SYLLABUS FOR
IV SEMESTER
MECHANICAL ENGINEERING
## SCHEME -2013

### IV SEMESTER

**MECHANICAL ENGINEERING (M)**

<table>
<thead>
<tr>
<th>Course No</th>
<th>Name of subject</th>
<th>Credits</th>
<th>Weekly load, hours</th>
<th>C A Marks</th>
<th>Exam Duration Hrs</th>
<th>U E Max Marks</th>
<th>Total Marks</th>
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<tr>
<td>13.401</td>
<td>Engineering Mathematics -III (BCHMNPSU)</td>
<td>4</td>
<td>3 1 -</td>
<td>50</td>
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<td>13.402</td>
<td>Manufacturing Process (MN)</td>
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<tr>
<td>13.403</td>
<td>Electrical Technology (MP)</td>
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<tr>
<td>13.404</td>
<td>Metullargy and Material Science (MNPU)</td>
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<td>13.405</td>
<td>Fluid Machinery (M)</td>
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<td>13.406</td>
<td>Machine Drawing (M)</td>
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<td>13.407</td>
<td>Fluid Mechanics &amp; Machines Lab(MN)</td>
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<td>13.408</td>
<td>IC Engines Lab (M)</td>
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13.401 ENGINEERING MATHEMATICS - III (BCHMNPSU)

Teaching Scheme: 3(L) - 1(T) - 0(P)  

Credits: 4

Course Objective:

- To introduce the basic notion in complex analysis such as Analytic Functions, Harmonic functions and their applications in fluid mechanics and differentiations and integration of complex functions, transformations and their applications in engineering fields.

- Numerical techniques for solving differential equations are also introduced as a part of this course.

Module – I

**Complex Differentiation:** Limits, continuity and differentiation of complex functions. Analytic functions – Cauchy Riemann equations in Cartesian form (proof of necessary part only). Properties of analytic functions – harmonic functions. Milne Thomson method.

**Conformal mapping:** Conformality and properties of the transformations $w = \frac{1}{z}$, $w = z^2$, $w = z + \frac{1}{z}$, $w = \sin z$, $w = e^z$ - Bilinear transformations.

Module – II

**Complex Integration:** Line integral – Cauchy’s integral theorem – Cauchy’s integral formula – Taylor’s and Laurent’s series – zeros and singularities – residues and residue theorem.

Evaluation of real definite integrals $\int_0^{2\pi} f(\sin x, \cos x)dx$, $\int_{-\infty}^{\infty} f(x)dx$ (with no poles on the real axis). (Proof of theorems not required).

Module – III


Module – IV

**Numerical integration** - Trapezoidal Rule- Simpson’s one third rule.


**Numerical Solution of two-dimensional partial differential equation** (Laplace equation) - using finite difference method (five point formula)
References:


**Internal Continuous Assessment** *(Maximum Marks-50)*

50% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

**University Examination Pattern:**

*Examination duration: 3 hours*  
*Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

**Part A (20 marks)** - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**Part B (80 Marks)** - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

**Course Outcome:**

After successful completion of this course, the students will be able to use numerical methods to solve problems related to engineering fields. This course helps students to master the basic concepts of complex analysis which they can use later in their career.
13. 402 MANUFACTURING PROCESS (MN)

Teaching Scheme: 3(L) - 1(T) - 0(P)                      Credits: 4

Course Objectives:

- The subject will enable the students to understand the basic manufacturing process of engineering materials and products including the modern manufacturing methods.

Module – I


Cores – Core Sand, Core Types, Core Prints, Core Baking, Principles of gating and risering – Riser location and Direction Solidification, Blind riser, Chills-Internal and External chills and Chaplets. Internal, external chills. Pressurised and Unpressurised Gating systems.

Module – II

Gravity die casting Pressure die casting-Hot and Cold chamber type, Centrifugal casting, Semi centrifugal casting Centrifuging, Continuous Casting. Solidification of Castings – Cleaning and Inspection of castings, Casting defects.


