DEPARTMENT OF MECHANICAL ENGINEERING

Scheme of Instructions

With Effect from academic year

2019-2020

UNIVERSITY COLLEGE OF ENGINEERING
(AUTONOMOUS)

OSMANIA UNIVERSITY
HYDERABAD-500 007, TELANGANA

SCHEME OF INSTRUCTION & EXAMINATION
B.E III Semester (Mechanical Engineering)

S.No.	Course Code	Course Title	Scheme of Instruction			Contact hr/week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
1	BS 304MT	Mathematics-III (PDE, Probability & Statistics)	3	1	-	4	30	70	4
2	ES 302EC	Applied Electronics	3	-	-	3	30	70	3
3	ES 301ME	Applied Mechanics	3	-	-	3	30	70	3
4	PC 302ME	Engineering Thermodynamics	3	-	-	3	30	70	3
5	PC 303ME	Materials Engineering	3	-	-	3	30	70	3
6	PC 304ME	Strength of Materials	3	-	-	3	30	70	3
PRACTICALS									
7	PC 351ME	Materials Engineering Lab	-	-	2	2	25	50	1
8	PC 352ME	Strength of Materials Lab	-	-	3	3	25	50	1.5
Total			**18**	**1**	**5**	**24**	**230**	**520**	**21.5**

SCHEME OF INSTRUCTION & EXAMINATION
B.E IV Semester (Mechanical Engineering)

S. No.	Code	Name of the Course	No of Hours				Scheme of Examination		Credits
			L	T	P	Contact Hrs/wk	CIE	SEE	
1.	PC 401ME	Kinematics of Machines	3	-	-	3	30	70	3
2.	PC 402ME	Thermal Engineering	3	-	-	3	30	70	3
3.	PC 403ME	Manufacturing Processes	3	-	-	3	30	70	3
4.	PC 404ME	Design of Machine Elements	3	-	-	3	30	70	3
5.	PC 405ME	Machine Drawing	-	-	6	6	30	70	3
6.	MC 401HS	Indian Constitution	2	-	-	2	30	70	-
PRACTICALS									
7.	ES 452EC	Applied Electronics Lab	-	-	2	2	25	50	1
8.	PC 451ME	Thermal Engineering Lab- I	-	-	3	3	25	50	1.5
9.	PC 452ME	Manufacturing Processes Lab	-	-	3	3	25	50	1.5
		Total	14		14	28	255	570	19
* At the end of IV semester students should undergo summer Internship- Marks will awarded in V semester.									

SCHEME OF INSTRUCTION & EXAMINATION
B.E IV Semester (ECE)
Service Courses Offered to other Departments

S.No.	Course Code	Course Title	Scheme of Instruction			Contact hr/week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
1	ES 401ME	Elements of Mechanical Engineering	3	-	-	3	30	70	3

- **Offered to ECE Department students**

BS 304MT

MATHEMATICS- III
(PDE, Probability & Statistics)

Credits: 4

Instructions: (3L+1T) hrs per week *Duration of SEE: 3hours*
CIE: 30 Marks *SEE: 70 Marks*

Course Objectives:

- To introduce the solution methodologies for first and second order Partial Differential Equations with applications in engineering
- To provide an overview of probability and statistics to engineers

Course Outcomes:

Upon completion of this course, students will be able to

- Solve field problems in engineering involving PDEs.
- They can also formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.

Contents:

Unit-I

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method.

Unit-II

Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Heat diffusion equyation, Separation of variables method to simple problems in Cartesian coordinates., one dimensional diffusion equation and its solution by separation of variables.

Unit-III

Measures of Central tendency: Moments, skewness and Kurtosis, Discrete random variables, expectation of discrete random variables, moments, variance of a sum, continuous random variables & their properties, distribution functions, and densities.

Unit-IV

Probability distributions: Binomial, Poisson and Normal, evaluation of statistical parameters for these three distributions, Curve fitting by the method of least squares: fitting of straight lines, second degree parabolas and more general curves, Correlation, regression and rank correlation.

Unit-V

Test of significance: Large sample test for single proportion, difference of proportions, Small sample Tests for single mean, difference of means, and difference of standard deviations, Test for ratio of variances, Chi- square test for goodness of fit and independence of attributes.

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.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons.2006.
4. S. Ross, "A First Course in Probability", Pearson Education India, 2002.
5. S.C Gupta & Kapoor: Fundamentals of Mathematical statistics, Sultan chand & sons, New Delhi.

ES 302EC

APPLIED ELECTRONICS

Credits: 3

Instructions: (3L) hrs per week *Duration of SEE: 3hours*
CIE: 30 Marks *SEE: 70 Marks*

Course Objectives:

- To understand the characteristics of diodes and transistor configurations
- To understand the design concepts of biasing of BJT and FET
- To understand the design concepts of feedback amplifiers and oscillators
- To study the design concepts of OP Amp and data converters

Course Outcomes:

- Study and analyze the rectifiers and regulator circuits.
- Study and analyze the performance of BJTs, FETs on the basis of their operation and working.
- Ability to analyze & design oscillator circuits.
- Ability to analyze different logic gates & multi-vibrator circuits.
- Ability to analyze different data acquisition systems

UNIT-I

Characteristics of PN Junction: Half wave rectifier, Full wave rectifier, filters, ripple, regulation, TIF and efficiency, Zener diode and Zener diode regulators. CRT construction and CRO applications

UNIT-II

Bipolar and Field Effect Transistors : Biasing FET , small signal model, h-parameter equivalent circuits, basic amplifier circuits-CB,CE,CC configurations of BJT and CG,CS and CD configurations of FETs, RC-coupled amplifier and its frequency response.

UNIT-III

Feedback Concepts: Types of negative feedback-modification of gain, bandwidth, input and output impedances-applications; Oscillators: RC phase shift, Wien bridge, LC and Crystal Oscillators.

