



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

Accredited A++ Grade by NAAC | 12B Status by UGC | Approved by AICTE

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School of Mechanical Engineering

Department of Mechanical Engineering

1.1.3 Courses having focus on Employability / Entrepreneurship / Skill Development

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SMEA1301	ENGINEERING METROLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Y To understand the basics of measurements and its applications.
- Y To acquire the knowledge on linear and angular measurements.
- Y To understand the measurements of power, pressure, temperature and flow.
- Y To learn the correct procedures adopted in various measurements.

UNIT 1 INTRODUCTION TO METROLOGY

9 Hrs.

Accuracy, precision, resolution and sensitivity of measuring instruments, classification of errors in measurements, alignment errors, evaluation and propagation of errors, Limits, fits and tolerances. Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly, limits of size, Indian standards, concept of limits of size and tolerances, definition of fits, hole basis system, shaft basis system, types of fits and their designation, geometric tolerance, position-tolerances. Classification of gauges, brief concept of design of gauges (Taylor's principles), Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials, Terminologies in Measurement - Care of Measuring Instruments- Reliability.

UNIT 2 LINEAR AND ANGULAR MEASUREMENTS

9 Hrs.

Linear Measuring Instruments – Evolution – Types – gauge design – Comparators: Functional requirements, classification, mechanical, sigma comparators, dial indicator, electrical principles, LVDT, Pneumatic- back pressure gauges, solex comparators and optical comparators- Zeiss ultra-optimizer, slip gauges – Types – Indian standards on slip gauge, method of selection of slip gauge, stack of slip gauge, adjustable slip gauge, wringing of slip gauge, care of slip gauge, slip gauge accessories, Angular measuring instruments – Sine bar, angle gauges, autocollimator, angle dekkor, tool maker's microscope, Bevel protractor, clinometers, spirit levels– Alignment telescope – Applications.

UNIT 3 MEASUREMENTS OF POWER, PRESSURE, TEMPERATURE AND FLOW

9 Hrs.

Power, Force and Torque – mechanical, hydraulic, pneumatic and electrical type – Pressure – low pressure measurement using McLeod gauge, thermal conductivity gauge and ionization gauges – high pressure measurement using diaphragm gauges and bulk modulus pressure gauge. Temperature – thermo couple, RTD, thermistor-electrical resistance thermometer- pyrometers. Flow – Turbine type flow meter, magnetic flow meter, ultra-sonic flow meter, thermal flow meter and hot wire anemometer, Venturimeter, Orifice meter, Rotameter, Pitot tube – Temperature: bimetallic strip.

UNIT 4 FORM MEASUREMENTS

9 Hrs.

Standard screw thread profiles, Terminology of screw threads, Measurement of major, minor and effective diameter by 2 wire, 3 wire method and best wire size, Screw thread gauges, Tool maker's microscope. Gear tooth profile measurement, Gear tooth terminology, tooth thickness measurement using constant chord method, addendum comparator method and base tangent method, measurement of pitch, concentricity, run out, and involute profile. Gear roll tester for composite error. Form measurement-Straightness - Flatness, Roundness, Surface finish measurement.

UNIT 5 ADVANCES IN METROLOGY

9 Hrs.

Basic concept of lasers - Advantages of lasers – Interferometry – laser interferometers – types – DC and AC Lasers interferometer- Applications – Straightness – Alignment. Computer Aided Inspection-Basic concept of Co-ordinate Measuring Machines(CMM) – Types of CMM – Constructional features – Probes –working principle, applications, alignment and errors; Machine Vision, elements of vision system, applications in manufacturing.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the terminologies of metrological measurements, methods of measurements and standards of measurements.
- CO2 - Understand the principles of fits and tolerance, limit gauges and their designs.
- CO3 - Recognize the working of slip gauges, angle gauges, autocollimators, LVDT, comparators and tool makers microscope.
- CO4 - Recognize the functioning of power, pressure, temperature and flow measuring devices.
- CO5 - Recognize the measurements of Screw thread, Gear tooth profiles, flatness, roundness and surface finish measurements.
- CO6 - Understand the concepts of advances in metrology using Laser interferometry, CMM and machine vision.

SMEA1303	FLUID MECHANICS AND MACHINERY	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- Y To understand the fluid properties, flow characteristics and hydrostatic force on surfaces.
- Y To study the equation of motions such as mass, momentum and energy equation and their practical applications.
- Y To understand the functioning and characteristic curves of hydraulic machines.

UNIT 1 FLUID PROPERTIES

9 Hrs.

Fluid Properties: Density-Specific Weight-Specific Gravity-viscosity-surface tension-capillarity-Vapour pressure-compressibility. Fluid Static: Hydrostatic Law-Pressure Variation in static fluid-Hydrostatic force on a submerged plane surfaces-Location of hydrostatic force. Manometers-Simple, U tube and differential Manometers. Buoyancy-Meta centric height-determination of stability of floating bodies and submerged bodies.

UNIT 2 EQUATIONS OF MOTION

9 Hrs.

Types of fluid flow-Concept of Control Volume- Control Volume Analysis of mass, momentum and energy. Differential equation of continuity and momentum - Euler's and Bernoulli's Equation and its applications. Flow Measurement: Orifice meter, Venturi meter, Piezometer, Pitot tube.

UNIT 3 FLOW THROUGH ORIFICE, NOTCHES, WEIRS AND PIPES

9 Hrs.

Hydraulic co-efficient-Flow through orifice, Notches and weirs. Laminar and Turbulent flow-Reynolds experiment-laminar flow through circular pipe (Hagen poiseuille's)-Major and minor losses in pipes-Darcy weisbach's equation, chezy's formula-friction factor- moody diagram-pipes in series and pipes in parallel-total energy line-hydraulic gradient line-Equivalent pipe. Concept of Boundary Layer-Types of boundary layer thickness-drag on flat plate.

UNIT 4 PUMPS

9 Hrs.

Centrifugal Pumps: Introduction-Definitions of heads and efficiencies-Operations-work done by the Impeller with Velocity triangles-Performance curves-Cavitations-Multi-staging: Pumps in Series and Parallel. Reciprocating Pumps: Operation-power required driving the pump-Slip-indicator Diagram-Separation-Air vessels.

UNIT 5 TURBINES AND DIMENSIONAL ANALYSIS

9 Hrs.

Hydraulic Turbines: Classification of hydraulic turbines-Working principle of Pelton wheel, Francis and Kaplan turbines-velocity triangles-draft tube-hydraulic turbine characteristics. Governing of turbines. Dimensional Analysis: Needs and methods-Buckingham's π Theorem, Non-Dimensional Numbers, Similarities of flow. Model studies

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the properties of fluids and compute the fluid pressure in a pipe.
- CO2 - Analyze the Bernoulli's theorem and its engineering applications.
- CO3 - Evaluate and compare the hydraulic coefficients and energy losses in pipes.
- CO4 - Explain the working principle and operating characteristic curves of different types of pumps and estimate the power required.
- CO5 - Distinguish the working principle and operating characteristic curves of different types of turbines and compute the power developed.
- CO6 - Understand the methods of dimensional analysis and its application in model analysis.

TEXT / REFERENCE BOOKS

- Bansal.R.K, Fluid Mechanics & Hydraulics Machines, 9th Edition, Laxmi Publications, 2015.
- Modi P.N., Seth S.M., Hydraulics and Fluid Mechanics Including Hydraulic Machines, 21st Edition, Standard Book House, 2017.
- Goyal, Manish Kumar, Fluid Mechanics and Hydraulic Machines, PHI Learning Pvt. Ltd., 2015.
- Kumar K.L., Engineering Fluid Mechanics, 8th Edition, Eurasia Publication House (P) Ltd, 2014.
- R. K. Rajput, Fluid Mechanics & Hydraulics Machines, 4th Edition, S. Chand Limited, 2008.
- Yunus.A.Cengel, John.M.Cimbala, Fluid Mechanics Fundamentals and Application, 3rd Edition, Tata McGraw Hill, 2013.
- Robert W. Fox, Alan T. McDonald, Philip J.Pritchard, John W.Mitchell, Fluid Mechanics, 9th Edition, Wiley India Edition, 2016.
- Franck M.White, Fluid Mechanics, 8th Edition, Tata McGraw Hill Publication, 2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100

PART A : 10 Questions of 2 marks each - No choice

PART B : 2 Questions from each unit of internal choice; each carrying 16 marks

Exam Duration : 3 Hrs.

20 Marks

80 Marks

Employability

SMEA1305	MECHANICS OF SOLIDS (COMMON TO MECH AND AUTO)	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- Y To study the aspects of Strength, Stiffness and Stability.
- Y To gain knowledge of different types of stresses, strain and deformation induced in the components due to external loads.
- Y To study the distribution of various stresses in the elements such as beams, shafts etc.
- Y To study the effect of component dimensions and shapes on the stresses and deformations.

UNIT 1 STRESS STRAIN DEFORMATION OF SOLIDS

9 Hrs.

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stresses and strains. Elastic constants – Relation between Elastic constants- Strain energy and unit strain energy – Strain energy in uniaxial loads.

UNIT 2 ANALYSIS OF STRESSES IN TWO DIMENSIONS

9 Hrs.

Principal planes and stresses – Mohr's circle for biaxial stresses – Maximum shear stress - simple problems- Stresses on inclined plane. Biaxial state of stresses – Thin cylindrical and spherical shells – **Deformation in thin cylindrical and spherical shells** – Efficiency of joint- Effect of Internal Pressure.

UNIT 3 BEAMS - LOADS AND STRESSES

9 Hrs.

Types of beams - Supports and Loads – **Shear force and Bending Moment in beams** – Cantilever, Simply supported and Overhanging beams – SFD and BMD for inclined loads and couples. Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced.

UNIT 4 TORSION

9 Hrs.

Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Composite shafts Springs - **Laminated springs, axial load and twisting moment acting simultaneously both for open and closed coiled springs**– Deflection of helical coil springs under axial loads – stresses in helical coil springs under torsion.

