FACULTY OF ENGINEERING

Scheme of Instruction & Examination

and

Syllabi

B.E. III-Semester & IV-Semester

of

Four Year Degree Programme

In

Production Engineering

(With effect from the academic year 2017 – 2018)
(As approved in faculty meeting held on 26 July 2017)

Issued by
Dean, Faculty of Engineering
Osmania University, Hyderabad
July 2017

SCHEME OF INSTRUCTION & EXAMINATION
B.E. III - Semester
(PRODUCTION ENGINEERING)

S. No	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1.	BS301MT	Engineering Mathematics-III	3	1	-	4	30	70	3	3
2.	ES321CE	Mechanics of Materials	3	1	-	4	30	70	3	3
3.	PC301ME	Engineering Thermodynamics	4	-	-	4	30	70	3	4
4.	PC302ME	Metallurgy & Material Science	4	-	-	4	30	70	3	4
5.	PC303ME	Fluid Mechanics	4	-	-	4	30	70	3	4
6.	MC916CE	Environmental Sciences	3	-	-	3	30	70	3	3
Practical/Laboratory Courses										
7.	ES361CE	Mechanics of Materials Lab.	-	-	2	2	25	50	3	1
8.	PC351ME	Machine Drawing	-	-	2	2	25	50	3	1
9.	PC352ME	Metallurgy Lab.	-	-	2	2	25	50	3	1
Total			**21**	**2**	**6**	**29**	**255**	**570**		**24**

BS: Basic Sciences ES: Engineering Sciences MC: Mandatory Course
PC: Professional Course HS: Humanities and Sciences
L: Lectures T: Tutorials Pr : Practicals Drg: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note: 1) Each contact hour is a Clock Hour
2) The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.
3) Students admitted into B.E./B.Tech. courses under lateral entry scheme (through ECET) from the academic year 2017-18 should undergo the following bridge course subjects at III Semester (CBCS).
(1) ES 154 CS Computer Programming Lab
(2) MC 156 EG Engineering English Lab

.

Course Code	Course Title						Core / Elective
BS301MT	**ENGINEERING MATHEMATICS -III**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	1	-	-	**30**	**70**	**3**

Course Objectives

- To introduce the concept of functions of complex variables and their properties
- To formulate partial differential equations and to introduce a few methods to solve first order linear and non-linear partial differential equations
- To study Fourier series and its applications to partial differential equations

Course Outcomes

- To determine the analyticity of a complex functions and expand functions as Taylor and Laurent series
- To evaluate complex and real integrals using residue theorem
- To expand function as a Fourier series
- To find solutions of first order and second order partial differential equations

UNIT-I

Functions of Complex Variables: Limits and continuity of function, differentiability and analyticity, necessary & sufficient conditions for a function to be analytic, Cauchy- Riemann equations in polar form, harmonic functions, complex integration, Cauchy's integral theorem, extension of Cauchy's integral theorem for multiply connected regions, Cauchy's integral formula, Cauchy's formula for derivatives and their applications.

UNIT-II

Residue Calculus: Power series, Taylor's series, Laurent's series, zeros and singularities, residues, residue theorem, evaluation of real integrals using residue theorem, bilinear transformation, conformal mapping.

UNIT-III

Fourier series: Fourier series, Fourier series expansions of even and odd functions, convergence of Fourier series, Fourier half range series.

UNIT-IV

Partial differential equations: Formation of first and second order partial differential equations, solution of first order equations, Lagrange's equation, Nonlinear first order equations, Charpit's method, higher order linear equations with constant coefficients.

UNIT-V

Fourier series applications to partial differential equations: Classification of linear second order partial differential equations, separation of variables method (Fourier method), Fourier series solution of one dimensional heat and wave equations, Laplace's equation.

Suggested Reading:

1. R.K.Jain & S.R.K Iyengar, **Advanced Engineering Mathematics**, Narosa Publication, 4th Edition, 2014.
2. B.S.Grewal, **Higher Engineering Mathematics**, Khanna Publications, 43rd Edition, 2014.
3. Gupta & Kapoor, **Fundamentals of Mathematical statistics**, Sultan Chand & Sons, New Delhi, 2014.
4. Erwin Kreyszig, **Advanced Engineering Mathematics,** 9th Edition, 2012.
5. James Brown and Ruel Churchill, **Complex variables and Applications,** 9th Edn. 2013.

Course Code	Course Title						Core / Elective
ES321CE	**MECHANICS OF MATERIALS**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	1	-	-	**30**	**70**	**3**

Course Objectives

- To understand the basic concept of stress and strains for different materials
- To know the mechanism of the development of shear force and bending moment in beams
- To know the theory of simple bending, direct & bending stress and distribution of shear stress
- To study the deflections and its applications
- To analyze and understand shear stress, torsional stress and spring applications

Course Outcomes

- To understand the theory of elasticity and Hookes's law
- To analyze beams to determine shear force and bending moments
- To solve problems on bars and to determine deflections at any point of the beams
- To analyze and design structural members subjected to combined stresses

UNIT – I

Simple stresses and strains: Types of stresses and strains. Hooks's Law, Stress- Strain curve for ductile materials, moduli of elasticity. Poisson's ratio, linear strain, volumetric strain, relations between elastic constants. Bars of varying sections, bars of uniform strength, compound bars and temperature stresses, change in length.

UNIT-II

Shear Force and Bending Moment: Relation between intensity of loading. Shear force and bending moment, shear force and bending moment diagrams for cantilever and simply supported beams with and without overhanging for point loads, uniformly distributed loads, uniformly varying loads and couples. Compound Stresses: Stresses on oblique planes, principal stresses and principal planes. Mohr circle of stress and ellipse of stress.

UNIT-III

Theory of simple bending: Assumptions derivation of basic equation: $M/I = F/y = E/R$ Modulus of section, Moment of resistance, determination of flexural stresses. Direct and Bending Stresses: Basic concepts, core of sections for rectangular, solid and hollow circular and I sections. Distribution of shear stress: Equation of shear stress, distribution across rectangular sections.

UNIT-IV

Deflections: Deflections of cantilever and simply supported beams including overhanging beams for point loads and uniformly distributed loads by double integration and Maualay's method. Strain Energy: Strain energy in bars due to gradually applied loads, sudden loads, impact loads and shock loads.