UNIT-IV

Operational Amplifier: Characteristics, applications, Differential amplifiers, logic gate circuits-Introduction to Digital Systems-AND,NAND,NOR,XOR gates, Binary half wave adder, full adder, Multi-vibrators-Bi-stable, Mono-stable and Astable Multi-vibrators (Qualitative treatment only),Schmitt trigger.

UNIT-V

Data Acquisition Systems: Construction and Operation of transducers-Strain gauge LVDT, Thermocouple, Instrumentation Systems, Magnetic tape recorders, FM recording, Digital recording, Digital to Analog and Analog to Digital conversions.

Suggested Reading:

1. Robert Boylestad L. and Louis Nashelsky, *Electronic Devices and Circuit Theory*, Prentice Hall of India , 2007

2. Helfrick D and David Cooper, *Modern Electronic Instrumentation and Measurements Techniques,* 1st edition, Prentice Hall of India, 2006.
3. Salivahanan, Suresh Kumar and Vallavaraj, *Electronic Devices and Circuits,* 2nd edition, Tata McGraw-Hill, 2010.

ES 301ME

APPLIED MECHANICS

Credits: 3

Instructions: (3L) hrs per week *Duration of SEE: 3hours*
CIE: 30 Marks *SEE: 70 Marks*

Course Objectives:

- To understand the resolution of forces, equilibrium of force systems
- To Learn the analysis of forces in the structures and also the basic concepts of friction and its
- Applications to mechanical devices.
- To understand the concepts of centroid, moment of inertia, centre of gravity and mass moment of inertia
- To learn the concept of principle of virtual work and its applications to solve engineering problem
- To understand the basic concepts of kinematics and kinetics

Course Outcomes:

- Determine the resultant and moment of a force system and apply the equations of equilibrium for a generalized force system
- Analyze the forces in trusses, frames and also friction in various mechanical devices.
- Determine the centroids, centers of gravity and moments of inertia of simple geometric shapes and understand the physical applications of these properties.
- Apply the concept of virtual work in analyzing various engineering problems
- Apply the basic concepts of dynamics to solve problems of engineering applications

UNIT- I

Introduction to Engineering Mechanics: Force systems: Basic Concepts, Resultant of coplarnar concurrent forces, Components of force in space, Moment of force and its applications, couples and resultant of force systems, Equilibrium of Force Systems, Free body diagram, Equations of equilibrium, Equilibrium of planar and spatial system.

UNIT-II

Analysis of Structures: Analysis of trusses by method of joints, method of sections; Analysis of frames by method of members.
Introduction to Friction, Laws of friction, Application to simple systems, Connected systems and belt friction, Wedge friction.

UNIT-III

Centroid and Centre of Gravity, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Radius of Gyration.

UNIT-IV

Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. systems with friction, mechanical efficiency. Conservative forces and potential

energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium.

UNIT-V

Introduction to Kinematics & Kinetics: Rectilinear motion; Plane curvilinear motion, 3-D curvilinear motion, principle of work energy, its applications to translation, Particle motion and connected systems, Fixed axis rotation and plane motion, D'Alembert's principle and its applications. Introduction to Vibrations: Basic terminology, free vibrations, resonance and its effects.

Suggested Reading:

1. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics.
2. S.P. Timoshenko and D.H. Young, *Engineering Mechanics*, McGraw-Hill International Edition, 1983.
3. S.B. Junarkar and H.J. Shah, *Applied Mechanics*, 2001.
4. J.H. Shames, *Engineering Mechanics*, Prentice Hall, 1987.
5. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

e-Resources:

1. http://nptel.ac.in/
2. http://mhrd.gov.in/e-contents
3. http://spoken-tutorial.org/

PC 302ME

ENGINEERING THERMODYNAMICS

Credits: 3

Instructions: (3L) hrs per week *Duration of SEE: 3hours*
CIE: 30 Marks *SEE: 70 Marks*

Course Objectives:

- To introduce the fundamental laws and principles of thermodynamics used by Engineers including the gas laws with nature of fluid flows and classification of thermodynamic systems, processes and Cycles.
- 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 the pure substance through the phase change processes in order to establish the relationships among thermodynamics properties ,calculations of Steam properties using Mollier diagram and steam Tables for Carnot and Rankine Cycle Power plant operations.
- To introduce thermodynamic analysis of gas mixtures with special emphasis on study of moist air properties and to introduce thermal design concepts employed in Air conditioning processes.

Course Outcomes:

- The Learning Outcomes are assessed through special assignments, class tests and a final end semester exam.
- ***Upon Completion of this course:***
- Students are expected to be explain the laws, symbols and vocabulary of thermodynamics with clear understanding of drawing thermodynamic cycles on Ts and PV plots
- Students are expected to be use ideal gas laws to solve Closed and Open system problems.
- Students are expected to be use Second law concepts to solve problems.
- Students are expected to be understand phase change phenomena of Pure Substances, with special reference to Steam as fluid. They are expected to use Mollier Chart and Steam Tables to calculate steam property changes in Rankine power plant cycles
- Students are expected to understand working principles of Air conditioning systems and devices and gain proficiency in using Psychrometry chart.

UNIT-I

Concepts of System, **Surroundings and Universe**. Types of systems. Classification of Properties-fundamental and secondary, intensive and extensive. Basic laws of Thermodynamics. Thermodynamic equilibrium.

Types of thermodynamic processes and their representation on P-V and T-s plots. Types of cycles-Open and Closed.

Ideal Gases- Equation of State. Specific Heats, Enthalpy, Internal energy, & Entropy. Real Gases-vander Waals Equation of State, Compressibility Factor.

UNIT-II

First Law analysis of Closed Systems: First law of thermodynamics. Heat and work transfers. Energy conservation equation for a closed system. Calculation of Work Transfer, Heat Transfer, and Internal Energy changes.