UNIT 5 BEAM DEFLECTION

9 Hrs.

Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine Gordon formula for columns. Elastic curve of Neutral axis of the beam under normal loads – **Evaluation of beam deflection and slope**: Double integration method, Macaulay Method, and Moment-area Method.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the fundamentals of Stress and Elastic Constants.
- CO2 - Understand the concept of Principal stresses and thin shells.
- CO3 - Construct Shear force & Bending moment diagram and Bending stress.
- CO4 - Apply the Concept of Torsion for Circular Shafts and Understand the concept of Springs.
- CO5 - Understand the theory of Column and Beam deflection.
- CO6 - Analyze overall deflection aspects related to Strength, Stiffness and Stability.

TEXT / REFERENCE BOOKS

1. Bansal R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 5th Edition, 2012.
2. Punmia B.C. & Jain A.K., Mechanics of Materials, Laxmi Publications, 2001.
3. Ryder G.H., "Strength of Materials, Macmillan India Ltd", 3rd Edition, 2002.
4. Ray Hulse, Keith Sherwin & Jack Cain, "Solid Mechanics", Palgrave ANE Books, 2004.
5. Allan F. Bower, Applied Mechanics of Solids, CRC Press, 2009, 820 pages.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks

80 Marks

Employability

SMEA1401	MANUFACTURING TECHNOLOGY – I	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the concepts of basic manufacturing processes.
- To understand various manufacturing techniques, such as metal casting, metal joining, metal forming and manufacture of plastic components.

UNIT 1 METAL CASTING PROCESSES

9 Hrs.

Sand casting – Sand moulds - Type of patterns – Pattern materials – Pattern allowances – Types of Moulding sand – Properties – Core making – Methods of Sand testing – Moulding machines – Types of moulding machines - Melting furnaces – Working principle of **Special casting processes** – Shell, investment casting – Ceramic mould – Lost Wax process – Pressure die casting – Centrifugal casting – 2CpOrocess – Sand Casting defects – Inspection methods.

UNIT 2 JOINING PROCESSES

9 Hrs.

Fusion welding processes – Types of Gas welding – Equipments used – Flame characteristics – Filler and Flux materials - Arc welding equipments - Electrodes – Coating and specifications – Principles of Resistance welding – Spot welding – seam welding – Percussion welding - Gas metal arc welding – Flux cored – Submerged arc welding – Electro slag welding – TIG welding – Principle and application of special welding processes - Plasma arc welding – Thermit welding – Electron beam welding – Friction welding – Diffusion welding – Weld defects – Brazing and soldering process – Methods and process capabilities – Filler materials and fluxes – Types of Adhesive bonding.

UNIT 3 BULK DEFORMATION PROCESSES

9 hrs.

Hot working and cold working of metals – **Forging processes** – Open, impression and closed die forging – Characteristics of the process – Types of Forging Machines – Typical forging operations – Rolling of metals – Types of Rolling mills - Flat strip rolling – Shape rolling operations – Defects in rolled parts - Principle of rod and wire drawing - Tube drawing – Principles of Extrusion – Types of Extrusion – Hot and Cold extrusion – Equipments used.

UNIT 4 SHEET METAL PROCESSES

9 Hrs.

Sheet metal characteristics - Typical shearing operations, bending and drawing operations – Stretch forming operations — Formability of sheet metal – Test methods – Working principle and application of special forming processes - Hydro forming – Rubber pad forming – Metal spinning – Introduction to Explosive forming, Magnetic pulse forming, Peen forming, Super plastic forming.

UNIT 5 MANUFACTURING OF PLASTIC COMPONENTS

9 Hrs.

Types of plastics - Characteristics of the forming and shaping processes – **Moulding of Thermoplastics** – Working principles and typical applications of - Injection moulding – Plunger and screw machines – Compression moulding, Transfer moulding - Typical industrial applications – **Introduction to Blow moulding – Rotational moulding – Film blowing – Extrusion - Thermoforming - Bonding of Thermoplastics.**

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand different metal casting processes, associated defects, merits and demerits.
- CO2 - Compare different metal joining processes.
- CO3 - Summarize various hot working and cold working methods of metals.
- CO4 - Study the various sheet metal making processes.
- CO5 - Distinguish various methods of manufacturing plastic components.
- CO6 - Understand the concept of moulding process.

TEXT / REFERENCE BOOKS

- Hajra Choudhury S.K. and Hajra Choudhury A.K., "Element of Manufacturing Technology Vol. I", Media Publications, 2009.
- Kalpakjian S., "Manufacturing Engineering and Technology", Pearson Education India Edition, 2006.
- Rao P.N., Manufacturing Technology Foundry, Forming and Welding, TMH, 2009.
- Roy A. and Lindberg, "Process and Material Manufacture". PHI 1995.
- Sharma P.C., "A Text book of Production Technology", S. Chand and Co. Ltd., 5th Edition, 2004.
- Rao P.N., Manufacturing Technology Vol. II Metal cutting and Machine Tools, 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each – No choice

20 Marks

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks

80 Marks

SMEA1403	POWER PLANT ENGINEERING	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- Y To provide essential knowledge of construction and working of various types of power plants.
- Y To detail the role of Mechanical Engineers in their operation and maintenance.

UNIT 1 STEAM POWER PLANT

9 Hrs.

Layout of Thermal Power Plant, Fuel And Ash Handling, Dust collection, Super Critical & FBC Boilers, Super heaters, Air pre heaters, Economizer, Condensers, Feed water heaters and evaporators – Draught System, Cooling pond and cooling towers, Feed Water Treatment.

UNIT 2 DIESEL, GAS, HYDRO ELECTRIC POWER PLANT

9 Hrs.

Layout and Components of **Diesel - Gas Turbine and Hydro Electric Power Plants**- site selection, operations, Advantages - Disadvantages - Applications.

UNIT 3 NUCLEAR & COMBINED POWER PLANT

9 Hrs.

Nuclear Engineering, **Layout and components of Nuclear Power Plants**, Working of Nuclear Reactors: BWR, PWR, CANDU, Fast Breeder, Gas Cooled and Liquid Metal Cooled Reactors, Combined and Binary Cycle Power Plants. Integrated Gasifier Combined Cycle power plants.

UNIT 4 ECONOMIC AND ENVIRONMENTAL ISSUES

9 Hrs.

Load Distribution Parameters, Load Curve, Capital and Operating Cost of Different Power Plants - Power Tariff Types - **Pollution Control Technologies** Including Waste Disposal Options for Thermal and Nuclear Power Plants.

UNIT 5 NON-CONVENTIONAL POWER GENERATION

9 Hrs.

Principle, **Construction and Working of Wind, Tidal, Solar Thermal, Solar Electrical, Geothermal, Biogas and Fuel Cell Power Systems**, Different Direct Energy conversion systems.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the different power generation methods.
- CO2 - Apply the basic thermodynamic principles to different power generation methods.
- CO3 - Understand construction of steam power plant, its working and significance.
- CO4 - Analyze thermodynamic cycles of Diesel, gas turbine & nuclear power plant.
- CO5 - Study the power generation, Distribution cost and impact of pollution from power plants.
- CO6 - Understand basic concepts of Non-Conventional Power Generation & its importance.

TEXT / REFERENCE BOOKS

- Nag. P.K., "Power Plant Engineering", 4th Edition, Tata McGraw – Hill Publishing Company Ltd., 2012
- Domkundwar, Power Plant Engineering - Dhanpat Rai & Sons, Delhi, 2016.
- Vopal and Stortzki, "Power Plant Engineering", PHI, 2007.
- Rajput.R.K, "Power Plant Engineering", 5th Edition, Laxmi Publications, 2016.
- Nagpal.G.R, Sharma.S.C, "Power Plant Engineering, 16th Edition, Khanna Publishers, 2012.
- Joel Weisomon and Roy Eckart, "Modern Power Plant Engineering", PHI, 1985.
- Rai G.D, Non Conventional Energy Sources, Khanna Publishers, New Delhi, 2011.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice each carrying 16 marks

80 Marks

Employability

SMEA1505	MANUFACTURING TECHNOLOGY – II	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching.
- To understand the basic concepts of Computer Numerical Control (CNC) of machine tools and CNC Programming.

UNIT 1 THEORIES OF METAL CUTTING

9 Hrs.

Introduction: **material removal processes**, types of machine tools – theory of metal cutting: chip formation, orthogonal cutting, cutting tool materials, tool wear, tool life, surface finish, cutting fluids.

UNIT 2 CENTRE LATHE AND SPECIAL PURPOSE LATHES

9 Hrs.

Centre lathe, constructional features, cutting tool geometry, various operations, taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes – automats – single spindle, Swiss type, automatic screw type, multi spindle - Turret Indexing mechanism, Bar feed mechanism.

UNIT 3 SHAPER, MILLING, DRILLING, BORING, PLANER AND BROACHING

9 Hrs.

Reciprocating machine tools: shaper, planer, slotter - Milling: types, milling cutters, operations - Hole making : drilling - Quill mechanism , Reaming, Boring, Tapping - Sawing machine: hack saw, band saw, circular saw; broaching machines: broach construction – push, pull, surface and continuous broaching machines.

UNIT 4 ABRASIVE PROCESSES AND GEAR CUTTING

9 Hrs.

Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centerless grinding – honing, lapping, super finishing, polishing and buffing, abrasive jet machining - Gear cutting, forming, generation, shaping, hobbing.

UNIT 5 CNC MACHINE TOOLS AND PART PROGRAMMING

9 Hrs.

Numerical control (NC) machine tools – CNC: types, constructional details, special features – design considerations of CNC machines for improving machining accuracy – structural members – slide ways – linear bearings – ball screws – spindle drives and feed drives. Part programming fundamentals – manual programming – computer assisted part programming.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the mechanism of material removal processes.
- CO2 - Describe the constructional and operational features of center lathe and other Special purpose lathes.
- CO3 - Describe the constructional and operational features of shaper, planner, milling, Drilling, sawing and broaching machines.
- CO4 - Explain the types of grinding and other super finishing processes apart from gear Manufacturing processes.
- CO5 - Summarize numerical control of machine tools.
- CO6 - Understanding concept of Part programming fundamentals.

