning committee as per Kerala Town and Country Planning Act, 2016 (9 Marks)

20. (a)"*The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation andResettlement (RFCTLARR) Act, 2013 address matters in land acquisition by creating active engagement of affected communities*" Substantiate this statement by the salient features of RFCTLARR Act, 2013. (9 Marks)

(b) Explain the purpose and relevance of Environmental Protection Act, 1986. (5 Marks)

Code	Course Name	Category	L	T	P	Credits	Year of Introduction
22 CEE 803.1	BRIDGE ENGINEERING	PEC	3	0	0	3	2019

Preamble: This course introduces code of practices and standards for bridge design and covers conceptual planning and structural design of bridges. This includes design of RCC, PSC and Steel composite superstructures. The course also familiarises site selection, fixing of alignment, hydraulic design, and loading standards for bridges. A brief overview of structural analysis methods for superstructure, types of bearings and design of substructures are also covered in this course.

Prerequisite: CET303 Design of Concrete Structures / CET413 Prestressed Concrete / CET401 Design of steel structures

Course Outcomes : After the completion of the course the student will be able to:

CO 1	Prepare General Arrangement Design of bridges.
CO 2	Explain various loads on bridge and methods of structural analysis of bridges.
CO 3	Design culverts and common bridge superstructures such as RCC Solid slab and T-beam & slab and its reinforcement detailing.
CO 4	Design composite superstructure such as PSC I girders and steel plate girders with RCC deck slab.
CO 5	Identify various bearings and design of bridge substructures and foundation.

Mapping of course outcomes with programoutcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3										
CO 2	3	3										
CO 3	3	3										
CO 4	3	3										
CO 5	3	3										

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember (K1)	5	5	10
Understand (K2)	10	10	20
Apply (K3)	20	20	40
Analyse (K4)	15	15	30
Evaluate (K5)	-	-	-
Create (K6)	-	-	-

Continuous Internal Evaluation pattern:

Attendance	:	10 marks
Continuous Assessment Tests	:	25 marks
Assignment/Quiz/Course project	:	15 marks
Total	**:**	**50 marks**

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

(Questions may be framed based on the outline given under each course outcome)

Course Outcome 1 (CO1):

1. Explain functions of various bridge elements and criteria for site selection and planning of bridge alignment.
2. Explain considerations for hydraulic design, geotechnical and span arrangement.
3. Problems on discharge calculation and linear waterway calculation.

Course Outcome 2 (CO2):

1. Explain types of structural forms, its actions and span ranges.
2. Explain various loads on bridge elements and its evaluation..
3. Explain methods for analysis of bridge superstructure.
4. Problems on load calculation and corresponding forces and moments on superstructure and substructure.

Course Outcome 3 (CO3):

1. Explain Load combination principles for Serviceability Limit State and Ultimate Limit State.
2. Problems on design for flexure, shear and torsion of box culverts, RCC solid slab and T beam & slab.

Course Outcome 4 (CO4):

1. Explain cable profiling for PSC girders and computation prestress losses.
2. Problems on design for flexure, shear and torsion of PSC I girders composite with RCC slab and Steel plate girders composite with RCC slab.

Course Outcome 5 (CO5):

1. Explain types and functions of bearings.
2. Problems on stability analysis and design of abutment and pier.
3. Problems on stability analysis and design of open foundation, well foundation and pile foundation.

Course Code: 22 CEE 803.1

BRIDGE ENGINEERING

Syllabus

Module I

General Arrangement Design: Classification of Bridges - Codes of practices for Highway and Railway bridges (IRC & IRS) - Types and functions of Bridge Elements - Site selection and planning of bridge alignment with approaches. Considerations for width of bridges - Hydraulic Design - Geotechnical considerations - Considerations for Span Arrangement - Bridge Aesthetics - Preparation of General Arrangement Drawing.

Module II

Structural Analysis of Bridges: Types of Structural forms and actions - Solid slab - Voided slab – T beam and slab – I girder and slab - Box girder - Bow string girder – Arch - Extradosed bridge - Cable stayed bridge - Suspension bridge.
Loads on bridges as per codal provisions - Vehicle Load with impact and braking effect -Wind load - Shrinkage and temperature effect - Earth pressure - Water current force - Seismic effect. Analysis methods for longitudinal and transverse actions - Orthotropic plate method - Grillage method – Pigeauds method - Courbon's method – Guyon-Massonet method using Morice and Littile charts - Overview of FEM based analysis software and Bridge Information Modelling.

Module III

Design of RCC Superstructures: Limit State Design concepts as per IRC: 112 - Load combination principles for SLS and ULS – Design for flexure, shear and torsion of Box culverts - RCC Solid Slab – T beam and slab -Detailing of primary reinforcements as per on IRC: 112.

Module VI

Design of PSC and Steel Superstructure: Basic concepts of prestressing as per IRC: 112 - Prestress losses - Cable profiling – Design for flexure, shear and torsion of PSC I girders composite with RCC slab.
Design considerations for steel bridges as per IRC: 22 & IRC 24, Design of Steel plate girders composite with RCC slab

Module V

Design of Substructures and Foundation: Types and functions of Bearings as per IRC: 84 - metallic bearings - Elastomeric bearing - Pot bearing - Spherical bearing.
Design considerations for Substructures as per IRC: 78 - Stability analysis and design of Abutment - Pier. Design considerations for Foundations as per IRC: 78 - Stability analysis and design of open and well foundations - Pile foundation - Design of pile cap and piles for vertical and lateral loads.

Text Books

1. Johnson Victor D, “Essentials of Bridge Engineering”, 7th Edition, Oxford, IBH publishing Co. Ltd, 2006.
2. Rajagopalan N., “Bridge Superstructure”, Narosa Publishing House, 2006
3. Krishna Raju N., “Design of Bridges”, Oxford & IBH Publishing Co. Pvt. Ltd., 2012.
4. Praveen Nagarajan, “Design of Concrete Bridges”, Wiley
5. Jagadeesh T.R. & Jayaram M.A., “Design of Bridge Structures”, Prentice-Hall of India Pvt. Ltd., 2009.

References:

1. Standard Specifications and Code of Practice for Road Bridges, IRC, New Delhi
   a) IRC:5-2015 “General Features of Design”
   b) IRC:6-2017, “Loads and Load Combinations”
   c) IRC:22-2015, “Composite Construction (Limit state design)”
   d) IRC:24-2010, “Steel Road Bridges (Limit state design)”
   e) IRC:78-2014,”Foundations and Substructure”
   f) IRC:83 (Part-1 2015, Part-2 2018, Part-3 2018, Part-4 2015), “Bearings”
2. IRC:SP: 105-2015, “Explanatory Handbook to IRC:112”, IRC, New Delhi.
3. IRS “Concrete Bridge Code”, RDSO, Lucknow.
4. IRS “Substructure and Foundation Code”, RDSO, Lucknow.
5. Bakht, B. and Jaegar, L.G., "Bridge Analysis simplified", McGraw Hill, 1985.
6. Surana C.S., “Grillage Analogy in Bridge Deck Analysis “, Alpha Science Int. Ltd.
7. E. C. Hambly , “Bridge Deck Behaviour” , CRC Press, 2nd edition.
8. Raina V.K., "Concrete Bridge Practice", Tata McGraw Hill Publishing Company, New Delhi, 1991.
9. Ponnu Swamy, “Bridge Engineering”, 4th Edition, McGraw-Hill Publication, 2008.
10. Swami Saran, “Analysis and Design of sub-structures”, 2nd Edition, Oxford IBH Publishing co Ltd., 2006.

Course Contents and Lecture Schedule:

Module	Topic	Course outcome addressed	No. of Lectures
Module I (7 hours)			
1.1	Classification of Bridges – based on function, span range, material, construction methodology. Introduction to codes of practices for Highway (IRC) and Railway (IRS) bridges. Functions of bridge elements such as deck slab, girder, bearing, pier, abutment, wing wall, foundation. Criteria for site selection for bridges. Planning of bridge alignment and approaches.	CO1	2
1.2	Geometric design considerations – number of lanes, width, gradient, superelevation, clearances for bridges. Geotechnical considerations – selection of foundation type.	CO1	1
1.3	Hydraulic Design – calculation of design discharge, linear waterway and maximum scour depth.	CO1	2
1.4	Considerations for Span Arrangement –economic span ranges, navigation requirement. Introduction to Bridge Aesthetics. Preparation of typical General Arrangement Drawing.	CO1	2
Module II (8 hours)			
2.1	Structural forms for bridges types and structural actions for Solid slab, Voided slab, T-beam and slab , I-girder and slab, Box girder, Bow string girder, Arch bridge, Extradosed bridge, Cable stayed bridge and Suspension bridge.	CO2	2
2.2	Loads on bridges as per codal provisions - Vehicle Load with impact and braking effects -Wind load – Temperature, shrinkage and creep effects - Earth pressure - Water current force - Seismic effect.	CO2	2
2.3	Analysis methods for longitudinal and transverse actions using Orthotropic plate method, Grillage method, Pigeauds method, Courbon’s method. Guyon-Massonet method.	CO2	1
2.4	Procedure for calculation of bending moment and shear force distribution in superstructure using Morice and Littile charts.	CO2	2
2.5	Overview of FEM based analysis software and Bridge Information Modelling (BrIM).	CO2	1
Module III (7 Hours)			
3.1	Limit State Design concepts as per IRC: 112. Load combination principles for Serviceability Limit State (SLS) and Ultimate Limit State (ULS) as per IRC: 6.	CO3	2
3.2	Design procedure for Box culvert: Calculation of reinforcement for flexure, verification of shear at ULS. Verification of stress, crack width and deflection at SLS.	CO3	1

3.3	Design procedure for RCC Solid slab: Calculation of reinforcement for flexure, verification of shear at ULS. Verification of stress, crack width and deflection at SLS.	CO3	1
3.4	Design procedure for RCC T-beam and slab: Calculation of reinforcements for flexure, shear and torsion at ULS. Verification of stress, crack width and deflection at SLS.	CO3	2
3.5	Detailing of primary reinforcements as per on IRC: 112.	CO3	1
Module IV (7 Hours)			
4.1	Basic concepts of design for prestressing as per IRC: 112	CO4	1
4.2	Calculation of immediate and time dependent prestress losses. Cable profiling within limiting zone for no tension stresses.	CO4	1
4.3	Design procedure for PSC I girder composite with RCC slab: Calculation of reinforcements for shear and torsion at ULS. Verification of stress, crack width and deflection at SLS.	CO4	2
4.4	Limit State Design concepts for steel bridges as per IRC: 22 & IRC 24,	CO4	1
4.3	Design procedure for Steel girder composite with RCC slab: Steel plate girder design for flexure, shear and torsion. Design of shear connectors.	CO4	2
Module V (7 Hours)			
5.1	Types of Bearings as per IRC: 84: Functions and components of metallic bearings, Elastomeric bearing, Pot bearing, and Spherical bearing.	CO5	1
5.2	Design considerations for Substructures as per IRC: 78: Calculation of main reinforcement for abutment and pier.	CO5	2
5.3	Design considerations for Open and Well foundations as per IRC: 78: Stability analysis and design for flexure and shear at ULS and SLS.	CO5	2
5.4	Design considerations for Pile foundations as per IRC: 78: Design of pile cap and piles for vertical and lateral loads. Calculation of main reinforcement.	CO5	2

Model Question paper

QP CODE:

PAGES:2

Reg. .No:_______________
Name:_______________

EIGTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22 CEE 803.1

Course Name: BRIDGE ENGINEERING

Max. Marks: 100 Duration: 3 Hours

(Use of IRC 5, 6, 22, 24, 78, 83, 112, SP:13, IRS codes and design charts may be permitted)

PART A (3 x 10 = 30 Marks)

Answer all Questions. Each question carries 3 Marks

1. State the criteria for bridge site selection.
2. State the functions of various bridge elements.
3. State the various structural forms of bridge superstructure with economic span ranges.
4. Name IRC standard vehicles with their gross vehicle weights.
5. Name the load combinations to be adopted for checking stress, crack width and deflection of RCC bridge structure as per IRC:6.
6. State the criteria for minimum and maximum percentage for longitudinal reinforcement of beams as per IRC:112.
7. Name immediate and long term prestress losses to be considered in a post tensioned bridge girder.
8. Draw the sketches of shear connectors used for steel plate girder composite with RCC deck slab superstructure.
9. Differentiate plain elastomeric and laminated elastomeric bearings with sketches.
10. State the functions of various components of a well foundation.

PART B (14 x 5 = 70 Marks)
Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. a) Explain the criteria for fixing span arrangement for bridges. **(4)**
    b) With the help of diagram classify bridges based on their function and span range. **(10)**
12. a) Explain the geometric dimensions for a two lane highway bridge with footpaths as per IRC:5 with cross sectional sketches. **(4)**
    b) Investigation for a minor bridge in Western Ghats provides the following data: Catchment area = 175sq. km, wetted area and perimeter of stream cross section at high flood condition are 205sq.m and 61m respectively, rugosity coefficient =

0.05, hydraulic slope of river = 0.02. Calculate design discharge using Dickens, Ryve's, Ingli's and Mannings formulae as per IRC:SP:13. **(10)**

Module 2

13. a) Differentiate structural action of girder bridge and bow string bridge. **(4)**

    b) Consider a 25m effective span box girder superstructure supported on bearings. Determine the maximum reactions on bearings due to IRC Class A and Class 70R wheeled vehicles when it is placed without transverse eccentricity. **(10)**

14. a) Explain grillage method of analysis for bridge superstructure. **(4)**

    b) Determine the maximum bending moments due to live load in girders of a simply supported three girder RCC T-beam and deck slab using Courbon's method with the following data: clear span = 18.0m, carriageway width = 7.5m, spacing of girders = 2.5m Loading: IRC class 70R tracked vehicle with a transverse eccentricity of 1.1m from centre. **(10)**

Module 3

15. a) Explain the design loads to be considered in the design of box culverts with the help of sketches. **(4)**

    b) Determine the main flexural reinforcement for a RCC solid slab superstructure for IRC 70R tracked vehicle as per IRC:6 with the following data: clear span = 8.0m, carriageway width = 7.5m, kerb width =0.5m, width of bearing = 0.5m, thickness of wearing coat = 65mm, assume self weight of hand rails as 0.1kN/m. grade of concrete = M30, grade of steel Fe500. **(10)**

16. Design the central longitudinal T-beam of a simply supported superstructure for highway bridge having 3 longitudinal beams with the following data: Effective span = 15m, spacing of T-beams = 3.0m, grade of concrete = M35, grade of steel = Fe500. Maximum bending moment at mid-span and shear force at support are given below:

	Self weight	Superimposed dead load	Wearing coat	Live Load
Bending moment (kNm)	668	35	181	1240
Shear force (kN)	196	10	50	409

Calculate flexural reinforcement required at mid-span and shear reinforcement at support and show the required steel bars in respective cross sections. Check for serviceability limit state need not be considered. **(14)**

Module 4

17. A prestressed concrete I-girder of a highway bridge superstructure having cross sectional area = 0.95m^2, modulus of section Z_{top} = 0.551m^3, Z_{bottom} = 0.661m3 is post tensioned with 3 cables of 12 numbers - 12.7mm dia 7ply low relaxation strands at downward eccentricity of 1.0m from CG of section at mid-span. Check the mid-span section for rare combination at SLS, if the immediate presstress loss is 10% of jack end stress and bending moment due to self weight of girder is 2302kNm. Check the stresses at top and bottom faces when the girder is composite with RCC deck slab having cross

sectional area = $1.625m^2$, modulus of section $Z_{top} = 1.359m^3$, $Z_{bottom} = 0.693m^3$, bending moment due to superimposed dead load = 2445kNm, live load = 2717kNm and the total prestress loss is 25%. **(14)**

18. Determine the moment resistance capacity a steel plate girder of a bridge superstructure having web size: 1400mm x 16mm, top flange: 550mm x 25mm, bottom flange: 700mm x 32mm. Effective length for torsional buckling = 18m. Apply bending stress reduction factor as per IRC: 24. **(14)**

Module 5

19. a) Explain the functions of bearing and the components of a typical pot bearing with a neat sketch. **(7)**

    b) Determine the maximum vertical load on pile under a circular pier for a) 4x4 pile group and b) 2x3 pile group having the following data: downward vertical force at pier base = 4560kN, longitudinal and transverse bending moment at pier base are 2600kN and 2350kN respectively, pile spacing in both directions = 2.5m. Self weight of piles and pile cap need not be considered. **(7)**

20. Explain the procedure to check the stability of open foundation for abutment for a) overturning, b) sliding and c) base pressure with neat sketches. **(14)**

22 CEE 803.2	ADVANCED FOUNDATION DESIGN	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PEC	3	0	0	3	2019

Preamble: Goal of this course is to impart to the students, in-depth knowledge about the basic concepts and theories of foundation design. After this course the students will be able to understand and apply the design considerations to satisfy the major and other requirements of the geotechnical design of foundations.

Pre-requisite : Geotechnical Engineering -II

Course Outcomes: On successful completion of the course the student will be able to:

CO 1	Explain allowable soil pressure and safe bearing capacity, evaluate safe bearing capacity of shallow foundations by IS formula
CO 2	Proportion and design pile foundations, evaluate settlement of pile groups , uplift capacity of single and group of piles in clay
CO 3	Calculate the deflection and ultimate lateral load capacity of vertical piles
CO 4	Evaluate the load carrying capacity of under reamed piles and load capacity and uplift resistance of belled piers
CO 5	Calculate depth of embedment for cantilever sheet pile walls in clay and sand, Analyse the considerations for design of machine foundations

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-
CO 3	3	3	-	2	-	-	-	-	-	-	-	-
CO 4	3	3	2	-	-	-	-	-	-	-	-	-
CO 5	3	3	3	-	-	-	-	-	-	2	2	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	5	5	10
Understand	10	10	20
Apply	25	25	50
Analyse			
Evaluate	10	10	20
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation (CIE) Pattern :

Attendance : 10 Marks

Continuous Assessment Test (2 numbers) : 25 Marks

Assignment/Quiz/Course project : 15 Marks

End Semester Examination (ESE) Pattern : There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

Course Outcome 1 (CO1):

i)Understand allowable soil pressure and safe bearing capacity

ii)Evaluate safe bearing capacity by IS

iii)Evaluate allowable bearing capacity of footings subjected to moments

iv)Understand the procedure of evaluating the safe bearing capacity of footings in layered soil

Course Outcome 2 (CO2):

i) Calculate load carrying capacity fromSPT and CPT,Values
ii) Explain equivalent raft concept and evaluate the total consolidation settlement of pile groups

ii) Evaluate pile group settlement in sand
iii) Evaluate uplift capacity of single piles and group of piles in clay

Course Outcome 3 (CO3):

i) Evaluate the safe bearing capacity of single bulb and double bulb under reamed piles in sand and clay.

ii) Perform geotechnical design of under reamed piles as per IS

iii) Evaluate uplift capacity of piles and allowable soil pressure for belled piers

Course Outcome 4 (CO4):

1. Calculate the deflection and lateral load capacity of vertical piles for the following cases

i. Rigid and elastic piles in clay and sand for free headed and fixed headed condition using Brom's curves.

ii. Explain IS lateral load test

Course Outcome 5 (CO5):

i) Evaluate the depth of embedment for cantilever sheet piles in sand and clay
ii) Understand behavior of anchored bulkheads installed in clay and sand with concept of free earth and fixed earth support
iii) Understand various terms related to vibration
iv) Create mathematical models for free and forced vibrations with and without damping
v) Explain the various design considerations of machine foundations
vi) Evaluate the soil parameter for natural frequencies of block foundations
vii) Explain different methods of vibration isolation and control

SYLLABUS

Module 1 (6 hrs)

Bearing capacity of shallow foundations-IS code formula - Numerical problems- Footings subjected to moments-Numerical problems- -Allowable bearing pressure from SPT N-values – Numerical problems-Footings on layered soil (concept only)

Module 2 (7 hrs)

Deep foundations- - Geotechnical Design of Piles from SPT and CPT-values-Numerical problems-Settlement of pile groups in clay and sand- equivalent raft approach-Numerical problems-Settlement of pile groups in sand-Skempton's method-Meyerhof's method- Numerical problems-Uplift capacity of single piles and group of piles in clay -Numerical problems-

Module 3 (7 hrs)

Under reamed piles – Load capacity in sand and clay-design considerations as per IS– numerical problems- Drilled piers (straight shafted and belled) in clay- - Design Considerations- Load Transfer Mechanism - Vertical Bearing Capacity and uplift capacity of belled pier-Numerical problems

Module 4 (8hrs)

Behavior of vertical piles under lateral loading, Pile resistance and deflection under lateral loads, IS and Brom's method, IS lateral load test on vertical piles- numerical problems

Module 5 (8 hrs)

Sheet pile walls-Types of sheet pile structures-Design of cantilever Sheet pile wall in clay and sand -Numerical problems-Anchored bulk heads –fixed earth and free earth support (concept only).

Machine foundations- Types of Machine foundations, basic definitions, degree of freedom of a block foundation, general criteria for design of machine foundation, free and forced vibrations, vibration analysis of a machine foundation, determination of natural frequency, vibration isolation and control.

Text Books:

1. Swami Saran, Analysis and design of substructures, Oxford &IBH publishing Co.PVt.Ltd. NewDelhi,2013
2. P.C.Varghese, Foundation Engineering, PHI Learning Private Limited, M-97, 2012
3. Das B. M., Principles of Geotechnical Engineering, Cengage India Pvt. Ltd., 2010.
4. Ranjan G. and A. S. R. Rao, Basic and Applied Soil Mechanics, New Age International, 2002.

References:

1. Arora K. R., Geotechnical Engineering, Standard Publishers, 2006.
2. Purushothamaraj P., Soil Mechanics and Foundation Engineering, Dorling Indersley (India) Pvt. Ltd., 2013
3. Murthy V.N.S,Geotechnical Engineering: Principles and practices of Soil Mechanics and Foundation Engineering, New York : Marcel Dekker, 2003.