First Law analysis of Open Systems: Derivation of Unsteady Flow Energy Equation (UFEE) and Steady Flow Energy Equation (SFEE). Calculation of Work Transfer, Heat Transfer, and Enthalpy changes. Thermodynamic analysis of flow through Nozzles, Diffusers, Turbines, Compressors, Throttling devices and Heat Exchangers.
Application of Unsteady Flow Energy Equation (UFEE) : Calculation of Heat transfer during charging /evacuation of a Cylinder.

UNIT-III
Carnot Cycle- Thermodynamic analysis of Carnot Cycle. Applications of Carnot cycle -Heat Engine, Heat Pump and Refrigerator.
Second Law of Thermodynamics: Statements of Second Law of thermodynamics. Equivalence of Kelvin-Planck and Clausius Statements. Clausius Inequality, Carnot Theorems, Thermodynamic Temperature Scale.
Concept of Entropy: Reversible and Irreversible processes. Calculation of Entropy change during various thermodynamic processes. Principle of Increase of Entropy. Second law analysis of a control Volume.
Concepts of Exergy and Anergy: Loss in available energy. Second law efficiency of Turbines and Compressors.

UNIT-IV
Pure Substances. Concept of Phase Change. Graphical representation of thermodynamic processes on P-V, P-T, T-V, T-s, h-s, P-h and P-V-T diagrams. Thermodynamic relations involving Entropy, Enthalpy and Internal Energy. Derivation of Maxwell's relations. Clapeyron equation.
Properties of Steam- Use of Steam Tables and Mollier diagram.
Power Plant Cycles-Carnot and Rankine Cycles and their representation on P-V, T-s and h-s diagrams. Evaluation of performance parameters–Efficiency, Work ratio, Specific Steam Consumption and Heat Rate.

UNIT-V
Non reactive Ideal homogenous gas Mixtures: Determination of properties of Mixture in terms of properties of individual components of the mixture. Gibbs Phase Rule.
Psychrometry : Moist Air Properties. Use of Psychrometric Chart and Tables.
Concept of Air-Conditioning: Heating, Cooling, Humidification and De-humidification and other psychrometric processes. Adiabatic Mixing of two Streams of Moist Air. Sensible heat factor and Bypass factor for heaters/coolers.
Introduction to summer and winter air-conditioning processes with a brief overview on devices used in Air Conditioning.

Suggested Reading:
1. Yunus Cengel, Michael Boles "*Thermodynamics: An Engineering Approach",* McGraw-Hill Education; 8 edition, 2017
2. Nag P.K, "*Engineering Thermodynamics'*: Tata McGraw Hill Publishing, 6th Edn, 2017.
3. Richard E.Sonntag, C.Borgnakke, G.J Van Wylen, *"Fundamentals of Thermodynamics':* John Wiley & Sons, 7th Edn., 2009.
4. Rajput R K, " *Engineering Thermodynamics*" Laxmi Publications, 4th Edition, 2016

PC 303ME

MATERIALS ENGINEERING

Credits: 3

Instructions: (3L) hrs per week *Duration of SEE: 3hours*
CIE: 30 Marks *SEE: 70 Marks*

Course Objectives:

- Describe various imperfections, fracture and fatigue in metals.
- To understand the basic uses of ferrous and non ferrous alloys
- To know the properties and applications of ceramics, polymers and composites
- To provide a detailed interpretation of equilibrium phase diagrams
- Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

Course Outcomes:

Student will be able to

- Identify crystal structures for various materials and understand various failures in metals like fracture, creep and fatigue.
- Acquire knowledge to tailor material properties of ferrous and non-ferrous alloys
- Differentiate the properties and applications of ceramics, polymers and composites.
- Interpret thermal equilibrium diagram of binary non ferrous alloys
- Design various heat treatments to produce specific microstructure and properties for steels using time- temperature-transformation and continuous cooling diagrams as needed.

UNIT–I

Crystal Structure: Unit cells, Metallic crystal structures. Imperfection in solids: Point, line, interfacial and volume defects; **Fracture:** Types of fracture in metals, modes of fracture, Ductile and brittle failure mechanisms, Griffith criterion for brittle materials. **Creep**: Creep strength, Creep curve, Creep Test. **Fatigue**: SN curve, endurance limit, Experimental determination of Fatigue strength.

UNIT-II

Plain Carbon Steels ,Alloying of steel, properties of stainless steel and tool steels, maraging steels; cast irons: grey, white, malleable and spheroidal cast irons; **Non-ferrous metals**: Copper and copper alloys, Aluminium and Al-Cu–Mg alloys, Nickel based super alloys and Titanium alloys

UNIT-III

Ceramics - Crystalline ceramics, Glasses, Properties and applications of ceramics; **Polymers** - Polymerization, Thermoplastics and thermosetting plastics, Properties and applications of polymers; Methods of processing of plastics; **Composites** - Concept of composites, Matrix and reinforcement, Rule of mixtures, Classification of composites, Applications of composites.

UNIT-IV

Phase diagrams: Substitutional and interstitial solid solutions. Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

UNIT-V

Heat Treatment of steel: Annealing, Normalizing, Hardening, Tempering. isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties. Austempering and Martempering. Case Hardening: Carburizing, Nitriding, Carbo-nitriding, Flame Hardening, Induction Hardening.

Suggested Reading:

1. W. D. Callister, 2007, adapted by R.Balasubramaniam, "Materials Science and Engineering", 7th Edition, Wiley India.
2. Kodgire V.D, Kodgire S.V., "Material Science and Metallurgy For Engineers" Everest Publishing House, 42nd Edition, 2018
3. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
4. Avner S.H, "Introduction to Physical Metallurgy", McGraw Hill Publishing Co.Ltd., 2nd Edition, 1974.
5. Nayak S.P, "Engineering Metallurgy And Material Science": Charotar Publishing House, 6th Edn., 1995.
6. Raghavan V, "Material Science and Engineering", Prentice Hall of India Ltd., 4th Edition, 1994.