TEXT / REFERENCE BOOKS

- 1 Hajra Choudhary. S.K. and Hajra Choudhary A.K, "Elements of Manufacturing Technology, Vol. 1st Edition, Media Publishers 2013.
- 2 RAO.P.N, "Manufacturing Technology, Metal cutting and Machine tools", 2nd Edition, TMH, 2010.
- 3 Chapman. W.A.J, "Workshop Technology Vol II", 5th Edition, Arnold Publishers, 2003.
- 4 Roy A. Lindberg, "Process and Material Manufacturers", 4th Edition, PHI, 1995.
- 5 Pabla B.S. and Adithan M., "CNC Machines", 1st Edition, New Age International, 2012.
- 6 H.M.T Production Technology Tata McGraw Hill, 2009.
- 7 Hastle Hurst M, Manufacturing Technology, 3rd Edition ELBS, 1998.
- 8 Sharma P.C., "A Text book of Production Technology", S.Chand and Co. Ltd., V edition, 2004.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each – No choice

20 Marks

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks

80 Marks

Employability

SMEA3004	FLUID POWER SYSTEMS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Y To provide the insights of the fundamental knowledge about the fluid power, types of fluid power systems and the general understanding of the system components.
- Y To detail the construction and working principle of various hydraulic and pneumatic system components and their applications in the hydraulic circuits for a variety of applications.
- Y To make aware of maintenance and trouble shooting of hydraulic or pneumatic system components.

UNIT 1 FUNDAMENTAL PRINCIPLES

9 Hrs.

Fluid power: Advantages and applications of fluid power, Components of fluid power system, Types of fluid power systems, Fluid power symbols. Basic Hydraulics: Physical properties of hydraulic fluids, General types of fluids, Review of mechanics, Pascal's law, Applications of Pascal's Law, Energy, power and flow rate hydraulics. Frictional Losses: Reynolds's number, Darcy's equation, Losses in laminar flow, Losses in turbulent flow, Losses in valves and fittings, Hydraulic circuit analysis. Illustrative problems.

UNIT 2 HYDRAULIC SYSTEM COMPONENTS

9 Hrs.

Hydraulic Pumps: Gear pumps, vane pumps and piston pumps, pump performance. **Hydraulic Cylinders: Single acting, double acting and special cylinders, Cylinder mountings and mechanical linkages**, Cylinder cushions. Hydraulic motors: Gear, vane and piston motors, Hydraulic motor performance. Hydraulic Valves: Director control valves, Pressure control valves, Flow control valves, Servo valves, Proportional control valves, Catridge valves, Hydraulic fuses. Ancillary Devices: Reservoirs, Accumulators, Pressure intensifiers, Sealing devices.

UNIT 3 DESIGN OF HYDRAULIC CIRCUITS

9 Hrs.

Control of a single-acting hydraulic cylinder, Control of a double-acting hydraulic cylinder, Regenerative cylinder circuit, Pump-unloading circuit, Counterbalance valve application, **Hydraulic cylinder sequencing circuits, Automatic cylinder reciprocating circuit, Cylinder synchronizing circuit, Fail-safe circuits**, Speed control of hydraulic cylinder, Speed control of hydraulic motor, Hydraulic motor braking system, Air-over-oil circuit. Case studies.

UNIT 4 PNEUMATIC SYSTEM COMPONENTS AND CIRCUITS

9 Hrs.

Pneumatic Sytem Components: Properties of air, Compressors, Fluid Conditioners, Air control valves, Pneumatic actuators. Circuits: Control of single-acting cylinder, **Control of double-acting cylinder, Air pilot control of double-acting cylinder**, Cylinder cycle timing system, Two-step speed control system, Two-handed safety control circuit, Control of air motor, Sequential circuit design for simple applications using cascade method. Case studies.

UNIT 5 ADVANCED CONTROLS AND MAINTENANCE

9 Hrs.

Electrical controls: Electrical components, Limit switches and pressure switches, Counting, timing and reciprocation, Fluid logic control systems, Electrohydraulic servo system, Programmable logic controls, Ladder diagrams, Illustrative examples. Case studies. Maintenance: Maintaining and disposing of fluids, Filters and strainers, Fluid cleanliness levels, Preventive maintenance procedures, Troubleshooting of fluid power systems, Safety considerations, Environmental issues.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the fundamentals of fluid power systems, basic components, need and the requirements.
- CO2 - Explain the construction and working of various system components used in hydraulic systems and simple hydraulic circuits.
- CO3 - Design hydraulic circuits for a variety of applications.
- CO4 - Explain the construction and working of various system components used in pneumatic systems.
- CO5 - Design pneumatic circuits for a variety of applications.
- CO6 - Explain the general maintenance guidelines, trouble shooting of various system components and safety aspects.

TEXT / REFERENCE BOOKS

- Anthony Esposito, "Fluid Power with Applications", 7th Edition, Pearson Education Limited, 2013.
- Andrew Parr, "Hydraulics and Pneumatics: A Technician's and Engineer's Guide", 3rd Edition, Elsevier, 2011..
- James R. Daines and Martha J. Daines, "Fluid Power: Hydraulics and Pneumatics", 3rd Edition, Good heart - Willcox Publisher, 2018.
- James Johnson, "Introduction to Fluid Power", Cengage Learning, 2002.
- S. Ilango and V. Soundararajan, "Introduction to Hydraulics and Pneumatics", 2nd Edition, PHI Learning Pvt. Ltd., 2011.

SMEA3007	COMPUTER INTEGRATED MANUFACTURING SYSTEMS	L	T	P	Credits	Total Marks
		1	0	4	3	100

COURSE OBJECTIVES

- To familiarize the student with current trend in production management activities.
- To prepare them to use modern technologies in future management systems.

UNIT 1 INTRODUCTION

9 Hrs.

Introduction to CAD,CAM, CIM, Types of production, Concurrent engineering, Elements of CIM systems, , CIM wheel, CIM components, Needs and Benefits of CIM, NC,CNC, DNC-applications, advantages and disadvantages. **Functions of NC, CNC, DNC.**

UNIT 2 GROUP TECHNOLOGY AND CELLULAR MANUFACTURING

9 Hrs.

Group technology - Role of G.T in CAD/CAM integration - Part families - Classification and Coding - DCLASS, MICLASS, OPTIZ coding systems - Benefits of GT. **Cellular manufacturing**-Machine cell design and layout-Quantitative analysis in cellular Manufacturing - Rank order Clustering method.

UNIT 3 COMPUTER AIDED PROCESS PLANNING

9 Hrs.

Approaches to computer aided process planning- Variant approach and generative approach - CAPP . Material Requirement Planning (MRP), Manufacturing Requirement Planning (MRP-II), Inventory control, **hop floor control (SFC), Enterprise Resources Planning (ERP).**

UNIT 4 FLEXIBLE MANUFACTURING SYSTEM AND AUTOMATED GUIDED VEHICLE SYSTEMS

9 Hrs.

Types of Flexibility-FMS-Components- application and Benefit, FMS Planning and Control, **Quantative analysis in FMS.** Automated Guided Vehicle (AGV) system -Applications, Vehicle Guidance technology-Vehicle management and safety.

UNIT 5 MONITORING AND QUALITY CONTROL

9 Hrs.

Types of production monitoring system, process control and strategies, direct digital control - Supervisory computer control - computer aided quality control - objectives of CAQC, QC and CIM, contact, non-contact inspection methods, CMM and Flexible Inspection systems. Integration of CAQC with CIM.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Develop an understanding of classical and state-of-the-art production systems, control systems, management technology, cost systems, and evaluation techniques.
- CO2 - Formulate competitive priorities and manufacturing strategy for a given production system to derive strategic advantage.
- CO3 - Apply ROP, MRP and JIT systems for inventory control in production systems.
- CO4 - Obtain an overview of computer technologies including computers, database and data collection, networks, machine control, etc., as they apply to factory management and factory floor operations.
- CO5 - Design push and pull systems using the principles of factory dynamics.
- CO6 - Design factory systems for shop floor control, production scheduling, aggregate planning and capacity planning.

TEXT / REFERENCE BOOKS

1. Kant Vajpayee. S., 'Principles of Computer Integrated Manufacturing', Prentice Hall of India, 1999.
2. Radhakrishnan.P, Subramanyan. S, 'CAD/CAM/CIM', New Age International publishers, 2009.
3. Scheer.A.W., 'CIM- Towards the factory of the future' Springer - Verlag, 1994.
4. Daniel Hunt.V., 'Computer Integrated Manufacturing Hand Book', Chapman & Hall, 1989.
5. Groover M.P, 'Computer Aided Design and Manufacturing', Prentice Hall of India, 1987.
6. YoremKoren, 'Computer Control of Manufacturing System', McGraw Hill, 1986.
7. Ranky Paul. G., 'Computer Integrated Manufacturing', Prentice Hall International, 1986.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

PART A: 10 Questions of 2 marks each – No choice

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks

Exam Duration: 3 Hrs.

20 Marks

80 Marks

Employability

SMEA3009	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Y To understand the integration of customer requirements in product.
- Y To learn about the principles of design for manufacture and environment.
- Y To understand the various aspects of design such as industrial design and design for manufacture.
- Y To apply structural approach to concept generation, selection and testing.