Course Contents and Lecture Schedule:

Module	Contents	Outcomes Addressed	Hours
1	**Module 1**		**6**
1.1	Bearing capacity of shallow foundations-Review of terminology-IS code formula for safe bearing capacity of shallow foundation	CO1	1
1.2	Numerical problems	CO 1	1
1.3	Footings subjected to moments-effective width concept-Numerical problems	CO 1	1
1.4	Allowable bearing pressure from N Value-Teng's equations for safe bearing capacity of strip, square and circular footings, Safe bearing pressure for a permissible settlement	CO1	2
1.5	Numerical problem- Footings on layered soil concept with explanation	CO 1	1
2	**Module 2**		**7**
2.1	Deep foundations- Geotechnical Design of Piles from SPT and CPT -values-number and spacing-Numerical problems-	CO 2	2
2.2	Settlement of pile groups in clay-equivalent raft concept-Numerical problem	CO 2	2
2.3	Settlement of pile groups in sand-Skempton's method-Meyerhof's method-Numerical problem	CO 2	1
2.4	Uplift capacity of single piles and group of piles in clay -Numerical problems	CO 2	2
3	**Module 3**		**7**
3.1	Under reamed piles-ultimate load carrying capacity in sand and clay-design considerations as per IS	CO3	1
3.2	IS formula-single and double bulb -Numerical problems	CO 3	2
3.3	Drilled piers (straight shafted and belled) in clay- Design Considerations- Load Transfer Mechanism	CO 3	2
3.4	Vertical Bearing Capacity and uplift capacity of belled pier -Numerical problems	CO 3	2
4	**Module 4**		**8**
4.1	Behavior of vertical piles under lateral loading - Failure mechanisms of short piles in cohesive and granular soils for restrained and unrestrained conditions, given by (Broms)	CO 4	1
4.2	Failure mechanisms of long piles in sand and clay both free headed and fixed headed given by Broms-	CO4	1
4.3	Empirical Methods to Determine Lateral Strength of Piles-IS 2911 and Brom's method	CO4	1

	IS2911 method-concept and assumptions made- Criteria for classification of piles into short rigid piles or long elastic piles: Lateral load test on vertical piles.		
4.4	Details of Broms Method- Chart for estimating the ultimate lateral resistance of short and long piles in clayey soils	CO 4	1
4.5	Chart for estimating the lateral deflection at ground level for piles in Clayey soils under working loads given by Broms.	CO 4	1
4.6	Chart for estimating the ultimate lateral resistance of short and long piles in sandy soils and Chart for estimating the lateral deflection at ground level for piles in Clayey soils under working loads given by Broms.	CO 4	1
4.7	Numerical problems using Brom's charts alone	CO 4	2
5	**Module 5**		**8**
5.1	Types of Sheet Pile Walls-Cantilever Sheet Pile Walls - Cantilever sheet pile walls with cohesion less backfill-deflection diagram-depth of embedment	CO 5	1
5.2	Cantilever sheet pile walls with cohesive backfill-depth of embedment	CO 5	1
5.3	Numerical problem- Anchored sheet pile walls-free earth support and fixed earth support analysis(concept only)-Rowe moment reduction factor	CO5	2
5.4	Machine foundations- Types of Machine foundations, basic definitions, -degree of freedom of a block foundation- general criteria for design of machine foundations	CO 5	1
5.5	Free vibration without damping –Spring mass system-free vibration with damping- Forced vibrations without damping-	CO 5	1
5.6	Vibration analysis of a machine foundation-determination of parameters required – Natural frequency of foundation soil system-Barken's method-Numerical problems	CO 5	1
5.7	Vibration isolation-active and passive isolation-vibration control	CO 5	1

Model Question Paper

QP CODE:

Reg No.:_______________ **Name:__________________________**

VIIIth SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEE 803.2
Course Name : ADVANCED FOUNDATION DESIGN

Max. Marks: 100 Duration: 3 hours

Note:Use of BROM's chart permitted

Part A

(***Answer all questions; each question carries 3 marks***)

16. Explain IS code formula for evaluating bearing capacity of shallow foundations.
17. Discuss the modifications made in evaluating the bearing capacity of a footing in a two layered soil deposit.
18. Explain equivalent raft concept of evaluating consolidation settlement of pile groups
19. Discuss on uplift capacity of a group of piles.
20. Sketch the failure mechanism of a rigid pile in clay given by Broms.
21. List the assumptions made in IS2911 for evaluating the lateral load capacity of a vertical pile.
22. Explain the basis of design of foundations on expansive soils
23. Explain the uses of under reamed piles
24. Differentiate between cantilever sheet piles and anchored bulk heads
25. Explain Barken's equation for evaluating natural frequency of a block foundation.

PART B

(Answer one full question from each module, each question carries 14 marks)

Module – 1

11. (a)Differentiate between safe bearing capacity and allowable soil pressure. (6 Marks)

(b)The applied load on a shallow square foundation make an angle of 15° with the vertical .Given B= 1.85m, D_f = 1.2m, Υ = 18.5 kN/m^3, ϕ = 30° , C= 26 kN/m^2. Use FS = 3. Determine the gross allowable load, use IS6403 recommendations. (8 Marks

12a). Explain Teng's equation for evaluating bearing capacity of shallow foundations. (4marks) b). A square footing 1.8mX1.8m is loaded with an axial load of 1800 kN and M_x =450kNm and M_y =360kNm,Given Φ=36°, depth of footing =1.8m, ϒ=18kN/m^3 WT at 6m below GL, determine net ultimate bearing capacity and factor of safety against shear failure. For Φ=36° take N_q=38 and $N_ϒ$=56.Use IS6403 recommendations and useful width concept (10marks)

Module – 2

13. (a) Explain the criteria regarding optimum spacing of piles. (4marks)

b). A group of piles has to support a vertical axial load of 2000 kN. The piles are driven into clay and have a length of 10.5 m. The thickness of the clay stratum is 15 m. The clay is followed by a rock. The saturated unit weight of clay is 19 kN/m^3 and its cohesion is 25 kN/m^2. The clay is normally consolidated and has a liquid limit of 60. Its specific gravity is 2.7. The water table is at the ground surface itself. Assuming the diameter of the piles as 300 mm, design a friction pile group. A factor of safety of 3 is required against shear failure. Compute its ultimate settlement.

(10marks)

14. (a) Explain evaluation of settlement of pile groups in sand (4marks)

(b) A concrete pile of 40 cm diameter is driven into a homogeneous mass of cohesion less soil. The pile carries a safe load of 650 kN. A static cone penetration test conducted at the site indicates an average value of q_c = 40 kN/m^2 along the pile and 12000 kN/m^2 below the pile tip. Compute the length of the pile with FS = 2.5. (10 Marks)

Module – 3

15. (a) Explain the load transfer mechanism of a belled pier in clay (4 Marks)

(b) Estimate the load carrying capacity of drilled pier whose shaft is 100 cm diameter for a length of 8m. The diameter is belled to 250 cm in a length of 4 m at the bottom. The top 10 m of the pier passes through submerged soft clay (γ_{sat} = 18 kN/m^3) with cohesion 20 kPa. The pier rests on dense sandy gravel with an angle of friction of 38°. The values of Nc, Nq and Nγ for 38° are 75, 80 and 50 respectively, ∞ =0.8. (10 Marks)

16. (a) Explain the advantages of an under reamed pile. (4 Marks)

(b)A single under reamed pile is installed in a soft clay deposit. The centres of the under ream is located at a depth of 15m from the ground surface. The diameters of the pile shaft and bulb are respectively 1m and 2.5m.determine the allowable load with a factor of safety of 2.5.The undrained shear strength of the soil obtained from the vane shear test is given by the relation Cu=65+7D where Cu is in kN/$m^2$and D is the depth in metres. Assume **α=1** (10 Marks)

Module – 4

21. (a) Differentiate between short and long piles. (4 Marks)

(b) A steel pipe pile of 61 cm outside diameter with 2.5 cm wall thickness is driven into saturated cohesive soil to a depth of 20 m. The undrained cohesive strength of the soil is 85 kPa. Calculate the ultimate lateral resistance of the pile by Broms' method with the load applied at ground level. (10 Marks)

22. (a) Sketch the deflection diagram of an elastic pile under lateral load (4 Marks)

(b) A reinforced concrete pile 50 cm square in section is driven into a medium dense sand to a depth of 20 m . The sand is in a submerged state. A lateral load of 50 kN is applied on the pile at a height of 5 m above the ground level. Compute the lateral deflection of the pile at ground level. Given: n_h = 15 MN/m^3, El = 1.15 x 10^3 kN-m^2. The submerged unit weight of the soil is 8. 75 kN/m^3. If the pile is fully restrained at the top, what is the deflection at ground level? (10Marks)

Module – 5

19 (a)Explain free earth analysis of anchored sheet pile walls. (4 Marks)

(b)A cantilever sheet pile is to be installed in cohesion less soil of unit weight 20kN/m^3 and φ = 30°. The height above dredge level is 6 m and water level above dredge level is 3 m. Estimate the depth of penetration needed for the sheet pile for stability. Find also the theoretical maximum bending moment in the pile (10marks)

20. (a)Explain any one method of method of vibration control. (6 Marks)

(b) Determine the natural frequency of a machine foundation of base area 2m × 2m and weight 150 kN, assuming that the soil mass participating in the vibration is 20% of the weight of foundation. Take Cu = 36,000 kN/m^3. (8 Marks)

22CEE 803.3	TRANSPORTATION PLANNING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	3	0	0	3	2019

Preamble

The course aims to introduce to the students the concept of transportation planning and impart in-depth knowledge on the four stage planning process and to highlight the need for sustainable transportation

Prerequisite: Nil

Course Outcomes: After the completion of the course the students will be able to

CO 1	Identify the need for transportation planning, the issues and challenges related to transportation and its interaction with urban structure and land use (K3)
CO 2	Apply the concept of travel demand and analyse its role in transportation planning and to apply the concept in systems approach to transportation planning process. (K3,K4)
CO 3	Apply the concept of delineation of study area, sampling of data, and data collection techniques for the four stage planning process and to analyse the techniques for predicting trip generation.(K3,K4)
CO 4	Apply and analyse the methods for predicting trip distribution, mode split and traffic assignment (K3, K4)
CO 5	Apply the land use transport models and to analyse the sustainable approaches to transportation planning and preparation of comprehensive mobility plan with application of GIS (K3, K4)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1		1	2	1		3	3	3				2
CO 2		1	2	2		2		1				2
CO 3	2	2	2	3	2	2		1				2
CO 4	3	3	3	3	3	2		1				2
CO 5	2	1	3	3	3	3	3	3		2	2	3

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (marks)
	Test 1 Marks	Test 2 Marks	
Remember	5	5	10
Understand	5	5	30
Apply	10	10	40
Analyse	5	5	20
Evaluate			
Create			

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern:

The question consists of two parts- Part A and Part B. Part A consists of 10 questions with 3marks each (two questions from each module). Part B consists of two questions from each module, out of which one has to be answered. Each question carries 14 marks and can have maximum 2 subdivisions.

Sample Course Level Assessment Questions:

Course Outcome 1 (CO1): Identify the issues and challenges in transportation.
Course Outcome 2 (CO2): Analyse the concept of travel demand in the context of consumer behaviour
Course Outcome 3 (CO3): Compare the various models for predicting trip generation
Course Outcome 4 (CO4): Discuss the assumptions involved in various route choice models.
Course Outcome 5 (CO5): Elaborate on the sustainable approaches to transportation planning

Syllabus- Transportation Planning

Module 1	**Need for transportation planning-** Characteristics of urban travel, Transportation issues and challenges**,**Detrimental effects of traffic on environment. **Urban Structure-** types and properties -centripetal, grid, linear, directional, Movement and Accessibility – Hierarchy of transportation facilities **Transportation and land use -** Role of urban activity analysis in transportation planning, Transportation impacts on activity system, Land use transportation interaction
Module 2	**Role of demand analysis in transportation planning-** Classification of urban transport demand and factors affecting demand, modelling based on consumer behavior of travel choices, Basic principles of travel demand analysis and assumptions. **Transportation planning process -**Systems approach, Elements/stages of transportation planning process - Goal, objectives and constraints, Trip-based and Activity-based approaches for transportation planning
Module 3	**Data collection** – Definition of study area, zoning- selection of cordon, Sampling techniques and sample size, Sources of data and types of surveys for planning, Evaluation of survey accuracy **Trip Generation**- Factors influencing grip generation, methods of forecasting trip generation rates- expansion factor, linear regression, category analysis
Module 4	**Trip Distribution**- Growth factor methods, Synthetic methods- Gravity models, opportunity model **Modal Split**- Factors influencing modal split, Types of mode split models – trip end, trip interchange, logit model **Traffic assignment**- Purpose, Elements of transportation networks- Nodes and links, Methods for traffic assignment
Module 5	**Land use models**- Selection of land use model, Lowry model-Structure, features, Model equation system **Sustainable transportation**- features, facilities, Transit oriented development, Non transport solutions to transport problems, Transportation demand management, Quick response techniques for demand estimation **Comprehensive Mobility Plan-** objectives and activities involved, Application of GIS in transport planning

Text Books:

1. Bruton,M.J.,IntroductiontoTransportationPlanning,HutchinsonofLondon
2. Chakraborthy,P and Das,A, Principles of Transportation Engineering
3. Hutchinson, B G, Principles of Urban Transport Systems Planning, McGraw Hill
4. Kadiyali, L.R, Traffic Engineering and Transport Planning, Khanna Publishers
5. Martin Rogers, Highway Engineering, Blackwell Science

References

1. Dickey, J. W. Metropolitan Transportation Planning, Tata McGrawHill
2. JotinKhisty, C, Transportation Engineering- An Introduction, Prentice Hall
3. Mayer, M.D and Miller, E .J, Urban Transportation Planning a Decision Oriented Approach, McGrawHill.
4. Garber,N. J and Hoel, L. A, Traffic and Highway Engineering, PWS Publishing
5. Papacostas, C. S. and Prevedouros, P.D., Transportation Engineering and Planning, Prentice Hall.
6. Newman, P. and Kenworthy, J, Sustainability and Cities – Overcoming Automobile Dependence, Washington DC: Island Press.

Course Content and lecture Schedule:

No.	Topic	Course Outcome	No. of Hrs
1	**Module 1**		**Total:7**
1.1	Introduction, Urban travel characteristics, issues and challenges, Detrimental effects of traffic on environment.	CO1	3
1.2	Urban Structure, Movement and Accessibility, Hierarchy of transportation facilities	CO1	3
1.3	Transportation and land use	CO1	1
2	**Module 2**		**Total: 8**
2.1	Urban transport demand, factors affecting demand, modelling based on consumer behaviour of travel choices	CO2	3
2.2	Basic principles of travel demand analysis and assumptions.	CO2	1
2.3	Systems approach to planning, Stages of transportation planning process	CO2	2
2.4	Trip-based and Activity-based approaches for transportation planning	CO2	2
3	**Module 3**		**Total: 7**
3.1	Selection of study area, zoning	CO3	1
3.2	Sampling techniques	CO3	2
3.3	Data collection methods	CO3	2
3.4	Trip Generation	CO3	2
4	**Module 4**		**Total: 7**
4.1	Trip Distribution	CO4	3
4.2	Modal Split	CO4	2
4.3	Traffic assignment	CO4	2
5	**Module 5**		**Total: 6**
5.1	Land use models	CO5	2
5.2	Comprehensive Mobility Plan	CO5	2
5.3	Sustainable transportation, Transport Demand Management, Quick response techniques	CO5	2

Model Question Paper

EIGHT SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR
Course Code: **22CEE803.3**
Course Name: **TRANSPORTATION PLANNING**

Max. Marks:100 Duration: 3 hrs

PART A
(Answer all Questions: Each question carries 3 marks)

1 What are the issues and challenges in transportation?
2 How transportation and land use are interrelated?
3 List the broad categories of urban demand classification.
4 Distinguish between goals and objectives in transport planning.
5 List out the need for sampling of data.
6 What are the three basic factors which affects trip generation?
7 What are the assumptions in growth factor models?
8 What are diversion curves?
9 What are the criteria for selection of land use transport model?
10 What is the importance of sustainable transportation?

(3 x 10=30 marks)

PART B
(Answer one full question from each module)

11	a.	Draw the directional type urban structure and state its characteristics.	10
	b.	What are the characteristics of urban travel?	4
		OR	
12	a.	Discuss the impacts of transportation on environment.	10
	b.	Distinguish between movement and accessibility.	4
13	a.	Discuss the factors affecting travel demand.	7
	b.	What are the basic principles and assumptions in demand analysis?	7
		OR	

14		Discuss the various stages in the transportation planning process with a flow chart.	14
15	a.	Discuss the various sampling techniques and their suitability.	10
	b.	How can you estimate trip generation by expansion factor?	4

OR

16	a.	Compare the multiple regression analysis and category analysis for predicting trip generation.	10
	b.	What are the assumptions made in Multiple Linear Regression analysis?	4
17	a.	What is the concept behind Gravity model? Explain the step by step procedure for the calibration of Gravity model.	10
	b.	Explain the capacity restraint assignment technique.	4

OR

18	a.	Estimate the future trip matrix by Furness method if the present trip matrix and future trip production/ attraction are as follows.	10

Origin	Destination				Future trip production
	A	B	C	D	
A	8	3	8	10	32
B	5	8	9	6	42
C	15	16	3	8	147
D	12	7	4	2	30
Future trip attraction	68	24	39	120	

	b.	Compare trip interchange and trip end mode split models.	4
19	a.	Illustrate the Lowry model structure.	7
	b.	What are the objectives of comprehensive mobility plan?	7

OR

20	a.	Discuss how transport demand management measures can reduce congestion.	8
	b.	Discuss briefly the quick response techniques for travel demand estimation.	6

Code	Course Name	Category	L	T	P	Credit	Year of Introduction
22 CEE 803.4	**INFORMATICS FOR INFRASTRUCTURE MANAGEMENT**	**PEC**	**3**	**0**	**0**	**3**	**2019**

Preamble: This course is aimed at exposing the students to the scope of Informatics and Internet of Things (IoT) in Civil Engineering. It introduces students to the fundamentals of data analytics, informatics &IoT as it is applicable to civil engineering field. After this course, students will be in a position to appreciate the use of informatics & IoT in civil engineering projects and follow the future developments in this sector.

Prerequisite: NIL

Course Outcomes:

After the completion of the course the students will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO 1	Explain the fundamental concepts of data science, informatics & internet of things	Remembering, Understanding
CO 2	Identify the use of geomatics in planning and site selection of infrastructure projects	Applying & Analysing
CO 3	Apply building informatics in construction, monitoring and project management	Applying& Analysing
CO4	Utilize IoT technology in infrastructure management	Applying& Analysing

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	-	-	-	2	-	-	-	-	-	-	2
CO 3	2	-	-	-	2	-	-	-	-	-	-	2
CO4	2	-	-	-	2	-	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	15
Understand	10	10	15
Apply	15	15	35
Analyse	15	15	35
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

Course Outcome 1 (CO1): *Explain the fundamental concepts of data science, informatics & internet of things.*

1. Explain DIKW pyramid.
2. Explain the data mining techniques
3. Discuss different data models
4. Discuss the vector data analysis techniques
5. Explain COBie standard
6. List IoT protocols
7. What are the elements of BIM?

Course Outcome 2 (CO2): *Identify the use of geomatics for planning and site selection of infrastructure projects.*

1. Discuss how geomatics help in site selection of a solid waste management facility
2. Discuss how terrain modeling is an important geographic information for project planning

Course Outcome 3 (CO3): *Apply building informatics in construction, monitoring and project management.*

1. How BIM helps inreducing the cost of construction?
2. Discuss the steps in developing a BIM for an infrastructure project.

Course Outcome 4 (CO4): *Utilize IoT technology in infrastructure management.*

1. How a water supply system could benefit by IoT technology?
2. Monitoring infrastructure projects could leverage from IoT technologies! Discuss.

Syllabus

Module 1 Data to Information

History of informatics, DIKW pyramid, data management- data types, Meta data, database management systems; Data analysis techniques-spatial and non-spatial data, trends and patterns

Module 2 Geoinformatics

Fundamental concepts in Geo-informatics- Components, Spatial data and attributes, vector and raster data models, Vector data analysis-buffering, overlay; Raster data analysis- local operations, neighborhood operations, zonal operations

Module 3 Planning and Site selection

Application of geoinformatic systems:
Site suitability analysis- Residential area, Industrial area and a Reservoir
Zoning- Ground water potential zonation, Hazard zonation
Network Analysis- Water supply line, Power line and a Road network

Module 4 Building Informatics

Building Information Modelling- Definition, Elements of BIM, steps in BIM development, COBie standard, potential and applications of BIM

Module 5 Internet of Things (IoT) in Civil Infrastructure

IoT Standards& Protocols, Concept of IoT in civil engineering- Applications in construction, product monitoring and project Management
Management Applications- Traffic Regulation, Water Supply and Smart Buildings

Text Books

1. J. Campbell, Essentials of Geographic Information Systems, Saylor Foundation, 2011.
2. RamezElmasri, ShamkantB.Navathe, "Fundamental of Database Systems", Pearson Addison Wesley, 2003.
3. BIM Handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers, Publisher: John Wiley & Sons; 2nd edition (1 July 2011), Language: English, ISBN-10: 9780470541371

Reference Books

1. Raja R. A. Issa and Svetlana Olbina,Building Information Modeling: Applications and Practices, ASCE, 2015.
2. Samuel Greengard, The internet of things, The MIT Press Essential Knowledge Series, 2015, ISBN: 978-0-262-52773-6.
3. ShashiShekhar and Sanjay Chawla,"Spatial Databases:A Tour", Prentice Hall, 2003.