UNIT-V

Torsion-Theory of pure torsion- derivation of basic equation T/J = q/R = NΘ/L and hollow circular shafts, strain energy- Transmission of power, combined bending and torsion. Springs: Close and open coiled helical springs subjected to axial loads and axial couples, strain energy in springs- carriage springs.

Suggested Readings:

1. D.S. Prakash Rao, **Strength of Materials – A practical Approach**, Universities Press, 1999.
2. R.K. Rajput, **Strenght of Materials,** S. Chand & Co., 2003.
3. B.C. Punmia, **Strength of Materials and Theory of Structures**, Laxmi Publishers, Delhi, 2000.
4. Ferdinand P Beer et.al., **Mechanics of Materials**, Tata McGraw-Hill, 2004.
5. G.H. Ryder, **Strength of Materials**, 3rd Edition, Macmillan Indian Limited, Delhi, 2002.
6. S. Ramamrutham, **Strength of Materials**, Dhanpat Rai & Sons, 1993.
7. S.S. Bhavakatti, **Strength of Materials**, Vikas Publications, 2003.

Course Code	Course Title						Core / Elective
PC 301 ME	**ENGINEERING THERMODYNAMICS**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	4	-	-	-	**30**	**70**	**4**

Course Objectives

- To introduce the principles of thermodynamics through everyday experiences which relate to energy and energy transformation of heat into other forms of energy. The Subject lays the groundwork for subsequent studies in courses like Applied Thermodynamics, Heat Transfer, Refrigeration and Air-conditioning, Automobile Engineering, Thermal Turbomachinery and Gas Dynamics etc.
- To introduce the first law of thermodynamics with the Conservation of Energy Principles and their application in both closed and open systems.
- To introduce the second law of thermodynamics with the Concept of Entropy and degradation of energy during the energy transfer in order to determine the theoretical limits for the performance of commonly used engineering systems.
- To introduce pure substance through the phase change processes in order to establish the relationships among thermodynamic properties.
- To introduce thermodynamic analysis of gas mixtures with special emphasis on study of moist air properties and design concepts employed in Air conditioning processes.

Course Outcomes

- To explain the laws, symbols and vocabulary of thermodynamics.
- To use ideal gas laws and steam tables successfully to solve thermodynamic closed and open system problems.
- To be able to use a problem solving procedure to process a preliminary statement of a problem into a final numeric solution for thermal power systems using the laws of thermodynamics.
- To explain working principles of Air conditioning devices.

UNIT-I

Introduction: Definition and Concept of Thermodynamics. Microscopic and Macroscopic approach of thermodynamics system. surroundings and property, intensive and extensive properties, Measurement of temperature, Zeroth law of thermodynamics: Temperature Scales, ideal gas and ideal gas thermometer, Reversibility and irreversibility quasi– static process, Specific heats for ideal gases, Thermodynamics Equilibrium.

UNIT-II

First law of Thermodynamics: Statement of First Law, Heat and work interactions, Thermodynamics work and Internal energy, Energy as property of system, First Law applicable to Closed system, Thermodynamic processes and calculation of work, Heat transfer, and internal energy, Heat as Path Function, First law analysis of flow processes and limitation, Calculation of work done during flow processes.

UNIT-III

Second Law of Thermodynamics: Physical description of second law, Kelvin– Planck and Clausius statement of Second Law of thermodynamics, Equivalence of Kelvin– Planck and Clausius statement, Reversible and irreversible processes, Cornet Theorems, Clausius Inequality, Calculation of entropy change during various thermodynamic processes principle of Entropy increase, T– S diagrams, Available and Unavailable energies in steady flow, Second Law Analysis of Control Volume, Helmholtz and Gibb's functions, Available function for flow and non– flow processes.

UNIT-IV

Thermodynamic properties of Fluids: Properties of pure substances, Concept of phase change, Graphical representation of Pressure, Volume and Temperature, (PVT)– T and H diagrams, Properties of steam, Use of steam Tables and Mollier diagram, Thermodynamic relations involving Entropy, Enthalpy, Internal Energy, Maxwell relations and Clapeyron equation.

UNIT-V

Air standard cycles: Air standard cycles– Otto, Diesel, Dual Combustion Cycle, sterling and ranking cycle.

Mixture of Gases: Mole fraction and mass fraction, Partial pressure and Dalton's Law, Amagat-Leduc Law of Partial volumes, Relation between partial pressure, mole fraction and volume fraction; Gas Constant, molecular mass and specific heats of the gas mixtures; relation between volumetric and gravimetric analysis

Suggested Reading:

1. P.K. Nag, **Basic & Applied Thermodynamics**, Tata McGraw Hill, 2nd Edn., 2008..
2. Y.V.C.Rao, **An Introduction to Thermodynamics**, Universities Press, 2nd Edn., 2010.
3. P.L Ballaney, **Thermal Engineering**, Khanna Publishers 2004.
4. E. Radha Krishnan, **Engineering Thermodynamics**, 2002.
5. D. S. Kumar, **Thermal science and Engineering**.

Course Code	Course Title						Core / Elective
PC 302 ME	**METALLURGY AND MATERIAL SCIENCE**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	4	-	-	-	**30**	**70**	**4**

Course Objectives

- To understand the basic concepts of metallurgy of metals and alloys
- To know the fundamentals of fracture, fatigue, creep and diffusion
- To familiarize with the principles of heat treatment and manufacturing of steel

Course Outcomes

- To understand and apply the different metallurgical phenomenon for Industrial applications
- To apply principles of fracture, fatigue and creep for selection of materials for specific applications
- To apply the principles of alloys and heat treatment for various field applications.

UNIT-I

Imperfections in crystals, Dislocation in crystals, Types of dislocations, Critical resolved shear stress, Effect of slip and twinning on the plastic deformation, Jogs and its effect on yield phenomenon, Hall-Petch equation, Orange peel effect, cold and hot working, strain Hardening and Bauchinger effect. Recovery, Recrystallisation, Grain growth and its effect on mechanical properties of metals.

Fracture: Types of fracture in metals, modes of fracture, Griffith theory of brittle fracture, Crack propagation, ductile fracture, Fracture under combined stress.