UNIT 1 INTRODUCTION

9 Hrs.

Introduction: Characteristics of successful product development, Design and development of products, duration and cost of product development, the challenges of product development. Development Processes and Organizations, Product Planning, Identifying Customer Needs - organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process. **Product Specifications: establishing target specifications, setting the final specifications.**

UNIT 2 BASIC CONCEPTS

9 Hrs.

Concept Generation: The activity of concept generation clarify the problem, search externally, search internally, explore systematically, and reflect on the results and the process. Concept Selection: Overview of methodology, concept screening, and concept scoring. Concept Testing: **Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, reflect on the results and the process.**

UNIT 3 PRODUCT ARCHITECTURE

9 Hrs.

Product development management - establishing the architecture - creation - clustering - geometric layout development - Fundamental and incidental interactions - related system level design issues - secondary systems -architecture of the chunks - creating detailed interface specifications-**Portfolio Architecture.**

UNIT 4 DESIGN FOR MANUFACTURING AND ECONOMICS

9 Hrs.

Design for Manufacturing: Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors. Prototyping: Prototyping basics, principles of prototyping, technologies, planning for prototypes. Product Development Economics: **Elements of economic analysis, base case financial mode, Sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis.**

UNIT 5 INDUSTRIAL DESIGN

9 Hrs.

Integrate process design - Managing costs - Robust design - Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically - Need for industrial design-impact – design process - investigation of customer needs - conceptualization - refinement - management of the industrial design process - technology driven products - user - driven products - **assessing the quality of industrial design.**

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Describe the new product based on mechanical design engineering.
- CO2 - Define the mechanical aspects of product design by incorporating concept, creativity, structural, manufacturing, aesthetics and ergonomics etc.
- CO3 - Understand contemporary issues and their impact on provided solution.
- CO4 - Solve open ended problem belongs to design engineering that meet the requirements. CO5 - Apply the various tools used for design development analysis and optimization.
- CO6 - Drafting various Industrial Design and management processes.

TEXT / REFERENCE BOOKS

- Karl T Ulrich, Steven D Eppinger, "Product Design & Development." Tata McGrawhill New Delhi 2003.
- Kevin Otto & Kristin Wood Product Design: "Techniques in Reverse Engineering and new Product Development." 1st Edition, Pearson Education New Delhi, 2004.
- David G Ullman, "The Mechanical Design Process." McGrawhill Inc Singapore 1992
- Product Design and Manufacturing - A C Chitale and R C Gupta, PH1, - 3rd Edition, 2003.
- New Product Development - Timjones. Butterworth Heinmann -Oxford. UCI -1997.
- Product Design for Manufacture and Assembly - Geoffrey Boothroyd, Peter Dewhurst and Winston Knight – 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

PART A: 10 Questions of 2 marks each – No choice

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks

Exam Duration: 3 Hrs.

20 Marks

80 Marks

Employability

SMEA3010	AUTOMATION IN MANUFACTURING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Y To provide the fundamentals, components and industrial applications of automation.
- Y To provide the automation facilities offered by automation in machine tools, manufacturing and materials handling.
- Y To provide basic knowledge of the modern automation systems.

UNIT 1 INTRODUCTION TO AUTOMATION

9 Hrs.

Developments in manufacturing technology, Need of automation, Levels of automation, Strategies, advantages, limitations and applications of automation. Analog-to-digital conversion, Digital-to-analog conversion, Input and output, Numbering systems, Mechanisms and machine elements. Components of a control system, Mathematical characterization and transfer functions, Laplace transforms and system response.

UNIT 2 CONTROLLERS, SENSORS AND ACTUATORS

9 Hrs.

Controllers: Microprocessors, microcontrollers, PLCs and computers. Actuators: Electrical linear and rotary actuators, Hydraulic linear and rotary actuators, Pneumatic linear and rotary actuators, Control elements. Sensors: Position, displacement and velocity sensors, Relays, Timers and Switches.

UNIT 3 AUTOMATION FOR MACHINE TOOLS

9 Hrs.

NC, DNC and CNC machine tools, Indexing mechanisms, Part identification, Automatic tool changers, Automatic assembly transfer systems, NC Programming, Line balancing, Automated assembly, CMM, Machine vision.

UNIT 4 AUTOMATION FOR MATERIALS HANDLING

9 Hrs.

Part identification techniques, Material handling equipments: Conveyors, Industrial vehicles, AGVs, AS/RS, Robot Technology: Robot classification, Parts of robot system and industrial applications.

UNIT 5 MODERN AUTOMATION AND APPLICATIONS

9 Hrs.

Rapid prototyping techniques and applications. Applications of artificial intelligence and expert systems in automation, Industry 4.0: Generations of industrial revolution, Smart manufacturing and Applications. Case studies and automation circuit design for a variety of industrial applications.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Recall the fundamentals and control theory of automation systems.
- CO2 - Understand the basics components, such as controllers, sensors and actuators used in the automation systems. CO3 - Examine various automations systems and techniques used for machine tools and quality testing.
- CO4 - Know various automations systems and techniques used for materials handling and storage.
- CO5 - Describe various modern automations systems, such as rapid prototyping, artificial intelligence and industry 4.0. CO6 - Apply automation principles for a variety of industrial applications.

TEXT / REFERENCE BOOKS

1. Mikell P. Groover, "Automation, Production Systems, and Computer-integrated Manufacturing", Prentice Hall, 2008.
2. Stamatis Manesis, George Nikolakopoulos, "Introduction to Industrial Automation", CRC Press, 2018.
3. Frank Lamb, "Industrial Automation: Hands On", McGraw Hill Professional, 2013.
4. A.K.Gupta and S.K.Arora, "Industrial Automation and Robotics", Firewall Media, 2007.
5. Shimon Y. Nof, "Springer Handbook of Automation", Springer Science & Business Media, 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

PART A: 10 Questions of 2 marks each – No choice

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks

Exam Duration: 3 Hrs.

20 Marks

80 Marks

Employability

SMEA1304	MACHINE DRAWING	L	T	P	Credits	Total Marks
		1	0	4	3	100

COURSE OBJECTIVES

- To understand and apply national standards while drawing machine components based on BIS.
- To understand the conventions, abbreviations and symbols to be followed by Engineers for making assembly drawings.
- To make the students to understand sectioning, concept of limits, fits and tolerances used for component design.
- To understand surface texture, riveted joints, welded joints and keys.
- To know various thread forms and its engineering applications.
- To make the students learn to draw the assembly, orthographic and sectional views of various machine components and to interpret the assembly drawing.

1. CONVENTIONS, ABBREVIATIONS AND SYMBOLS

Conventional representation of shaft, hollow shaft, bar - Conventional representation of common machine elements such as threads, slotted head, bearings, straight and diamond knurling, holes on a linear and circular pitch, helical spring, leaf spring

– Conventional representation of metals, glass, packing and insulating materials, liquids, concrete and wood – Conventional representation of screw, rivet and pin in section. Abbreviations for iron, carbon steel, alloy steel – Abbreviations for across corners, across flats, assembly, bearing, center of gravity, counterbore, countersunk, insulation, left hand, right hand, nominal, pitch circle diameter, tolerance, undercut.

2. SECTIONAL VIEWS

Full section, half section, partial or local section, revolved or superimposed section, removed section, successive section, parts that are not sectioned.

3. LIMITS, FITS AND TOLERANCES

Definitions: Limits, Fits and Tolerances – Upper limit, lower limit, tolerance, deviation, upper deviation, lower deviation, tolerance zone – Standard tolerance grades – Computation of IT tolerance using formulae and tables – Fundamental deviation – Computation of fundamental deviation – System of fits - Clearance fit – Interference fit – Transition fit – Problems on clearance and interference fit on shaft and hole basis system.

4. SURFACE TEXTURE

Nominal surface – Roughness – Waviness – Lay – Sampling length – Indication of surface roughness by roughness values, roughness grade number, roughness symbols – Indication of surface roughness by surface texture symbol with all the characteristics.

5. THREADED FASTENERS AND ITS APPLICATIONS

Screw thread terminology – Basic forms of screw threads - Standard forms of V threads – Basic form of square threads – Modified forms of square threads – Basic knuckle thread – Standard form of knuckle thread - Conventional representation of internal V thread and external V thread – Square thread – Designation of threads – Empirical proportions of hexagon and square head bolt and nut.

6. RIVETED JOINTS, WELDED JOINTS AND KEYS

Application of riveted joints – Difference between a bolt and a rivet – Disadvantages of riveted joints – Types of riveted joints – Empirical proportions of riveted joints – Types of welded joints – Symbolic representation of weld – Elementary weld symbols – Keys – Application of keys.

7. ASSEMBLY DRAWING (USING MINI-DRAFTER) FOR THE FOLLOWING WITH PART DRAWINGS GIVEN

Preparation of assembled views from exploded views for the following components: Cotter joint with sleeve, screw jack, snug type pedestal bearing, swivel bearing, tail stock.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Identify the national standards related to the machine drawing based on BIS and applying the standards.
- CO2 - Analyze limits and tolerances for assembly and evaluate to choose appropriate fits for the assembly.
- CO3 - Understand and apply surface finish and welding symbols.
- CO4 - Assemble machine components through drawings.
- CO5 - Interpret the machine components and conventions used in the drawing.
- CO6 - Interpret the components such as fasteners, riveted joints, welded joints and keys

SAIC4001	INDUSTRY 4.0	L	T	P	Credits	Total Marks
		2	-	2	2	100

UNIT 1 ADVANCED TECHNOLOGY AND ADVANCED MATERIALS

7 Hrs.

Advanced electro-optical sensing technology-active, passive multi-spectral and hyper spectral imaging; electronic beam steering; vacuum technology, surface and coating technology, health care technology, Nanotechnology- Nanomechanics, Nano optoelectronics; energy storage technology-next generation Li-based Batteries, Hydrogen storage, solar photovoltaic's, Flexible electronics. Intellectual Property Rights - case studies governing/pertaining to Materials/Technology.

UNIT 2 TRANSFORMING TECHNOLOGIES IN BIOENGINEERING

7 Hrs.

Establishment of smart biotechnology factory, Artificial intelligence in Bioprocess technology, Omics – Big data analysis through automation, 3D bio printing for tissue engineering. Simulation tools, RSM and Box model. Cyber physical system based telemedicine, diagnosis and therapeutics through real time biosensors. Bionanotechnology. Intellectual Property rights (IPR): Case Studies.

UNIT 3 ADVANCEMENTS IN SUSTAINABLE BUILT ENVIRONMENT

7 Hrs.

Introduction – Technological developments in Architectural, Engineering and Construction (AEC) - Building Information Modelling (BIM) using Cloud computing technology and Internet of things (IoT) – Unmanned Aerial Vehicles, sensors – Additive manufacturing in construction – Concrete 3D printing - Materials used - Lightweight and functionally graded structures - Net Zero Energy buildings, Bioswales, Biofiltration pond, Ecosan systems- Recent developments in Waste water Management, Air pollution control, waste disposal - Integration of energy, water and environmental systems for a sustainable development- Emerging Technologies: Robot Highway- Vertical farming - Intellectual Property rights: Case studies.