4. Building Information Modeling: BIM in Current and Future Practice, Publisher: John Wiley & Sons; 1 edition (15 August 2014), Language: English, ISBN-10: 9781118766309

Lecture Plan – Informatics for Infrastructure Management

Module	*Topic*	*Course outcomes addressed*	*No. of Lectures*
1	**Module I : Total lecture hours : 7**		
1.1	History of informatics	CO1	Lecture 1
1.2	DIKW pyramid& Meta data	CO1	Lecture 2
1.3	Data management	CO1	Lecture 3
1.4	Data types & Meta data	CO1	Lecture 4
1.5	Database management systems	CO1	Lecture 5
1.6	Data analysis techniques	CO1	Lecture 6
1.7	Trends & Patterns in data analysis	CO1	Lecture 7
2	**Module II : Total lecture hours : 7**		
2.1	Fundamental concepts in Geo-informatics-	CO1	Lecture 1
2.2	Components of GIS	CO1	Lecture 2
2.3	Spatial data and attributes	CO1	Lecture 3
2.4	Data models- vector & raster	CO1	Lecture 4
2.5	Vector data analysis	CO1	Lecture 5
2.6	Raster data analysis- local & neighbourhood analysis	CO1	Lecture 6
2.7	Raster data analysis- zonal analysis	CO1	Lecture 7
3	**Module III : Total lecture hours : 7**		
3.1	Site suitability analysis for Residential area	CO2	Lecture 1
3.2	Site suitability analysis for Industrial area	CO2	Lecture 2
3.3	Site suitability analysis for reservoir	CO2	Lecture 3
3.4	Ground water potential zonation& Hazard zonation mapping	CO2	Lecture 4
3.5	Network analysis for water supply	CO2	Lecture 5
3.6	Network analysis for power line	CO2	Lecture 6

3.7	Network analysis for road network	CO2	Lecture 7
4	**Module IV : Total lecture hours : 7**		
4.1	Building Information Modelling- Definition	CO3	Lecture 1
4.2	Elements of BIM	CO3	Lecture 2& 3
4.3	Steps in BIM development	CO3	Lecture 4 & 5
4.4	COBie standard	CO3	Lecture 6
4.5	Potential & applications of BIM	CO3	Lecture 7
5	**Module V : Total lecture hours : 7**		
5.1	IoT Standards & Protocols, Concept of IoT in civil engineering	CO4	Lecture 1
5.2	Application of IoT in construction, product monitoring & project management	CO4	Lecture 2,3 & 4
5.3	Management applications of IoT- Traffic, water supply, smar buildings	CO4	Lecture5,6 & 7

Model Question Paper

QP CODE:

Reg No.:_______________ **Name:__________________________**

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22CEE803.4
Course Name: INFORMATICS FOR INFRASTRUCTURE MANAGEMENT

Max. Marks: 100 Duration: 3 hours

Part A
(***Answer all questions; each question carries 3 marks***)

26. Explain different data types.
27. Explain DIKW pyramid.
28. Compare vector & raster model.
29. What are the components of GIS?
30. Explain network analysis.
31. What is the importance of terrain modeling?
32. Define BIM.
33. What is COBie standard?
34. List the IoT protocols.
35. Explain the concept of smart buildings.

PART B
(Answer one full question from each module, each question carries 14 marks)

36. (a) Discuss data analysis techniques for spatial data. (5 Marks)
    (b) Explain the steps in processing data into information. (9 Marks)

OR

37. (a) Briefly describe the history of informatics (5 Marks)
    (b) Explain various data analysis techniques. (9 Marks)

38. (a) Discuss various components of GIS (5 Marks)
    (b) Explain various vector analysis techniques. (9 Marks)

OR

39. (a) Explain buffering analysis. What is its application? (5 Marks)

(b) Explain various raster data analysis techniques. (9 Marks)

40. (a) How the site suitability analysis is carried out for a reservoir? (7 Marks)

(b) Explain how geomatics is useful for mapping hazard zones. (7 Marks)

OR

16. (a) Explain the methodology for road network analysis. (7 Marks)

(b) Explain the process of converting data to information for a industrial area selection. (7 Marks)

23. (a) What are the applications of BIM? (5 Marks)

(b) Discuss the steps in developing a BIM for an infrastructure project.(9 marks)

OR

24. (a) Explain the elements of BIM. (5 Marks)

(b) How BIM helps in reducing the cost of construction? (9 Marks)

25. (a) What sensors & devices would help in monitoring water distribution network. (5 Marks)

(b) Infrastructure management could leverage from IoT technologies! Discuss. (9 Marks)

OR

26. (a) What are the selection criteria for sensors & devices used in IoT technologies. (7 Marks)

(b) Discuss how IoT technologies could help in traffic management. (7 Marks)

22 CEE 803.5	REPAIR AND REHABILITATION OF BUILDINGS	Category	L	T	P	Credit	Year of Introduction
		PEC	3	0	0	3	2019

Preamble :

Repair and Rehabilitation of Buildings is an elective course in the study of construction engineering.The course provides basic idea and needs of maintenance, repair , rehabilitation and strengthening measures of building structures and helps students to identify various deterioration mechanisms or damage mechanisms in buildings . The course introduces both scientific aspects and its practical applications at the site. Various non-destructive techniques and semi destructive techniques are introduced in this course, for damage diagnosis and assessment of a structure at the site. Severalpractices for maintenance and rehabilitation like surface repair, corrosion protection, structural strengthening and stabilization, etc. are discussed in details. At the end of the course students will be able to suggest evaluation and repair/maintenace methods for extending the service life of buildings.

Prerequisite : CET 303 Design of Concrete Structures

Course Outcomes: After the completion of the course the student will be able to

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Recall the basics ideas and theories associated withConcrete technology and Masonry structures.	Remembering
CO2	Understand the need and methodology of repair and rehabilitation of structures, the various mechanisms used, and tools for diagnosis of structures	Understanding
CO3	Identifying the criterions for repairing / maintenanceand the types and properties of repair materials used in site. Learn various techniques for repairing dam- aged and corroded structures	Understanding
CO4	Proposing wholesum solutions for maintenance/re-habilitation and applying methodologies for repair- ing structures or demolishing structures.	Applying
CO5	Analyse and asses the damage to structures usingvarious tests	Analysing

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1											
CO2	3	2		2								
CO3	3	2	3		3	2	1					
CO4	3			1	3	2	1					
CO5	3	2	2	1	2		2					

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	40
Apply	10	10	20
Evaluate			
Analyse	10	10	30
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10
Continuous Assessment Test (2 numbers) : 25
marksAssignment/Quiz/Course project : 15

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marksand can have maximum 2 sub-divisions.

Course Level Assessment (Sample) Questions

CO1: Recall the basics ideas and theories associated with Concrete technology and Masonry structures.

1. Discuss in details thermal properties of concrete
2. Discuss in detail the quality assurance for Concrete Construction
3. Write a brief note on permeability concrete
4. What are the factors affecting the durability of concrete?
5. Write a short note on effect of cover thickness?

CO2: Understand the need and methodology of repair and rehabilitation of structures, the various mechanisms used ,and tools for diagnosis of structures

1. What is underpinning?
2. Discuss the step by step procedure for epoxy injection to repair cracks in concrete
3. Briefly explain the various types of corrosion inhibitors
4. Enlist Strengthening Techniques and discuss the factors affecting strengthening methods
5. In which situation self compacting concrete is desirable?

CO3: Identifying the criterions for repairing / maintenance and the types and properties of repair materials used in site. Learn various techniques for repairing damaged and corrodedstructures

1. How do you classify maintenance of a structure?
2. What is overlay?
3. Elucidate Cathodic Protection of Steel Concrete?

CO4: Proposing wholesum solutions for maintenance/rehabilitation and applying methodologiesfor repairing structures or demolishing structures.

1. How can you develop a demolition strategy?
2. Describe a detailed assessment procedure for evaluating a damaged structure using a flow chart
3. How do you repair and rehabilitate a structure distressed due to fire.

CO5: Analyse and asses the damage to structures using various tests

1. Explain any three Non Destructive Tests used to test the strength of Concrete
2. What are partial destructive tests. Explain any one of them.
3. With a graph explain the service life behaviour of a concrete structure. Also explain in detail about time based maintenance.

SYLLABUS

Module 1

Introduction - Maintenance, rehabilitation, repair, retrofit and strengthening, need for rehabilitation of structures. Cracks in R.C. buildings - Various cracks in R.C. buildings, causes and effects Damagesto masonry structures - Various damages to masonry structures and causes

Module 2

Damage diagnosis and assessment - Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, Visual inspection, Non Destructive Testing using Rebound hammer,Ultra sonic pulse velocity, Semi destructive testing, Probe test, Pull out test, Chloride penetration test,Carbonation, Carbonation depth testing, Corrosion activity measurement, Core test, Load test.

Module 3

Strength and Durability of Concrete - Quality assurance for concrete – Strength, Durability and Thermal properties of concrete – Effects due to climate, temperature, Sustained elevated temperature,Corrosion - effects of cover thickness. Substrate preparation - Importance of substrate/surfacepreparation, General surface preparation methods and procedure, reinforcing steel cleaning.

Module 4

Maintenance - Maintenance importance of maintenance, routine and preventive maintenance. Repair materials -Various repair materials, Criteria for material selection, Methodology of selection,Health and Safety precautions for handling and applications of repair materials.

Special mortars and concretes- Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self compacting concrete, Self-healing concrete, Geopolymer concrete, Reactive powder concrete, Concrete made withindustrial wastes, Polymer Concrete and Mortar, Quick setting compounds, Gunite and Shotcrete, Expansive cement, Ferro cement, Concrete chemicals.

Grouting materials - Gas forming grouts, Salfoaluminate grouts, Polymer grouts, Acrylate and Urethane grouts.

Bonding agents - Latex emulsions, Epoxy bonding agents.

Protective coatings - Protective coatings for Concrete and Steel.FRP sheets

Module 5

Crack repair - Various methods of crack repair, Grouting, Routing and sealing, Stitching, Dry packing,Autogenous healing, Overlays, Repair to active cracks, Repair to dormant cracks.

Corrosion of embedded steel in concrete - Corrosion of embedded steel in concrete, Mechanism, Stages ofcorrosion damage, Repair of various corrosion damaged of structural elements (slab, beam and columns) , Cathodic protection.

Jacketing - Jacketing, Column jacketing, Beam jacketing, Beam Column joint jacketing, Reinforced concrete jackets, Steel jacketing, FRP jacketing.

Strengthening - Strengthening of Structural elements, fire, Leakage, earthquake, Epoxy injection, Shoring, Underpinning.

Demolition Techniques - Non-explosive demolition, and Explosive demolition, engineered demolitiontechniques for dilapidated structures - Wrecking Ball Method, Concrete Sawing Method, Top down method, Hydraulic crusher, Implosion by delayed detonation technique

Text Books:

1. Concrete repair and maintenance Illustrated by Peter.H.Emmons, Galgotia publications Pvt. Ltd.,2001.
2. Repair and protection of concrete structures by Noel P.Mailvaganam, CRC Press, 1991.
3. "Earthquake resistant design of structures" by Pankaj agarwal, Manish shrikande, PHI, 2006.
4. "Concrete Structures, Materials, Maintenance and Repair", Denison Campbell, Allen and HaroldRoper, Longman Scientific and Technical UK, 1991.
5. Repair of Concrete Structures, Allen R.T. & Edwards S.C, Blakie and Sons, UK, 1987

References:

1. Failures and repair of concrete structures by S.Champion, John Wiley and Sons, 1961.
2. Diagnosis and treatment of structures in distress by R.N.Raikar Published by R & D Centre ofStructural Designers and Consultants Pvt.Ltd, Mumbai.
3. Handbook on repair and rehabilitation of RCC buildings, CPWD, Government of India.
4. Handbook on seismic retrofit of buildings, A. Chakrabarti et.al., Narosa Publishing House, 2010
5. "Concrete Technology – Theory and Practice", ShettyM.S., S.Chand and Company, 2008.
6. "Design and Construction Failures", Dov Kominetzky.M.S., Galgotia Publications Pvt. Ltd., 2001
7. "Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Ravishankar.K.,Krishnamoorthy.T.S, Allied Publishers, 2004.
8. Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, NarosaPublishers, 2008.
9. "Concrete Technology", Gambhir.M.L., McGraw Hill, 2013
10. "Self-Healing Concrete", David J. Fisher, Materials Research Forum LLC, 20-May-2021
11. "Demolition: Practices, Technology, and Management", Richard J. Diven, Mark Shaurette, 2011

Lecture Plan - Repair and Rehabilitation of Buildings

Module	*Topic Cours e*	*Course Outcomes Addressed*	*No. of Lectures*
1	**Module I : Total lecture hours : 6**		
1.1	Introduction - Maintenance, rehabilitation,repair, retrofit and strengthening, need for rehabilitation of structures	CO1 , CO2	1
1.2	Cracks in R.C. buildings - Various cracks in R.C.buildings, causes and effects	CO2	2
1.3	Damages to masonry structures - Various damages to masonry structures and causes	CO1	3
2	**Module II : Total lecture hours : 8**		
2.1	Damage diagnosis and assessment - Various aspects of Inspection, Assessment procedure forevaluating a damaged structure	CO2 , CO4, CO5	2
2.2	Visual inspection, Non Destructive Testing usingRebound hammer, Ultra sonic pulse velocity,	CO2 ,CO4	2
2.3	Semi destructive testing , Probe test, Pull outtest, Chloride penetration test, Carbonation,	CO2, CO4	2
2.4	Carbonation depth testing, Corrosion activitymeasurement, Core test, Load test.	CO2 , CO4	2
3	**Module III : Total lecture hours : 7**		

3.1	Strength and Durability of Concrete - Quality assurance for concrete – Strength, Durability andThermal properties of concrete	CO1 , CO3	1
3.2	Effects due to climate, temperature, Sustainedelevated temperature, Corrosion - effects of cover thickness.	CO2 , CO3, CO4	2
3.3	Substrate preparation - Importance of substrate/surface preparation,	CO2	2
3.4	General surface preparation methods andprocedure, reinforcing steel cleaning.	CO3 , CO5	2
4	**Module IV : Total lecture hours : 7**		
4.1	Maintenance - Maintenance importanceof maintenance, routine and preventive maintenance.	CO2,CO4	1
4.2	Repair materials -Various repair materials, Criteria for material selection, Methodology ofSelection	CO2,CO1	1
4.3	Health and safety precautions for handling andapplications of repair materials	CO2, CO3	1

4.4	Special mortars and concretes- Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete,	CO1, CO2	1
4.5	High performance concrete, Vacuum concrete, Self compacting concrete, Self-healing concrete, Geopolymer concrete, Reactive powder concrete,	CO2, CO5	1
4.6	Concrete made with industrial wastes, Polymer Concrete and Mortar, Quick setting compounds,Gunite and Shotcrete, Expansive cement, Ferro cement, Concrete chemicals.	CO1, CO2, CO4	1
4.7	Grouting materials - Gas forming grouts, Salfoaluminate grouts, Polymer grouts, Acrylateand Urethane grouts. Bonding agents - Latex emulsions, Epoxy bonding agents. Protective coatings - Protective coatings for Concrete and Steel. FRP sheets	CO2, CO1	1
5	**Module V : Total lecture hours : 7**		
5.1	Crack repair - Various methods of crack repair, Grouting, Routing and sealing, Stitching, Dry packing, Autogenous healing, Overlays, Repair toactive cracks, Repair to dormant cracks.	CO2, CO3	1
5.2	Corrosion of embedded steel in concrete - Corrosion of embedded steel in concrete, Mechanism, Stages ofcorrosion damage, Repairof various corrosion damaged of structural elements (slab, beam and columns) , Cathodic protection.	CO1,CO2	1
5.3	Jacketing - Jacketing, Column jacketing, Beam jacketing, Beam Column joint jacketing, Reinforced concrete jackets, Steel jacketing, FRPjacketing.	CO2, CO5	1
5.4	Strengthening - Strengthening of Structural elements, fire, Leakage, earthquake, Epoxy injection, Shoring, Underpinning.	CO2, CO1	1
5.5	Demolition Techniques - Non-explosive demolition, and Explosive demolition,	CO2, CO1	1
5.6	Engineered demolition techniques for dilapidated structures - Wrecking Ball Method,Concrete Sawing Method, Top down method, Hydraulic crusher, Implosion by delayed detonation technique.	CO2, CO4, CO5	2

Model Question Paper

EIGHTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22 CEE 803.5

Course Name: REPAIR AND REHABILITATION OF BUILDINGS

Marks : 100 Duration : 3 hrs

PART A

(Answer all Questions. Each Question carries 3 Marks)

1. What is Inspection and Mention its purpose?
2. What is the difference between maintenance and rehabilitation of structures ?
3. List any three causes of detrioration of structures ?
4. State the properties of Corrossion Inhibitors ?
5. List four engineered demolition techniques for RCC structures ?
6. List two methods of retrofitting of concrete structures subjected to leakage ?
7. What is Shoring and state its purpose?
8. Define Durability and name two tests to assess durability.
9. Mention a salient feature and application of polymer concrete.
10. List the types of Polymer Concrete

PART B

(Answer one full question from each module, Each question carries 14 marks)

Module 1

11. What are the types of Cracks in R.C.C buildings . Explain the causes and effects .

OR

12. Explain the service life behaviour of a concrete structure with a Graph. Also explain in detailabout time based maintenance.

Module 2

13. Explain the following Non Destructive Testing techniques in detail as per IS
    i) Rebound Hammer Test
    ii) Ultrasonic Pulse Velocity

OR

14. Explain the following Testing techniques in detail as per IS
    i) Semi destructive testing
    ii) Probe test
    iii) Pull out test
    iv) Chloride penetration test

Module 3

15. Discuss the effects of temperature and climate on concrete structures

OR

16. Discuss in detail the quality assurance for Concrete Construction

Module 4

17. (a) Explain carbonation of concrete in detail.(b)Write a brief note on Ferrocement

OR

18. (a)Write short note on expansive cement
(b) Definie alkali aggregate reaction, explain causes and preventive measures of alkali aggregatereaction

Module 5

19. Discuss the implosion method of demolition of Structures .

OR

20. How do you repair and rehabilitate a structure damaged due to fire.

22 CEE 803.6	ENVIRONMENTAL REMOTE SENSING	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PEC	3	0	0	3	2019

Preamble

This course introduces students to the concepts of remote sensing and its applications in environmental monitoring. They will learn basic terminology and physics of remote sensing, characteristics of sensors and image processing fundamentals. The students will also explore how satellite based remote sensing play a significant role in monitoring land, vegetation, soil, air and water resources.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Describe the physics of remote sensing	Remembering
CO2	Explain the concepts of image processing	Understanding
CO3	Explain existing technologies, data products and algorithms useful in environmental remote sensing	Understanding
CO4	Show the role of remote sensing in monitoring land, vegetation, soil, air and water	Applying

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	3	-	-	-	-	-	-	-
CO 2	3	-	-	-	3	-	-	-	-	-	-	-
CO 3	3	-	-	-	3	-	-	-	-	-	-	-
CO4	3	-	-	-	3	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	25
Understand	10	10	25
Apply	30	30	50
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Course Level Assessment Questions

CO1: Describe the physics of remote sensing

1.What are atmospheric windows?

2. How spectral signatures are useful in classifying land surface features?

3. Compare active and passive remote sensing.

CO2: Explain the concepts of image processing

1. What are False Colour Composites?

2. Explain the geometric corrections applied on satellite images.

3. What are the elements of visual image interpretation?

CO3: Explain existing technologies, data products and algorithms useful in environmental remote sensing

1. Explain the use of LIDAR for monitoring atmospheric profiles.

2. Discuss the capabilities of any 3 satellite sensors.

3. Explain the levels in satellite data products.

CO4 Show the role of remote sensing in monitoring land, vegetation, soil, air and water

1. What are vegetation indices? How these indices are useful in environmental monitoring?

2. What is aerosol optical depth? How they are used in air quality monitoring?

3. How oil spills are detected using satellite remote sensing?

SYLLABUS

Module 1

Physics of remote sensing, interaction of earth surface features with electromagnetic radiations, atmospheric windows, effects of atmosphere, spectral signatures

Types of remote sensing, active and passive measurements, platform characteristics, satellite orbits, some popular satellite sensors-Landsat, MODIS, Sentinel, SCATSAT and INSAT 3D R

Module 2

Sensor characteristics-spatial, temporal, spectral, radiometric resolutions, principles of image processing, methods of encoding image data-BIL, BIP, BSQ, False Color Composite (FCC), elements of visual image interpretation, image correction techniques- atmospheric, geometric and radiometric, principles of photogrammetry, algorithms and data products

Module 3

Remote sensing of land, soil and vegetation: Analysis of land surface biophysical properties, land surface temperature, classification of land use and land cover-supervised and unsupervised techniques, change detection, development of terrain models-DEM &DTM, soil type and soil moisture monitoring, vegetation indices, classification of vegetation using satellite data, detection of biomass burning

Module 4

Atmospheric remote sensing: Interaction of EM radiations with aerosols and gases- scattering, absorption and extinction, radiative transfer models and retrieval algorithms, aerosol optical depth, air quality monitoring using satellite data, LIDAR measurement of atmospheric profiles, meteorological monitoring and forecast

Module 5

Remote sensing of water resources: Mapping water resources- surface and groundwater, watershed health assessment, water quality monitoring, flood monitoring, ocean monitoring, aquatic biodiversity mapping, oil spill detection

Text Books:

1. Lillesand T.M. and Kiefer R.W., Remote sensing and image interpretation, Second Edition, John Wiley and Sons, 1987.
2. George Joseph and Jeganathan C., Fundamentals of remote sensing, 3rd Edition, University Press

References:

1. Manual of Remote Sensing, American Society of Photogrammetry and Remote Sensing, 1993.
2. Paul Curran P.J., Principles of Remote Sensing, ELBS, 1983.
3. Sabins F.F. Jr., Remote Sensing Principles and Interpretation, W.II. Freeman and Company, 1978.
4. Martin, R.V., Satellite remote sensing of air quality, Atmospheric Environment, Vol 42(34), pp 7823-7843, 2008.
5. Hamlyn G Jones and Robin A Voughan, Remote sensing of vegetation: Principles, Techniques, and applications, Oxford University Press, 2010.
6. Seelye Martin, An introduction to ocean remote sensing, Cambridge University Press, 2014
7. Ravi Sankar Dwivedi, Remote sensing of soils, Springer, 1st Edition, 2017.
8. Prasad S., and Thenkabail, Remote sensing of water resources, disasters and urban studies, CRC Press, 2019.