Module – III


Module – IV

Welding- classification, Weldability, Metallurgy of welding, structure of weld, HAZ. Gas welding, types of flames. Arc welding- Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG, MIG. Resistance welding- Spot welding, Seam welding,

References


Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

*Examination duration: 3 hours  Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

**Part A (20 marks)** - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

**Part B (80 Marks)** - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

- The students will understand the various aspects of moulding, casting, forming and welding.
- The students will be able to identify the features of different manufacturing processes and to select suitable process for a specific material.
13.403 ELECTRICAL TECHNOLOGY (MP)

Teaching Scheme: 3(L) - 1(T) - 0(P)  
Credits: 4

Course Objectives:

The objective of this course is to give a strong foundation on all electrical machines including dc machines, transformers, induction motors and synchronous motors. It also gives a basic idea about traction and welding.

Module – I

DC Machines-principle of operation-emf equation-types of excitations. Separately excited, shunt and series excited DC generators, compound generators. General idea of armature reaction, OCC and load characteristics - simple numerical problems.


Module – II


Three phase induction motors- slip ring and squirrel cage types- principles of operation – rotating magnetic field- torque slip characteristics- no load and blocked rotor tests. Circle diagrams- methods of starting – direct online – auto transformer starting.

Module – III


Module – IV

References:


**Internal Continuous Assessment** *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

**University Examination Pattern:**

*Examination duration: 3 hours *

*Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

**Part A** (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

**Part B** (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

**Course Outcome:**

*The student will get a good grasp on working of electrical machines and transformers, and their applications.*


13.404 METALLURGY AND MATERIAL SCIENCE (MNPU)

Teaching Scheme: 3(L) - 1(T) - 0(P)  
Credits: 4

Course Objective:
To impart knowledge on engineering materials, deformation of materials, equilibrium diagrams of selected alloy systems, heat treatment of steels, properties of steels, cast iron and other alloys and their applications.

Module – I

Introduction to material science and engineering, Classification of engineering materials, Crystal structure of metallic materials. Imperfections in crystals: point defects, line defects, surface defects.

Mechanical behaviour of materials: Elastic, visco elastic, anelastic behaviour.

Mechanisms of plastic deformation: role of dislocation, slip and twinning; Schmid’s law. 
Strengthening mechanisms: Grain size reduction, solid solution strengthening, work hardening, Precipitation hardening. Recovery, recrystallisation and grain growth.

Specimen preparation for microstructural examination: Etching. Grain size determination by comparison with standard chart, Hall-Petch equation.

Module – II

Fracture: ductile fracture, brittle fracture, Griffith’s theory of brittle fracture, ductile to brittle transition, fracture toughness.


Phase diagrams: Phase rule, Lever Rule, Relationship between micro structure and properties, Isomorphous systems: Cu-Ni phase diagram, Eutectic systems: Pb-Sn phase diagram. Eutectoid and peritectic reactions.

Module – III

Iron- Carbon equilibrium diagram Development of microstructure in Iron Carbon alloys,
Phase transformations in steel. Detailed discussion on Iron-Iron Carbide phase diagram with reference to micro constituents like austenite, ferrite, cementite, pearlite and ledeburite.

TTT diagram for eutectoid steel, CCT diagram, critical cooling rate. Transformation of austenite to pearlite, bainite, martensite spheroidite etc.

**Module – IV**

Applications of ferrous and non ferrous alloys: Steel- low, medium, high carbon steels, Alloy steels: effect of various alloying elements in steel.


Composite materials for mechanical engg applications: classification, fabrication methods: stir casting, powder metallurgy and filament winding. Introduction to Smart materials, Nano materials, Bio materials, Bioplastics. Selection of materials based on properties, service, economic and environmental considerations.

**References:**


**Internal Continuous Assessment** *(Maximum Marks-50)*

- 50% - Tests (minimum 2)
- 30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.
- 20% - Regularity in the class
University Examination Pattern:

Examination duration: 3 hours
Maximum Total Marks: 100

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After successful completion of the course, the students will possess knowledge on:

- The property classifications of materials that determine their applicability.
- The mechanisms of elastic and plastic deformations and thereby be able to modify the mechanical properties of materials.
- Heat treatment processes and how to select suitable heat treatments for specific applications.
- Different failure mechanisms and thereby how to decide steps to avoid failures.
- Different alloy systems and their applications, so that proper selection of material can be made.
- Newer engineering materials like Composites, smart materials, nanomaterials.
13.405 FLUID MACHINERY (M)

Teaching Scheme: 3(L) - 1(T) - 0(P)  Credits: 4

Course Objectives:

- To provide information on selected hydraulic machines, rotodynamic and reciprocating pumps, and compressors.
- To learn the theory of operation, construction, and performance of centrifugal pumps, positive displacement pump, and turbo machines with their different types.