PC 304ME

STRENGTH OF MATERIALS

Credits: 3

Instructions: (3L) hrs per week *Duration of SEE: 3hours*
CIE: 30 Marks *SEE: 70 Marks*

Course Objectives:

- Understand the concept of stress, strain and elastic behaviour of materials
- Know the concepts of strain energy, principal stress and principal planes
- Learn the bending moment, shear force and the corresponding stress distribution
- Study the deflections and its applications
- Understand the theory of torsion and stresses in springs

Course Outcomes:

- Apply the fundamental concepts of stress and strain
- Determine principal stresses and principal planes of a state of stress
- Analyze the structural members subjected to tension, compression,
- Compute the bending, torsion and combined stresses
- Solve the stresses in springs

UNIT - I

Simple Stresses and Strains: Types of stresses and strains, Hook's law, stress-strain curve for ductile materials, moduli of elasticity, Poisson's ratio, linear strain, volumetric strain, relation between elastic constants, bars of varying sections, bar of uniform strength, compound bars and temperature stresses.

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, principle stresses and principle planes, Mohr circle of stress and ellipse of stress.

UNIT - III

Theory of Simple Bending: Assumptions, derivation of basic equation, section modulus, moment of resistance, determination of flexural stresses. Direct and Bending Stresses: Basic concepts, core for rectangular solid and hollow circular and I sections. Distribution of Shear Stress: Equation of shear stress, distribution across rectangular, circular, diamond, T and I sections.

UNIT - IV

Torsion: Theory of pure torsion, derivation of basic equation, 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.

UNIT - V

Deflections: Deflections of cantilever and simply supported beams including overhanging beams for point loads and uniformly distributed loads by double integration and Macaulay's method.

Strain Energy: Strain energy in bars due to gradually applied loads, sudden loads, impact loads and shock loads.

Suggested Reading:

1. Ferdinand P Beer et.al., Mechanics of Materials, Tata McGraw-Hill, 2004.
2. B.C. Punmia, Strength of Materials, Laxmi Publishers, 2000.
3. S. Ramamrutham, Strength of Materials, DhanpatRai& Sons, 1993.
4. D.S. Prakash Rao, Strength of Materials - A Practical Approach, Universities Press, 1999.
5. R.K. Rajput, Strength of Materials, S. Chand & Co., 2003.
6. G.H. Ryder, Strength of Materials, Third Edition in SI units, Macmillan Indian Limited, Delhi, 2002.

PC 351ME

MATERIALS ENGINEERING LAB

Credits: 1

Instructions: (2P) hrs per week *Duration of SEE: 3hours*
CIE: 25 Marks *SEE: 50 Marks*

Course Objectives:

- To get familiarized with the procedure of metallurgical specimen preparation for microscopic examination and viewing the structure
- To learn the concept of the preparation of samples to perform characterization such as microstructure, grain size.
- To know the method of identifying phases of micro structure and identifying different metals and alloys
- To Explain hardenability and factors affecting it by Jominy Quench Test
- To learn the concepts of improving the mechanical properties of materials by different methods like heat treatment, surface treatment etc.

Course Outcomes:

Student will be able to

- Acquire experimentation skills in the field of material testing.
- Identify different metals and alloys based on metallurgical phases observed in the micro structure
- To analyze the microstructure of a specimen quantitatively.
- Apply various methods of preparing a specimen for viewing the microstructure
- Distinguish the phase changes in a heat treated specimen compared to untreated specimen.

List of Experiments:

1. Study of Crystal Structures, Metallurgical Microscope, Iron-Iron Carbide diagram
2. Sample Preparation techniques for Metallographic Analysis
3. Grain size measurement
4. Metallographic Study of Pure Iron, Low carbon steel
5. Metallographic Study of Medium carbon 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/ White heart Malleable cast iron
11. Metallographic Study of Copper alloy
12. Metallographic Study of Aluminium alloy
13. Determination of hardenability by Jominy Quench Test
14. Study of microstructure after hardening, normalizing and annealing of steel specimen.

PC 352ME

STRENGTH OF MATERIALS LAB

Credits: 1.5

Instructions: (3P) hrs per week *Duration of SEE: 3hours*
CIE: 25 Marks *SEE: 50 Marks*

Course Objectives:

- Understand the experiments on various materials to assess their behavior and limitations
- Learn the brittle and ductile material failure patterns
- Understand the shear force, bending moment and deflection for different types of beams
- Know the rigidity modulus by conducting spring and torsion test

Course Outcomes:

- Evaluate Young's modulus, rigidity modulus, hardness number, flexural rigidity and impact strength of given specimens
- Find the cracking stress and compressive strength.
- Determine the stiffness of close coiled helical springs
- Find the deflection of a beam

List of Experiments:

1. Uni-axial tension test on a specimen of ductile material
2. Stress-Strain characteristics of a ductile material
3. Brinell's hardness test
4. Torsion test on a specimen of ductile material
5. Compression test on close coiled helical spring
6. Bending test on simply supported beam of steel
7. Bending test on fixed beam of steel
8. Izod impact test
9. Stiffness of close coiled helical spring.

PC 401ME

KINEMATICS OF MACHINES

Credits: 3

Instructions: (3L) hrs per week *Duration of SEE: 3hours*
CIE: 30 Marks *SEE: 70 Marks*

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:

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

UNIT-I

Definitions of link, pair, chain mechanism, degrees of freedom, Kutzbach's and Grubbler's criterion. Grashof's Law, Inversions of four bar mechanisms with all revolute joints, single and double slider crank mechanisms. Instantaneous Centre, Space Centrode and Body Centrode, Kennedy Theorem. Definitions and scope of Type, Number and Dimensional Synthesis. Pantograph and Geneva mechanisms. Ackerman and Davis steering gear mechanisms and Hooke's Joint. Peaucellier, Hart, Scott-Russel, Watt and Tchebicheff mechanisms.