Lecture Plan- Environmental Remote Sensing

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module 1: Total Lecture Hours -7**		
1.1	Physics of remote sensing, interaction of earth surface features with electromagnetic radiations	CO1	2
1.2	atmospheric windows, effects of atmosphere, spectral signatures	CO1	2
1.3	Types of remote sensing, active and passive measurements	CO1	1
1.4	Platform characteristics, satellite orbits	CO1	1
1.5	Some popular satellite sensors-Landsat, MODIS, Sentinel, SCATSAT and INSAT3D R	CO3	1
2	**Module II: Total Lecture Hours- 7**		
2.1	Sensor characteristics-spatial, temporal, spectral, radiometric resolutions	CO2	1
2.2	Principles of image processing, methods of encoding image data-BIL, BIP, BSQ, False Color Composite (FCC),	CO2	2
2.3	Elements of visual image interpretation	CO2	1
2.4	Image correction techniques- atmospheric, geometric and radiometric, Principles of photogrammetry	CO2	2
2.5	Algorithms and data products	CO3	1
3	**Module III: Total Lecture Hours-7**		
3.1	Analysis of land surface biophysical properties, land surface temperature, classification of land-use and land cover-supervised and unsupervised techniques, change detection	CO4	3
3.2	Development of terrain models-DEM &DTM	CO4	1
3.3	Soil type and soil moisture monitoring	CO4	1
3.4	Vegetation indices, classification of vegetation using satellite data	CO4	1
3.5	Detection of biomass burning	CO4	1
4	**Module IV: Total Lecture Hours- 7**		
4.1	Interaction of EM radiations with aerosols and gases- scattering, absorption and extinction	CO4	1

4.2	Radiative transfer models and retrieval algorithms	CO3	2
4.3	Aerosol optical depth, air quality monitoring using satellite data	CO4	2
4.4	LIDAR measurement of atmospheric profiles	CO3	1
4.5	Meteorological monitoring and forecast	CO4	1
5	**Module V: Total Lecture Hours- 7**		
5.1	Mapping water resources- surface and groundwater	CO4	1
5.2	Watershed health assessment, water quality monitoring, flood monitoring	CO4	3
5.3	Ocean monitoring, aquatic biodiversity mapping	CO4	2
5.4	Oil spill detection	CO4	1

Model Question Paper

Reg No.:_______________ **Name:__________________________**

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: 22 CEE 803.6
Course Name: ENVIRONMENTAL REMOTE SENSING

Max. Marks: 100 Duration: 3 Hours

Part A
(***Answer all questions; each question carries 3 marks***)

41. What are atmospheric windows?
42. How spectral signature is useful in remote sensing?
43. Explain False Colour Composite image.
44. What is sensor revisit time?
45. What is NDVI?
46. Explain how land use changes can be detected through remote sensing.
47. What is aerosol optical depth?
48. How wind scatterometers work?
49. Explain principle of groundwater remote sensing.
50. How oil slick thickness is monitored by remote sensing?

PART B
(Answer one full question from each module, each question carries 14 marks)

51. (a) Discuss in detail types of satellite sensors. Name any three operational satellite sensors and describe which type they are. (9 Marks)
    (b) Explain the effects of atmosphere on remote sensing data. (5 Marks)

OR

52. (a) Compare active and passive remote sensing. (5 Marks)
    (b) Discuss various types of platforms used in remote sensing. (5 Marks)
    (c) Explain types of satellite sensors based on the orbit. (4 marks)

53. (a) Discuss various sensor parameters. (9 Marks)
    (c) What is BIP format? (5 Marks)

OR

54. (a) Discuss various correction techniques applied to a satellite imagery. (9 Marks)
    (b) What is a data product? (5 Marks)

55. (a) Explain the techniques for classification of land use data. (9 Marks)
    (b) How soil moisture is detected in satellite remote sensing? (5Marks)

OR

16. (a) How fire pixels detection algorithms work? (7 Marks)
    (b) What is DEM? How is it developed? (7 Marks)

27. (a) Aerosol optical depth may not be a suitable surrogate for surface level particulate pollution. Discuss (5 Marks)
    (b) Explain the principle of wind measurement using satellite sensors. (5 Marks)
    (c) Weather forecasts have become more reliable with the availability of satellite sensors. Discuss. (4 Marks)

OR

28. (a)Discuss the challenges and opportunities in air quality remote sensing. (9 Marks)
    (b)How LIDARs are useful in air quality monitoring? (5 Marks)

29. (a) Discuss how health of a watershed can be assessed through remote sensing. (8 Marks)
    (b) Explain the principle of remote sensing of water quality. (6 Marks)

OR

30. (a) Explain how remote sensing is useful in flood monitoring. (7 Marks)
    (b) Discuss how remote sensing play a significant role in ocean monitoring. (7 Marks)

22 CEE 803.7	BUILDING SERVICES	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	3	0	0	3	2019

Preamble: The course aims to provide a basic understanding about the various building services and enable the students to apply them in building planning and construction

Pre-requisite: CET 304 Environmental Engineering

Course outcomes

After the completion of the course, the student will be able to

Course outcome	Description
CO 1	Recommend appropriate water management services
CO 2	Develop a system for the management of waste
CO 3	Identify suitable electrical and mechanical building services
CO 4	Recall the various firefighting services
CO 5	Choose relevant materials and practices for good acoustics
CO 6	Propose sustainable construction materials, methods, and practices

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1				2				1	
CO2	2	3	1				1				1	
CO3	2											
CO4	2					2						
CO5	3	3									3	
CO6	2					2	3				2	

Assessment pattern:

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (Marks)**
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	15	20
Understand	15	20	20
Apply	10	10	40
Analyse	5	5	10
Evaluate	5		5
Create	5		5

Mark distribution

Total marks	CIE	ESE	ESE Duration
150	50	100	3 Hrs

Continuous Internal Evaluation Pattern:

Attendance: 10 Marks
Continuous Assessment Test (2 numbers): 25 Marks
Assignment/Quiz/Course project: 15 Marks

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one question completely. Each question can have maximum 2 sub-divisions and carry 14 marks.

SYLLABUS

Module I

Water management services
Pipes for water distribution, joints, fixtures and valves, water meters, etc. - Water storage tanks: capacity and location - water purifiers
Terminology such as flow, pressure, head, etc. - principles of water supply in buildings (low-rise, multi-storeyed)
Rain water Harvesting - roof top harvesting, type of spouts, sizes of rainwater pipes, methods of rain water harvesting – harvesting tanks and pit - typical details

Module II

Liquid and solid waste management services
Types of traps and chambers: inspection chamber, disconnecting chamber, intercepting trap, S-trap, P-trap, gully trap, grease trap - sanitary fixtures: washbasins, WCs, bathtubs, urinals, flushing cistern - Types of pipes and joints.
Design principles of sanitary layout: location and ventilation of chambers, traps, fixtures - Building sanitation systems: separate, combined, single stack, one pipe and two pipe - On-site treatment: Septic tanks, Soak pits, Cess pools, dispersion trenches – decentralized treatment systems for multi-storeyed buildings (theory only, no design) - recycling grey water: practices
Solid waste quantity, Types and composition, characteristics, on-site processing and disposal methods

Module III

Electrical and Mechanical services

Electrical installations and Accessories of wiring (terminologies and symbols only), Systems of wiring, Electrical layout for residence, small workshop, show room, school building, etc.
Air Conditioning: Types of Air Conditioners, (Central type, Window Type, Split Unit), capacity selection of air conditioner
Lift: Definition, Types of Lifts, Location, Sizes, Component parts - Elevators & Escalators: Different types of elevators and Escalators, Freight elevators, Passenger elevators, Hospital elevators - Uses of different types of elevators – Escalators – Dumbwaiters: Types and uses - Conveyors: Types and uses.
Pumps – Types, Selection, installation, and maintenance

Module IV

Fire and Acoustic management services

Causes and Effects of fire, General Requirements of Fire Resisting building as per IS and NBC 2005, Characteristics of Fire resisting materials, Maximum Travel Distance, Fire Fighting Installations for Horizontal Exit, Roof Exit / Fire Lifts, External Stairs - Firefighting equipment and different methods of fighting fire, means of escape, alarms, etc

Requirement of good Acoustic - Factors to be followed for noise control in residential building - Acoustical Materials: Porous materials, panel absorbers, membrane absorbers, acoustical plasters, diffusers, cavity or Helmholtz resonators. Role of functional absorbers, Adjustable acoustics and variable sound absorbers. Acoustical correction and retrofits to existing spaces

Module V

Miscellaneous services

Concept of Green buildings – Sustainable features of Green building – LEED India rating system - energy efficiency, water efficiency – Green materials and equipment - waste reduction during construction, materials with recycled content, local materials, material reuse, certified wood, Rapidly renewable building materials and furniture, HVAC
Concept of building automation - Design issues related to building automation and its effect on functional efficiency, Components of building automation system; modern security system, alarm system, fire-protection, inter- communication, monitoring devices, mechanical means of vertical and horizontal transportation, Intelligent lighting system etc.

References

1. Birdie, G. S., and Birdie, J. S., Water Supply and Sanitary Engineering, Dhanpat Rai and Sons, New Delhi,2007.
2. Duggal, K. N., Elements of Environmental Engineering, S Chand and Co. Ltd., New Delhi, 2008.
3. Modi, P. N., Sewage Treatment and Disposal and Wastewater Engineering, Standard Book House, New Delhi,2008

4. Rainwater harvesting and conservation manual, CPWD, GOI, 2002
5. K B Raina and S K Bhattacharya, Electrical design estimating and costing, New age international pvt. Ltd publishers, 2005
6. Arora C.P, Refrigeration and Air Conditioning, Tata McGraw Hill, 2000
7. Charles J Kibert, Sustainable construction – Green building design and delivery, Wiley, 2016
8. E F Curd and C A Howard, Introduction to building services, Macmillan, 1996
9. Chadderton DV, Building services engineering, Taylors & Francis Group

Lecture Schedule

Module	Contents	Outcomes addressed	Hours
1	**Module 1**		**5**
1.1	Pipes for water distribution, joints, fixtures and valves, water meters, etc	CO 1	1
1.2	Water storage tanks: capacity and location - water purifiers	CO 1	1
1.3	Terminology such as flow, pressure, head, etc. - principles of water supply in buildings (low-rise, multi-storeyed)	CO 1	1
1.4	Rainwater Harvesting - roof top harvesting, type of spouts, sizes of rainwater pipes	CO 1	1
1.5	Methods of rainwater harvesting – harvesting tanks and pit - typical details	CO 1	1
2	**Module 2**		8
2.1	Types of traps and chambers: inspection chamber, disconnecting chamber, intercepting trap, S-trap, P-trap, gully trap, grease trap	CO 2	1
2.2	sanitary fixtures: washbasins, WCs, bathtubs, urinals, flushing cistern - Types of pipes and joints.	CO 2	1
2.3	Design principles of sanitary layout: location and ventilation of chambers, traps, fixtures	CO 2	1
2.4	Building sanitation systems: separate, combined, single stack, one pipe and two pipe	CO 2	1
2.5	On-site treatment: Septic tanks, Soak pits, Cess pools, dispersion trenches	CO 2	1
2.6	Decentralized treatment systems for multi-storeyed buildings (theory only, no design)	CO 2	1
2.7	Practices for Recycling grey water	CO 2	1
2.8	Solid waste quantity, Types and composition, characteristics	CO 2	
2.9	On-site processing and disposal methods	CO 2	1
3	**Module 3**		7
3.1	Electrical installations and Accessories of wiring (terminologies and symbols only), Systems of wiring	CO 3	1
3.2	Electrical layout for residence, small workshop, show room, school building, etc.	CO 3	1
3.3	Air Conditioning: Types of Air Conditioners, (Central type, Window Type, Split Unit), capacity selection of air conditioner	CO 3	1
3.4	Lift: Definition, Types of Lifts, Location, Sizes, Component parts	CO 3	1
3.5	Different types of elevators and Escalators, Freight elevators, Passenger elevators, Hospital elevators - Uses of different types of elevators	CO 3	1

3.6	Escalators – Dumbwaiters: Types and uses -Conveyors: Types and uses.	CO 3	1
3.7	Pumps – Types, Selection, installation, and maintenance	CO 3	1
4	**Module 4**		7
4.1	Causes and Effects of fire, General Requirements of Fire Resisting building as per IS and NBC 2005	CO 4	1
4.2	Characteristics of Fire resisting materials, Maximum Travel Distance, Fire Fighting Installations for Horizontal Exit, Roof Exit / Fire Lifts, External Stairs	CO 4	1
4.3	Firefighting equipment and different methods of fighting fire, means of escape, alarms, etc	CO 4	1
4.4	Requirement of good Acoustic - Factors to be followed for noise control in residential building	CO 5	1
4.5	Acoustical Materials: Porous materials, panel absorbers, membrane absorbers, acoustical plasters, diffusers, cavity or Helmholtz resonators	CO 5	1
4.6	Role of functional absorbers, Adjustable acoustics and variable sound absorbers	CO 5	1
4.7	Acoustical correction and retrofits to existing spaces	CO 5	1
5	**Module 5**		8
5.1	Concept of Green buildings – Sustainable features of Green building	CO 6	1
5.2	LEED India rating system - energy efficiency, water efficiency	CO 6	1
5.3	Green materials and equipment - waste reduction during construction, materials with recycled content, local materials, material reuse, certified wood, Rapidly renewable building materials and furniture	CO 6	1
5.4	HVAC	CO 6	1
5.5	Concept of building automation - Design issues related to building automation and its effect on functional efficiency	CO 6	1
5.6	Components of building automation system; modern security system, alarm system, fire-protection, inter-communication, monitoring devices,	CO 6	1
5.7	Mechanical means of vertical and horizontal transportation,	CO 6	1
5.8	Intelligent lighting system	CO 6	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDITS	Year of Introduction
22 CEE 804.1	EARTHQUAKE RESISTANT DESIGN	PEC	3	0	0	3	2019

Preamble: This course is intended to introduce students to the concepts of earthquake resistant of structures. Fundamental theory of structural dynamics based on which seismic design principles are rooted are also covered. The course also familiarizes the relevant Indian standards for the estimation of seismic demand and ductile detailing provisions.

Prerequisite: CET Mechanics of Solids CET Structural Analysis I

Course Outcomes : After the completion of the course the student will be able to:

CO 1	Formulate appropriate SDOF models of simple structural systems under dynamic loads apply them to the solution of engineering problems.
CO 2	Analyze and interpret the dynamic response of SDOF systems for various dynamic inputs.
CO 3	Develop appropriate mathematical models for 2 DOF systems MDOF shear building models and estimate the natural frequencies and vibration modes for the same.
CO 4	Explain the basics of engineering seismology, ground motion characteristics, behavior of structures to ground motion and appreciate the various principles of seismic design philosophy
CO 5	Apply the provisions of various Indian seismic design standards for the estimation of seismic demand over structures.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3									
CO 2	3	3	3									
CO 3	3	3	3									
CO 4	3	3	3									
CO 5	3	3	3									

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember (K1)	5	5	10
Understand (K2)	10	10	20
Apply (K3)	20	20	40
Analyse (K4)	15	15	30
Evaluate (K5)	-	-	-
Create (K6)	-	-	-

Continuous Internal Evaluation pattern:

Attendance	:	10 marks
Continuous Assessment Tests	:	25 marks
Assignment/Quiz/Course project	:	15 marks
Total	**:**	**50 marks**

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

(Questions may be framed based on the outline given under each course outcome)

Course Outcome 1 (CO1):

4. Demonstrate how D'Alembert's principle can be applied for setting up the equation of motion of SDOF systems.
5. Problems involving idealization of structures as equivalent SDOF systems and estimation of natural frequency.

Course Outcome 2 (CO2):

1. Problems involving estimation of dynamic response of structures idealized as SDOF systems
2. Explain the significance of frequency ratio (excitation to natural frequency) in dynamic response of structures.

Course Outcome 3 (CO3):

1. Problems involving development of equation of motions of 2 DOF systems or MDOF shear buildings
2. Problems involving estimation of natural frequencies and mode shapes of 2 DOF systems

Course Outcome 4 (CO4):

1. Discuss how the following irregularities influence the seismic behavior of buildings.
   (i) Open ground stories (ii) Torsional irregularities
2. Explain the seismic design philosophy followed by Indian standards.

Course Outcome 5 (CO5):

1. Give suitable explanation(s) for the following ductile detailing provisions of IS 13920 (2016) for seismic design of structures.
   (i) At the joint face of a beam, the positive steel must be at least equal to half of the negative steel at that face.
   (ii) The spacing of transverse reinforcement (rectangular hoops) in columns shall not exceed 300 mm. Also, the spacing of hoops shall not exceed half the least lateral dimension of the column.
2. Problems involving estimation of base shear and its distribution along height.

Course Code: 22 CEE 804.1
EARTHQUAKE RESISTANT DESIGN
Syllabus

Module I (7 Hours)

***Overview of structural dynamics*: ** Fundamental objective of dynamic analysis- classification of dynamic loads – essential characteristics of a dynamic problem – methods of discretization – lumped mass procedure – generalized displacements – single degree of freedom system – basic components of a dynamic system.

Formulation of equation of motion – Newton's 2^{nd} law and D' Alembert's principle; influence of gravitational forces – generalized SDOF systems.

Module II (7 Hours)

Solution of the equation of motion – undamped free vibration – damped free vibration- critically damped under damped and over damped SDOF systems, Logarithmic decrement.

Response to harmonic loading – transient and steady state response of undamped and damped SDOF systems – dynamic amplification factor, force transmissibility and vibration isolation.

Module III (7 Hours)

Response to periodic loading – Fourier series representation of periodic loads. Response of SDOF systems.

Base excited SDOF system - formulation of equation of motion – Response of SDOF base excited systems; Concept of pseudo acceleration, velocity. Response spectra, Four way logarithmic plot – DVA spectrum (concept only).

Two degree of freedom systems – Formulation of equations of motion – free vibration analysis – frequencies and mode shapes – orthonormalization of modes.

Module IV (6 Hours)

Lumped mass modelling of MDOF systems - Shear building; free vibration analysis – frequencies and mode shapes; Modal expansion of response, Mode superposition technique (concept only).

Introduction to engineering seismology – Plate tectonics – faults – causes of earthquake – energy release – seismic waves - Intensity and Magnitude of earthquake ; Measurement of ground motion-Seismographs, Characteristics of ground motion; Seismic zones in India.

Module V (7 Hours)

Behaviour of buildings under earthquakes – factors influencing structural performance **–** building configuration, strength, stiffness and ductility; effects of structural irregularities on building performance.

Estimation of Seismic Demand –Seismic zones and coefficients; response reduction factors, Estimation of base shear and its distribution along height based on Equivalent static method using IS 1893 for multi storied buildings.

Ductility considerations in earthquake resistant design of buildings – Impact and requirements for ductility – factors affecting ductility – ductile detailing considerations in buildings as per IS 13920

Text books / References

1. Mario Paz, “Structural Dynamics – Theory and Computations”, CBS Publishers, NewDelhi.
2. Chopra A.K., “Dynamics of Structures” 5th edition, Pearson Education, NewDelhi
3. Clough R.W. and Penzien, J., “Dynamics of Structures”, McGraw Hill International.
4. Humar J.L., “Dynamics of Structures” A.A. Balkema Publishers Tokyo.
5. Agarwal P., and Shrikhande, M., “Earthquake Resist Design of Structures”, PHI Learning Pvt. Ltd. NewDelhi.
6. Paulay T. and Priestley M.J.N., “Seismic Design of Reinforced Concrete and Masonry Buildings”, John Wiley & Sons Inc. NewYork.
7. IS: 1893(part I), (2016), *Indian Standard Criteria for Earthquake Resistant Design of Structures*, Bureau of Indian Standards, NewDelhi.
8. IS: 13920 (2016) *Indian Standard Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces*, Bureau of Indian Standards, NewDelhi.