UNIT-II

Fatigue: S-N curve, Structure of fatigue fracture specimen. Fatigue crack propagation, Effect of metallurgical variables on fatigue of metal, Low cycle fatigue, Cumulative fatigue and fatigue damage, Experimental determination of fatigue strength (RR-Moore Test), Factors to be considered for the improvement of the fatigue life.

Creep: Creep strength, Creep curve, Creep deformation mechanisms, Creep Test, Differences between creep curve and stress rupture curve. Diffusion: Fick's law of diffusion, Application of diffusion theory in Mechanical Engineering.

UNIT-III

Structure of Alloys: Construction and interpretation of Thermal equilibrium diagram of binary nonferrous alloys, study of Eutectic, Eutectoid, peritectic, Peritectoid reactions. Iron-Iron Carbide. Equilibrium diagram, Construction and interpretation. Types of Plain Carbon Steels, Cast Iron and their properties and Characteristics.

UNIT-IV

Heat Treatment: Annealing, Normalising, Hardening, Tempering, Construction and interpretation of T.T.T Curve. Austempering and Martempering. Case Hardening: Carburising,

Nitriding, Carbo-nitriding, Flame Hardening, Induction Hardening. Brief introduction of Age Hardening.

UNIT-V

Introduction to Extractive Metallurgy, Method of production of pig iron by blast furnace, Cast Iron by Cupola furnace, Method of production of Copper and Aluminum. Method of production of steel by Bessemer Convertor, L.D. Process, Electric Arc process. Modern steel making process by Electric slag refining.

Alloy Steels: Effects of alloying elements like Nickel, Chromium, Manganese, Silicon and Tungsten. Titanium. Study about Stainless steels, HSS, Maraging steels, Brass, Bronze, Muntz Metal, Invar, Duralumin and Ti Alloy (Ti-6Al-4V) – their composition and Properties.

Suggested Reading:

1. V.Raghavan, **Material Science and Engineering**, Prentice Hall of India Ltd., 4th Edition, 1994.
2. S.H.Avner, **Introduction to Physical Metallurgy**, Tata McGraw Hill, 2nd Edn. 1997.
3. S.P.Nayak, **Engineering Metallurgy and Material Science**, Charoter Publishing House, 6th Edition, 1995.
4. E. Dieter, **Mechanical Metallurgy, Metric Editions,** Tata McGraw Hill, 3rd Edn, 1997.

Course Code	Course Title						Core / Elective
PC 303 ME	**FLUID MECHANICS**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	4	-	-	-	**30**	**70**	**4**

Course Objectives

- To know various fluid properties, concept and method of fluid pressure measurement.
- To understand the basic concepts of fluid motion.
- To study different equations of fluid motion and fluid dynamics.
- To analyze different flow characteristics of laminar and turbulent flows.
- To study the motion of gasses for different conditions of expansion.
- To lay the groundwork for subsequent studies in courses like Hydraulics Machinery and Systems, Thermal Turbomachinery and Gas Dynamics etc.

Course Outcomes

- To explain the laws and terminology of fluid flows, classify fluid flows, state law of mass conservation and derive relevant equations
- To apply principles of energy and momentum conservation to analyze fluid flow and compute forces exerted on control volumes due to change of momentum
- To describe flow and pressure measurement devices and obtain relevant equations for computing flow in pipes and open channels.
- To describe flow regimes in pressure conduits and boundary layer development; compute drag and lift forces on aerofoil and also frictional losses in pressure conduits.
- To develop and apply laws of mass, energy and momentum conservation in compressible flow.

UNIT-I

Properties of fluids: Definition of fluid and concept of continuum. Fluid properties; pressure, density, specific weight, specific volume, dynamic and kinematic viscosity. Classification of fluids; ideal and real fluids.

Fluid Kinematics: General concepts of path lines, stream lines, streak lines and stream tubes. Classification of fluid flow; steady and unsteady, uniform and non-uniform, laminar and turbulent, rotational and irrotational, one-, two-and three-dimensional flows. Definition and properties of stream function and velocity potential function, and use of flow nets.

UNIT-II

Fluid Dynamics: Energy of a fluid body, potential energy and potential head, pressure energy and pressure head, kinetic energy and kinetic head, energy equation. Derivation of Euler's and Bernoullis' equations, and their applications. Impulse momentum equation and its applications.

UNIT-III

Measurement of Fluid Flows: Measurement of pressure, and use of pressure measuring devices such as manometers, Bourdon's pressure gauge and transducers. Measurement of velocity, and use of velocity measuring devices such as pitot tube and hot wire anemometer. Measurement of discharge, and use of discharge measuring devices such as venturimeter,

orifice meter and rotameter; derivation of relevant formulae. Discharge formulae for weirs and notches.

UNIT-IV

Laminar and Turbulent Flow through Pipes: Distinction between laminar and turbulent flows; Reynold's number and its significance. Upper and lower critical values of Reynold's numbers for flow in pipes. Development of laminar and turbulent flow in circular pipes. Hagen-Poiseuille equation; frictional losses in pipes. Darcy's equation. Estimation of Darcy's friction factor. Empirical formulae and Moody's chart.

Boundary Layer Theory: Development of laminar and turbulent boundary layers on a flat plate, pressure gradient, and phenomenon of separation. Fluid flow over an aerofoil, flow around a cylinder at rest, rotational flow around a cylinder at rest, lift and drag forces, and coefficients; circulation and Magnus effect.

UNIT-V

Compressible fluid flow: Concepts of compressible flow, continuity, momentum and energy equation of compressible flow. Velocity of sound in compressible and incompressible fluids. Mach Number. Classification of compressible flow; adiabatic flow in perfect gas, stagnation pressure and temperature. Temperature, pressure, density ratios as functions of Mach number.

