UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2013 SCHEME)

SYLLABUS FOR

IV SEMESTER

MECHANICAL ENGINEERING

SCHEME -2013

IV SEMESTER
MECHANICAL ENGINEERING (M)

Course No	Name of subject	Credits	Weekly load, hours			C A Marks	Exam Duration Hrs	U E Max Marks	Total Marks
			L	T	D/ P				
13.401	Engineering Mathematics -III (BCHMNPSU)	4	3	1	-	50	3	100	150
13.402	Manufacturing Process (MN)	4	3	1	-	50	3	100	150
13.403	Electrical Technology (MP)	4	3	1	-	50	3	100	150
13.404	Metullargy and Material Science (MNPU)	4	3	1	-	50	3	100	150
13.405	Fluid Machinery (M)	4	3	1	-	50	3	100	150
13.406	Machine Drawing (M)	3	-	-	3	50	3	100	150
13.407	Fluid Mechanics & Machines Lab(MN)	3	-	-	3	50	3	100	150
13.408	IC Engines Lab (M)	3	-	-	3	50	3	100	150
	Total	**29**	**15**	**5**	**9**	**400**		**800**	**1200**

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 – $\int_0^{2\pi} f(sinx, cosx)dx$, $\int_{-\infty}^{\infty} f(x)dx$ (with no poles on the real axis). (Proof of theorems not required).

Module – III

Numerical techniques-Solutions of algebraic and transcendental equations-Bisection method – Regula-falsi method – Newton - Raphson method. Solution of system of equations - Gauss elimination, Gauss- Siedel iteration. Interpolation – Newton's Forward and backward formulae - Lagrange's interpolation formula.

Module – IV

Numerical integration-Trapezoidal Rule- Simpson's one third rule.

Numerical solution of ODE –Taylor's series method - Euler's method - Modified Euler's method – Runge-Kutta method of order Four.

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

References:

1. Bali N. P. and M. Goyal, *Engineering Mathematics*, 7/e, Laxmi Publications, India, 2012.
2. Kreyszig E., *Advanced Engineering Mathematics*, 9/e, Wiley India, 2013.
3. Grewal B. S., *Higher Engineering Mathematics*, 13/e, Khanna Publications, 2012.
4. Koneru S. R., *Engineering Mathematics*, 2/e, Universities Press (India) Pvt. Ltd., 2012.
5. Sastry S. S., *Introductory Methods of Numerical Analysis*, 5/e, PHI Learning, 2012.
6. Babu Ram, *Numerical Methods*, 1/e, Pearson Education, 2010.

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

Foundry – basic requirements of casting processes. Patterns – types, materials, allowances. Moulding Sand – Properties, testing, Sand Muller, Types of mould – Green Sand Mould, Dry Sand Mould– Carbon Dioxide Moulding, Shell Moulding, Ceramic Mould Casting, Plaster mould casting.

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.

Plastic injection moulding and plastic blow moulding. . Introduction to powder metallurgy process – Compacting and sintering. Forming and shaping of glass. Processing of metal matrix and ceramic matrix.

Module – III

Forming - plastic deformation and yield criteria - relation between tensile and shear yield stress – Rolling - cold, hot rolling - Types of rolling mills-Rolling of channels, I and rail sections. Rolling of tubes, wheels and axles. Defects in rolled products. Forging- open and closed die forging, press forging, roll forging, types of forging presses. Defects in forging. Extrusion-hot and cold extrusion-Wire drawing- Tube drawing, Rotary piercing-Rotary swaging, Cold forming-thread rolling, metal spinning.

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,

Projection welding, Butt welding, Flash butt welding, Percussion welding. Solid phase welding-forge welding, friction welding, explosive welding, ultrasonic welding. Thermit welding, Atomic hydrogen welding, Electron beam welding. Weld defects and inspection.

References

1. Kalpakjian S. and S. R Schmid, *Manufacturing Engineering and Technology*, 4/e, Pearson Education, 2001.
2. Ghosh A. and A. Mallik, *Manufacturing Science*, Affiliated East West Press Ltd., New Delhi, 2002.
3. Taylor H. F., M. C. Flemings and J. Wulff, *Foundry Engineering*, Wiley Eastern, 1973.
4. Campbell J. S., *Principles of Manufacturing Materials and Processes*, Tata McGraw Hill, 1999.
5. DeGramo E. P., J. T. Black and R. A. Kosher, *Materials and Process in Manufacturing*, 9/e, Prentice Hall, 2003.

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.

Principles of dc motors-torque and speed equations-torque speed characteristics- variations of speed, torque and power with motor current. Applications of dc shunt series and compound motors. Principles of starting, losses and efficiency – load test- simple numerical problems.

Module – II

Transformers – principles of operations – emf equation- vector diagrams- losses and efficiency – OC and SC tests. Equivalent circuits- efficiency calculations- maximum efficiency – all day efficiency – simple numerical problems. Auto transformers constant voltage transformer- instrument transformers.