Course Contents and Lecture Schedule:

Module	Topic	Course outcome addressed	No. of Lectures
Module I (7 hours)			
1.1	Introduction: Fundamental objective of structural dynamic analysis; Types of prescribed loadings; Essential characteristics of a dynamic problem; Method of discretization - lumped mass procedure – generalized displacements.	CO1	2
1.2	Degree of freedom and stiffness – equivalent stiffness, Numerical examples.	CO1	1
1.3	Single degree of freedom system – Components of the basic dynamic system – formulation of the equation of motion – using Newton's 2nd law and D'Alembert's principle. Influence of gravitational forces.	CO1	2
1.4	Systems modelled as rigid body assemblage-Numerical examples on formulation of equation of motion	CO1	1
1.5	Generalized SDF systems – expression for generalized system properties – Numerical examples.	CO1	1
Module II (7 hours)			
2.1	Free vibration of single degree of freedom system:- Solution of equation of motion for un-damped systems. Free vibration response of damped systems – critically damped and over damped systems.	CO2	2
2.2	Free vibration response of under-damped systems- Logarithmic decrement. Numerical examples on free vibration response of un-damped and damped systems.	CO2	1
2.3	Response of un-damped and damped SDF systems to harmonic excitation; Dynamic Amplification factor.	CO2	2
2.4	Numerical examples on harmonic excitation problems;	CO2	1
2.5	Force transmissibility and vibration isolation- numerical examples	CO2	1
Module III (7 hours)			
3.1	Response of SDF systems to periodic loading – Fourier series representation of periodic loading. Response of undamped and damped SDF systems to loads expressed as Fourier series expansion- Numerical examples	CO2	2
3.2	Base excited SDOF systems - formulation of equation of motion – Response of SDOF base excited systems- numerical examples	CO2	1
3.3	Concept of pseudo acceleration and velocity. Response spectra, Four way logarithmic plot – DVA spectrum (concept only).	CO2	2

3.4	Two degree of freedom systems – Formulation of equations of motion for simple 2 DOF systems – free vibration analysis – frequencies and mode shapes – orthonormalization of modes	CO3	2
Module IV (6 hours)			
4.1	Shear building – assumptions involved in idealization- equation of motion- free vibration analysis – frequencies and mode shapes.	CO3	2
4.2	Modal expansion of response, Mode superposition technique (concept only).	CO3	1
4.3	Introduction to engineering seismology – Plate tectonics – faults – causes of earthquake – energy release – seismic waves	CO4	2
4.4	Intensity and Magnitude of earthquake ; Measurement of ground motion-Seismographs, Characteristics of ground motion; Seismic zones in India.	CO4	1
Module V (6 hours)			
5.1	Behaviour of buildings under earthquakes – factors influencing structural performance – building configuration, strength, stiffness and ductility; effects of structural irregularities on building performance.	CO4	2
5.2	Estimation of Seismic Demand –Seismic zones and coefficients; response reduction factors, Estimation of base shear and its distribution along height based on Equivalent static method using IS 1893 for multi storied buildings	CO5	2
5.3	Ductility considerations in earthquake resistant design of buildings – Impact and requirements for ductility – factors affecting ductility – ductile detailing considerations in buildings as per IS 13920	CO5	2

Model Question paper

PAGES:2

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Name:______________

EIGHTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22 CEE 804.1

Course Name: EARTHQUAKE RESISTANT DESIGN

Max. Marks: 100 Duration: 3 Hours

(Use of IS:1893 (part I) 2016 permitted in exam hall)

PART A (3 x 10 = 30 Marks)

Answer all Questions. Each question carries 3 Marks

1. Briefly explain the various sources of dynamic excitation for engineering structures
2. An unknown mass *m* kg attached to the end of an spring with unknown stiffness *k* has a natural frequency of 1.57 Hz. When a 0.453 kg mass is added to *m,* the natural frequency is lowered to 1.278 Hz. Determine the unknown mass *m* and the spring constant *k* N/m.
3. Explain the terms (i) Dynamic amplification factor and (ii) Transmissibility ratio.
4. A vibrating system consisting of a weight of W = 4.54 kg and a spring with stiffness *k* = 3500 N/m is viscously damped so that the ratio of two consecutive amplitudes is 1.00 to 0.85. Determine the logarithmic decrement.
5. Write short note on (i) response spectrum and (ii) four way logarithmic plot.
6. Write short note on mass orthonormalization.
7. Set up the equation of motion for a 3 storey shear building with the following properties. Floor mass = M; storey stiffness = K.
8. List the two different kind of body waves and explain how they differ.
9. Explain importance factor and response reduction factor in the context of earthquake response analysis.
10. Briefly explain the factors which affect the ductility.

PART B (14 x 5 = 70 Marks)

Answer any one full question from each module. Each question carries 14 Marks

Module 1

17. a) Demonstrate how D'Alembert's principle can be applied for setting up the equation of motion of SDOF systems **(4)**

b) Set up the equation of motion for the system shown in Fig 1 and hence determine its natural frequency **(10)**

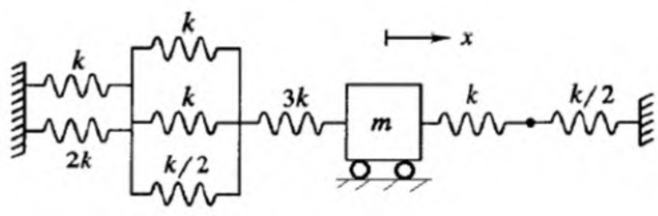

Fig. 1.

18. a) Explain distributed mass and lumped mass models in the context of system idealization for dynamic analysis. **(4)**

. b) A rigid uniform bar of mass *m* and length *l* is pinned at O and is supported by a spring and viscous damper as shown in Fig.2. Set up the equation of motion for small oscillations of the rod and hence determine its undamped natural frequency **(10)**

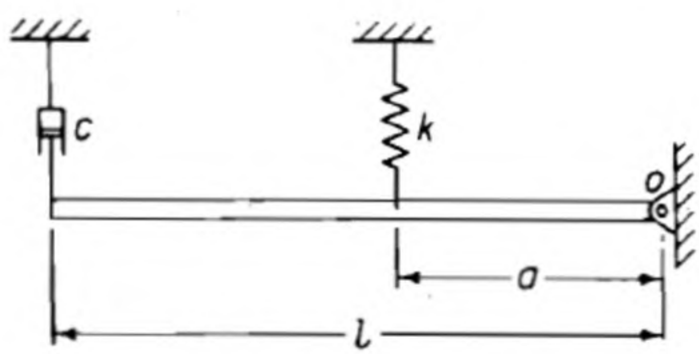

Fig.2.

Module 1I

19. a) Explain logarithmic decrement and its practical significance **(4)**

b) A one storey building is idealized as a rigid girder supported by weightless columns as shown in Fig. 3. In order to evaluate the dynamic properties of this structure, a free vibration test is made, in which the roof system is displaced laterally by a hydraulic jack and then released. During the jacking operation, it is observed that a force of 90kN is required to displace the roof system by 0.51 cm. After the instantaneous release of this initial displacement, the maximum displacement on the return swing is only 0.406 cm and the period of this displacement cycle is T = 1.4 s. **(10)**

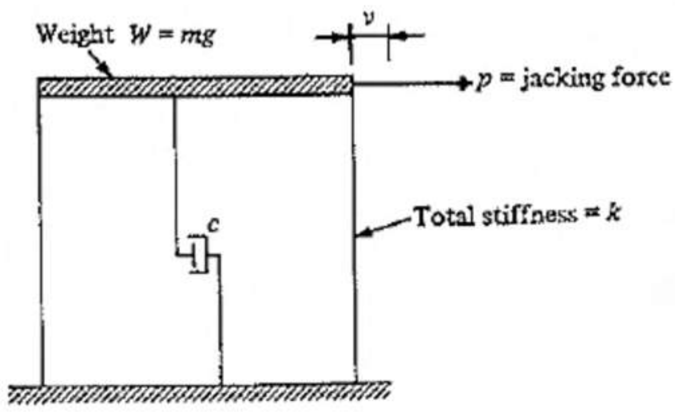

Fig.3

20. a) Write short notes on force transmissibility and vibration isolation **(4)**

b) A 50 kg turbine is mounted on four parallel springs, each of stiffness 3 x 10^5 N/m. When the machine operates at 40 Hz, its steady-state amplitude is observed as 1.8 mm. Compute is the magnitude of the excitation? **(10)**

Module 1II

21. a) Briefly explain how a periodic loading can be expressed as an infinite series of harmonic functions using Fourier theorem. **(4)**

b) A single bay single storey portal frame with the following properties is subjected to a ground acceleration history that can be idealized as 0.5 Sin(15t). find the peak steady state amplitude of floor vibration and column shear if the floor mass is 4540 kg and 2013 kN/m. **(10)**

6. a) Write short notes on the following (i) Pseudo acceleration (ii) DVA spectrum **(4)**

b) Setup the equations of motion for the 2 DOF system shown in Fig.4. and hence estimate its natural frequencies. Following data may be utilized. m1 = m2 = M; and k1 = k2 = K.

(10)

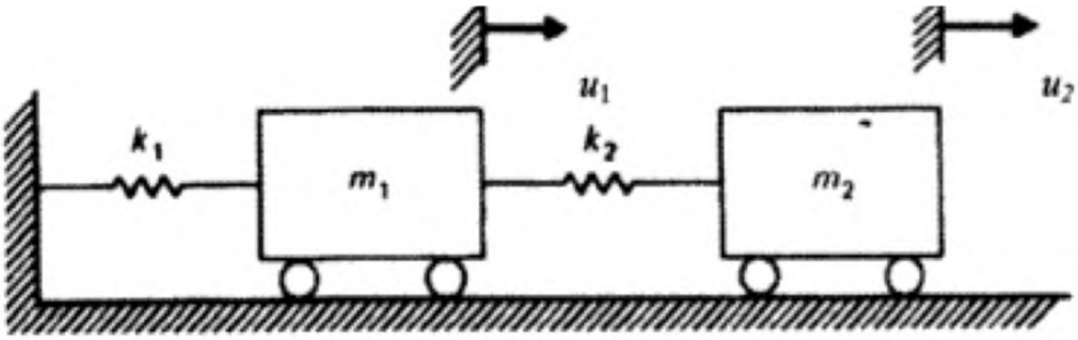

Fig.4.

Module 1V

7. a. What is a shear building? List the assumptions made in the lumped mass idealization of shear buildings?. **(4)**

b. For the two storey shear building with floor mass and storey shears as shown in Fig.5. set up the equation of motion and hence determine its natural frequencies and vibration modes **(10)**

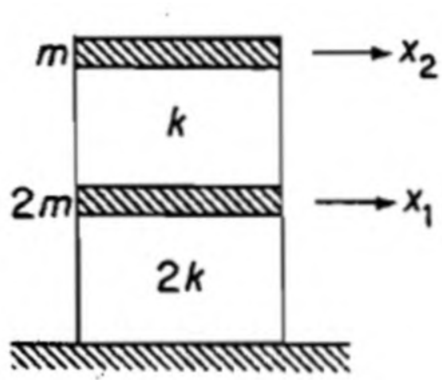

Fig.5.

11. a. Explain mode superposition technique for the estimation of vibration response of multi degree of freedom systems **(6)**

b) Distinguish between the following

(i) Body waves and Surface waves (ii) Rayleigh waves and love waves (iii) intensity and magnitude of earthquakes. **(8)**

Module V

12. a) Explain how the various building irregularities affect the behaviour of structures to earthquake excitation. **(6)**

b) The plan of a five storey building is shown in Fig 6. Dead load including self weight of slabs, finishes, partitions etc can be assumed as 5 kN/m^2 and live load as 4 kN/m^2 on each floor and as 1.5 kN/m^2 on the roof. Determine the base shear and shears at different storey levels for the frame 1-1 marked in figure. **(8)**

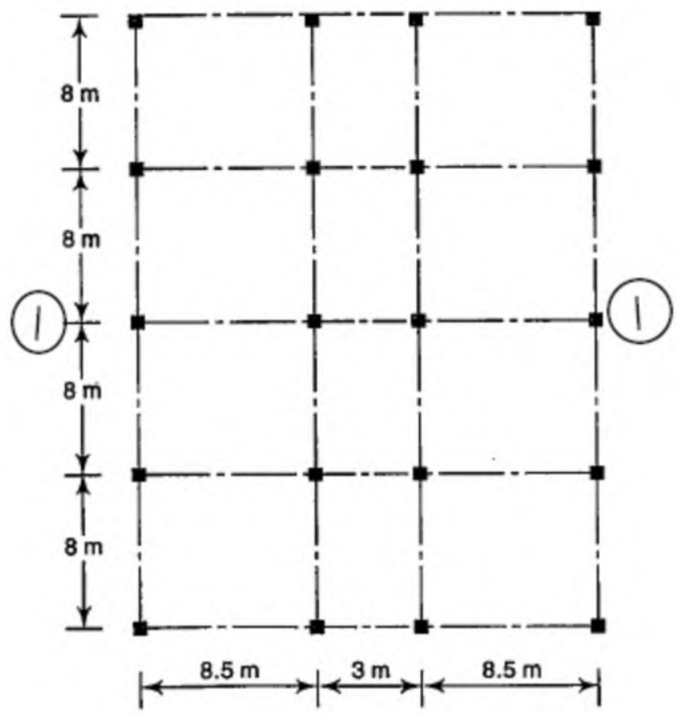

Fig.6.

13. a) Explain the seismic coefficient method for seismic analysis of the structures. **(6)**

b) (i) Discuss on the significance of ductility in seismic design. **(4)**

(ii) Briefly discuss the various ductile detailing provisions in IS 13920 for beams **(4)**

CODE	COURSE NAME	CATEGORY	L	T	P	CREDITS
22 CEE 804.2	**SOIL STRUCTURE INTERACTION**	**PEC**	**3**	**0**	**0**	**3**

Preamble: This course introduces the importance of behaviour and analysis of structures while interacting with soil. The actual behaviour of structures with respect to foundation and behaviour of foundation with respect to soil are studied considering different models. This knowledge will be helpful for economising the foundation size and to understand the complex behaviour of soil under particular situation.

Prerequisite: CET204 Geotechnical Engineering 1/ CET305 Geotechnical Engineering II / CET302 Structural Analysis II

Course Outcomes : After the completion of the course the student will be able to:

CO 1	Explain elastic soil behavior related to bearing capacity and settlement
CO 2	Identify the significance of SSI in foundation design
CO 3	Explain various soil idealizations for SSI
CO 4	Apply the mathematical models for 1- Dimensional soil structural analysis
CO 5	Apply SSI for general engineering design problems

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	2									2
CO 2	3	4	3									
CO 3	2	3	3									
CO 4	3	3	3									
CO 5	3	2	2									2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember (K1)	5	5	10
Understand (K2)	10	10	20
Apply (K3)	20	20	40
Analyse (K4)	15	15	30
Evaluate (K5)	-	-	-
Create (K6)	-	-	-

Continuous Internal Evaluation pattern:

Attendance	:	10 marks
Continuous Assessment Tests	:	25 marks
Assignment/Quiz/Course project	:	15 marks
Total	**:**	**50 marks**

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code: 22CEE804.2

Soil structure interaction

MODULE I:

Soil bearing capacity: (7 Hours)
Bearing capacity analysis by Terzaghi's theory, Skempton, Meyorhof and IS code method. Types of settlement for soil – immediate or elastic settlement, primary consolidation settlement, secondary compression settlement. Settlement calculation for granular and clayey soils based on IS code method.

MODULE II:

Fundamentals of Soil-Structure Interaction: (7 Hours)
Introduction to soil-structure interaction– significance of SSI. Contact pressure distribution beneath rigid and flexible footings-cohesive and non-cohesive soils, concept of subgrade modulus-influencing factors, concentrically and eccentrically loaded cases - Static and Dynamic loading effects-static & dynamic SSI (concept only).

MODULE III:

Elastic models for soil response: (7 Hours)
Winkler model, Elastic continuum models – isotropic elastic continuum, layered & structured elastic media, Two parameter elastic models – Filonenko-Borodich, Hetenyi and Pasternak models. Elastic -Plastic behaviour – Time dependent behaviour.

MODULE IV:

Beams on Elastic Foundations: (7 Hrs)
Infinite beams resting over Winkler medium – governing differential equation, solutions for the case of infinite beams subjected to concentrated forces and uniform force of finite length.

Finite beams resting over Winkler medium- Hetenyi's principle of superposition. Classification of finite beams in relation to their stiffness.

MODULE V:

Applications of SSI in engineering design (7 Hrs)
Soil-structure interactions effects in design of isolated and mat foundations. Soil-structure interaction effects in vertical and lateral pile capacities.

Dynamic soil structure interaction – Applications in Low rise residential buildings, multi-storey buildings, bridges, dams, nuclear power plants.

Text Books

1. Selvadurai, A.P.S., Elastic Analysis of Soil Foundation Interaction, Elsevier, 1979.
2. Structure Soil Interaction- The real behaviour of Structures, Institution of structural Engineers, London, 1989.
3. Hemsley, J.A., Elastic Analysis of Raft Foundations, Thomas Telford, 1998
4. Nainan P. Kurian, Design of Foundation Systems, Narosa, 2005
5. Murthy, V.N.S., Advanced Foundation Engineering, CBS Publishers, New Delhi, 2007.
6. Cakmak, A.K., Soil-Structure Interaction ,Developments in Geotechnical Engineering 43, Elsevier and Computational Mechanics Publications, 1987.
7. Kramer,S.L.,Geotechnical-Earthquake Engineering, Pearson Education, 1996.
8. Hall, W,S., Oliveto Kluwer,O., Boundary Element Method for Soil-Structure Interaction , Academic Publishers, 2003.
9. Wolf, J.P., Dynamic Soil-Structure Interaction , Prentice-Hall, 1985.

Reference Books

1. Wolf, J.P.,Soil-Structure Interaction in the Time-Domain, Prentice-Hall, 1988.
2. Chen, Wai-Fah, Duan Lian, Bridge Engineering Seismic Design, CRC Press, 2003.

Course Contents and Lecture Schedule:

Module	Topic	Course outcome addreseed	No. of Lectures
Module I (7 hours)			
1.1	Bearing capacity analysis by Terzaghi's theory, Skempton, Meyorhof and IS code method	CO1, CO2	2
1.2	Types of settlement for soil – immediate or elastic settlement, primary consolidation settlement, secondary compression settlement.	CO1, CO2	2
1.3	Settlement calculation for granular and clayey soils based on IS code method	CO1, CO2	2
1.4	Review Problems	CO1, CO2	1
Module II (7 hours)			
2.1	Introduction to soil-structure interaction– significance of SSI..	CO1, CO2	1
2.2	Contact pressure distribution beneath rigid and flexible footings-cohesive and non-cohesive soils- Problems	CO1, CO2	2
2.3	concept of subgrade modulus-influencing factors, concentrically and eccentrically loaded cases	CO1, CO2	2
2.4	Static and Dynamic loading effects-static & dynamic SSI (concept only	CO1, CO2	2
Module III (7 Hours)			
3.1	Winkler model, Elastic continuum models – isotropic elastic continuum, layered & structured elastic media,	CO3	2
3.2	Two parameter elastic models – Filonenko-Borodich, Hetenyi and Pasternak models.	CO3	3
3.3	Elastic -Plastic behaviour	CO3	1
3.4	Time dependant behaviour	CO3	1
Module IV (7 Hours)			
4.1	Infinite beams resting over Winkler medium – governing differential equation, solutions for the case of infinite beams subjected to concentrated forces and uniform force of finite length.	CO4	4

4.2	Finite beams resting over Winkler medium- Hetenyi's principle of superposition. Classification of finite beams in relation to their stiffness.	CO4	4
Module V (7 Hours)			
5.1	Soil-structure interactions effects in design of isolated and mat foundations	CO5	1
5.2	Soil-structure interaction effects in vertical and lateral pile capacities.	CO5	1
5.3	Dynamic soil structure interaction – Applications in Low rise residential buildings	CO5	2
5.4	Dynamic soil structure interaction – Applications in multi storey buildings.	CO5	2
5.5	Dynamic soil structure interaction – Applications in bridges, dams, nuclear power plants.	CO5	1

22 CEE 804.3	AIRPORT, SEAPORT AND HARBOUR ENGINEERING	Category	L	T	P	Credit	Year of Introduction
		PEC	3	0	0	3	2019

Preamble

Objective of the course is to introduce the principles of planning design and practice of Airport, Sea port and Harbor Engineering.

Prerequisite: Nil

Course Outcomes: At the end of the course, students will be able to

CO 1	Explain the basic principles of planning and design for site selection, Airport components based on air traffic characteristics
CO 2	Explain the basic design principles of Runway orientation, basic runway length and corrections required, Geometric design of runways, Design of taxiways and aprons, Terminal area planning,
CO 3	Explain various aspects such as Airport markings, Lighting of runway approaches, taxiways and aprons, Air traffic control methods.
CO 4	Explain the basic principles ,site selection characteristics ,lay out ,break waters, quays, piers, wharves, jetties, transit sheds and warehouses - navigational aids - light houses, signals - types - Moorings
CO 5	Explain the basics of Docks – Functions and types - dry docks, wet docks arrangement of basins and docks

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	1		1	3	1		2		1
CO 2	3	1	3	1		1	1	1		1		1
CO 3	3	2	2	1					1	2		2
CO 4	2						2	1				2
CO 5	3	3	3			3		2				

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (marks)
	Test 1 Marks	Test 2 Marks	
Remember	7.5	7.5	30
Understand	7.5	7.5	30
Apply	5	5	20
Analyse	5	5	20
Evaluate			
Create			

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern:

The question consists of two parts- Part A and Part B. Part A consists of 10 questions with 3marks for each (two questions from each module). Part B consists of two questions from each module, out of which one has to be answered. Each question carries 14 marks and can have maximum 2 subdivisions.

Sample Course Level Assessment Questions:

Course Outcome 1 (CO1):

Explain the basic principles to be followed for selection of sites and planning of Airport.Explain the various air traffic characteristics and standards as per ICAO and FAA

Course Outcome 2 (CO2):

Apply the basic principles to be followed for runway orientation and design. Explain the various types' correction to be applied for runway design.Solve Problem related to application of correction like temperature, altitude

Course Outcome 3 (CO3):

Elaborate the principles and functions and working of airport markings and lighting. Different means of air traffic control.

Course Outcome 4 (CO4):

Explain the function and design aspects of marine structures like break waters, quays, piers, wharves, jetties and functions and working of different types of navigational aids

Course Outcome 5 (CO5):

Discuss the principles, types, design considerations, functions and working of wet and dry Docks

Syllabus

Module	Contents	Hours
I	**Introduction to Airport Engineering**, Components of airport, selection of site for airport. Requirements of an ideal airport layout. Aircrafts and its characteristics, airport classifications as per ICAO. Location and planning of airport as per ICAO and F.A.A. recommendations, airport Elements -airfield, terminal area,	8
II	**Run Way Design-** Wind rose diagram and orientation of runway, wind coverage and crosswind component, factors affecting runway length, basic runway length, and corrections to runway length, runway geometrics and runway patterns (configurations). Design of taxiways and aprons, Terminal area planning, obstructions, approach zone, zoning laws, airport capacity, airport size (introduction only)	8
III	**Introduction to Airport markings**, Runway marking, Lighting of runway approaches, taxiways and aprons, Air traffic control-objectives, control system, control network-visual aids-landing information system,	5
IV	**Harbours** – Harbour components, ship characteristics, characteristics of good harbour, and principles of harbour planning, size of harbour, site selection criteria and layout of harbours, classification, features, requirements. Break waters quays, piers, wharves, jetties, transit sheds and warehouses - necessity and functions, classification. navigational aids - light houses, signals - types - Channel and entrance demarcation, buoys, beacons, light house communication devices	8
V	**Docks** – Functions and types - dry docks, wet docks-purpose, design consideration, operation of lock gates and passage, repair docks - graving docks, floating docks and repair of docks	7

Text Books

1. Khanna S K, Arora M G and Jain S S, "Airport Planning and Design", Nemchand and Brothers, Roorkee, 2012.
2. Bindra S P, "A Course in Docks and Harbour Engineering", Dhanpat Rai and Sons, New Delhi, 2013
3. Rangwala S C "Airport Engineering", Charotar Publishing company 16 e, 2016.
4. Rangwala, "Harbor Engineering", Charotar Publishing House, 2013.
5. Oza.H.P. and Oza.G.H., "A course in Docks & Harbour Engineering". Charotar Publishing Co., 2013
6. Srinivasan R. " Harbour,Dock and Tunnel Engineering", 28th Edition
7. G.V. Rao Airport Engineering Tata McGraw Hill Pub. Co.