Suggested Reading:

1. K. L. Kumar, **Engineering Fluid Mechanics**. Eurasia Publishing House, 1997.
2. R. K. Rajput, **Fluid Mechanics and Hydraulic Machines**, S. Chand & Co., 2003.
3. P. N. Modi and S. M. Seth, **Hydraulic and Fluid Mechanics**, Standard Book House, 1995.
4. V. L. Streeter, Fluid Mechanics. McGraw-Hill Co. Ltd.,

Course Code	Course Title						Core / Elective
MC 916 CE	**ENVIRONMENTAL SCIENCES**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	**30**	**70**	**3**

Course Objectives

- To study the basic concepts, sources of water, floods and their impact on environment
- To know the ecosystems and energy resource systems
- To understand the Biodiversity concepts and their advantages
- To study the different pollutions and their impact on environment
- To know the social and environment related issues and their preventive measures

Course Outcomes

- Awareness of effects of hazardous environment.
- Idea about optimum utilization of natural resources.
- Be a catalyst in moving towards Green technologies
- Information about rules and regulations of pollution control

UNIT-I

Environmental studies: Definition, scope and importance, need for public awareness. Natural resources: Water resources; use and over utilization of surface and ground water, Floods, drought, conflicts over water, dams-benefits and problems. Effects of modern Agriculture, Fertilizer-pesticide problems, water logging and salinity.

UNIT-II

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in ecosystem, food chains, ecological pyramids, aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries) Energy resources: Growing energy needs renewable and non-renewable energy sources. Land Resources, land as a resource, land degradation, soil erosion and desertification.

UNIT-III

Biodiversity: Genetic species and ecosystem diversity, bio-geographical classification of India. Value of biodiversity, threats to biodiversity, endangered and endemic species of India, conservation of biodiversity.

UNIT-IV

Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution and solid waste management. Environmental protection act: Air, water, forest and wild life Acts, enforcement of Environmental legislation.

UNIT-V

Social issues and the Environment: Water conservation, watershed management, and environmental ethics. Climate change, global warming, acid rain, ozone layer depletion. **Disaster management:** Types of disasters, impact of disasters on environment, infrastructure, and development. Basic principles of disaster mitigation, disaster management, and methodology, disaster management cycle, and disaster management in India.

Suggested Reading:

1. De A.K., **"Environmental Chemistry**", Wiley Eastern Ltd.,
2. Odum E.P., **"Fundamentals of Ecology",** W.B. Sunders Co., USA.
3. Rao M.N and Datta A.K., "**Waste Water Treatment**", Oxford and IBK Publications.
4. Benny Joseph**, "Environmental studies",** Tata McGraw Hill, 2005
5. Sharma V.K., **"Disaster *Management"***, National Centre for Disaster management, IIPE, Delhi,1999

Course Code	Course Title						Core / Elective
ES 361 CE	**MECHANICS OF MATERIALS LAB.**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	2	**25**	**50**	**1**

Course Objectives

- To know and understand the experiments on various materials to assess their behavior/limitations.
- To know the brittle and ductile material failure patterns etc., by conducting experiments
- To understand shear force, bending moment and deflections for different types of beams
- To know the rigidity modulus by conducting spring and torsion test.

Course Outcomes

- To perform various experiments on engineering materials.
- To distinguish between brittle and ductile materials.
- To be Able to determine the mechanical properties of various materials.

Cycle – I

1. Direct tension test on metal bars
2. Young's modulus of metal specimen
3. Harness tests: Brinell and Rockwell
4. Compression test on bricks
5. Impact test
6. Shear force and bending moment tests

Cycle – II

7. Spring test
8. Torsion test
9. Bending test on simply supported beam
10. Bending test on continuous beam
11. Bending test on fixed beam
12. Curved beam

Note: At least ten experiments should be conducted in the Semester

Course Code	Course Title						Core / Elective
PC 351 ME	**MACHINE DRAWING**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	2	-	**25**	**50**	**1**

Course Objectives

- To understand format of drawing sheet, angle of projections, isometric projections and practice on simple machine elements
- To practice free hand sketching of machine elements
- To understand assembly drawings of typical machine parts such as Connecting rod, Eccentric, Cross head, Machine vice, Screw jack, Non-return valves, Safety valves, Bearings, Tail stock etc.

Course Outcomes

- To draw isometric and orthogonal projections and sectional views of various mechanical components.
- To draw free hand sketches of various mechanical components
- Understand the shape and structure of different types of joints, screws, keys and Couplings
- To apply sufficient knowledge to use both the software and drafter to produce assembly views of various mechanical components from part drawings.
- To read and understand the industrial drawings pertaining to industries like automobile industry, Aero-space and general engineering industries.

1. INTRODUCTION:

Format of drawing sheet, title block, conventions of drawing lines and dimensions, First and third angles projections, convention for sectional views. Orthographic projections including sectional views of simple machine elements.

2. DRAWING OF FASTENERS, JOINTS AND COUPLINGS:

Practice of sketching work: Free hand sketches of typical machine elements for simple cases for riveted and screwed fastenings, joints and coupling.

The sketches should be proportionate; Dimensions should be in terms of proportions to the basic size and dia.

3. ASSEMBLY DRAWING:

Preparation of assembly drawings from given details, Ability to supply additional views, the exercises will be drawings of typical machine parts viz., Connecting rod, Eccentric, Cross head, Stuffing box, Pipe vice, Screw jack, Ram's bottom safety valve, Lathe Tool Post, Tail stock, Revolving centre, Pedestal bearing (Plummer block), Swivel bearing.

Note: The test is for the ability of the student to read and interpret drawing. The drawing should include part list in standard format.

Suggested Reading:

1. N.D. Bhatt, **Machine Drawing**, Charotar Publishing house, Anand, New Delhi, 28th edn, 1994.
2. N. Siddeshwar**, Machine Drawing**, Tata McGraw Hill Publishing Co. Ltd., 5th edn, 1994
3. K.L. Narayana, P.Kannaiah, K.Venkat Reddy, **Machine Drawing**, New Age Intnal (P) Ltd., 2nd edition 1999.
4. K. C. John, Text book of Machine Drawing, PHI Learning,

Course Code	Course Title						Core / Elective
PC 352 ME	**METALLURGY LAB**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	2	**25**	**50**	**1**

Course Objectives

- To get familiarized with the procedure of metallurgical specimen preparation for microscopic examination and viewing the structure
- To know the method of identifying phases of micro structure and identifying different metals and alloys
- To understand the effects of various heat treatment procedures
- To understand relation between material properties with its grain size and shape