Module – I

Impact of jets: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat & curve), Series of vanes, work done and efficiency, fundamental equation of energy transfer in turbo machines, Euler’s equation and its alternate forms.

Hydraulic Turbines: Impulse and Reaction Turbines, Degree of reaction, Pelton Wheel, Constructional features, Velocity triangles, Euler’s equation, Speed ratio, jet ratio & work done, losses and efficiencies, design of Pelton wheel.

Inward and outward flow reaction turbines, Francis Turbine, Constructional features, Velocity triangles, work done and efficiencies.

Axial flow turbine (Kaplan), Constructional features, Velocity triangles, work, done and efficiencies.

Characteristic curves of turbines, theory of draft tubes, surge tanks, Cavitation in turbines, Governing of turbines, Specific speed of turbine, Type Number, Characteristic curves, scale Laws, Unit speed, Unit discharge and unit power.

Module – II

Rotary motion of liquids - free, forced and spiral vortex flows, rotodynamic pumps, centrifugal pump impeller types, velocity triangles, manometric head, work, efficiency and losses, H-Q characteristics.

Cavitation in centrifugal pumps- NPSH required and available-Type number-Pumps in series and parallel operations. Performance characteristics- Specific speed-Shape numbers, Impeller shapes based on shape numbers.

Module – III

Positive displacement pumps- reciprocating pump, Single acting and double acting, slip, negative slip and work required and efficiency, indicator diagram, acceleration head, - effect of acceleration and friction on indicator diagram, speed calculation.

Air vessels and their purposes, saving in work done to air vessels multi cylinder pumps. Multistage pumps-selection of pumps-pumping devices, hydraulic ram, Accumulator, Intensifier, Jet pumps, gear pumps, vane pump and lobe pump.
Module – IV

Compressors:- classification of compressors, reciprocating compressor-single stage compressor, equation for work with and without clearance volume, efficiencies, multistage compressor, intercooler, free air delivered (FAD)

Rotary compressors:- classification, centrifugal compressor-working, velocity diagram, work done, power required, width of blades of impeller and diffuser, isentropic efficiency, slip factor and pressure coefficient, surging and choking.

Axial flow compressors:- working, velocity diagram, degree of reaction, performance. Roots blower, vane compressor, screw compressor.

References:


**Internal Continuous Assessment (Maximum Marks-50)**

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class
University Examination Pattern:

Examination duration: 3 hours  Maximum Total Marks: 100

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

At the end of the course, the student is expected to:

• have knowledge in the effect of hydrodynamic force on various types of vanes.

• know the theory of operation, construction, and performance of centrifugal pumps, positive displacement pump, and turbo machines with their different types.
13.406 MACHINE DRAWING (M)

Teaching Scheme: 0(L) - 0(T) - 3(P)  Credits: 3

Course Objective:

- To provide general overview on fits and tolerance etc.
- To familiarize modeling softwares
- To equip the students to prepare assembly and working drawings of machine components.

Module – I

Production drawing fundamentals: Fits and Tolerances, form tolerance and position tolerance, Geometric tolerance and its indications on drawing, Surface texture- indication of surface roughness, indication of production method, surface treatment, IS specifications.

Familiarization of modeling softwares like Solid works, Pro –E, Catia, Inventer etc.

Module – II

Assembly and working drawing (Part drawing): Shaft bearing and supports – Pedestal bearings, Plummer block and foot step bearing.

I.C. Engine parts – Piston, Connecting Rod, fuel pump for a diesel engine and fuel injection nozzle.

Valves - Stop valve for boilers, feed check valve, Ramsbottom safety valve, lever safety valve and dead weight safety valve.

Machine parts- Lathe tail stock, Lathe tool post and screw jack.

References:-


Internal Continuous Assessment (Maximum Marks-50)

40% - Tests (minimum 2)
40% - Class work.
20% - Regularity in the class
University Examination Pattern:

Examination duration: 4 hours               Maximum Total Marks: 100

The question paper shall consist of 2 parts. Part A and Part B

Part A  (20 marks)

The question paper contains three questions from Module I. Each full question carries 10 marks. The candidates have to answer any two full questions out of the three.