UNIT-II

Analytical method to find velocities and accelerations in mechanisms. Velocities in mechanisms by instantaneous centre method, velocity and acceleration of mechanisms by using relative velocity method including Coriolis component of acceleration.

UNIT- III

Laws of friction. Screw threads, Pivots, Collars. Clutches -Single and Multi plate, Cone and centrifugal clutches. Friction circle and friction axis of a link. Belt, Rope and introduction to Chain drives.

UNIT-IV

Brakes and Dynamometers: Block or shoe, band, band and block, internal expanding shoe brakes and disc brakes. Prony, Rope brake, Belt transmission and epicyclic train Dynamometers.

Cams and Followers: Types of Cams and followers, motion of the follower, follower displacement diagram, Cam profile for specified follower motion and Cams with specified contours.

UNIT-V

Theory of Gearing, Terminology and Definitions, Law of Gearing, Tooth profiles, Path of contact and Arc of contact. Interference, methods of avoiding interference. Contact Ratio. Introduction to Helical, Bevel and worm gears.

Gear Trains: Simple, Compound, Reverted and Epicyclic gear trains. Differential of an Automobile.

Suggested Reading:

1. J. E. Shigley and John J. Uicker "Theory of Machines and Mechanisms", Tata McGraw Hill, 2nd Edn., 1995.
2. Thomas Bevan, "Theory of Machines", College Book Store (CBS) Publishers Ltd., 3rd Edn., 1985.
3. S.S. Rattan, "Theory of Machines", Tata McGraw Hill, 3rd Edn., 1995.
4. J.S. Rao and R.V. Dukkipati, "Mechanisms and Machine Theory", Wiley Eastern Limited, 1992.
5. Amitabha Ghosh and Ashok Kumar Mallik, Theory of Mechanisms and Machines, East West Press Pvt. Ltd, 2008

PC 402ME

THERMAL ENGINEERING

Credits: 3

Instructions: (3L) hrs per week *Duration of SEE: 3hours*
CIE: 30 Marks *SEE: 70 Marks*

Course Objectives:

- The Students are expected to be able to understand the working principles and quantify the behavior of reciprocating air compressors.
- To understand classification of IC Engines and their supporting systems and their working principles. ,
- To understand Combustion Phenomena in Engines and working principles of Combustion chambers.
- To gain the knowledge on construction and working principles of Thermal Power plantevices-Boilers, Condensers
- To understand construction and working principles of Steam Nozzles and to analyse Rankine cycle applied to thermal power plants.

Course Outcomes:

The Learning Outcomes are assessed through special assignments, class tests and a final end semester exam.

Upon Completion of this course:

- Students are expected to be able to quantify the behavior of reciprocating air compressors.
- Students are expected to be able to explain thermal design and working principles of IC Engines and their supporting systems and carry out performance analysis of IC Engines.
- Students are expected to be able to explain working principles of Combustion chambers used in IC Engines and understand methods to minimize abnormal combustion in IC Engines.
- Students are expected to be able to explain the thermal design and working principles of Power plant devices - Boilers, Condensers.
- Students are expected to be able to quantify the behavior of power plants based on the Rankine cycle, including the effect of enhancements such as superheat, reheat and regeneration (Direct and Indirect).They are expected to understand construction and working principles of Steam Nozzles.

Unit-I

Reciprocating Air Compressors: Classification and applications. Ideal and actual P-V diagrams, work input and efficiency relations for single and multi stage compressors. Effect of clearance volume on work input and efficiency. Inter cooling and after cooling concepts.

Unit-II

Internal Combustion Engines: Classification and applications. Working principles of four stroke and two stroke engines, Spark Ignition and Compression ignition engines. Deviation of actual cycles from Air Standard cycles. Performance parameters of I.C. Engines. Heat balance sheet of I. C. Engine.

Overview of Engine supporting systems- Cooling Systems, Lubrication systems- Wet sump, Dry sump and Mist Systems. Working principles of S.I. Engine fuel systems- Carburetors, Battery and Magneto Ignition systems. Working principles of C.I. Engine fuel systems- Fuel pump and Fuel injector.

Unit-III

I.C. Engine Combustion phenomena: Stages of combustion in S.I. Engines- Ignition delay, Flame front propagation and After burning. Abnormal combustion- Pre-ignition and Knocking.

Factors affecting Knocking. Stages of combustion in C.I. Engines, Delay period, Period of Uncontrolled Combustion, Period of Controlled Combustion and after burning. Abnormal Combustion-Knocking. Factors affecting Knocking. Octane and Cetane rating of fuels. Design considerations for combustion chamber and cylinder head. Type of combustion chambers of S.I. engines and C.I. engines.

Unit-IV

Steam Boilers: Classification and Working Principles. Water tube boilers- Babcok & Wilcox and Stirling boilers. Fire tube boilers- Cornish, Cochran, Locomotive and Lancashire boilers. High Pressure boilers / Supercritical boilers: La mont, Benson boiler, Loeffler boiler and Velox boiler.

Boiler Mountings and Accessories: Working Principles of Water level indicator, Pressure gauge, Steam stop valve, Feed check valve, Blow-off cock, Fusible plug, Safety valves, Economizers, Superheaters and Steam separator. Steam Condensers: Jet and Surface condensers, Principle of Operation and Applications.

Unit-V

Steam power plant cycles: Carnot and Rankine cycles of operation and their efficiencies. Analysis of Rankine cycle with superheating, reheating and regeneration (Direct and Indirect types).