Course Outcomes

- To understand and apply various methods of preparing a specimen for viewing the microstructure
- To know the method of identifying different metals and alloys based on metallurgical phases observed in the micro structure
- To understand grain geometry and know the effects of various heat treatments

List of Experiments:

1. Study of: Metallurgical Microscope
   Iron-Iron Carbide diagram Procedure for specimen preparation
2. Metallographic Study of Pure Iron
3. Metallographic Study of Low carbon steel
4. Metallographic Study of Medium carbon steel
5. Metallographic Study of Eutectoid steel
6. Metallographic Study of Hyper Eutectoid steel
7. Metallographic Study of Wrought iron
8. Metallographic Study of Grey cast iron
9. Metallographic Study of White cast iron
10. Metallographic Study of Black heart Malleable cast iron
11. Metallographic Study of white heart Malleable cast iron
12. Metallographic Study of Brass and Bronze
13. Study of microstructure after hardening, normalizing and annealing of steel specimen.

Note: *At least ten experiments should be conducted in the Semester*

SCHEME OF INSTRUCTION & EXAMINATION
B.E. IV - Semester
(PRODUCTION ENGINEERING)

S. No	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/Drg	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1.	BS401MT	Engineering Mathematics-IV	3	1	-	4	30	70	3	3
2.	ES422EE	Electrical Circuits & Machines	3	-	-	3	30	70	3	3
3.	ES934EC	Basic Electronics	3	-	-	3	30	70	3	3
4.	PC401MP	Applied Thermodynamics & Heat Transfer	4	-	-	4	30	70	3	4
5.	PC402ME	Kinematics of Machines	4	1	-	5	30	70	3	4
6.	PC403ME	Design of Machine Elements	4	-	-	4	30	70	3	4
Practical/Laboratory Courses										
7.	ES461EE	Electrical Circuits & Machines Lab.	-	-	2	2	25	50	3	1
8.	ES955EC	Basic Electronics Lab.	-	-	2	2	25	50	3	1
9.	PC453MP	Applied Thermodynamics & Heat Transfer Lab.	-	-	2	2	25	50	3	1
Total			**21**	**2**	**6**	**29**	**255**	**570**		**24**

BS: Basic Sciences ES: Engineering Sciences MC: Mandatory Course
PC: Professional Course HS: Humanities and Sciences
L: Lectures T: Tutorials Pr : Practicals Drg: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note: 1) Each contact hour is a Clock Hour
2) The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.

Course Code	Course Title						Core / Elective
BS401MT	**ENGINEERIN MATHEMATICS-IV**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	1	-	-	**30**	**70**	**3**

Course Objectives

- To introduce transforms Fourier , Z-transforms and their properties
- To introduce a few numerical methods to solve certain types of problems
- To understand curve fitting, correlation and regression
- To provide the knowledge of probability distributions like uniform, normal and exponential distributions, tests of significance, correlation and regression.

Course Outcomes

- Evaluate certain types of improper integrals.
- Solve difference equations using z-transforms
- Find numerical solution of algebraic, transcendental equations and ordinary differential equations.
- Perform a regression analysis and to compute and interpret the coefficient of correlation

UNIT- I

Fourier transforms: Introduction, Fourier integrals, Fourier sine and cosine integrals, Complex form of Fourier integral, Fourier transform, Fourier sine and cosine transforms, Finite Fourier sine and cosine transforms, Properties of Fourier transforms, Convolution theorem for Fourier transforms.

UNIT- II

Z-Transforms: Introduction, basic theory of Z-transforms, Z-transforms of standard sequences, existence of Z-transform, linearity property, translation theorem, scaling property, initial and final value theorems, differentiation of Z-transform, convolution theorem, solution of difference equations using Z-transforms.

UNIT- III

Numerical methods: Solution of Algebraic and Transcendental equations**:** Bisection method, Newton-Raphson method, Solution of linear system of equations: Gauss elimination method, Gauss- Seidel iteration method, Interpolation: Lagrange's interpolation, Newton's divided difference interpolation, Newton's Forward and Backward difference interpolations, Numerical differentiation, Numerical solutions of ordinary differential equations : Taylor's series method, Euler method, Runge-Kutta method of 4^{th} order.

UNIT- IV

Curve fitting: Curve fitting by method of least squares**,** correlation and regression, types of correlations, Karl Pearson's coefficient of correlation, Spearman's rank correlation coefficient, equal ranks, equations to the lines of regression.

UNIT- V

Probability:

Random variables, Uniform, Normal, Exponential distributions, Mean, median, mode and standard deviation, Conditional probability and Baye's theorem, Tests of significance, t-test, F-test and χ^2 test.

Suggested Reading:

1. R.K.Jain & S.R.K.Iyengar, *Advanced Engineering Mathematics*, Narosa Publications, 4th Edition, 2014.
2. B.S.Grewal, *Higher Engineering Mathematics*, Khanna Publications, 43rd Edition, 2014.
3. Vasishtha and Gupta, *Integral Transforms*, Krishnan Prakashan Publications, 2014.
4. Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons ,9th Edition, 2012.
5. S.C.Gupta and V.K.Kapoor, *Fundamentals of Mathematical Statistics,* Sultan Chand& Sons, 2014.

Course Code	Course Title						Core / Elective
ES422EE	**ELECTRICAL CIRCUITS AND MACHINES**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	**30**	**70**	**3**

Course Objectives

- To acquire knowledge in electrical circuits.
- To be able to understand the basic principle operation and performance of electrical machines.

Course Outcomes

- Know the basics of Electrical Engineering with good knowledge on underlying principles of operation.
- Relate these basics with daily experiences.

UNIT I

DC Circuits: Ohm's law, Network elements, Kirchhoff's laws, Power in DC circuits, Series & parallel resistances, Thevenin's and Norton's theorems. AC Circuits: Sinusoidal sources, Phasor representation of sinusoidal quantities, Average and RMS values, Form factor, Analysis of RLC circuits to sinusoidal inputs, Power factor, Active & reactive powers, energy stored in inductance and capacitance, Mutual inductance.