Part  B  (80 marks)

The question paper contains one compulsory question on dimensioned drawing from Module II which carries 80 marks.

Course Outcome:

At the end of the course, Students will be able to prepare detailed drawing of machine parts with fits and tolerances.
13.407 FLUID MECHANICS & MACHINES LAB (MN)

Teaching Scheme: 0(L) - 0(T) - 3(P)  
Credits: 3

Course Objective:

- To demonstrate the applications of the basic fluid mechanics and hydraulic machines and to provide a more intuitive and physical understanding of the theory.

Preliminary study:

1. Study of flow measuring equipments - water meters, venturimeter, orifice meter, current meter.
2. Study of gauges - pressure gauge, vacuum gauge, manometers.
4. Study of pumps – Centrifugal, Reciprocating, Rotary, Jet.
5. Study of Turbines - Impulse and reaction types.
6. Study of Hydraulic ram, accumulator etc.

List of Experiments:

1. Determination of Coefficient of discharge and calibration of Notches, Orifice meter, Nozzle and Venturimeter.
2. Determination of Chezy’s constant and Darcy’s coefficient on pipe friction apparatus
3. Determination of Hydraulic coefficients of orifices
4. Determination of Metacentric Height and Radius of gyration of floating bodies.
5. Performance test on Rotodynamic and Positive displacement pumps
6. Performance test on Impulse and Reaction turbines
7. Speed variation test on Impulse turbine

Internal Continuous Assessment (Maximum Marks-50)

40% - Test  
40% - Class work and Record  
20% - Regularity in the class
University Examination Pattern:

Examination duration: 3 hours  
Maximum Total Marks: 100

Questions based on the list of experiments prescribed in Part II.

75% - Theory, Procedure and tabular column (30%);
   Conducting experiment, Observation, Tabulation with Sample calculation (30%)
   Graphs, Results and inference (15%)

25% - Viva voce (Based on Part I and Part II)

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

At the end of this course the student is expected to:

- gain a fundamental physical and mathematical understanding of the topic rather than memorizing the equations and situations.
- understand physical basis of Bernoulli's equation, and apply it in flow measurement (orifice, Nozzle and Venturimeter), and to a variety of problems.
- determine the efficiency and plot the characteristic curves of different types of pumps and turbines.
13.408 IC ENGINES LAB (M)

Teaching Scheme: 0(L) - 0(T) - 3(P)  
Credits: 3

Course Objective:

- To study the various types IC engines and their parts
- To conduct the performance test on IC engines
- To familiarize equipment used for measuring viscosity, flash and fire point and Calorific value of petroleum products

List of Experiments:

1. Study of I.C engines :-
   a) Diesel engines - all systems and parts
   b) Petrol engines - all systems and parts
2. Determination of flash and fire points of petroleum products
3. Determination of viscosity of lubricating oil using Redwood Viscometer
4. Determination of calorific value of solid, liquid and gaseous fuels using Bomb calorimeter and Gas Calorimeter
5. Experiment on I C Engines
   a) Performance test on IC Engines (Petrol and Diesel)
   b) Heat Balance test
      i) Heat exchanger method
      ii) Flue gas analysis method
      iii) Volumetric efficiency method
   c) Valve timing diagram
   d) Economic speed test
   e) Best cooling water Temperature test
   f) Retardation test
   g) Volumetric efficiency and Air-fuel ratio test
6. Morse test on petrol engine.

Internal Continuous Assessment (Maximum Marks-50)

40% - Test
40% - Class work and Record
20% - Regularity in the class

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University Examination Pattern:

Examination duration: 3 hours  Maximum Total Marks: 100

Questions based on the list of experiments prescribed.

75% - Theory, Procedure and tabular column (30%);
   Conducting experiment, Observation, Tabulation with Sample calculation (30%)
   Graphs, Results and inference (15%)

25% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

At the end of the course, the students will be able to:

- Determine the efficiency and plot the characteristic curves of different types of Internal Combustion engines.
- Conduct experiments for the determination of viscosity, calorific value etc of petroleum products.