UNIT 4 SMART MANUFACTURING

8 Hrs.

Smart factories and interconnection, Smart Manufacturing – automation systems, Additive Manufacturing, Smart grids, Micro Electro Mechanical Systems (MEMS), Stealth technology, Metal Finishing, Self propelled vehicles, e mobility, Green fuels, drones – unmanned aerial vehicles(UAVs), aerodynamics. Robotic Automation and Collaborative Robots – Augmented reality and haptics, engineering cybernetics and artificial intelligence (AI), Disruptive Technologies – Frugal Innovations – Emerging Technologies - Autonomous Robots, Swarm Robot, Modular Robotics, Space craft, Intellectual Property Rights (IPR): Case Studies.

UNIT 5 SMART WORLD

8 Hrs.

Smart Sensors and IIOT, Smart grid, Hybrid renewable energy systems, Electronics in Smart city, Integration of Sensors in Robots and Artificial Intelligence, 5G Technology, Communication protocols, Human-Machine Interaction, Virtual Reality, Quantum Computing: Changing trends in transistor technology: Processor, Emerging Trends: Deep Space, Swarm Robots, Cyborg, Geofencing, Pervasive Computing, Intellectual Property Rights- Case Studies.

UNIT 6 CYBER PHYSICAL SYSTEMS

8 Hrs.

Introduction to Cyber Physical Systems (CPS), Architecture of CPS, Data science and technology for CPS, Prototypes of CPS, Emerging applications in CPS including social space, crowd sourcing, healthcare and human computer interactions, Industrial Artificial Intelligence, Networking systems for CPS applications, Wearable cyber physical systems and applications, Domain applications of CPS: Agriculture, Infrastructure, Disaster management, Energy, Transportation, Intellectual Property Rights (IPR) : Case Studies.

Max. 45 Hrs.

TEXT / REFERENCE BOOKS

1. William D. Callister, "Materials Science and Engineering, An Introduction, John Wiley and Sons Inc. Singapore, 2001.
2. V. Raghavan, "Physical Metallurgy: Principle and Practice, Prentice Hall India Pvt Ltd, 2006.
3. Flavio Craveiro, Jose Pinto Duarte, Helena Bartolo and Paulo Jorge Bartolo, "Additive manufacturing as an enabling technology for digital construction: A perspective on Construction 4.0", Automation in Construction, Vol. 103, pp. 251-267, 2019.
3. Klaus Schwab, "Fourth Industrial Revolution", Random House USA Inc, New York, USA, 2017.
4. Oliver Grunow, "SMART FACTORY AND INDUSTRY 4.0. The current state of Application Technologies", Studylab Publications, 2016.
5. Alasdair Gilchrist, "INDUSTRY 4.0: Industrial Internet of Things", Apress, 2016.
6. Sang C. Suh, U. John Tanik, John N Carbone, Abdullah Eroglu, "Applied Cyber-Physical Systems", Springer Publications, New York, 2013.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A: 11 Questions of 2 marks each-No choice

22 Marks

PART B : 2 Questions from each unit with internal choice, each carrying 13 marks

78 Marks

SMEA1402	MECHANICS OF MACHINES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Y Provide the insights of the fundamentals of Mechanisms and Cams.
- Y Understand the basics of Flywheels, Balancing of Rotating and Reciprocating unbalance systems.
- Y Enhance knowledge of Single degree - Free and Damped Vibrations.
- Y Provide the detailed overview of Forced Vibrations.
- Y Discuss the fundamentals of Gears, Gyroscopes and Governors.

UNIT 1 MECHANISMS AND CAMS

9 Hrs.

Mechanisms – Terminology and definitions – Kinematics inversions of 4 bars and slider crank chain – **Kinematic analysis in simple mechanisms** **Types of cams and followers** – Terminology and definitions – Displacement diagrams – SHM, uniform velocity, uniform acceleration and retardation. Graphical constructions of cam profiles – Disc cam with knife edge follower, roller follower and flat-faced follower.

UNIT 2 FLY WHEELS AND BALANCING

9 Hrs.

Turning moment diagrams – **Fluctuation of Energy and speed – Energy stored in Flywheel** – Mass of Flywheel – Dimensions of Flywheel. Balancing – Static and Dynamic Balancing of Rotating Masses - Balancing of several masses rotating in same plane and in different planes- Partial Balancing of locomotives – Variation of tractive force, Hammer blow and swaying couple.

UNIT 3 FUNDAMENTALS OF VIBRATION

9 Hrs.

Basic features of vibratory systems - Lumped mass systems - Degrees of freedom - Free vibration of Longitudinal, Transverse and Torsional systems of Single degree of freedom - Equations of motion - Natural frequency – Whirling of shafts and critical speed - Dunkerley's Method – Torsional vibration of Two and Three rotor system. Damped free vibration - Types of Damping –Critical damping coefficient - Damping Factor – Logarithmic Decrement.

UNIT 4 FORCED VIBRATION

9 Hrs.

Forced vibration of single degree freedom system with damping - Response to periodic forcing- Harmonic Forcing - Force transmissibility and amplitude transmissibility - Reciprocating and rotating unbalance - vibration isolation and transmissibility - Support motion - self excited vibration with examples.

UNIT 5 GEARS, GOVERNORS AND GYROSCOPES

9 Hrs

Spur gear terminology – law of toothed gearing – Involute gearing – Path of contact, arc of contact and contact ratio. Interchangeable gears – Gear tooth action – interference and undercutting – Gear trains – Epicyclic gear train – tabular method of finding velocity ratio. Governors - Types - Centrifugal governors – Porter– Characteristics –Sensitivity – Stability – Hunting – Isochronisms – equilibrium speed - Controlling Force- Gyroscopes - Gyroscopic couple - Gyroscopic stabilization - Gyroscopic effects in Aeroplanes.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the fundamentals of Mechanisms and Cams.
- CO2 - Understand the principle of Flywheel, Rotating and Reciprocating masses.
- CO3 - Understand the basics of Single degree - Free and Damped Vibrations.
- CO4 - Learn about Forced Vibrations.
- CO5 - Apply the fundamentals of Gears.
- CO6 - Apply the fundamentals of Gyroscopes, Governors.

TEXT/REFERENCE BOOKS

1. Khurmi R.S. & Gupta J.S, "Theory of Machines", 16th Edition, S.Chand & Company, 2005, Reprint 2016.
2. Singh V.P, "Mechanical Vibrations", 3rd Edition, Dhanpatrai & Co., 2006.
3. Ghosh A. and Malik A.M, "Theory of Mechanism and Machines", 4th Edition, Affiliated East West Press (P) Ltd., 2009.
4. Ashok G. Ambekar, "Mechanism and Machine Theory", 1st Edition, PHI Learning Private limited, 2009.
5. Rattan S. S, Theory of Machines, 3rd Edition, Tata Mcgraw Hill, 2009.
6. Gordon R Pennock, Joseph E Shigley, "Theory of Machine and Mechanisms" SI Edition, 4th Edition, Oxford University Press, 2014.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

PART A: 10 Questions of 2 marks each – No choice

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks

Exam Duration: 3 hrs.

20 Marks

80 Marks

SMEA1501	CAD / CAM	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Y To provide the fundamental information about computer graphics, elements of CAD/CAM and basic understanding about transformations, clipping, windowing and hidden line removal.
- Y To provide understanding of various wireframe, surface and solid modelling techniques used for generating computer models.
- Y To provide the details on how computer applications are used directly and indirectly for the manufacturing applications.

UNIT 1 FUNDAMENTALS OF CAD/CAM

9 Hrs.

Introduction: **Elements of CAD, Elements of CAM** CAD/CAM integration, Advantages and applications. Computer graphics: Input and output devices, CAD/CAM databases, Requirements of Computer graphics packages. Transformations: Geometric transformation versus viewing transformation, Basic transformation matrices, such as translation, rotation and scaling.

UNIT 2 GEOMETRIC MODELLING - I

9 Hrs.

Wireframe modelling of analytical curves, such as line, circle and conics, and synthetic curves, such as Hermite cubic spline, Bezier curve and B-Spline curve. Surface modelling of analytical surfaces, such as plane surface, ruled surface, surface of revolution and tabulated cylinder, and synthetic surfaces, such as Hermite cubic surface, Bezier surface and B-Spline surface.

UNIT 3 GEOMETRIC MODELING - II

9 Hrs.

Solid modelling techniques: Constructive solid geometry (CSG) representation and Boundary representation. Assembly modelling: Assembly of part drawing, Approaches, Interferences of positions and orientation. Graphics standards: Product data exchange, File format of DXF, IGES and STEP files. Capabilities of modelling & analysis packages.

UNIT 4 COMPUTER AIDED MANUFACTURING - I

9 Hrs.

NC, DNC and CNC machine tools: NC Programming: point to point and continuous path machining approaches, G Codes, M Codes, Canned cycles, Manual NC programming for turning and milling operations. Use of computer applications in inspection, rapid prototyping, material handling and other manufacturing related tasks.

UNIT 5 COMPUTER AIDED MANUFACTURING - II

9 Hrs.

Computer Aided Process Planning (CAPP): Traditional process planning. Benefits of CAPP, Variant and Generative approaches. Computer integrated production system (CIPS): Traditional production planning, Benefits of CIPS, Master production Schedule, Material Requirement Planning, Inventory Management, Capacity planning, Shop floor control.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the fundamental information about computer graphics, elements of CAD/CAM and apply the knowledge of transformations, clipping, windowing and hidden line removal for simple problems.
- CO2 - Learn various wireframe and surface modeling techniques used for generating computer models.
- CO3 - Explain various solid modeling techniques, assembly modeling and drafting facilities provided by CAD packages.
- CO4 - Explain the file structure of various product data exchange file formats and their applications.
- CO5 - Analyze the details on computer applications used directly for the manufacturing applications.
- CO6 - Analyze the details on computer applications used indirectly for the manufacturing industry.