UNIT II

Three-Phase Circuits: Production of 3-phase voltages, balanced star and delta connections, Measurement of power by Two-wattmeter method. Single Phase Transformers: Principle of operation, Transformer on No-load and Load, Equivalent circuit, Efficiency & regulation, O.C and S.C tests, Principle of autotransformer.

UNIT III

DC Machines: Construction and working principle of generator and motor, EMF in generator, Types of excitation, Characteristics of series and shunt generators, Applications, Torque in a DC motor, Characteristics of shunt and series motors, Speed control of dc shunt motors, Losses & efficiency, Three point starter.

UNIT IV

Three-Phase Induction Motors: Production of rotating magnetic field, Construction and principle of Induction motors, Torque-slip characteristics, Star delta and Autotransformer starters, Speed control by Stator voltage and Rotor resistance methods.

UNIT V

Single-Phase Motors: Capacitor start and Capacitor run motor, Universal motors. Three - Phase alternators: Construction, emf equation, Regulation by synchronous impedance method.

Suggested Reading:

1. Naidu M.S. & Kamakshiah S, "**Introduction to Electrical Engineering"**, Tata McGraw Hill 1995
2. Mehta V.K., **"Principles of Electrical Engineering and Electronics",** S.Chand & Co., 1995
3. A.Chakrabarti, Sudipta Nath, Chandan Kumar Chanda, **"Basic Electrical Engineering"** Tata McGraw Hill Education PVT LTD, 2009

Course Code	Course Title						Core / Elective
ES934EC	**BASIC ELECTRONICS**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	**30**	**70**	**3**

Course Objectives

- Analyze the behavior of semiconductor diodes in Forward and Reverse bias.
- Design of Half wave and Full wave rectifiers with L, C, and LC & CLC Filters.
- Explore V-I characteristics of Bipolar Junction Transistor n CB, CE & CC configurations.
- Explain feedback concept and different oscillators.
- Analyze Digital logic basics and Photo Electric devices.

Course Outcomes

- Explain VI characteristics of Semiconductor diode, BJT, FET and MOSFET
- Calculate ripple factor, efficiency and % regulation of rectifier circuits
- Analyze feedback amplifiers, BJT oscillator circuits, Opamp, basic digital logic gates and data acquisition system

UNIT-I

Semi Conductor Theory: Energy Levels, Intrinsic and Extrinsic Semiconductors, Mobility, Diffusion and Drift current. Hall Effect, Characteristics of P-N Junction diode, Parameters and Applications

Rectifiers: Half wave and Full wave Rectifiers (Bridge, center tapped) with and without filters, ripple regulation and efficiency. Zener diode regulator.

UNIT-II

Bipolar Junction Transistor: BJT, Current components, CE, CB, CC configurations, characteristics, Transistor as amplifier. Analysis of CE, CB, CC Amplifiers (qualitative treatment only).

JFET: Construction and working, parameters, CS, CG, CD Characteristics, CS amplifier.

UNIT-III

Feedback Concepts – Properties of Negative Feedback Amplifiers, Classification, Parameters.

Oscillators – Barkhausen Criterion, LC Type and RC Type Oscillators and Crystal Oscillators. (Qualitative treatment only)

UNIT-IV

Operational Amplifiers – Introduction to OP Amp, characteristics and applications –Inverting and Non-inverting Amplifiers, summer, Integrator, Differentiator, Instrumentation Amplifier.

Digital Systems: Basic Logic Gates, half, Full Adder and Subtractors.

UNIT-V

Data Acquisition systems: Study of transducer (LVDT, Strain gauge, Temperature, Force). **Photo Electric Devices and Industrial Devices:** Photo diode, Photo Transistor, LED, LCD, SCR, UJT Construction and Characteristics only.

Display Systems: Constructional details of CRO and Applications.

Suggested Reading:

1. Jocob Millman, Christos C. Halkias and Satyabrata Jit, **Electronics Devices and Circuits,** 3rd edition, McGraw Hill Education(India) Private Limited, 2010.
2. Rama Kanth A. Gaykward, **Op-AMPS and Linear Integrated Circuits** 4th Edition Prentice Hall of India, 2000.
3. M. Morris Mano, **Digital Design**, 3rd Edition, Prentice Hall of India, 2002.
4. William D Cooper, and A.D. Helfrick, **Electronic Measurements and Instrumentations Techniques**, 2nd ed., Prentice Hall of India, 2008.
5. S. Shalivahan, N. Suresh Kumar, A. Vallava Raj, **Electronic Devices and Circuits**, 2nd ed., McGraw Hill Education(India) Private Limited, 2007.

Course Code	Course Title						Core / Elective
PC401MP	**APPLIED THERMODYNAMICS & HEAT TRANSFER**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	4	-	-	-	**30**	**70**	**4**

Course Objectives

- To familiarize with the working of single and multi stage air compressor, work done, and efficiency of air compressor
- To know constructional features and combustion phenomenon in IC engines, working cycles, ignition systems, cooling and lubrication of IC engines and performance of an IC Engines.
- To know the modes and laws of heat transfer conduction through slabs, hollow cylinders and spheres. convection and radiation equation. Heat exchangers and their types

Course Outcomes

- To quantify the behavior of reciprocating compressors.
- To explain thermal design and working principles of IC Engines,their supporting systems and Combustion chambers.
- To quantify the behavior of power plants based on the Rankine cycle, including the effect of enhancements such as superheat, reheat and regeneration.
- Toexplain the thermal design and working principles of Power plant devices - Boilers, Condensers, Pumps &Nozzles.

UNIT-I

Reciprocating Air Compressor: Single stage and multi stage compressors, work done, efficiency of multi stage compressor. Effect of clearance volume on work done and efficiency. After cooling and intercooling. Uses of compressed air.

UNIT-II

Internal Combustion Engines: Classifications, working principles, deviation of actual cycles from air standard cycles, Index of compression and expansion for variable specific heats, Performance of I.C Engines-determination of indicated power, brake power, frictional power, brake thermal efficiency, mechanical efficiency, indicated thermal efficiency, relative efficiency, volumetric efficiency, specific fuel consumption based on brake power and indicated power, heat balance sheet.