Steam Nozzles: Flow of steam through convergent - divergent nozzles, velocity of steam flowing through the nozzle, mass of steam discharge through the nozzle, condition for maximum discharge, critical pressure ratio and nozzle efficiency. Super saturated expansion of steam through nozzles. General relationship between area, velocity and pressure in Nozzle flow.

Suggested Reading

1. R.K. Rajput, *" Thermal Engineering"*, Laxmi Publications, 10th Edn., 2018
2. V. Ganesan, *"Internal Combustion Engines",* Tata McGraw Hill Publishing, 4th Edn, 2017
3. P.L. Ballaney, " *Thermal Engineering: Engineering Thermodynamics & Energy Conversion Techniques*" Khanna Publishers, 19th Edn, 2005.
4. Richard Stone, *"Introduction to I.C. Engines*", Palgrave Mac Millan, 4th Edn., 2012

PC 403ME

MANUFACTURING PROCESSES

Credits: 3

Instructions: (3L) hrs per week *Duration of SEE: 3hours*
CIE: 30 Marks *SEE: 70 Marks*

Course Objectives:

- To understand the basic concepts of casting and welding
- To understand the manufacturing of plastics and composites
- To familiarize the forming processes and forming load estimation.
- To understand the principle of high energy rate forming processes

Course Outcomes:

- Understand the basic working principles of casting, forming and welding.
- Some understanding of types, manufacturing processes and applications of plastics and composite materials.
- Recommend appropriate part manufacturing processes when provided a set of functional requirements.
- Ability to analyze problems on forging, rolling, drawing and extrusion.
- Communicate effectively with industry personnel by developing a manufacturing-centric vocabulary.

UNIT-I

Introduction to Casting: Moulding Sands, Properties of sands, Testing of Sand properties and their improvements. Types of patterns and pattern materials, Pattern allowances. Core sands, core sand properties and core making processes. Machine Moulding techniques. Riser and Riser size estimationChvorinov and Caine's rules. Types gates and components of gating system. Theory of solidification. Introduction to Furnaces: Cupola, Arc and Induction.

UNIT-II

Special Casting Processes: Shell Mould Casting, Co2 Casting, Investment Casting, Gravity and Pressure Die Casting, Centrifugal Casting and Continuous Casting. Cleaning of Castings, Casting defects and their Causes. Processing of Plastics: Blow molding, Injection molding, Reaction injection molding, Rotational molding and Extrusion. Manufacturing of Composites: Hand lay-up, Filament winding, Compression molding, Resin infusion molding

UNIT-III

Sheet Metal Working: Geometry of Punch and Die for Blanking/Piercing operations, Cup Drawing, Strip Layout, Force Calculations. Metal spinning. High Energy Rate Forming: Explosive forming, Magnetic forming, Electro-hydraulic forming and Rubber pad forming.

UNIT - IV

Bulk Deformation Processes: Simple Estimation of Forces in Forging, Rolling, Rod Drawing and Extrusion. Hydrostatic Extrusion. Powder Metallurgy: Powder production methods, steps in powder metallurgy processes, cold and hot isostatic pressing, typical industrial applications.

UNIT-V

Gas Welding: Oxy-Acetylene Welding-Basic set up, Welding and Cutting Torches, Types of Flames. Arc Welding: Schematics of SMAW, GTAW, GMAW, PAW, SAW, LBW and EBW, Electrode Coatings and Electrode Specifications. Resistance Welding: Spot, Seam, Projection and butt welding, Flash welding. Solid State Welding: Pressure Welding, Ultrasonic Welding, Friction welding and Explosive welding. Basics of soldering and brazing.

Suggested Reading:

1. P.N.Rao, "Manufacturing Technology," Vol. 1, Tata McGraw Hill Publ., 3nd Ed., 2011.
2. Amitabh Ghosh & Mallick, "Manufacturing Science", Assoc. East west Press Pvt. Ltd. 4th Ed., 2011.
3. Serope Kalpakjian, "Manufacturing Engineering and Technology", Addison, Wesley Publishing Company, 2006
4. Kaushish J.P, "Manufacturing Processes", PHI Learning Pvt. Ltd., 2nd, 2010

PC 404ME

DESIGN OF MACHINE ELEMENTS

Credits: 3

Instructions: (3L) hrs per week *Duration of SEE: 3hours*
CIE: 30 Marks *SEE: 70 Marks*

Course Objectives:

- To understand the basics of mechanics of materials and design of a machine for static and fatigue strength, rigidity and wear criterions, usage of codes and standards.
- To know the principles of ergonomic 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.
- Determining size of the machine components for torque transmission, bending and axial loads.
- Identifying the type of joints and fasteners required for a given application and predicting its efficiency

Unit-I

Introduction, Materials used in machine design and their specifications to Indian standards. Important mechanical properties of materials used in design. Codes and standards used in design. Reliability, Principles of good Ergonomic Design, Manufacturing considerations. Preferred numbers. Value analysis.

Analysis of Stress and Strain : Definition of stress and strain, Types of loading, Direct normal stress, bending stress, Torisonal stress, crushing and bearing stresses, Biaxial stress and Triaxial stress.

Theories of elastic failure, Stress concentration factor, factor of safety, Design of components for static loads, Introduction to thermal stresses.

Unit-II

Design for Fatigue and Impact loads; Importance of fatigue in design, Fluctuating stresses, fatigue strength and endurance limit. Factors affecting fatigue strength. S-N Diagram, Soderberg and Modified Goodman's diagrams for fatigue design. Cumulative fatigue, Miner's rule, Design of components for fatigue. Design of components for impact loading.

Unit-III

Design of keys, shafts – solid hollow stepped shafts and splined shafts under torsion and bending loads.

Unit-IV

Design of cotter and knuckle joints, riveted and welded joints under direct and eccentric loading. Design of couplings – Muff and Split Couplings, Flange, Flexible and Marine type of couplings.