References

1. Horonjeff R. and McKelvy, F., Planning and Design of Airports, McGraw Hill, 5e, 2010

Course Content and lecture Schedule:

No.	Topic	Course Outcome	No. of Hrs
1	**Module 1**		**Total:8**
1.1	Introduction, air port components, site selection	CO1	3
1.2	Requirements of an ideal airport layout. Aircrafts and its characteristics,	CO1	3
1.3	Airport classifications as per ICAO. Location and planning of airport, airport Elements -airfield, terminal area,	CO1	2
2	**Module 2**		**Total: 8**
2.1	**Run Way Design-** Wind rose diagram and orientation of runway, wind coverage and crosswind component	CO2	2
2.2	Factors affecting runway length, basic runway length, and corrections to runway length, runway geometrics and runway patterns (configurations).	CO2	3
2.3	Design of taxiways and Aprons, Terminal area planning,	CO2	1
2.4	Approach zone, zoning laws, airport capacity, airport size (introduction only)	CO2	2
3	**Module 3**		**Total: 5**
3.1	Introduction to Airport markings, Runway markings	CO3	1
3.2	Lighting of runway approaches, taxiways and aprons,	CO3	2
3.3	Air traffic control-objectives, control system, control network-visual aids-landing information system,	CO3	2
4	**Module 4**		**Total: 8**
4.1	Harbor Planning: Basic principles ,site selection characteristics	CO4	3
4.2	**Classification, features, requirements**. Of Break waters quays, piers, wharves, jetties, transit sheds and warehouses - necessity and functions, classification.	CO4	3

4.3	**Navigational aids** - light houses, signals - types - Channel and entrance demarcation, buoys, beacons, light house communication devices	CO4	2
5	**Module 5**		**Total: 7**
5.1	Functions -types and purpose of docks	CO5	2
5.2	Design considerations of docks	CO5	2
5.3	Operation of lock gates and passage, repair docks - graving docks, floating dock	CO5	3

Model Question Paper

EIGHTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: **22 CEE 804.3**
Course Name: **AIRPORT, SEAPORT AND HARBOUR ENGINEERING**

Marks:100 Duration: 3 hrs

PART A
(Answer all questions. Each question carry three marks)

4. With a sketch, Describe aero plane components parts draw sketch.
5. Enumerate the various factors which would be kept in view while selecting Site for air port
6. What are functions of taxiways?
7. Explain the term wind rose Diagram
8. Give the classification of air traffic control systems .
9. Explain objectives of runway lightings
10. Define the following terms (1) Harbour, (2) Port, (3) Fenders,
11. (i) define terms:- tides, turning basin breakwater, draft
12. Why fenders are provided on docking platform? Draw the sketch of wooden and rubber fenders.
13. Differentiate between gravity docks and floating docks

.

PART B
(Answer one full question from each module)

11. a) Give the classification of airports as per I.C.A.O. &Enlist components of an airport 7

b) Requirements of an ideal airport layout 7

Or

12. a) Explain the various factors to be considered for selection of site for airport. 7

b) Explain the principles of planning of airport as per ICAO and F.A.A recommendations 7

13.a) The length of a runway under standard conditions is 1500m. The airport is to be provided at an elevation of 110m above mean sea level. The airport reference temperature is 320C. Following data refers to the proposed longitudinal section of runway. Determine the corrected length of runway.

End to end of runway (m)	Grade (%)	End to end of runway (m)	Grade (%)
0 to 300	+1	1500 to 1800	+1
300 to 900	-0.2	1800 to 2100	-0.3
900 to 1500	+0.5		

14

OR

14. a)Explain by drawing sketch wind rose diagram type II showing direction, duration and intensity of wind. 7

b) What are the purposes of airport terminal building? Draw layout of airport terminal building 7

OR

15 a) Explain with sketches the various of Runway markings and salient features 7

b) List out the various visual aid visual aids-landing information system, Explain any one 7

OR

16a) what are the advantages lighting of runway approaches? 7

b) What are variouscontrol system, usedin airports. 7

17 a) State the natural and meteorological phenomena a harbour engineer has to study and briefly mention the effects of these phenomena 14

OR

18a) What is breakwater? Explain designfeatures of break water 6

b) Explain necessity and functions transit sheds and warehouses 8

.

19 a) Describethe working of a lock with sketches. 6

b) Explain with sketches the basic principle of gravity dock 8

OR

20 a) What are the various types of docks .Explain the primary functions of docks 10

b) draw sketch of floating Dock 4

***

22 CEE 804.4	HYDROCLIMATOLOGY	Category	L	T	P	Credit	Year of Introduction
		PEC	**3**	**0**	**0**	**3**	**2019**

Preamble: The general objective of this course is to give exposure to students on the link between hydrology and climatology through the basic scientific principles and processes will be explored. The students will get an exposure to different hydro-climatological extremes and climate changes. This course also am to impart the knowledge on modeling the hydrologic impact of climate changes, basic characteristic properties of hydrologic data etc.

Pre-requisite: CET307 Hydrology and Water Resources Engineering

Course outcome

After the course, the student will be able to:

CO1	Explain the role of meteorological variables on the hydrology of a region
CO2	Describe the characteristics of hydrologic extremes and climate change
CO3	Apply statistical methods in modeling of hydro-climatic extremes
CO4	Describe its procedures for modeling hydrologic impact of climate change
CO5	Apply statistical principles in the characterization of hydrologic data

CO - PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							2					
CO2							2					
CO3	3	2										
CO4	2						2					
CO5	3	2										

Assessment pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	5	5	15
Understand	10	10	15
Apply	20	20	40
Analyze	15	15	30
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance	:	10 Marks
Continuous Assessment Test (2 numbers)	:	25 Marks
Assignment/Quiz/Course project	:	15 Marks
Total	**:**	**50 Marks**

End semester examination pattern – There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 Marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 Marks.

Sample Course Level Assessment Questions

Course Code: 22 CEE 804.4
Hydroclimatology

Q. No	Question	Marks	CO Assessed
	Part A (Answer ALL Questions)		
1	Differentiate weather and climate	3	CO1
2	Explain the forms of precipitation	3	CO1
3	Explain the laws of radiation	3	CO2
4	Explain temperature extremes and heat wave	3	CO2
5	Enlist the causes of floods	3	CO3
6	Differentiate Risk and reliability	3	CO1, CO2
7	Describe on IPCC Assessment reports	3	CO4
8	Enlist the methods of statistical downscaling	3	CO4
9	Explain change point in hydro-climatic series	3	CO5
10	Explain stationarity and non-stationarity of hydro-climatic data	3	CO5
	Part B (Answer ANY ONE FULL question from each module)		
	Module I		
11(a)	Explain the different types of clouds Explain the different types of clouds	8	CO1
11(b)	Explain the role of global climate oscillations on Indian monsoon rainfall	6	CO1
12 (a)	Differentiate ElNino and LaNina.	8	CO1
12 (b)	Explain the vapour pressure temperature relationship in the process of precipitation	6	CO1
13(a)	State the characteristics of Indian Monsoon	5	CO1
13 (b)	Explain in detail different types of precipitation	9	CO1
Module II			
14 (a)	Explain the vertical structure of atmosphere with relevant sketch	10	CO2
14 (b)	Explain thermal time	4	CO2
15 (a)	Differentiate Hadley cell and Ferrel cell	6	CO2

15 (b)	Explain the modeling of vertical variation in air temperature	8	CO2
16 (a)	Explain general circulation of atmosphere. Describe the triple cell general circulation model with the help of neat diagrams.	10	CO2
16(b)	Explain temporal variation of air temperature	4	CO2
	Module III		
17 (a)	Explain the classification of droughts	8	CO3
17 (b)	Explain the methods of flood control	6	CO3
18 (a)	A cofferdam has been built to protect homes in a floodplain until a major channel project can be completed. The cofferdam was built for a 20-year flood event. The channel project will require 3years to complete. What are the probabilities that a) The cofferdam will not be overtopped during the 3 years ? b) The cofferdam will be overtopped in any one year? c) The cofferdam will be overtopped exactly once in 3 years? d) The cofferdam will be overtopped at least once in 3 years ? e) The cofferdam will be overtopped only in the third year?	10	CO3
18 (b)	What are drought indices ? Enlist its different types	4	CO3
19(a)	Explain the method of estimation of any four types of drought indices	8	CO3
19 (b)	Explain Frequency analysis of hydro climatic extremes	6	CO3
	Module IV		
20 (a)	Explain the causes of climate change	8	CO4
20 (b)	Differentiate statistical downscaling and dynamic downscaling	6	CO4
21 (a)	Explain (a) general circulation models (b) regional climate models	8	CO4
21 (b)	Explain the typical framework for modeling the impact of climate change on water resources	6	CO4
22 (a)	Explain the types of uncertainty in downscaling studies	6	CO4
22 (b)	Explain the salient features of most recent global climate data for downscaling studies	8	CO4
	Module V		
23 (a)	Explain Principal component analysis	5	CO5

23 (b)	Explain any three methods for analyzing the trend of hydrologic data	9	CO5
24 (a)	Explain non-stationarity of hydroclimatic series	5	CO5
24 (b)	Explain any three methods of determination of change point of hydro-climatic series	9	CO5

Syllabus

Course Code: 22 CEE 804.4

HYDROCLIMATOLOGY

Module I (8 Hours)

Introduction - weather and climate; hydrometeorology- variables affecting precipitation- humidity, vapor pressure, saturation vapor pressure–temperature relation (simple problems), perceptible water, forms and types of precipitation; cloud - types; Monsoon- characteristics of Indian summer monsoon rainfall- climate oscillations and Indian monsoon rainfall- ElNino and LaNina.

Module II (7Hours)

Atmosphere- vertical structure; radiation and temperature; the general circulation of atmosphere- triple cell model, laws of radiation; temperature variation- modeling vertical variation and temporal variation of air temperature; temperature extremes; diurnal temperature range, heat waves- definition

Module III (8 Hours)

Climate variability and extremes: Floods- causes, types, methods of control, flood modeling (brief description only); Frequency analysis of extreme rainfall and flood-problems, Return period Risk and reliability in hydrologic design- simple problems; Droughts-types, characteristics and drought indices

Module 1V (6Hours)

Climate change: Causes and effects of climate change, modeling of climate hydrologic impact of climate change on water resources-typical framework, general circulation models and regional climate models; Downscaling-concept and types; IPCC assessment reports, scenarios and database (brief description and salient features only), uncertainty in downscaling studies (brief description only)

Module V (6 Hours)

Statistical methods in hydro-climatology: principal component analysis and its use in climate change studies, methods for change point analysis, methods for trend analysis-statistical and graphical methods, stationary and non-stationary series- determination of non-stationarity of hydro-climatic series (no problems)

Text Book

- G. S. Campbell, and J. M. Norman, An Introduction to Environmental Biophysics, Springer, 2013.
- Rajib Maity, Statistical Methods in Hydrology and Hydroclimatology, Springer, 2018
- P. Jayarami Reddy, A Text Book of Stochastic Hydrology, Laxmi Publications, New Delhi, 2nd edition, 2016.
- M. L. Shelton, Hydroclimatology: Perspectives and Applications, Cambridge University Press, 2009.

References

- IPCC, Fourth to Sixth Assessment Reports, 2016.
- M. Karamouz, S Nasif and M Falahi. Hydrology and Hydroclimatology. CRC press, 2012
- NT. Kottegoda, R Rosso. Applied Statistics for Civil and Environmental Engineers. Wiley Blackwell, 1997
- KS. Raju, DN Kumar. Impact of Climate change on water resources –with modeling techniques and case studies. Springer, 2008

Course Code: 22 CEE 804.4

Hydroclimatology

Course Plan

	Topic	Cos Mapped	No. of Hours
Module I (8 Hours)			
1	Introduction-weather and climate, climate system	CO1	1
2	Climate variables-affecting precipitation- climate variables affecting precipitation, humidity, vapor pressure, saturation vapor pressure–temperature relation	CO1	2
3	Perceptible water, Forms and types of precipitation	CO1	2
4	Cloud – types, atmospheric stability	CO1	1
5	Monsoon- wind pattern in India, Indian summer monsoon rainfall- characteristics	CO1	1
6	Role of global climate oscillations on Indian monsoon rainfall-ElNino and LaNina.	CO1	1
Module II (7 Hours)			
7	Atmosphere- vertical structure	CO2	1
8	Radiation and temperature; laws of radiation	CO2	1
9	The general circulation	CO2	1
10	Random temperature variation; modeling vertical variation in air temperature	CO2	2
11	Temporal variation of air temperature	CO2	1
12	Temperature extremes, heat waves- definition	CO2	1
Module III (8 Hours)			
13	Floods- causes, types	CO3	1
14	Floods- methods of control, flood modeling	CO3	1
15	Frequency analysis of hydro climatic extremes	CO3	2
16	Return period Risk and reliability in hydrologic design- simple problems,	CO3	2
17	Droughts-types, characteristics, drought indices	CO3	2
Module IV (6 Hours)			
18	Causes of climate change	CO4	1
19	Modeling of climate hydrologic impact of climate change- typical framework	CO4	1
20	General circulation models, regional climate models	CO4	1
21	Downscaling- concept and types	CO4	1
22	IPCC reports, scenarios and databases	CO4	1
23	Uncertainty in downscaling studies	CO4	1
Module V (6 Hours)			
24	Principal component analysis	CO5	1

25	Methods for change point analysis	CO5	2
26	Methods for trend analysis	CO5	2
27	Stationary and non-stationary series- determination of non-stationarity of hydro-climatic series	CO5	1

Model Question Paper

Reg No.:………………….. **QP CODE:………………..**

Name:………………………………………

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22 CEE 804.4
Course Name: Hydroclimatology

Max. Marks: 100 **Duration: 3 hours**

PART A

(Answer all questions; each question carries 3 Marks)

1 Differentiate weather and climate

2 Explain the different forms of precipitation

3 Explain temperature extremes

4 Explain the laws of radiation

5 Differentiate risk and reliability of hydrosystems

6 Explain the causes of floods

7 Write a brief description of IPCC Assessment reports

8 What is downscaling in climate studies ?

9 Explain change points in hydrologic series

10 Explain stationarity and non-stationarity of hydro-climatic data 10*3=30

PART B

(Answer one full question from each module, each question carries 14 Marks)

Module I

11 a. Explain precipitable water (8 Marks)

	b.	Explain the role of global climate oscillations on Indian monsoon rainfall	(6 Marks)

OR

12	a.	Explain the different types of clouds	(8 Marks)
	b.	Differentiate ElNino and La Nina	(6 Marks)

Module II

13	a.	Explain the vertical structure of atmosphere with relevant sketches	(10 Marks)
	b.	Explain heat waves	(4 Marks)

OR

14	a.	Explain general circulation of atmosphere. Describe the triple cell general circulation model with the help of neat diagrams.	(10 Marks)
	b.	Explain temporal variation of air temperature	(4 Marks)

Module III

15 a. A cofferdam has been built to protect homes in a floodplain until a major channel project can be completed. The cofferdam was built for a 20-year flood event. The channel project will require 3years to complete. What are the probabilities that (10 Marks)

a) The cofferdam will not be overtopped during the 3 years ?

b) The cofferdam will be overtopped in any one year?

c) The cofferdam will be overtopped exactly once in 3 years?

d) The cofferdam will be overtopped at least once in 3 years ?

e) The cofferdam will be overtopped only in the third year?.

b. Explain the methods of flood control (4 Marks)

OR

16	a.	Explain different types of droughts.	(6 Marks)
	b.	Explain the method of estimation of any four types of drought indices	(8 Marks)

Module IV

17	a.	Explain the causes of climate change.	(8 Marks)
	b.	Differentiate statistical downscaling and dynamic downscaling	(6 Marks)

OR

18	a.	Explain the typical framework for modeling the impact of climate change on water resources	(8 Marks)

	b.	Explain the sources of uncertainty in downscaling studies	(6 Marks)

Module V

19	a.	Explain Principal component analysis and its importance in climate change studies	(5 Marks)
	b.	Explain any three methods for analyzing the trend of hydrologic data	(9 Marks)

OR

20	a.	Explain thy three methods of determination of change point of hydro-climatic data	(9 Marks)
	b.	Explain non-stationarity detection of hydro-climatic studies	(5 Marks)

22 CEE 804.5	SUSTAINABLE CONSTRUCTION	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PEC	3	0	0	3	2019

Preamble: Goal of this course is to expose the students to the fundamental concepts of sustainable building construction. After this course, students will develop an awareness on sustainable building materials and construction practices and also exposed to applications of ICT in sustainable construction.

Prerequisite: MCN 201 Sustainable Engineering

Course Outcomes: After completion of the course the student will be able to:

CO 1	Explain the fundamental concepts of sustainability
CO 2	Describe the properties and uses of sustainable building materials
CO 3	Identify suitable construction techniques and practices for sustainable buildings
CO 4	Discuss the standards and guidelines for sustainable buildings
CO 5	Comment on the role of BIM and automation in sustainable construction

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	-	-	-	-	2	3	-	-	-	-	2
CO 2	2	-	-	-	-	2	3	-	-	-	-	2
CO 3	2	-	-	-	-	2	3	-	-	-	-	2
CO 4	2	-	-	-	-	2	3	-	-	-	-	2
CO 5	2	-	-	-	-	2	3	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	40
Understand	35	30	50
Apply		5	10
Analyse			

Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation (CIE) Pattern :

Attendance : 10 Marks

Continuous Assessment Test (2 numbers) : 25 Marks

Assignment/Quiz/Course project : 15 Marks

End Semester Examination (ESE) Pattern : There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

Course Outcome 1 (CO1):

1. The fundamental concepts of sustainability
2. Describe the features of sustainability indicators
3. Discuss the concepts of sustainability analysis

Course Outcome 2 (CO2):

7. To get a comprehensive overview of materials used for sustainable buildings
8. Identify the properties and uses of sustainable building materials
9. Discuss the role of various Govt and non-Govt organizations in promoting sustainable building materials

Course Outcome 3 (CO3):

1. Apply cost effective technologies and methods in construction
2. Discuss the role of various organizations in promoting sustainable construction practices
3. Discuss case studies pertaining to Kerala context

Course Outcome 4 (CO4):

6. Describe the features of green building rating systems
7. Discuss case studies based on green rating in Indian context

Course Outcome 5 (CO5):

5. Discuss the concepts and benefits of BIM
6. Discuss the applications of BIM in construction management
7. Identify the applications of automation for functional efficiency of buildings

SYLLABUS

Module 1

Introduction to concepts of sustainability : impacts of global warming, sustainability indicators - Carbon foot print, Embodied energy and carbon, sustainability analysis - Life Cycle Analysis, EIA - Concept of Green Buildings

Module 2

Sustainable building materials : Introduction to sustainable building materials, qualities, use, examples - Natural building materials, locally available and locally manufactured materials – wood, earth, stone and lime based materials.

Contemporary Building Materials- concrete, eco block, stabilized blocks (mud blocks, steam cured blocks, Fal-G Blocks stone masonry block.), insulated concrete forms(ISF), hydra form, prefabs / structural insulating panels, cellulose insulation, adobe, rammed earth, earth sheltered and recycled materials - Bio materials : Properties, application, specification and standards(Indian and International) - Bio materials from industrial waste, mining waste, mineral waste, agricultural waste - Non toxic materials: low VOC paints, coating and adhesives - Use of waste materials such as paper, glass bottles, tires, shipping containers - Use of post-consumer and industrial waste such as fly-ash, bags, building construction &demolition waste – use of salvaged and recycled materials from flooring, columns, beams, timber, glass, etc.

Alternative Building Materials - Overview and definition of alternative or appropriate building materials - Alternative materials developed and promoted by government organisations like CSIR labs: CBRI and SERC, GRIHA, ASTRA (IISc), BMTPC, HUDCO and its building centres - Alternative materials developed and promoted by non-government organisations DA, Auroville, TERI

Module 3

Sustainable methods & technologies–Eco friendly and low cost techniques - Different substitute for wall construction - Flemish Bond - Rat Trap Bond – Arches – Panels - Cavity Wall - Ferro Cement and Ferro Concreteconstructions – different pre cast members using these materials - Alternate roofing systems - Filler Slab - Composite Beam and Panel Roof -Pre-engineered and ready to use building elements - wood products -steel and plastic –Mivan technique - Contributions of agencies - Costford - Nirmithi Kendra – Habitat

Module 4

Green building rating systems – Guidelines from IGBC – LEED rating system, TERI-GRIHA rating system.
Codes - Energy Conservation Building Code (BEE), National Building Code.
Green Building Case studies – Residential, Institutional, and Commercial.
Concept of Net Zero buildings – Use of BIPV and other renewable energy in buildings

Module 5

ICT for Sustainable Construction : Building Information modeling – Introduction to BIM, concepts and benefits, BIM for construction scheduling, cost estimation and construction management.

Building Automation – Concepts, components of BA, applications of BA for functional efficiency of buildings.