UNIT-III

Combustion Phenomenon: Combustion Phenomenon in spark ignition and compression ignition engines, detonation, knocking, effect of engine variables in combustion. Working principle of simple and Zenith carburetors, fuel pump and fuel injectors, cooling and

lubrication systems of Internal Combustion engines, types of combustion chambers in SI and CI engines along with merits and demerits.

UNIT-IV

Modes of Heat Transfer: Laws of heat transfer- Fourier, Newton, Stefan Boltzmann General conduction equation in Cartesian, cylindrical coordinates, one dimensional steady state conduction through slabs, hollow cylinders and spheres with and without heat generation. Effects of variable thermal conductivity in heat transfer of one dimensional steady state conduction of plates, cylinders, steady state heat transfer through composite slabs and cylinders, critical radius of insulation.

UNIT-V

Convection: Dimensional analysis and its uses in free and forced convection. Buckingham theorem, physical significance of different dimensional numbers.

Radiation: Definition of absorptivity, reflectivity and transmissivity, concept of Black body and emissivity. Kirchhoff's law, Planck`s black body spectral distribution, Wien's and Stefan Boltzmann law.

Heat Exchangers: Classification, simple problems on parallel flow and counter flow heat exchangers with LMTD concept.

Suggested Reading:

1. Ganeshan V, **"Internal Combustion Engines",** Tata McGraw Hill Publishing, New Delhi, 2004.
2. Ballaney PL, **"Thermal Engineering"** Khanna publishers, New Delhi, 2004.
3. Pakirappa, **"Thermal Engineering** "Durga Publishing House, Hyderabad 2015.
4. Holman JP, **"Heat Transfer** ", Tata McGraw Hill Publishing, New Delhi, 2004.
5. Sachedeva RC, **"Fundamentals of Engineering, Heat and Mass Transfer"** New Age International (P) Ltd., New Delhi, 2004.
6. Chattopadhyaya P **"Engineering Thermodynamics"** 2nd Edn, Oxford University Press, New Delhi.

Course Code	Course Title						Core / Elective
PC 402 ME	**KINEMATICS OF MACHINES**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	4	1	-	-	**30**	**70**	**4**

Course Objectives

- To understand the basic elements of machinery and their motion characteristics
- To know the kinematic properties of mechanisms and machines
- To understand basic machine elements
- To know classification and applications of cams, gears and gear-trains

Course Outcomes

- To determine the degree of freedom of a given mechanical system.
  To understand the importance of mechanisms and their applications.
- To develop new mechanisms for various applications.
- To develop a power drive system for a specific system.
- To understand the importance of friction and its applications.

UNIT-I

Definition of link, element, pair, kinematic chain, mechanism and machine, Grubler's criterion, single and double slider chains, inversions of quadratic cycle chain, inversions of single and double slider crank chains. Fundamentals of coupler curves, Robert's law, mechanism with lower pairs and straigh line motion mechanism, Pantograph, Peaucerlier, Hart, Davis and Ackerman's Steering gear mechanisms

UNIT-II

Analysis of Mechanisms: Graphical methods to find velocities of mechanisms, instantaneous centre, body centre and space centre, Kennedy's theorem, Graphical determination of acceleration of different mechanisms including Coriolis component of acceleration. Analytical method to find the velocity and acceleration, analysis of four bar mechanism with turning parts, Freudenstein's method for four bar linkage synthesis.

UNIT-III

Laws of Friction: Friction in screw threads, pivots, collars and clutches, friction axis of link and friction circle

Belts and Ropes: Open and closed belt drives, length of belt, ratio of tensions, effect of centrifugal tension and initial tension over power transmission, condition for maximum power
Brakes and Dynamometers: Block or shoe, band and block, internal expanding shoe brake, Prony, Rope brake, belt transmission, Torsion dynamometers.

UNIT-IV

Cams: Types of cams and followers, Displacement diagrams for followers, uniform motion, parabolic motion, simple harmonic motion, cycloidal motion drawing cam profile with knife-edge follower, translating roller follower and translating Flat follower, cams of specified contour: Eccentric circle cam with translating flat power, Eccentric circle cam with translating roller follower.

UNIT-V

Gears: Classification of gears. Spur gears- Nomenclature, law of gear tooth action, involute as gear tooth profile, interference of involute gears, minimum number of teeth to avoid interference, contact ratio, cycloidal tooth profile, comparison of involute and cycloidal tooth profile.

Helical gears: Helical gear tooth relations, contact of helical gear teeth. Gear trains- Simple and compound, reverted, and epicyclic gear trains.

Suggested Reading:

1. S.S. Rattan, **Theory of Machines,** Tata McGraw-Hill, 3rd Edition, 2009.
2. J. E. Shigley, **Theories of Machines,** McGraw-Hill Publications, 2005.
3. Thomas Bevan, **Theory of Machines**, CBS Publishers,
4. J.S. Rao and R.V. Dukkipati, **"Mechanisms and Machine Theory",** Wiley Eastern Ltd, 1992.
5. Amitabha Ghosh and Ashok Kumar Mallik, **Theory of Mechanisms and Machines**, East West Press Pvt. Ltd, 2008

Course Code	Course Title						Core / Elective
PC 403 ME	**DESIGN OF MACHINE ELEMENTS**						
Prerequisite	Contact Hours per Week				CIE	SEE	Core
	L	T	D	P			Credits
NIL	4	-	-	-	**30**	**70**	**4**

Course Objectives

- To understand the basics of mechanics of materials and design of a machine for static and fatigue strength, rigidity and wear criterions use of codes and standards.
- To know the principles of ergonomic design and use of theories of failure for safe design
- To learn the principles to design shafts, keys, belt drives, joints and couplings.

Course Outcomes

- To select proper material for the machine component based on theories of failure, different fatigue loads.
- To determining size of the machine components for torque transmission, bending and axial loads.
- To identify the type of joints and fasteners required for a given application and predicting its efficiency

UNIT-I

Design considerations of Machine Elements. Materials used in machine design and their specifications according to Indian Standards. Codes and standards used in design. Important mechanical properties of materials used in design. Preferred numbers. Manufacturing considerations in design. Review of types of loads and simple stresses. Stresses due to Biaxal and Triaxal loads. Factor of safety. Theories of failures. Design of components subjected to impact loading.