Unit-V

Design of bolts and nuts, locking devices, bolt of uniform strength, design of gasket joints, design of power screws and screw jack.Thick and thin cylinders.

Suggested Reading:

1. V.B. Bhandari, *Machine Design*, Tata Mc Graw Hill Publication, 1991.
2. J.E. Shigley, C.R. Mischne, *Mechanical Engineering Design*, Tata Mc Graw Hill Publications, 2003.
3. Robert C. Juvinall, *Fundamentals of Machine Component Design*, John Wiley & Sons, 2005
4. Robert L. Norton, *Machine Design: An Integrated Approach*,2/e Pearson Education, 2000
5. M.F. Spotts, *Design of Machine Elements*, Prentice Hall of India, 1964.

PC 405ME

MACHINE DRAWING

Credits: 3

Instructions: (6P) hrs per week *Duration of SEE: 3hours*
CIE: 30 Marks *SEE: 70 Marks*

Course Objectives:

- To understand format of drawing sheet, angle of projections, isometric projections, sectional views and practice on simple machine elements
- To practice sketching of standard machine elements
- To have knowledge on ISO system of Limits and Fits
- To understand assembly drawings of typical machine parts such as Connecting rod, Eccentric, Cross head, Machine vice, Screw jack, Bearings, Tail stock etc.

Course Outcomes: At the end of the course students will be able to

- Draw isometric and orthogonal projections and sectional views of various mechanical components.
- Draw sketches of standard machine elements
- Select suitable limits & fits for a given assembly of machine parts.
- Use both the software and drafter to produce assembly views of various mechanical components from part drawings.
- Understand various conventions and symbols given on the industrial drawings (shop floor production drawings).

The following contents are to be drawn using conventional method

UNIT-I

Standard Drawing Practices:

Format of drawing sheet, title block, conventions of drawing lines and dimensions. conventional representation of materials and parts (Screwed joint, Welded joints, Springs, Gears, machine tool elements). Abbreviated indication of standard parts in assembly drawings.

First and third angle projections, conventions for sectional views, views of simple machine elements from the given pictorial and orthographic views.

UNIT II

Machine Elements: sketching of the following standard machine elements

Screwed Fastenings: Screw thread nomenclature, thread series, designation, thread profiles, multi start threads, representation of threads, bolted joints, studded joint, eye bolt.

Keys, Cotters and Pin Joints: Introduction, saddle keys, sunk keys, cotter joint with sleeve, cotter joint with socket and Spigot ends, cotter joint with a Gib and knuckle joint.

Shaft Couplings: Rigid couplings, flexible couplings, disengaging couplings and non-aligned couplings.

Riveted Joints: Introduction, classification of riveted joints, terminology of riveted joints, rivet heads.

Welded Joints: Introduction, types of welded joints, representation of welds on drawings.

Unit-III

Assembly Drawings:

Assembly drawings from given details of component drawings and working description of the assembly. Ability to supply additional views. The exercises will be drawings of typical machine parts, assemblies e.g., Connecting rod, Eccentric, Cross head, Machine vice, pipe vice, Screw jack,

Plummer block, Pedestal Bearing, Tail stock, Gate valve, Universal coupling, Geneva cam etc. These are only examples and actual exercise or examination may include any assembly.

Limits and fits:

Introduction, fundamental deviations for Hole based and Shaft based systems, alpha numeric designation of limits & fits. Types of Fits. Form and positional tolerances.

Conventional practices of indicating limits and fits, geometrical form and position tolerances, surface finish and surface treatments requirements. Study of Examples involving selection of fits and calculation of limits. Suggestion of suitable fits for mating parts.

The following contents are to be drawn using software package

Unit-IV

Sectional views

Creating solid models of complex machine parts and creating sectional views

Assembly drawing:

Lathe tool post, Connecting rod, Eccentric, Cross head, Machine vice, pipe vice, Screw jack, Plummer block, Pedestal Bearing, Tail stock, Gate valve, Universal coupling, Geneva cam.

UNIT V

Manufacturing drawing:

Representation of limits fits and tolerances for mating parts. Use any four parts of above assembly drawings and prepare manufacturing drawing with dimensional and geometric tolerances.

Pattern of Exam:

Internals: Conventional and CAD Software

Externals: Conventional

N.B. Tolerance charts to be provided in the examination Hall for calculation of limits.

Suggested Reading:

1. Siddeshwar N, Kannaiah P and Sastry VVS, "*Machine Drawing*", Tata McGraw Hill Publishing Co. Ltd., 5th Edition, 1994.
2. Bhatt N.D, "*Machine Drawing*", Charotar Publishing House, Anand, New Delhi, 28th Edition, 1993.
3. Narayan K.L, Kannaiah P, Venkat Reddy K, "*Machine Drawing*", New Age International (P) Ltd., 2nd Edition, 1999.
4. K. C. John, "*Text book of Machine Drawing*", PHI Learning, 2010.
5. P. Narsimha Reddy, T.A. Janardhan Reddy, C.S. Rao, *Production Drawing Practice*, High Tech Publishers, 2001.
6. R.K. Jain, *Engineering Metrology*, Khanna Publishers, 8th Ed. 1985.
7. K.L. Narayana, P. Kannayya and K. Venkat Reddy, *Production Drawing*, New Age International (p) Ltd. Revised edition, 1997.
8. The Solid Works software manual

MC 401HS

INDIAN CONSTITUTION

Credits: NIL

Instructions: (2L) hrs per week *Duration of SEE: 3hours*
CIE: 30 Marks *SEE: 70 Marks*

Course Objectives

- To create awareness among students about the Indian Constitution.
- To acquaint the working conditions of union, state, local levels, their powers and functions.
- To create consciousness in the students on democratic values and principles articulated in the constitution.
- To expose the students on the relations between federal and provincial units.
- To divulge the students about the statutory institutions.