References:

5. Sustainable Building - Design Manual Pt 1 & 2, The Energy and Resources Institute, TERI, 2004
6. Ross Spiegel.G, Green Building Materials A Guide to Product Selection and Specification, 3rd Edition by, John Wiley &Sons, 2010
7. Jagadish. K.S. Alternative Building Materials and Technologies, New age International Pvt Ltd Publishers, 2008
8. Traci Rose Rider, Stacy Glass, Jessica McNaughton, Understanding Green Building Materials, W.W.Norton andCompany, 2011
9. BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors- Chuck Eastman, et al.
10. Automation Systems in Smart and Green Buildings (Modern Building Technology), Er. V K Jain, Khanna Publishers
11. BIS, National Building Code 2005, New Delhi, 2005
12. Energy Conservation Building Code of India, User manual, 2007
13. P.K. Singh, Rainwater Harvesting: Low cost indigenous and innovative technologies, Macmillan Publishers India, 2008
14. Jagadish. K.S. Building with stabilised mud, I.K. International Publishing House Pvt. Limited, 2007

Course Contents and Lecture Schedule:

Module	Contents	Outcomes Addressed	Hours
1	**Module 1**		**6**
1.1	**Introduction to concepts of sustainability** : impacts of global warming	CO 1	1
1.2	Sustainability indicators - Carbon foot print	CO 1	1
1.3	Embodied energy and carbon	CO 1	1
1.4	Sustainability analysis - Life Cycle Analysis	CO 1	1
1.5	EIA	CO 1	1
1.6	Concept of Green Buildings	CO 1	1
2	**Module 2**		**8**
2.1	**Sustainable building materials** : Introduction to sustainable building materials, qualities, use, examples	CO 2	1
2.2	Natural building materials, locally available and locally manufactured materials – wood, earth, stone and lime based materials	CO 2	1
2.3	**Contemporary Building Materials** - concrete, eco block, stabilized blocks (mud blocks, steam cured blocks, Fal-G Blocks stone masonry block.), insulated concrete forms (ISF), hydra form, prefabs / structural insulating panels, cellulose insulation, adobe, rammed earth, earth sheltered and recycled materials	CO 2	1
2.4	Bio materials : Properties, application, specification and standards (Indian and International) - Bio materials from industrial waste, mining waste, mineral waste, agricultural waste	CO 2	1
2.5	Non toxic materials: low VOC paints, coating and adhesives - Use of waste materials such as paper, glass bottles, tires, shipping containers.	CO 2	1
2.6	Use of post-consumer and industrial waste such as fly-ash, bags, building construction & demolition waste – use of salvaged and recycled materials from flooring, columns, beams, timber, glass, etc.	CO 2	1
2.7	**Alternative Building Materials** - Overview and definition of alternative or appropriate building materials - Alternative materials developed and promoted by government organisations like CSIR labs: CBRI and SERC, GRIHA, ASTRA (IISc), BMTPC, HUDCO and its building centres	CO 2	1
2.8	Alternative materials developed and promoted by non-govt organisations DA, Auroville, TERI	CO 2	1
3	**Module 3**		**8**
3.1	**Sustainable methods & technologies** – Eco friendly and low-cost techniques - Different substitute for wall construction - Flemish Bond - Rat Trap Bond	CO 3	1
3.2	Arches – Panels - Cavity Wall	CO 3	1

3.3	Ferro Cement and Ferro Concrete constructions	CO 3	1
3.4	Different pre cast members using these materials - Alternate roofing systems - Filler Slab - Composite Beam and Panel Roof	CO 3	1
3.5	Pre-engineered and ready to use building elements	CO 3	1
3.6	Wood products - steel and plastic, Mivan technique	CO 3	1
3.7	Contributions of agencies - Costford	CO 3	1
3.8	Nirmithi Kendra – Habitat	CO 3	1
4	**Module 4**		**7**
4.1	**Green building rating systems** – Guidelines from IGBC – LEED rating system, TERI-GRIHA rating system.	CO 4	2
4.2	**Codes** - Energy Conservation Building Code (BEE), National Building Code.	CO 4	1
4.3	**Green Building Case studies** – Residential, Institutional, and Commercial.	CO 4	2
4.4	**Concept of Net Zero buildings** – Use of BIPV and other renewable energy in buildings	CO 4	2
5	**Module 5**		**6**
5.1	**ICT for Sustainable Construction** : Building Information modeling – Introduction to BIM, concepts and benefits	CO 5	1
5.2	BIM for construction scheduling	CO 5	1
5.3	BIM for Cost estimation and construction management.	CO 5	1
5.4	Building Automation – Concepts	CO 5	1
5.5	Components of BA	CO 5	1
5.6	Applications of BA for functional efficiency of buildings.	CO 5	1

Model Question Paper

QP CODE:

Reg No.:_______________ **Name:__________________________**

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22 CEE 804.5
Course Name : SUSTAINABLE CONSTRUCTION

Max. Marks: 100 Duration: 3 hours

Part A
(***Answer all questions; each question carries 3 marks***)

56. Discuss any one sustainability indicator
57. What is EIA? Explain its significance
58. Define eco blocks
59. Enumerate the properties of wood-based materials that make it sustainable
60. Explain pre-engineered building construction
61. Differentiate between ferrocement and ferro-concrete
62. Discuss the role of NBC in sustainable building construction
63. Describe net zero building
64. What are the benefits of BIM?
65. List the components of building automation system

PART B
(Answer one full question from each module, each question carries 14 marks)

Module – 1

66. (a) What is embodied energy? Explain its significance. (5 Marks)
    (b) Illustrate the process of Life Cycle Analysis. (9 Marks)
67. (a) Explain the features of green buildings. (5 Marks)
    (b) Describethe methods for estimation of carbon foot print. (9 Marks)

Module – 2

68. (a) Discuss the initiatives of GRIHA in alternative materials development. (5 Marks)
    (b) List out the various types of agro and industrial wastes and explain their properties (9 Marks)
69. (a) Discuss any five sustainable materials that can be made from utilization of wastes. (5 Marks)
    (b) Elaborate the steps involved in manufacturing of stabilized mud blocks. (9 Marks)

Module – 3

70. (a) Draw the plan of odd and even courses of a corner wall comprising rat trap bond. (5 Marks)
    (b) List out the merits and demerits of Mivan construction technique. (9 Marks)
16. (a) Explain the concept of filler slab roofing systems. (7 Marks)
    (b) Discussthe role of Habitat in propagating cost-effective constructions. (7 Marks)

Module – 4

31. (a) Describe green building features based on a residential case study. (5 Marks)

(b) Compare the rating frameworks of LEED and GRIHA (9 Marks)

32. (a) What are the applications of building integrated photo voltaics? (5 Marks)

(b) Discuss the features of energy efficient buildings based on (i) institutional case study (ii) commercial case study (9 Marks)

Module – 5

33. (a) Enumerate the role of building automation in energy conservation (5 Marks)

(b) Describe the implementation of BIM in construction scheduling. (9 Marks)

34. (a) Illustrate the application of building automation in water conservation (5 Marks)

(b) Explain the process of BIM in cost optimisation. (9 Marks)

22 CEE 804.6	CLIMATE CHANGE AND SUSTAINABILITY	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PEC	3	0	0	3	2019

Preamble: Goal of this course is to expose the students to the fundamental concepts of climate, its influencing factors, climate change and its relationship with sustainability. After this course, students will be able to recognize the real-world problems that can happen due to climate change, aware of the various mitigation and adaptation techniques using sustainable technologies for combating the adverse impacts due to climate change and respond accordingly.

Prerequisite: Nil

Course Outcomes: After completion of the course the student will be able to:

CO 1	Explain the fundamental concepts of climate and its influencing factors
CO 2	Explain the factors affecting climate change and the harmful impacts due to climate change
CO 3	Discuss the problems due to urbanization and the need for sustainable development
CO 4	Demonstrate the various adaptation and mitigation techniques for combating climate change
CO 5	Discuss multilateral agreements on climate change, Case studies on Climate change

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	2	-	2	-	-	2	-	-	-	-	-
CO 3	-	3	-	3	-	-	2	-	-	-	-	-
CO 4	2	-	-	-	-	-	3	-	-	-	-	-
CO 5	-	-	-	-	-	-	2	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	20	20	40
Understand	20	20	40

Apply	10	10	20
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation (CIE)Pattern :

Attendance : 10 Marks

Continuous Assessment Test (2 numbers) : 25 Marks

Assignment/Quiz/Course project : 15 Marks

End Semester Examination (ESE)Pattern : There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

CO1: Explain the fundamental concepts of climate and its influencing factors

1. What is atmospheric stability?
2. Explain in detail the factors influencing climate.
3. Discuss how inversions are formed.

CO2: Explain the factors affecting climate change and the harmful impacts due to climate change

10. Explain vulnerability index.
11. Discuss the impact of climate change on agriculture.
12. What are the anthropogenic drivers of climate change?

CO3: Discuss the problems due to urbanization and the need for sustainable development

1. Explain urban heat islands.
2. What are the causes for urban floods?
3. Discuss how life cycle analysis helps in sustainable development.

CO4: Demonstrate the various adaptation and mitigation techniques for combating climate change

8. How green engineering can help in combating climate change?
9. Explain circular economy
10. Discuss nature based solutions in disaster management.

CO5: Discuss multilateral agreements on climate change, Case studies on Climate change

1. What is Clean Development Mechanism?
2. How emission trading helps fighting climate change?
3. Explain Kyoto mechanisms to reduce GHG emissions.

SYLLABUS

Module 1

Climate

Climate and weather, Meteorology and climatology, Composition and structure of atmosphere.Factors influencing climate-Insolation, Temperature, Humidity, Pressure, Wind, Precipitation, Topography.Atmospheric stability, Lapse rate, Inversions, Types of inversions.Cyclones and Anticyclones.

Module 2

Climate change

Climate change, anthropogenic drivers of climate change, Global warming, Green house effect, Air pollution, carbon foot print, Impact of climate change on water cycle, agriculture, forest, water resources, urban areas, biodiversity, human health. Carbon sequestration , vulnerability index.

Module 3

Urbanisation and Sustainable development

Urbanisation and Industrialization, Urbanisation, problems of urbanisation, Urban sprawl, Urban heat islands, causes, mitigation measures. Urban flooding, water conservation and ecological aspects.Urban Planning, Zoning of Land Use

Pillars of Sustainable development**,** Sustainability indicators, Life cycle analysis, Material flow analysis, Green energy, Waste management, 3R concepts, Sustainable cities, Sustainable Urbanisation

Module 4

Adaptation and mitigation strategies

Green Engineering, Design for Engineering, Green technologies, Circular economy. Planning of cities as climate resilient, Climate change and infrastructure planning, Climate resilient infrastructure, nature based solutions in disaster management, adaptation strategies for combating climate change

Module 5

Climate and sustainability

Sustainability Engineering , Kyoto mechanisms to reduce GHG emission- Clean Development Mechanism, Joint Implementation, Emission trading, Case studies on Kyoto mechanism, Case studies on climate change and climate change risk reduction.

References

- Lal, DS, “Climatology”, Published by Sharda Pustak Bhawan, ISBN8186204121
- John T. Hardy, Jean Ponce, “Climate Change - Causes, Effects, and Solutions”, Wiley Publications, 2003
- Jonathan Tomkin, Tom Theis, "Sustainability - A Comprehensive Foundation", 12th Media Services, 2018
- Karthik Karuppu, "Green Building Guidance: The Ultimate Guide for IGBC Accredited Professional Examination Book", NVICO Notion Press, 2019
- Keith D. Alverson, ZintaZommers, "Resilience : The science of adaptation to climate change", Elsevier, 2018
- Leal Filho, W., Azul, A.M., Brandli, L., Özuyar, P.G., Wall, T. (Eds.), “Sustainable Cities and Communities” Springer
- Intergovernmental Panel on Climate Change (IPCC) reports

Course contents and Lecture schedule `

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module 1: Total Lecture Hours -7**		
1.1	Climate and weather, Meteorology and climatology, Composition and structure of atmosphere.	CO1	1
1.2	Factors influencing climate-Insolation, Temperature, Humidity, Pressure, Wind, Precipitation, Topography.	CO1	2
1.3	Atmospheric stability, Lapse rate, Inversions, Types of inversions.	CO1	3
1.4	Cyclones and Anticyclones.	CO1	1
2	**Module II: Total Lecture Hours- 7**		
2.1	Climate change, anthropogenic drivers of climate change	CO2	1
2.2	Global warming, Green house effect, Air pollution, carbon foot print,	CO2	2
2.3	Impact of climate change on water cycle, agriculture, forest, water resources, urban areas, biodiversity, human health.	CO2	3
2.4	Carbon sequestration , vulnerability index.	CO2	2
3	**Module III: Total Lecture Hours-7**		
3.1	Urbanisation and Industrialization, Urbanisation, problems of urbanisation, Urban sprawl, Urban heat islands, causes, mitigation measures.	CO3	2
3.2	Urban flooding, water conservation and ecological aspects.Urban Planning, Zoning of Land Use	CO3	1
3.3	Pillars of Sustainable development**,** Sustainability indicators,	CO3	1
3.4	Life cycle analysis, Material flow analysis,	CO3	1
3.5	Green energy, Waste management, 3R concepts,	CO3	1
3.6	Sustainable cities, Sustainable Urbanisation	CO3	1
4	**Module IV: Total Lecture Hours- 7**		
4.1	Green Engineering, Design for Engineering, Green technologies	CO4	2

4.2	Circular economy	CO4	1
4.3	Planning of cities as climate resilient, Climate change and infrastructure planning, Climate resilient infrastructure.	CO4	2
4.4	Nature based solutions in disaster management	CO4	1
4.5	Adaptation strategies for combating climate change	CO4	1
5	**Module V: Total Lecture Hours- 7**		
5.1	Sustainability Engineering , Kyoto mechanisms to reduce GHG emission, Case studies on Kyoto mechanism.	CO4	3
5.2	Clean Development Mechanism, Joint Implementation, Emission trading	CO3, CO4	2
5.3	Case studies on climate change and climate change risk reduction	CO4	2

Model Question Paper

Reg No.:_______________ **Name:___________________________**

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: 22 CEE 804.6
Course Name: CLIMATE CHANGE & SUSTAINABILITY

Max. Marks: 100 Duration: 3 Hours

Part A
(***Answer all questions; each question carries 3 marks***)

71. Explain lapse rate.
72. How climate is different from weather.
73. What is carbon footprint?
74. Explain carbon sequestration.
75. Explain urban sprawl.
76. What is 3R concept in waste management?
77. What is a climate resilient city?
78. How adaptation and mitigation strategies are different?.
79. Explain CDM.
80. What is emission trading?

PART B
(Answer one full question from each module, each question carries 14 marks)

81. (a) Discuss how inversions are formed. What are different types of inversion? (7 Marks)
    (b) Describe the composition and structure of atmosphere with a neat sketch .(7 Marks)

OR

82. (a) Explain in detail the factors influencing climate (8 Marks)
    (b) Compare cyclones and anticyclones ? (6 Marks)

83. (a) Discuss the impact of climate change on agriculture (8 Marks)
    (d) Explain vulnerability index (6 Marks)

OR

84. (a) What are the anthropogenic drivers for climate change? (8 Marks)
(b) Explain Green house effect. How it influence climate? (6 Marks)

85. (a) What is urban heat island? What are the causes? (8 Marks)
(b) Explain life cycle analysis. (6 Marks)

OR

16. (a) Discuss the causes and mitigation measures for urban flood (7 Marks)
(b) Explain the pillars of sustainable development (7 Marks)

35. (a) Explain how green technologies help in combating climate change. (7Marks)
(b) Discuss nature based solutions in disaster management. (7 marks)

OR

36. (a)Explain how circular economy concepts helps in climate change mitigation (7 Marks)
(b) What are the factors to consider while designing a climate resilient city? (7 Marks)

37. (a) Explain Kyoto mechanisms to reduce GHG emissions (7 Marks)
(b) How emission trading is effective as a climate change reduction strategy? (7 Marks)

OR

38. Elaborate climate change reduction strategies with an example case study (14 Marks)

22CEE 804.7	BUILDING INFORMATION MODELLING	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PEC	3	0	0	3	2019

Preamble: Goal of this course is to expose the students to the use of Building Information Modelling in building construction projects.Students will learn terminology associated with buildings, the theory and evolution of BIM, and how to develop BIM models using software like Autodesk Revit.

Prerequisite : CEL 334 Civil Engineering Software Lab

Course Outcomes: After completion of the course the student will be able to:

CO 1	Explain the concept and advantages of BIM
CO 2	Apply the various processes on a BIM model
CO 3	Appraise the collaborative and interoperability capabilities of BIM
CO 4	Explain BIM execution plan
CO 5	Explain the principles of integrated project delivery

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	-	-	-	-	1	-	-	-	-	-	-
CO 2	1	-	1	-	1	-	-	-	-	-	-	-
CO 3	1	-	1	-	1	-	-	-	3	3	-	-
CO 4	1	-	1	-	1	-	-	-	3	-	3	-
CO 5	1	-	1	-	1	-	-	-	3	3	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	30
Understand	20	25	40
Apply	10	5	10
Analyse	10	10	20
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation (CIE)Pattern :

Attendance	: 10 Marks
Continuous Assessment Test (2 numbers)	: 25 Marks
Software assignments	: 15 Marks

End Semester Examination (ESE)Pattern : There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from 1st ,3rd ,4th and 5th module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 15 marks.

Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

Course Outcome 1 (CO1):

1. Identify the inadequacies of traditional construction and planning practices
2. How construction practices can be improved by BIM
3. Evolution and development of BIM from its origin to today
4. Concept of BIM as a lifecycle platform

Course Outcome 2 (CO2):

13. Proficiency in various tools provided by Revit software
14. Proficiency in various software that make up 5D BIM

Course Outcome 3 (CO3):

4. BIM and collaboration between construction stakeholders
5. Explain types of Data Exchange Methods
6. Appraisal of BIM guides

Course Outcome 4 (CO4):

11. How to identify and resolve issues in model
12. Benefits of BIM project execution plans
13. List the project goals that can be served by BIM uses
14. Explain BIM overview and BIM use maps

Course Outcome 5 (CO5):

9. What are the principles of Integrated Project Delivery?

SYLLABUS

Module 1
Introduction to BIM Traditional AEC Business Model and its inefficiencies What is BIM? – BIM vs 3D vs 2D – BIM as a product vs BIM as a process BIM as a lifecycle platform Why BIM – incentives and benefits – technical and financial. The Evolution to Object-Based Parametric Modeling BIM Model Quality and Model Checking
Module 2
BIM software training Create Modeling Views - Model Layout - Architectural Modeling-Structural Modeling-MEP Modeling-Construction Modeling - Project Management - Revit Families - Tools and Techniques - Project Phasing - Document and Present the Design -Analyze the Design (Energy, solar, area, etc.) – Schedules - Rendering – Walkthroughs (Topics have to be discussed and demonstrated with the help of software at the Laboratory; Each topic will be an assignment in each week. Theory classes may progress with the other modules.)
Module 3
Collaboration, Interoperability and roles BIM for stakeholders - Owners , Facility Managers and Government Institutions , Architects and Engineers, Contractors, Subcontractors and Fabricators. BIM Adoption, Maturity Levels BIM Guides (From countries like Finland, Denmark, Belgium etc) Data Exchange Methods – File based, Cloud based and local data exchange methods Product Data Models and Standardization File-Based Exchange and BIM Servers, IFC – Industry Foundation classes, COBie
Module 4
BIM Execution Plan Overview of the BIM Execution Planning Procedure for Building Information Modeling Establish Project Modeling Goals Select Model Uses Design the BIM Process

Define the Information Exchanges Plan Infrastructure Implementing the BIM Project Execution Planning Procedure BIM Project Execution Planning for Organizations Conclusions and Recommendations
Module 5
Integrated Project Delivery Principles of Integrated Project Delivery - Mutual Respect and Trust ,Mutual Benefit and Reward, Collaborative Innovation and Decision Making, Early Involvement of Key Participants, Early Goal Definition, Intensified Planning, Open Communication, Appropriate Technology, Organization and Leadership Setting Up an Integrated Project - IPD Team Building and Functioning, Defining Roles, Responsibilities and Scopes of Services, Defining and Measuring Project Outcomes Delivering an Integrated Project- Building an Integrated Team, Project Execution / Redefining Project Phases

References:

15. BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors by Eastman, Chuck; Tiecholz, Paul; Sacks, Rafael; Liston, Kathleen
16. BIM Project Execution Planning Guide, Version 3.0 by John Messner, ChimayAnumba, Craig Dubler, Sean Goodman, Colleen Kasprzak, Ralph Kreider, Robert Leicht, Chitwan Saluja, NevenaZikic, and Sagata Bhawani
17. Integrated Project Delivery: A Guide by AIA
18. Autodesk Revit: User Guide by Autodesk

Course Contents and Lecture Schedule:

Module	Contents	Outcomes Addressed	Hours
1	**Module 1**		**7**
1.1	Traditional AEC Business Model and its inefficiencies	CO 1	1
1.2	What is BIM? – BIM vs 3D vs 2D – BIM as a product vs BIM as a process	CO 1	1
1.3	BIM as a lifecycle platform – Applications of BIM in the entire lifecycle of a building	CO 1 & CO 2	2
1.4	Why BIM – incentives and benefits – technical and financial	CO 1 &CO 3	1
1.5	The Evolution to Object-Based Parametric Modeling	CO 1	1
1.6	BIM Model Quality and Model Checking	CO 1	1
2	**Module 2**		**8**
2.1	Create Modeling Views - Model Layout	CO 2	1
2.2	Architectural Modeling	CO 2	1
2.3	Structural Modeling	CO 2	
2.4	MEP Modeling	CO 2	1
2.5	Construction Modeling - Project Management	CO 2	1
2.6	Revit Families - Tools and Techniques	CO 2	1
2.7	Project Phasing - Document and Present the Design	CO 2	1
2.8	Analyze the Design (Energy, solar, area, etc.)	CO 2	1
2.9	Schedules - Rendering – Walkthroughs	CO 2	1
3	**Module 3**		**7**
3.1	BIM for stakeholders - Owners , Facility Managers and Government Institutions , Architects and Engineers, Contractors, Subcontractors and Fabricators.	CO 1& CO 3	2
3.2	BIM Adoption, Maturity Levels	CO 1	1
3.3	BIM Guides (From countries like Finland, Denmark, Belgium etc)	CO 1	1
3.4	Data Exchange Methods – File based, Cloud based and local data exchange methods	CO 3	1
3.5	Product Data Models and Standardization	CO 2	1
3.6	File-Based Exchange and BIM Servers, IFC – Industry Foundation classes, COBie	CO 3	1

4	**Module 4**		**7**
4.1	Overview of the BIM Execution Planning Procedure for Building Information Modeling	CO 1& CO 4	1
4.2	Establish Project Modeling Goals	CO 4	1
4.3	Select Model Uses Design the BIM Process	CO 4	1
4.4	Define the Information Exchanges	CO 4	1
4.5	Plan Infrastructure	CO 4	1
4.6	Implementing the BIM Project Execution Planning Procedure	CO 4	1
4.7	BIM Project Execution Planning for Organizations, Conclusions and Recommendations	CO 4	1
5	**Module 5**		**7**
5.1	**Principles of Integrated Project Delivery** - Mutual Respect and Trust , Mutual Benefit and Reward ,Collaborative Innovation and Decision Making , Early Involvement of Key Participants, Early Goal Definition, Intensified Planning, Open Communication, Appropriate Technology, Organization and Leadership	CO 5	1
5.2	**Setting Up an Integrated Project** - IPD Team Building and Functioning, Defining Roles, Responsibilities and Scopes of Services, Defining and Measuring Project Outcomes	CO 5	4
5.3	**Delivering an Integrated Project-**Building an Integrated Team, Project Execution / Redefining Project Phases	CO 5	2

Model Question Paper

QP CODE:

Reg No.:_______________ **Name:___________________________**

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: 22 CEE 804.7
Course Name: BUILDING INFORMATION MODELLING

Max. Marks: 100 Duration: 3 hours

Part A
(***Answer all questions; each question carries 4 marks***)

86. Write a short note on the history of BIM
87. How is BIM a lifecycle process?
88. State the tools used in structural modelling in BIM.
89. List the tools in REVIT used to do architectural modelling.
90. Explain the various maturity Levels of BIM
91. Write short note on IFC
92. List the BIM model uses in various project phases.
93. How is the Information Exchange worksheet designed?
94. Describe examples of standardized clash detection tests that might be saved and repeated across many projects.
95. Describe the types of viewpoints that would focus on primary concerns of different stakeholders?