TEXT / REFERENCE BOOKS

1. Ibrahim Zeid and R. Sivasubramanian, "CAD/CAM : Theory and Practice: Special Indian Edition", 2nd Edition, McGraw Hill Education, 2009.
2. M. Groover and E. Zimmers, "CAD/CAM Computer-Aided Design and Manufacturing", 1st Edition, Pearson Education, 2003.
3. Donald D. Hearn and M. Pauline Baker, "Computer Graphics, C Version", 2nd Edition, Pearson Education, 2014.
4. John F. Hughes, Andries van Dam, Morgan McGuire, David F. Sklar, James D. Foley, Steven K. Feiner and Kurt Akeley, "Computer Graphics: Principles and Practice", 3rd Edition, Pearson Education India, 2013.
5. Mikell P Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing", 4th Edition, Pearson Education, 2014.

SMEA1503	FINITE ELEMENT ANALYSIS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- Y To understand the concepts of Mathematical Modeling of Engineering Problems.
- Y To apply the use of FEM in various engineering problems.
- Y To learn the efficient implementation of finite element method in solving of simple problems.
- Y To solve simple and complicated 2D structural problems for stress analysis under impact loads from general engineering aspects.

UNIT 1 INTRODUCTION

9 Hrs.

Historical Background– Basic Concepts of FEM – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems–Residual Methods- Variational Formulation of Boundary Value Problems – Ritz Method .

UNIT 2 ONE-DIMENSIONAL PROBLEMS

9 Hrs.

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices- Solution of problems from solid mechanics and heat transfer-Bar, Beam Elements – Applications to Heat Transfer.

UNIT 3 TWO DIMENSIONAL PROBLEMS

9 Hrs.

Basic Boundary Value Problems in Two Dimensions – Triangular, quadrilateral, higher order elements – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.

UNIT 4 SOLUTION TO PLANE ELASTICITY PROBLEMS

9 Hrs.

Introduction to Theory of Elasticity – Plane Stress – Plane Strain and Axisymmetric Formulation – Body forces and temperature effects – Stress calculations - Plate and shell elements.

UNIT 5 ISO PARAMETRIC FORMULATION

9 Hrs.

Natural Co-ordinate System – Lagrangian Interpolation Polynomials – Iso-parametric Elements – Formulation –Numerical Intergration – 1D -2D Triangular elements – rectangular elements – Introduction to Analysis Software— h & p elements- Errors and Types

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the basics of matrix manipulations required for Finite Element Analysis.
- CO2 - Apply finite element formulations to solve one dimensional Problems.
- CO3 - Apply finite element formulations to solve two dimensional scalar Problems.
- CO4 - Apply finite element method to solve two dimensional Vector problems.
- CO5 - Apply finite element method to solve problems on iso parametric element.
- CO6 - Analyze the importance of ethical issues pertaining to the effective utilization of FEA in Mechanical engineering.

TEXT / REFERENCE BOOKS

1. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2010.
2. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
3. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 4th Edition, Prentice Hall College Div, 1997.
4. Rao, S.S., "The Finite Element Method in Engineering", 4th Edition, Butterworth Heinemann, 2005.
5. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

SMEA1601	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	Credits	Total Marks
		3	*	0	3	100

(Use of approved design data book is permitted)

COURSE OBJECTIVES

- Y To gain knowledge on the principles and procedure for the design of Mechanical power transmission components.
- Y To understand the standard procedures available for Design of Transmission Elements.
- Y To identify critical static and dynamic stresses in a mechanical component.
- Y To learn to use standard data from the design data book and catalogues.

UNIT 1 DESIGN OF FLEXIBLE DRIVES

9 Hrs.

Design of Flat belts and pulleys – Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys- Design of Transmission chains and Sprockets.

UNIT 2 SPUR GEARS AND PARALLEL AXIS HELICAL GEARS

9 Hrs.

Speed ratios and number of teeth-Force analysis- Tooth stresses –Dynamic effects-Fatigue strength-Factor of Safety-Gear materials-**Design of Straight tooth spur and helical gears based on strength and wear considerations**- Pressure angle in the normal and transverse plane –Equivalent number of teeth – Forces for helical gears.

UNIT 3 BEVEL AND WORM GEARS

9 Hrs.

Straight bevel gear: Tooth terminology- Design of pair of straight bevel gears - Tooth forces and stresses Worm Gear: Merits and demerits- Terminology. Design of the worm and gear - Forces and stresses, efficiency.

UNIT 4 GEAR BOXES

9 Hrs.

Geometric progression - Standard step ratio - Ray diagram, kinematics layout **Design of sliding mesh gear box** - Constant mesh gear box. - Design of multi speed gear box.

UNIT 5 CLUTCHES AND BRAKES

9 Hrs.

Design of plate clutches –Cone clutches – Centrifugal clutches- Electromagnetic clutches. Band and Block brakes- External shoe brakes – Internal expanding shoe brake.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Recognize the need for friction drives and positive drives.
- CO2 - Design of spur and helical gears.
- CO3 - Design Bevel and worm gears based on strength and wear consideration.
- CO4 - Design various types of gear boxes
- CO5 - Understand the Mechanical Design procedure of clutches and brakes
- CO6 - Design transmission components used in engine and machines

TEXT / REFERENCE BOOKS

- Bhandari V, "Design of machine elements", 4th Edition, Tata Mcgraw Hill Book Company, 2017.
- Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett —Mechanical.
- Engineering Design, 8th Edition, Tata McGraw-Hill, 2008.
- Prabhu. T.J., —Design of Transmission Elements, Mani Offset, Chennai, 2000.
- Sundararajamoorthy T. V, Shanmugam .N, — Machine Design, Anuradha Publications, Chennai, 2003.
- GitinMaitra, L. Prasad — Hand book of Mechanical Design, 2nd Edition, Tata McGraw-Hill, 2001.
- C.S.Sharma, Kamlesh Purohit, —Design of Machine Elements, Prentice Hall of India, Pvt. Ltd., 2003.
- Bernard Hamrock, Steven Schmid, Bo Jacobson, —Fundamentals of Machine Elements, 2nd Edition, Tata McGraw-Hill Book Co., 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each – No choice

20 Marks

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks

80 Marks

SMEA3001	ADDITIVE MANUFACTURING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Y To explore the technology used in additive manufacturing.
- Y To understand the importance of additive manufacturing in advance manufacturing process. Y To acquire knowledge, techniques and skills to select relevant additive manufacturing process. Y To explore the potential of additive manufacturing in different industrial sectors.
- Y To apply 3D printing technology for additive manufacturing.

UNIT 1 INTRODUCTION

9 Hrs.

Overview, Basic principle need and advantages of additive manufacturing, Procedure of product development in additive manufacturing, Classification of additive manufacturing processes, Materials used in additive manufacturing, Challenges in Additive Manufacturing.

UNIT 2 ADDITIVE MANUFACTURING PROCESSES

9 Hrs.

Z-Corporation 3D-printing, Stereolithography apparatus (SLA), Fused deposition modeling (FDM), Laminated Object Manufacturing (LOM), Selective deposition lamination (SDL), Ultrasonic consolidation, Selective laser sintering (SLS), Laser engineered net shaping (LENS), Electron beam free form fabrication (EBFFF), Electron beam melting (EBM), Plasma transferred arc additive manufacturing (PTAAM), Tungsten inert gas additive manufacturing (TIGAM), Metal inert gas additive manufacturing (MIGAM).

UNIT 3 ADDITIVE MANUFACTURING MACHINES AND SYSTEMS

9 Hrs.

Axes, Linear motion guide ways, Ball screws, Motors, Bearings, Encoders/ Glass scales, Process Chamber, Safety interlocks, Sensors. Introduction to NC/CNC/DNC machine tools, CNC programming and introduction, Hardware Interpolators, Software Interpolators, Recent developments of CNC systems for additive manufacturing.

UNIT 4 PRE-PROCESSING IN ADDITIVE MANUFACTURING

9 Hrs.

Preparation of 3D-CAD model, Reverse engineering, Reconstruction of 3D-CAD model using reverse engineering, Part orientation and support generation, STL Conversion, STL error diagnostics, Slicing and Generation of codes for tool path, Surface preparation of materials.

UNIT 5 POST-PROCESSING IN ADDITIVE MANUFACTURING

9 Hrs.

Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques, Brief information on characterization techniques used in additive manufacturing, Applications of additive manufacturing in rapid prototyping, rapid manufacturing, rapid tooling, repairing and coating.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Define the various process used in Additive Manufacturing.
- CO2 - Analyze and select suitable process and materials used in Additive Manufacturing.
- CO3 - Identify, analyze and solve problems related to Additive Manufacturing.
- CO4 - Apply knowledge of additive manufacturing for various real-life applications.
- CO5 - Apply technique of CAD and reverse engineering for geometry transformation in Additive Manufacturing.
- CO6 - Understand the basic concept of additive manufacturing application.

TEXT / REFERENCE BOOKS

- Gibson, I, Rosen, D W., and Stucker,B., Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010.
- Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", 3rd Edition, World Scientific Publishers, 2010.
- Chee Kai Chua, Kah Fai Leong, 3D Printing and Additive Manufacturing: Principles and Applications: 4th Edition of Rapid Prototyping, World Scientific Publishers, 2014.
- Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003. Kenneth G. Budinski& Michael K. Budinski, "Engineering Materials: Properties and Selection", 9th Edition, Pearson, 2009, 792 pages.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

PART A: 10 Questions of 2 marks each – No choice

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks

Exam Duration: 3 Hrs.

20 Marks

80 Marks

SMEA3005	NON DESTRUCTIVE TESTING AND TECHNIQUES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Y To enable the student to understand the modern NDT techniques.
- Y To present the underlying principles and alternatives for destructive testing procedures.
- Y To provide the student with the opportunity for hands-on experience for diverse domains of application.