Course Outcomes

After completing this course, the student will

- Know the background of the present constitution of India.
- Understand the working of the union, state and local levels.
- Gain consciousness on the fundamental rights and duties.
- Be able to understand the functioning and distribution of financial resources between the centre and states.

Be exposed to the reality of hierarchical Indian social structure and the ways the grievances of the deprived sections can be addressed to raise human dignity in a democratic way.

UNIT-I

Evolution of the Indian Constitution: 1909 Act, 1919 Act and 1935 Act. Constituent Assembly: Composition and Functions; Fundamental features of the Indian Constitution.

UNIT-II

Union Government: Executive-President, Prime Minister, Council of Minister
State Government: Executive: Governor, Chief Minister, Council of Minister
Local Government: Panchayat Raj Institutions, Urban Government

UNIT-III

Rights and Duties: Fundamental Rights, Directive principles, Fundamental Duties

UNIT-IV

Relation between Federal and Provincial units: Union-State relations, Administrative, legislative and Financial, Inter State council, NITI Ayog, Finance Commission of India

UNIT-V

Statutory Institutions: Elections-Election Commission of India, National Human Rights Commission, National Commission for Women

Suggested Readings:

1. D.D. Basu, Introduction to the constitution of India, Lexis Nexis, New Delhi
2. Subhash Kashyap, Our Parliament, National Book Trust, New Delhi
3. Peu Ghosh, Indian Government &Politics, Prentice Hall of India, New Delhi
4. B.Z. Fadia & Kuldeep Fadia, Indian Government &Politics, Lexis Nexis, New Delhi

ES 452EC

APPLIED ELECTRONICS LAB

Credits: 1

Instructions: (2P) hrs per week *Duration of SEE: 3hours*
CIE: 25 Marks *SEE: 50 Marks*

Course Objectives:

- To understand the characteristics of diodes and transistor configurations
- To understand the design concepts of biasing of BJT and FET
- To understand the design concepts of feedback amplifiers and oscillators
- To study the design concepts of OP Amp and data converters

Course Outcomes:

- Ability to design diode circuits & understand the application of zener diode.
- Ability to analyze characteristics of BJTs & FETs.
- Ability to understand the different oscillator circuits.
- Ability to understand operation of HWR & FWR circuits with & without filters.
- Ability tom design Analog-to-Digital converters & Digital-to-Analog converters.

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

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.

PC 451ME

THERMAL ENGINEERING LAB-1

Credits: 1.5

Instructions: (3P) hrs per week *Duration of SEE: 3hours*
CIE: 25 Marks *SEE: 50 Marks*

Course Objectives

- To understand applications of thermal engineering concepts through experimentation.
- To measure flow properties of fuel /lubricants
- To test reciprocating and heat transfer machinery.

Course Outcomes:

- Will be able to perform experiments to find the efficiency of Petrol and Diesel engines.
- Will be able to find the properties of unknown fuels/lubricants.
- Will be able to perform experiments CI and SI engines.
- Will be able to experiments on heat exchangers and design suitable exchangers for a given application.

List of Experiments:

1. To determine valve / port timing diagram of a diesel/ petrol engine
2. To conduct performance test on diesel engine
3. To conduct heat balance test on diesel engine
4. To conduct performance test on petrol engine
5. To conduct heat balance test on petrol engine
6. To determine the viscosities of lubricating oils
7. To determine the flash point and fire points of fuels
8. To conduct Performance test on VCR engine
9. To conduct Heat balance test on VCR engine
10. To conduct the Morse test on multi cylinder Petrol Engine.
11. To determine volumetric efficiency and mass flow rates of a two stage reciprocating air compressor.

PC 452ME

MANUFACTURING PROCESSES LAB

Credits: 1.5

Instructions: (3P) hrs per week *Duration of SEE: 3hours*
CIE: 25 Marks *SEE: 50 Marks*

Course Objectives:

- To understand the manufacturing processes, preparation of sand mould, casting process
- To learn about electrode composition and different welding processes like arc, gas, spot, TIG, MIG welding.
- To know the forming process.

Course Outcomes:

- Able to test sand properties, make gating system and prepare mould for sand casting.
- Able to join materials using different welding techniques, study of welding properties and defects
- Able to manufacture components using drawing, blanking, piercing, extrusion and sheet metal forming.

List of Experiments:

Foundry:

1. Study of foundry setup, equipment and the displayed charts with particular attention to moulding machines, sand muller, shell moulding machine & centrifugal casting machine.
2. Mixing and preparation of molding sand samples, Testing of greensand properties.
3. Preparation of molding sand aggregate and simple moulds of greensand complete with sprues, gates and risers.
4. Exercise of melting and casting involving prepared moulds, aluminium metal and crucible furnace. Cleaning of castings, study of the features of the final casting, its features and any visible defects.
5. Experimental Study of blow moulding.
6. Experimental study of centrifugal casting

Welding:

1. Study of the welding equipment and tools related to Arc, gas and resistance welding & displayed charts.
2. Practice of Arc, Resistance Spot, Resistance Butt and Gas welding. Identification of different types of gas flames.
3. Experimental study of
   (a) Electrode characteristics of SMAW.
   (b) Arc length and welding speed on bead characteristics.
   (c) Welding current on bead penetration.
4. Determination of weld characteristics using DC and AC power sources.
5. TIG and MIG welding process - study and exercises.

Forming:

1. Study of the forming equipment: Different types of mechanical presses and hammers, Metal spinning Lathe.
2. Conventional extrusion of metals.
3. Study of sheet metalworking dies and sheet metal working with existing dies.
4. Testing of metals: Fatigue tests. Testing of sheet metals for formability by using Erichson cupping test.
5. Study of HERF processes. Sheet metal forming with water hammer forming equipment.