PART B
(Answer one full question from each module, each question carries 15 marks)

Module – 1

96. (a)What are the technical and financial incentives of using BIM? (10 Marks)
    (b) How is BIM different from 2D and 3D CAD (5 Marks)

97. Explain BIM model checking with respect to its 5 phases (15 Marks)

Module – 3

98. Differentiate between File based, Cloud based and Local Data exchange methods in BIM

(15 Marks)

99. Explain the importance of BIM for each stakeholders - Owners , Facility Managers and Government Institutions , Architects and Engineers, Contractors, Subcontractors and Fabricators (15 Marks)

Module – 4

39. (a) Why should the project team develop a BIM Project Execution Plan (5 Marks)
    (b) Outline and discuss the 5 step procedure to develop a detailed BEP. (10 Marks)

40. Explain in detail how the Information Exchange worksheet is designed? (15 Marks)

Module – 5

41. Explain the principles of integrated project delivery (15 Marks)

42. Define the roles, responsibilities and scope of services of the integrated project delivery stakeholders (15 Marks)

22CEV 805	COMPREHENSIVE COURSE VIVA	CATEGORY	L	T	P	CREDIT
		PCC	1	0	0	1

Preamble: The objective of this Course viva is to ensure the basic knowledge of each student in the most fundamental core courses in the curriculum. The viva voce shall be conducted based on the core subjects studied from third to eighth semester. This course helps the learner to become competent in placement tests and other competitive examinations.

Guidelines

1. The course should be mapped with a faculty and classes shall be arranged for practicing questions based on the core courses listed in the curriculum.
2. The viva voce will be conducted by the same three member committee assigned for final project phase II evaluation. It comprises of Project coordinator, expert from Industry/research Institute and a senior faculty from a sister department.
3. The pass minimum for this course is 25.
4. The mark will be treated as internal and should be uploaded along with internal marks of other courses.
5. Comprehensive Viva should be conducted along with final project evaluation by the three member committee.

Mark Distribution

Total marks: 50, only CIE, minimum required to pass : 25 Marks

22CEP 806	PROJECT PHASE II	CATEGORY	L	T	P	CREDIT
		PWS	0	0	12	4

Preamble: The course 'Project Work' is mainly intended to evoke the innovation and invention skills in a student. The course will provide an opportunity to synthesize and apply the knowledge and analytical skills learned, to be developed as a prototype or simulation. The project extends to 2 semesters and will be evaluated in the 7th and 8th semester separately, based on the achieved objectives. One third of the project credits shall be completed in 7th semester and two third in 8th semester. It is recommended that the projects may be finalized in the thrust areas of the respective engineering stream or as interdisciplinary projects. Importance should be given to address societal problems and developing indigenous technologies.

Course Objectives

- To apply engineering knowledge in practical problem solving.
- To foster innovation in design of products, processes or systems.
- To develop creative thinking in finding viable solutions to engineering problems.

Course Outcomes [COs]: After successful completion of the course, the students will be able to:

CO1	Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: **Apply**).
CO2	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: **Apply**).
CO3	Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: **Apply**).
CO4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: **Apply**).
CO5	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: **Analyze**).
CO6	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: **Apply**).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	2	2	2	1	1	1	1	2
CO2	2	2	2		1	3	3	1	1		1	1
CO3									3	2	2	1
CO4					2			3	2	2	3	2

CO5	2	3	3	1	2							1
CO6					2			2	2	3	1	1

Abstract POs defined by National Board of Accreditation			
PO #	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO0	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

PROJECT PHASE II

Phase 2 Targets

- In depth study of the topic assigned in the light of the report prepared under Phase - I;
- Review and finalization of the approach to the problem relating to the assigned topic.
- Preparing a detailed action plan for conducting the investigation, including teamwork.
- Detailed Analysis/ Modeling / Simulation/ Design/ Problem Solving/Experiment as needed.
- Final development of product/ process, testing, results, conclusions and future directions.
- Preparing a paper for Conference Presentation/ Publication in Journals, if possible.
- Presenting projects in Project Expos conducted by the University at the cluster level and/ or state level as well as others conducted in India and abroad.
- Filing Intellectual Property Rights (IPR) if applicable.
- Preparing a report in the standard format for being evaluated by the Department Assessment Board.
- Final project presentation and viva voce by the assessment board including the external expert.

Evaluation Guidelines & Rubrics

Total: 150 marks (Minimum required to pass: 75 marks).

- Project progress evaluation by guide: 30 Marks.
- Two interim evaluations by the Evaluation Committee: 50 Marks (25 marks for each

evaluation).

- Final evaluation by the Final Evaluation committee: 40 Marks
- Quality of the report evaluated by the evaluation committee: 30 Marks

(The evaluation committee comprises HoD or a senior faculty member, Project coordinator and project supervisor. The final evaluation committee comprises of Project coordinator, expert from Industry/research/academic Institute and a senior faculty from a sister department).

Evaluation by the Guide

The guide/supervisor must monitor the progress being carried out by the project groups on regular basis. In case it is found that progress is unsatisfactory it should be reported to the Department Evaluation Committee for necessary action. The presence of each student in the group and their involvement in all stages of execution of the project shall be ensured by the guide. Project evaluation by the guide: 30 Marks. This mark shall be awarded to the students in his/her group by considering the following aspects:

Project Scheduling & Distribution of Work among Team members: Detailed and extensive Scheduling with timelines provided for each phase of project. Work breakdown structure well defined. (5)

Literature survey: Outstanding investigation in all aspects. (4)

Student's Diary/ Daily Log: The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily/weekly activity diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily/weekly activity diary shall be signed after every day/week by the guide. (7)

Individual Contribution: The contribution of each student at various stages. (9)

Completion of the project: The students should demonstrate the project to their respective guide. The guide shall verify the results and see that the objectives are met. (5)

EVALUATION RUBRICS for PROJECT Phase II: Interim Evaluation - 1

No.	Parameters	Marks	Poor	Fair	Very Good	Outstanding
2-a	Novelty of idea, and Implementation scope [CO5] [Group Evaluation]	5	The project is not addressing any useful requirement. The idea is evolved into a non-implementable one. The work presented so far is lacking any amount of original work by the team.	Some of the aspects of the proposed idea can be implemented. There is still lack of originality in the work done so far by the team. The project is a regularly done theme/topic without any freshness in terms of specifications, features, and/or improvements.	Good evidence of an implementable project. There is some evidence for the originality of the work done by the team . There is fresh specifications/ features/improvements suggested by the team. The team is doing a design from fundamental principles, and there is some independent learning and engineering ingenuity.	The project has evolved into incorporating an outstandingly novel idea. Original work which is not yet reported anywhere else. Evidence for ingenious way of innovation which is also Implementable. Could be a patentable / publishable work.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
2-b	Effectiveness of task distribution among team members. [CO3] [Group Evaluation]	5	No task distribution of any kind. Members are still having no clue on what to do.	Task allocation done, but not effectively, some members do not have any idea of the tasks assigned. Some of the tasks were identified but not followed individually well.	Good evidence of task allocation being done, supported by project journal entries, identification of tasks through discussion etc. However, the task distribution seems to be skewed, and depends a few members heavily than others. Mostly the tasks are being followed by the individual members.	Excellent display of task identification and distribution backed by documentary evidence of team brainstorming, and project journal entries. All members are allocated tasks according to their capabilities, and as much as possible in an equal manner. The individual members are following the tasks in an excellent manner.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)

2-c	Adherence to project schedule. [CO4] [Group Evaluation]	**5**	Little or no evidence of continued planning or scheduling of the project. The students did not stick to the plan what they were going to build nor plan on what materials / resources to use in the project. The students do not have any idea on the budget required even after the end of phase - I. No project journal kept or the journal.	There is some improvement in the primary plan prepared during phase I. There were some ideas on the materials /resources required, but not really thought out. The students have some idea on the finances required, but they have not formalized a budget plan. Schedules were not prepared. The project journal has no useful details on the project.	Good evidence of planning done and being followed up to a good extent after phase I. Materials were listed and thought out, but the plan wasn't followed completely. Schedules were prepared, but not detailed, and needs improvement. Project journal is presented but it is neither complete nor updated regularly.	Excellent evidence of enterprising and extensive project planning and follow-up since phase I. Continued use of project management/version control tool to track the project. Material procurement if applicable is progressing well. Tasks are updated and incorporated in the schedule. A well-kept project journal showed evidence for all the above, in addition to the interaction with the project guide.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-d	Interim Results. [CO6] [Group assessment]	**5**	There are no interim results to show.	The team showed some interim results, but they are not complete / consistent to the current stage, Some corrections are needed.	The interim results showed were good and mostly consistent/correct with respect to the current stage. There is room for improvement.	There were significant interim results presented which clearly shows the progress.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-e	Presentation [Individual assessment]	**5**	Very poor presentation and there is no interim results. The student has no idea about the project proposal.	Presentation is average, and the student has only a feeble idea about the team work.	Good presentation. Student has good idea about the team's project. The overall presentation quality is good.	Exceptionally good presentation. Student has excellent grasp of the project. The quality of presentation is outstanding.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
Phase-II Interim Evaluation - 1 Total Marks: 25						

EVALUATION RUBRICS for PROJECT Phase II: Interim Evaluation – 2

No	Parameters	Marks	Poor	Fair	Very Good	Outstanding
2-f	Application of engineering knowledge [CO1] [Individual Assessment]	10	The student does not show any evidence of applying engineering knowledge on the design and the methodology adopted. The student's contribution in application of engineering knowledge in the project is poor.	The student appears to apply some basic knowledge, but not able to show the design procedure and the methodologies adopted in a comprehensive manner.	The student is able to show some evidence of application of engineering knowledge in the design and development of the project to good extent.	Excellent knowledge in design procedure and its adaptation. The student is able to apply knowledge from engineering domains to the problem and develop solutions.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
2-g	Involvement of individual members [CO3] [Individual Assessment]	5	No evidence of any Individual participation in the project work.	There is evidence for some amount of individual contribution, but is limited to some of the superficial tasks.	The individual contribution is evident. The student has good amount of involvement in core activities of the project.	Evidence available for the student acting as the core technical lead and has excellent contribution to the project.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-h	Results and inferences upon execution [CO5] [Group Assessment]	5	None of the expected outcomes are achieved yet. The team is unable to derive any inferences on the failures/ issues observed. Any kind o f observations or studies are not made.	Only a few of the expected outcomes are achieved. A few inferences are made on the observed failures/issues. No further work suggested.	Many of the expected outcomes are achieved. Many observations and inferences are made, and attempts to identify the issues are done. Some suggestions are made for further work.	Most of the stated outcomes are met. Extensive studies are done and inferences drawn. Most of the failures are addressed and solutions suggested. Clear and valid suggestions made for further work.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-i	Documentation and presentation. .[CO6]	5	The individual student has no idea on the presentation of his/her part. The presentation is of poor quality.	Presentation's overall quality needs to be improved.	The individual's presentation performance is satisfactory.	The individual's presentation is done professionally and with great clarity. The individual's performance is excellent.

	[Individual assessment]		(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
Phase-II Interim Evaluation - 2 Total Marks: 25						

EVALUATION RUBRICS for PROJECT Phase II: Final Evaluation

No	Parameters	Marks	Poor	Fair	Very Good	Outstanding
2-j	Engineering knowledge. [CO1] [Group Assessment]	10	The team does not show any evidence of applying engineering knowledge on the design and the methodology adopted.	The team is able to show some of the design procedure and the methodologies adopted, but not in a comprehensive manner.	The team is able to show evidence of application of engineering knowledge in the design and development of the project to good extent. There is scope for improvement.	Excellent knowledge in design procedure and its adaptation. The team is able to apply knowledge from engineering domains to the problem and develop an excellent solution.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
2-k	Relevance of the project with respect to societal and/or industrial needs. [Group Assessment] [CO2]	5	The project as a whole do not have any societal / industrial relevance at all.	The project has some relevance with respect to social and/or industrial application. The team has however made not much effort to explore further and make it better.	The project is relevant to the society and/or industry. The team is mostly successful in translating the problem into an engineering specification and managed to solve much of it.	The project is exceptionally relevant to society and/or industry. The team has made outstanding contribution while solving the problem in a professional and/ or ethical manner.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-i	Innovation / novelty / Creativity [CO5] [Group Assessment]	5	The project is not addressing any useful requirement. The idea is evolved into a non-implementable one. The work presented so far is lacking any amount of original work by the team.	Some of the aspects of the proposed idea appears to be practical. There is still lack of originality in the work done. The project is a regularly done theme/topic without any freshness in terms of specifications, features, and/ or improvements.	Good evidence of an implementable project. There is some evidence for the originality of the work done by the team. There is fresh specifications/ features/improvements suggested by the team. The team is doing a design from fundamental principles, and there is some independent learning and engineering ingenuity. Could be translated into a product / process if more work is done.	The project has evolved into incorporating an outstandingly novel idea. Original work which is not yet reported anywhere else. Evidence for ingenious way of innovation which is also Implementable. Could be a patentable publishable work.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)

2-m	Quality of results / conclusions / solutions. [CO1] [Group Assessment]	10	None of the expected outcomes are achieved. The team is unable to derive any inferences on the failures/issues observed. Any kind of observations or studies is not made.	Only a few of the expected outcomes are achieved. A few inferences are made on the observed failures/issues. No further work suggested.	Many of the expected outcomes are achieved. Many observations and inferences are made, and attempts to identify the issues are done. Some suggestions are made for further work.	Most of the stated outcomes are met. Extensive studies are done and inferences drawn. Most of the failures are addressed and solutions suggested. Clear and valid suggestions made for further work.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)

2-n	Presentation - Part I Preparation of slides. [CO6] [Group Assessment].	5	The presentation slides are shallow and in a clumsy format. It does not follow proper organization.	Presentation slides follow professional style formats to some extent. However, its organization is not very good. Language needs to be improved. All references are not cited properly, or acknowledged. Presentation slides needs to be more professional.	Presentation slides follow a good style format and there are only a few issues. Organization of the slides is good. Most of references are cited properly. The flow is good and team presentation is neatly organized. Some of the results are not clearly shown. There is room for improvement.	The presentation slides are exceptionally good. Neatly organized. All references cited properly. Diagrams/Figures, Tables and equations are properly numbered, and l i s ted. Results/ inferences clearly highlighted and readable.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
	Presentation - Part II: Individual Communication [CO6] [Individual Assessment].	5	The student is not communicating properly. Poor response to questions.	The student is able to explain some of the content. The student requires a lot of prompts to get to the idea. There are language issues.	Good presentation/ communication by the student. The student is able to explain most of the content very well. There are however, a few areas where the student shows lack of preparation. Language is better.	Clear and concise communication exhibited by the student. The presentation is outstanding. Very confident and tackles all the questions without hesitation. Exceptional traits of communicator.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
Phase-II Final Evaluation, Marks: 40						

EVALUATION RUBRICS for PROJECT Phase II: Report Evaluation						
Sl. No.	**Parameters**	**Marks**	**Poor**	**Fair**	**Very Good**	**Outstanding**
2-o	Report [CO6]	30	The prepared report is shallow and not as per standard format. It does not follow proper organization. Contains mostly unacknowledged content. Lack of effort in preparation is evident. References are not cited. Unprofessional and inconsistent formatting.	Project report follows the standard format to some extent. However, its organization is not very good. Language needs to be improved. All references are not cited properly in the report. There is lack of formatting consistency.	Project report shows evidence of systematic documentation. Report is mostly following the standard style format and there are only a few issues. Organization of the report is good. Mostly consistently formatted. Most of references/sources are cited/ acknowledged properly.	The report is exceptionally good. Neatly organized. All references cited properly. Diagrams/Figures, Tables and equations are properly numbered, and listed and clearly shown. Language is excellent and follows professional styles. Consistent formatting and exceptional readability.
			(0 - 11 Marks)	(12 - 18 Marks)	(19 - 28 Marks)	(29 - 30 Marks)
Phase - II Project Report Marks: 30						

22CEMR 807	MINI PROJECT	CATEGORY	L	T	P	CREDIT
		PWS	0	0	3	4

Preamble: Mini Project Phase I: A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The object of Project Work I is to enable the student to take up investigative study in the broad field of Civil Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on a group of three/four students, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

- Survey and study of published literature on the assigned topic;
- Preparing an Action Plan for conducting the investigation, including team work;
- Working out a preliminary Approach to the Problem relating to the assigned topic;
- Block level design documentation
- Conducting preliminary Analysis/ Modelling/ Simulation/ Experiment/ Design/ Feasibility;
- Preparing a Written Report on the Study conducted for presentation to the Department;

CO1	Identify and synthesize problems and propose solutions to them.
CO2	Prepare work plan and liaison with the team in completing as per schedule.
CO3	Validate the above solutions by theoretical calculations and through Experimental
CO4	Write technical reports and develop proper communication skills.
CO5	Present the data and defend ideas.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3					3	3		2
CO2	3			3				3	3	3	3	
CO3	3	3	3	3	3					3		
CO4					3			3	3	3		1
CO5	3	3	3	3				3		3	3	1

*1-slight/low mapping, 2- moderate/medium mapping, 3-substantial/high mapping

Assessment Pattern

The End Semester Evaluation (ESE) will be conducted as an internal evaluation based on the product, the report and a viva- voce examination, conducted by a 3-member committee appointed by Head of the Department comprising HoD or a senior faculty member, academic coordinator for that program and project guide/coordinator. The Committee will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, working knowledge and involvement.

The Continuous Internal Evaluation (CIE) is conducted by evaluating the progress of the mini project through minimum of TWO reviews. At the time of the 1st review, students are supposed to propose a new system/design/idea, after completing a thorough literature study of the existing systms under their chosen area. In the 2nd review students are expected to highlight the implementation details of the proposed solution. The review committee should assess the extent to which the implementation reflects the proposed design. A well coded, assembled and completely functional product is the expected output at this stage. The final CIE mark is the average of 1st and 2nd review marks.

A zeroth review may be conducted before the beginning of the project to give a chance for the students to present their area of interest or problem domain or conduct open brainstorming sessions for innovative ideas. Zeroth review will not be a part of the CIE evaluation process.

Marks Distribution

Total Marks	CIE	ESE
150	75	75

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Marks awarded by Guide : 15 marks
Project Report : 10 marks
Evaluation by the Committee : 40 Marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks.

(a) Demonstration : 50 Marks
(b) Project report : 10 Marks
(d) Viva voce : 15marks

Course Plan

In this course, each group consisting of three/four members is expected to design and develop a moderately complex software/hardware system with practical applications. This should be a working model. The basic concept of product design may be taken into consideration.

Students should identify a topic of interest in consultation with Faculty-in-charge of miniproject/Advisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives. Demonstrate the novelty of the project through the results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews**.**

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The product has to be demonstrated for its full design specifications. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight.

22CEHR 808	MINI PROJECT	CATEGORY	L	T	P	CREDIT
		PWS	0	0	3	4

Preamble: Mini Project Phase I: A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The object of Project Work I is to enable the student to take up investigative study in the broad field of Civil Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on a group of three/four students, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

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- Preparing an Action Plan for conducting the investigation, including team work;
- Working out a preliminary Approach to the Problem relating to the assigned topic;
- Block level design documentation
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Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3					3	3		2
CO2	3			3				3	3	3	3	
CO3	3	3	3	3	3					3		
CO4					3			3	3	3		1
CO5	3	3	3	3				3		3	3	1

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