UNIT 1 INTRODUCTION AND VISUAL INSPECTION METHODS

9 Hrs.

Scope and advantages of NDT. Comparison of NDT with DT. Some common NDT methods used since ages, Terminology. Flaws and Defects, Visual inspection-Unaided, Equipment used for visual inspection. Ringing test chalk test (oil whitening test). **Attractive uses of above tests in detecting surface cracks, bond strength and surface defects.**

UNIT 2 LIQUID PENETRANT TESTING AND MAGNETIC PARTICLE TESTING

9 Hrs.

Die penetrate test (liquid penetrate inspection), Principle, scope. Equipment & techniques, Tests stations, Advantages, types of penetrant and developers. Illustrative examples – Heavy castings of large size, frame of jet engine, porosity testing of nickel alloys, leak testing. **Magnetic particle Inspection – Scope, principle, Ferro Magnetic and Non-ferro magnetic materials, equipment & testing.** Advantages, limitations Interpretation of results. DC and AC magnetization, Skin Effect, use of dye and wet powders for magna glow testing, different methods to generate magnetic fields, Applications and demonstration.

UNIT 3 RADIOGRAPHIC METHODS

9 Hrs.

X-ray radiography principle, equipment and methodology. Applicability, types of radiations limitations. Interpretation of Radiographs, limitations of gamma-ray radiography –principle, equipment. Attenuation of electromagnetic radiations, source of radioactive materials and technique. Photo electric effect, Rayleigh's scattering (coherent scattering), Compton's scattering (Incoherent scattering). Pair production, Beam geometry, scattering factor. Precautions against radiation hazards. Xero-Radiography, Digital Radiography, Gamma ray Radiography, **Safety in X- ray and Gamma ray radiography. Advantages of gammaray radiography over X-ray radiography.**

UNIT 4 ULTRASONIC TESTING AND ACOUSTIC EMISSION TESTING

9 Hrs.

Introduction, Principle of operation, Piezoelectricity. Ultrasonic probes, CRO techniques, advantages, Limitation & typical applications. Applications in inspection of castings, forgings, Extruded steel parts, bars, pipes, rails and dimensions measurements. **Acoustic Emission Technique – Introduction, Types of AE signal, AE wave propagation, Source location, Kaiser effect, AE transducers.** Principle, AE parameters, AE instrumentation, Advantages& Limitations, Applications and demonstration.

UNIT 5 EDDY CURRENT TESTING AND THERMOGRAPHY

9 Hrs.

Eddy current Testing – Principle, properties of eddy currents, Eddy current sensing elements, probes, Instrumentation, Types of arrangement, Advantages and Limitations and applications. **Thermography – Introduction, Principle, Contact and Non-Contact inspection methods, Active and Passive methods,** Liquid Crystal – Concept, example, advantages and limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Applications and demonstration.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Recall the basic concepts of NDT.
- CO2 - Interpret the quality of the components.
- CO3 - Design the precautions against the radiation hazards.
- CO4 - Apply the knowledge on Interpretation of results.
- CO5 - Analyze products as production team member.
- CO6 - Apply the knowledge on Electromagnetic spectrum.

TEXT / REFERENCE BOOKS

1. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Research Techniques in NDT Vol.3, R.S. Shah, Academic 2002.
3. Paul E Mix, "Introduction to non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005.
4. Ravi Prakash, "Non-Destructive Testing Techniques", New Age International Publishers, 1st Revised Edition, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each – No choice

20 Marks

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks

80 Marks

SMEA3006	REFRIGERATION AND AIR - CONDITIONING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Y To understand and discuss fundamentals of refrigeration principles, vapour compression cycles and its performance, refrigerants, compressors, condensers, evaporators.
- Y To understand Non-conventional Refrigeration Systems and Psychrometry.
- Y To understand air conditioning systems and their design, load calculation, control and accessories.
- Y To have a thorough knowledge of the applications of refrigeration and air conditioning.

UNIT 1 BASICS OF REFRIGERATION

9 Hrs.

Definition and methods, Unit of refrigeration, COP, EER, Carnot Principle, Heat pump and Refrigerator, Air Refrigeration System, Reversed Brayton cycle– Quantitative treatment, Aircraft refrigeration system, Refrigerants properties, Types, Selection criteria, Designation, Oil Compatibility, Eco Friendly Refrigerants, Environmental Impact, Ozone depletion potential and Global warming potential, Montreal / Kyoto protocols.

UNIT 2 VAPOUR COMPRESSION REFRIGERATION

9 Hrs.

Simple and actual VCR cycle, T-s and p-h representation, Effect of Sub cooling and superheating – Quantitative treatment, Two stage compression, flash chamber, Intercooler. Compressors: single and multistage, Hermetic, Screw, Vane and Centrifugal compressors, Condensers and evaporators; Expansion devices, Cooling towers, types –Qualitative treatment only.

UNIT 3 NON-CONVENTIONAL REFRIGERATION

9 Hrs.

Vapour absorption refrigeration, importance, Principle of Operation of Ammonia-Water, Lithium Bromide-Water VAR systems, Comparison of VCR and VAR systems, merits over VCR system, Electrolux System, Steam ejector system. Introduction to adsorption system, Thermoelectric, Vortex tube and pulse tube refrigeration, Descriptive study of Low temperature refrigeration, Joule Thomson effect, Applications of cryogenics – Qualitative treatment only.

UNIT 4 PSYCHROMETRICS AND AIR CONDITIONING

9 Hrs.

Psychrometry properties, charts, processes and relations, Gibbs-Dalton's law, Adiabatic mixing of two streams, Human comfort, factors affecting comfort, Comfort chart, Ventilation requirement, Comfort air conditioning, Air conditioning loads, load estimation, Solar radiation, infiltration and ventilation, Air washer; BPF, ADP temperature, RSHF, GSHF, ERSHF – Quantitative treatment.

UNIT 5 AIR CONDITIONING SYSTEMS

9 Hrs.

Summer, winter and central air conditioning systems. room air conditioners, packaged air conditioning plant, central air conditioning systems, split air conditioning systems Ducts, types, various types of losses of fluid flow in ducts, Methods of duct design, arrangement system. Air distribution system, Fans and blowers, filters, sources of noise in AC equipments and methods to control noise; Refrigeration and air conditioning controls: pressure, humidity, temperature sensors; safety controls; actuators.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the various types of refrigeration systems and learn the classification and properties of refrigerants.
- CO2 - Analyze the performance of refrigeration cycles and various components used in the cycles.
- CO3 - Describe the various refrigeration concepts other than the vapour compression cycle.
- CO4 - Understand the Psychrometric chart and processes in design the air conditioning and cooling load calculations.
- CO5 - Analyze the Air Conditioning equipments, air distribution equipments and their applications.
- CO6 - Apply the knowledge gained in various refrigeration and air conditioning systems.

TEXT / REFERENCE BOOKS

- Refrigeration and Air conditioning, Manohar Prasad- New Age International, 3rd Edition, 2011.
- Refrigeration and Air Conditioning, C. P. Arora, Tata McGraw-Hill Education, 3rd Revised Edition, 2010.
- Principles of Refrigeration, Roy J. Dossat, Pearson Education, 5th Edition, 2012.
- Basic Refrigeration and Air Conditioning, P. N. Ananthanarayanan, TMH, 4th Edition, 2013.
- Refrigeration and Air conditioning, W.F.Stoecker, Tata McGraw-Hill, 2nd Edition, 2010.
- ASHRAE Handbook (Fundamentals) 2018.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each – No choice

20 Marks

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks

80 Marks

SPRA5102	DESIGN FOR MANUFACTURE AND ASSEMBLY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Y To know the theory concepts of design for manufacturing and assembly.
- Y To know the general design guidelines for Metal casting, Metal Joining and Assembly.
- Y To know some aspects of the computer application in design for manufacturing and assembly.

UNIT 1 INTRODUCTION

9 Hrs.

General design principles for manufacturability - steps in Design process - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric tolerances - Assembly limits -Datum features - Tolerance stacks. Creativity in design - Materials: Types of materials-Composites and Nano materials, Selection of Materials for design Developments in Material technology - criteria for material selection — **Material selection interrelationship with process selection, process selection charts.**

UNIT 2 MACHINING PROCESS

9 Hrs.

Overview of various machining processes - general design rules for machining - Dimensional tolerance and surface roughness — Design for machining — Ease — **Redesigning of components for machining ease with suitable examples.**

UNIT 3 METAL CASTING

9 Hrs.

Introduction to different manufacturing processes -Appraisal of various casting processes, selection of casting process, - general design considerations for casting — casting tolerances — use of solidification simulation in casting design — **product design rules for sand casting. Advantage and Disadvantage of castings.**

UNIT 4 METAL JOINING

9 Hrs.

Introduction to different metal joining methods -Appraisal of various welding processes, Factors in design of weldments — general design guidelines — pre and post treatment of welds — **effects of thermal stresses in weld joints** — design of brazed joints. Forging — Design factors for Forging - Extrusion & Sheet Metal Work: Design guidelines for Extruded sections - design principles for Punching, Blanking, Bending, and Deep Drawing.

UNIT 5 DESIGN OF ASSEMBLY

9 Hrs.

Design for assembly fits in the design process, general design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency, Identification of uneconomical design - **Modifying the design - group technology - Computer Applications for DFMA. Design for Disassembly** —Design for interchangeable-Ergonomics considerations in Design.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Outline the appropriate design for economical production and select the materials.
- CO2 - Select between various machining and general design rules for Machining.
- CO3 - Apply a systematic understanding of knowledge in the field of metal casting
- CO4 - Understand the metal joining Processes and appraisal of welding process.
- CO5 - Understand the design guidelines for manual assembly and systematic methodology of DFA
- CO6 - Identify the design and apply the ergonomic consideration in Design

Max. 45 Hrs.

TEXT / REFERENCE BOOKS

- Geoffrey Boothroyd and Peter Dewhurst, "Product Design for Manufacturing and Assembly", CRC Press, 2010.
- Geoffrey Boothroyd, "Assembly Automation and Product Design", Marcel Dekker Inc., NY, 1992.
- George E. Deiter, "Engineering Design – Material & Processing Approach", McGraw Hill Intl. 2nd Edition, 2000.
- Geoffrey Boothroyd "Hand Book of Product Design" Marcel and Dekken, N.Y.1990.
- Delbainbre, A "Computer Aided Assembly" London, 1992.
- Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 1995.