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

Single phase motors- principle of operation of single phase induction motor – split phase motor – capacitor start motor- stepper motor- universal motor Synchronous machines- types – emf equation of alternator – regulation of alternator by emf method. Principles of operation of synchronous motors- methods of starting- V curves- synchronous condenser.

Module – IV

Electric traction – systems of power supply – functional schematic of ac electric locomotives- types of motors used in traction systems. Methods of speed control – methods of braking. Electric welding. Different types.

References:

1. Theraja B. L. and A. K. Theraja, *A Text Book of Electrical Technology*, S. Chand & Company Ltd., 2008.
2. Kothari D. P. and I. J. Nagrath, *Electrical Machines*, Tata McGraw Hill, 2004.
3. Partab H., *Art and Science of Utilization of Electric Energy*, Dhanpat Rai & Sons, 1980.
4. Mehta V. K. and R. Mehta, *Principles of Electrical and Electronics***,** S. Chand & Company Ltd., 1996.
5. Gupta B. R. and V. Singhal, *Fundamentals of Electric Machines*, New Age International Publishers Ltd, New Delhi, 2005.
6. Sivanagaraju S., M. B. Reddy and D. Srilatha, Generation and Utilization Electrical Energy, Pearson Education, 2010.

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.

Fatigue: mechanism of fatigue, S-N curve. Creep: creep curve, mechanism of creep.

Diffusion: Fick's laws of diffusion, Mechanisms of diffusion, applications. Solidification of metals and alloys. Solid solution, Hume Rothery's rules.

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.

Heat treatment of steel: Annealing, normalizing, hardening, tempering, austempering, martempering, Hardenability, Jominy end quench test. Surface treatments: Case Hardening, Carburising, Nitriding, Cyaniding, CVD, PVD, Thermal spraying.

Module – IV

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

Stainless steels -ferritic, austenitic, martensitic, duplex steels. Tool steels. Cast iron- gray, white, ductile cast irons. Copper and its alloys. Aluminium and its alloys, Magnesium and alloys, Titanium and its alloys.

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:

1. Callister W. D. and D. G. Rethwisch, *Material Science and Engineering*, 8/e, John & Wiley Sons, 2010.
2. Raghavan V., *Material Science and Engineering*, PHI Learning Pvt. Ltd., 2004.
3. Jose S. and Mathew E. V., *Metallurgy and Materials Science,* Pentagon Educational Services, 2011.
4. Shackelford J., *Introduction to Materials Science for Engineers*, 7/e, Pearson, 2009.
5. Van Vlack L. H., *Elements of Materials Science and Engineering*, Addison-Wesley, 1989.
6. Lakhtin Y., *Engineering Physical Metallurgy*, Gordon and Breach Science Publishers, 1965.
7. Dieter G. E., *Mechanical Metallurgy*, McGraw-Hill, 1976.
8. Reed-Hill R. E., *Physical Metallurgy*, PWS-Kent Publishing Company, 1992.
9. Avner S. H*., Introduction to Physical Metallurgy*, McGraw-Hill, 1974.

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 chocking.

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

References:

1. Shepherd D. G., *Principles of Turbo Machinery*, Macmillan, 1969.
2. Stepanoff A. J., *Centrifugal and Axial Flow Pumps*, John Wiley & Sons, 1991.
3. Binder R. C., *Advanced Fluid Mechanics*- 1, Prentice Hall, 1962.
4. Bansal R. K., *A Textbook of Fluid Mechanics and Hydraulic Machines*, Laxmi Publications, 2005.
5. Rajput R. K., *Fluid Mechanics and Hydraulic Machines*, S. Chand & Co.,2006.
6. Modi P. N. and S. M. Seth, *Hydraulics & Fluid Mechanics*, S.B.H Publishers, New Delhi, 2002.
7. Durgaiah D. R., *Fluid Mechanics and Machinery*, New Age International (P) Ltd., 2009.
8. Jagdish Lal, *Hydraulic Machines Including Fluidics*, Metropolitan Book Company, 2007.
9. Cengel Y. A. and J. M. Cimbala*, Fluid Mechanics*, Tata McGraw Hill, 2013.
10. Yahya S. M., *Fans, Blower and Compressor*, Tata McGraw Hill, 2005.
11. Domkundwar A. V., *A Course in Thermal Engineering*, 5/e, Dhanpat Rai & Sons, 2002.
12. Rajput R. K., *Thermal Engineering*, 9/e, Laxmi Publications (P) Ltd., 2013.
13. Rathore M. M., *Thermal Engineering*, Tata McGraw-Hill Education, 2010.
14. Ballaney P. L., *Thermal Engineering*, Khanna Publishers, 2007.

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:-

1. Bhatt N. D. and V. M. Panchal, *Machine Drawing*, Charotar Publisher, 2002.
2. Varghese P. I., *Machine Drawing*, VIP Publishers, Thrissur, 2012.
3. Gill P. S., *Machine Drawing*, S.K. Kataria & Sons, New Delhi, 2010.
4. Parkinson A. C., *Engineering Drawing*, Pitman & Sons, 1966.

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.
3. Study of valves - stop valve, gate valve and foot valve.
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
8. Determination of best guide vane opening for Reaction 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

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.*