UNIT-II

Design for Fatigue: Fluctuating stresses, fatigue strength and endurance limit Stress concentration factor and Notch sensitivity. Factors affecting fatigue strength. S-N diagram, Soderberg and Modified Goodman's diagrams for fatigue design. Cumulative fatigue - Miner's rule.

UNIT-III

Design of shafts: solid, hallow and splined shafts under torsion and bending loads. Design of keys. Design of couplings - Muff, Split muff, Flange, Flexible, Marine type couplings.

UNIT-IV

Design of Joints: Cotter and Knuckle joints. Design of pulleys. Design of chain drives linked and laminated chains. Design of bolts and nuts, Locking devices for nuts, Bolts of uniform strength. Bolted joints under eccentric loads. Design of gasket joints.

UNIT-V

Design of Screws: Design of power Screws and screw jack. Differential and Compound Screws. Design of rivetted and welded joints under direct and eccentric loads.

Suggested Reading:

1. M.F. Spotts, **"Design of Machine Elements",** Pearson Edu, 7th Edn. 2003
2. V. B. Bhandari, **"Design of Machine Elements",** Tata McGraw-Hill Publ, 3rd Edn. 2010
3. P.C. Sharma & D.K. Aggarwal, **"Machine Design",** S.K. Kataria & Sons, 10th edn, 2003
4. P. Kannaiah, **Machine Design**, Sci-Tech Publ., 2009
5. J.E. Shigley & Charles R. Mischke **"Mechanical Engineering Design",** Tata McGraw-Hill., 6th Ed. 2010

Course Code	Course Title						Core / Elective
ES461EE	**ELECTRICAL CIRCUITS AND MACHINES LAB**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	2	**25**	**50**	**1**

Course Objectives

- To learn practical electric AC & DC circuits
- To learn operation and performance characteristics of electrical machines by conducting various tests practically

Course Outcomes

- Aware of various electric safety rules to be followed while working with electric circuits and equipments
- Explore themselves in designing basic electric circuits
- Identify requirements for electric machines for domestic and industrial purpose

List of Experiments:

1. Verification of Kirchhoff's Laws.
2. Verification of Thevenin's and Norton's Theorems.
3. Study of Three-Phase Balanced Circuits.
4. Measurement of Power by Two-Wattmeter Method.
5. Study of Single-Phase RLC Series Circuits.
6. Magnetization Curve of a Separately Excited DC Generator.
7. Load Characteristics of Shunt Generator.
8. Performance Characteristics of Shunt Motor.
9. Speed Control of DC Shunt Motor.
10. O.C and S.C Tests on Single-Phase Transformer.
11. Load Test on Single-Phase Transformer.
12. Load Test on Three-Phase Induction Motor.

Note: At least ten experiments should be conducted in the Semester.

Course Code	Course Title						Core / Elective
EC955EC	**BASIC ELECTRONICS LAB**						
Prerequisite	Contact Hours per Week				CIE	SEE	Core
	L	T	D	P			Credits
NIL	-	-	-	2	**30**	**70**	**1**

Course Objectives

- Demonstrate the characteristics of Semiconductor diodes
- Realize the filters and Rectifiers.
- Verify the characteristics of different transistor Configurations.
- Design of Biasing Circuits for BJT and FET Amplifiers.
- Design different circuits using Operational Amplifiers.

Course Outcomes

- Plot characteristics of diode and transistor
- Calculate ripple factor, efficiency and % regulation of rectifier circuits
- Analyze feedback amplifiers and BJT oscillator circuits
- Demonstrate Opamp, data converter and strain gauge measurement

List of Experiments:

1. CRO-Applications, Measurements of R, L and C using LCR meter, Color code method and soldering practice.
2. Characteristics of Semiconductors diode (Ge,Si and Zener)
3. Static Characteristics of BJT-Common Emitter
4. Static Characteristics of BJT-Common Base
5. Static Characteristics of FET
6. RC-Phase Shift Oscillator
7. Hartley and Colpitts Oscillators
8. Common Emitter Amplifier
9. Astable Multivibrator
10. Full-wave rectifier with and without filters using BJT
11. Operational Amplifier Applications
12. Strain Guage Measurement
13. Analog-to-Digital and Digital to Analog Converters

Note: At least ten experiments should be conducted in the Semester.

Suggested Reading:

1. Maheshwari and Anand, **Laboratory Experiments and PSPICE Simulations in Analog Electronics**, 1st Edition, Prentice Hall of India, 2006.
2. David Bell A., **Laboratory Manual for Electronic Devices and Circuits**, Prentice Hall of India, 2001.

Course Code	Course Title						Core / Elective
PC453MP	**APPLIED THERMODYNAMICS & HEAT TRANSFER LAB**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	2	**25**	**50**	**1**

Course Objectives

- To familiarize with constructional features of IC Engines and to perform tests on them to determine various efficiencies.
- To understand the concept of heat transfer modes from different materials and different types of heat exchangers.
- To know and evaluate the heat transfer coefficients and Stefan-Boltzmann constant
- To conduct experiments on exhaust gas analysis on Petrol and Diesel Engine.

Course Outcomes

- To perform experiments to find the efficiency of Petrol and Diesel engines.
- To perform experiments on CI and SI engines.
- To perform experiments of reciprocating air compressor.
- To Perform Experiments on heat exchangers and design suitable exchangers for a given application.
- To perform exhaust gas analysis on Petrol and Diesel engines.

List of Experiments:

1. Determination of Valve/Port timing diagram of an IC Engine.
2. Determination of performance characteristics of a multi-cylinder petrol engine.
3. To conduct Morse Test on multi cylinder petrol engine.
4. To conduct performance test on Diesel Engine.
5. To determine volumetric efficiency and isothermal efficiency of multi stage reciprocating air compressor.
6. Determination of Thermal conductivity of metal bar.
7. Determination of convective heat transfer coefficient under natural/forced convection phenomenon.
8. Determination of heat transfer coefficient in parallel and counter flow heat exchanger.
9. Determination of emissivity of given plate.
10. Determination of the values of Stefan-Boltzmann constant.
11. Determination of thermal conductivity of composite wall.
12. Exercise on Exhaust gas analysis on Petrol and Diesel Engine.

Note: At least ten experiments should be conducted in the Semester.