END SEMESTER QUESTION PAPER PATTERN

Max. Marks: 100

PART A: 5 Questions of 6 marks each – No choice

PART B: 2 Questions from each unit of internal choice; each carrying 14 marks

Exam Duration: 3 Hrs.

30 Marks

70 Marks

SPRA5104	INTEGRATED MANUFACTURING SYSTEMS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Y At the end of the course, the student will be able.
- Y Serves as an introduction to the modern manufacturing methods.
- Y To gain knowledge of manufacturing systems integrated with CAD/CAM.
- Y To learn how computers integrated at various levels of production planning.
- Y To understand computer aided planning and control and computer monitoring.
- Y To discuss current or recent manufacturing trends and possible future development.

UNIT 1 INTRODUCTION

9 Hrs.

Objectives of manufacturing systems – identifying business opportunities – classification of problems in manufacturing and production systems. Strategy of linking manufacturing systems – system analysis of manufacturing operation. Automated Manufacturing Systems, Computerized Manufacturing Systems, Reason for Automation, Strategies of Automation.

UNIT 2 GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING

9 Hrs.

Role of Group Technology (GT) in CAD/CAM Integration – Part Families – Parts Classification and Coding – OPITZ coding systems – Production Flow Analysis – Composite part Concept – Machine cell design and layout – Application of GT – Quantitative analysis in cellular Manufacturing – rank order clustering method – Arranging Machines in a GT cell – Case studies. **Role of process planning in CAD/CAM integration - Computer Aided Process Planning (CAPP) – Approaches to CAPP.**

UNIT 3 COMPUTER AIDED PLANNING AND CONTROL

9 Hrs.

Production planning and control – Cost planning and control – inventory management – Material Requirement Planning (MRP) – case studies – Basics of JIT – Shop Floor Control – Factory data collection systems – Automatic identification systems – barcode technology – Automated data collection systems. Development of actual shop floor control systems (involving LAN, Communication server). **Interface of shop floor controller with business systems (ERP or order systems).**

UNIT 4 COMPUTER MONITORING

9 Hrs.

Types of production monitoring systems - Structure of manufacturing process – Process control and its strategies. Direct digital control – Supervisory computer control – Computer in Quality Control (QC) – **Contact inspection and non contact inspection methods – flexible Inspection Systems – Computer Aided testing – Integration of CAQC with CAD/CAM.**

UNIT 5 INTERATED MANUFACTURING SYSTEM

9 Hrs.

Role of integrative manufacturing in CAD/CAM integration – Application and features – Types of manufacturing systems – Material handling systems – Computer control systems. Introduction of Flexible Manufacturing Systems (FMS) – Components of FMS - **Flexible manufacturing strategy** – Case studies - Benefits of computer integrated manufacturing systems – rapid prototyping – Artificial Intelligence and Expert System in CIM.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the principle of automation in manufacturing systems.
- CO2 - Construct part programming using ISO format for given simple component.
- CO3 - Learn about structural analysis of material requirement.
- CO4 - Know the integration of computer in Quality control.
- CO5 - Develop an FMS layout for given simple part family using group technology concepts.
- CO6 - Recognize the use of Artificial Intelligence and Expert Systems in CIM.

TEXT/REFERENCE BOOKS

- Groover M.P. "Automation, Production systems and CIM", Prentice Hall of India, 2001.
- David Bedworth, "Computer Integrated Design and Manufacturing", TMH, New Delhi.
- Yorem Koren, "Computer Integrated Manufacturing Systems", McGraw Hill, 2017.
- Ranky, Paul G, "Computer Integrated Manufacturing", Prentice Hall International, 2005.
- Yeomanas, R.W. A.Choudry and P.J.W.Ten Hagen. "Design rules for a CIM systems", North Holland Amsterdam, 2002
- Radhakrishnanan O. Subramaniyam S ad Raju V, "Cnationa (P(AD/CAM/CIM" 2nd Edition New age international (P) Ltd., New Delhi, 2008.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

PART A: 5 Questions of 6 marks each – No choice

PART B: 2 Questions from each unit of internal choice; each carrying 14marks

Exam Duration: 3 Hrs.

30 Marks

70 Marks

SMEA1203	FUNDAMENTALS OF MECHANICAL ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Y To understand the design concepts and various product development stages.
- Y To learn the fundamentals of the machining processes and machine tools.
- Y To study the working principles of power plant, IC engines and the related components.

UNIT 1 CONCEPTS OF DESIGN

9 Hrs.

Introduction to engineering design, Need for design, Product life cycle, Product development process, Types of product development process, Idea generation methods, Design process.

UNIT 2 FOUNDRY, FORMING AND JOINING PROCESSES

9 Hrs.

Concepts of manufacturing, Foundry: tools, patterns and allowances - green and dry sand moulding, furnaces. Casting principles. Metal forming: Concepts and principles, forging, rolling, extrusion and drawing, Metal joining processes: Arc welding and Gas welding, brazing and soldering. Sheet metal operations: Shearing, piercing, blanking, bending, forming and spinning.

UNIT 3 MACHINING PROCESSES

9 Hrs.

Machining Concepts, Tool and work holding devices. Machine tools and operations: lathe, drilling machine, boring machine, milling machine, shaper, planer, broaching machine and grinder. Introduction to digital manufacturing: NC, DNC and CNC.

UNIT 4 I.C. ENGINES

9 Hrs.

Engine classification -Working principle of S.I. and C.I. engines - four stroke and two stroke cycles - comparison of four stroke and two stroke engines, Components of I.C. engines - function of piston, piston rings, cylinder, connecting rod and crankshaft. Ignition systems - single jet carburettor - spark plug - cooling systems - lubrication systems - fuel pump and fuel injector.

UNIT 5 POWER GENERATION

9 Hrs.

Energy demand, Non-renewable energy, Renewable energy. Power plants: Thermal, Gas turbine, diesel, hydro, wind, solar, nuclear, geothermal power plants. Boilers: Classification and types of Boilers, Modern high pressure boilers, Turbines: Classification, construction and working principle of impulse and reaction turbines.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the fundamentals of product design and development.
- CO2 - Understand the basics of the manufacturing processes.
- CO3 - Understand the basics of machine tools and operations.
- CO4 - Understand the working principles of four stroke and two stroke engines and components.
- CO5 - Understand various sources of energy and their significance.
- CO6 - Understand the working principles of various power plants and accessories.

TEXT / REFERENCE BOOKS

- Karl T. Ulrich, Steven D. Eppinger, "Product Design & Development", Tata McGraw Hill, New Delhi, 2003.
- Kevin Otto & Kristin Wood Product Design, "Techniques in Reverse Engineering and new Product Development", 1st Edition, Pearson Education, New Delhi, 2004.
- Hajra Choudhury S.K., Hajra Choudhury A.K., Nirjhar Roy, "Elements of Workshop Technology", Vol.1, Media Promoters, 2009.
- Serope Kalpakjian, Steven R. Schmid, "Manufacturing Engineering & Technology", 7th Edition, Pearson Publications, 2014.
- Mikell P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing", 4th Edition, Pearson Education, 2014.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Question of 2 marks each – No choice

20 Marks

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks

80 Marks

SMEA1202	ENGINEERING MECHANICS (FOR MECH, MECHATRONICS, AERO AND AUTO)	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- Y To understand the concept of Statics.
- Y To learn the concept of Equilibrium.
- Y To understand the properties of surfaces and solids.
- Y To learn the theory of Friction.
- Y To acquire the knowledge about concept of Dynamics.

UNIT 1 BASICS & STATICS OF PARTICLES

9 Hrs.

Introduction-Units and Dimensions-Laws of Mechanics-Vectors-Vectorial representation of forces and moments - Vector operations-resolution and composition of forces - equilibrium of a particle - Free body diagram - forces in space-equilibrium of a particle in space-equivalent systems of forces-principle of transmissibility-Resultant and Equilibrant.

UNIT 2 EQUILIBRIUM OF RIGID BODIES

9 Hrs.

Types of supports and their reactions - requirements of stable equilibrium – Moments and Couples- Varignon's theorem- Equilibrium of Rigid bodies in two dimensions- Equilibrium of Rigid bodies in three dimensions.

UNIT 3 PROPERTIES OF SURFACES AND SOLIDS

9 Hrs.

Determination of Areas - First moment of Area and the centroid - simple problems involving composite figures. Second moment of plane area-Parallel axis theorem and perpendicular axis theorem-Polar moment of Inertia – Principal moments of Inertia of plane areas – Principle axes of inertia – relation to area moments of Inertia. Second moment of plane area of simple sections like C,I,T,Z etc. - Basic Concept of Mass moment of Inertia.

UNIT 4 FRICTION

9 Hrs.

Frictional Force - Laws of Coulomb friction - Cone of friction-Angle of repose-relation between cone of friction and angle of repose- limiting friction-Rolling resistance- Simple contact friction - Screw - Wedge- Ladder- Belt friction.

UNIT 5 KINETICS OF RIGID BODIES AND DYNAMICS OF PARTICLES

9 Hrs.

Dynamics- Classification- Kinematics- Kinetics- Types of energy-Displacement, Velocity and acceleration their relation- Relative motion - Curvilinear motion - Newton's Law - D'Alembert's Principle, Work Energy Equation- Impulse and Momentum- Impact of elastic bodies- General plane motion.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the fundamentals of Statics.
- CO2 - Apply the concept of Equilibrium.
- CO3 - Calculate the Centroid and Area Moment of Inertia.
- CO4 - Analyze the Friction in different applications.
- CO5 - Understand the fundamentals of Dynamics.
- CO6 - Analyze overall Rigid body system of Kinematics and Kinetics.

TEXT / REFERENCE BOOKS

- Bhavikatti S.S., Engineering Mechanics, 1st Edition, New Age International publishers, 2017.
- Bansal R.K., A Textbook of Engineering Mechanics, 4th Edition, Laxmi Publications, 2002.
- Bedi D.S., Engineering Mechanics, 1st Edition, Khanna Publishing Co. (P) Ltd, 2013.
- Khurmi R.S. and Khurmi N, Engineering Mechanics, S.Chand Publishing, 2018.
- Beer & Johnston, "Vector Mechanics for engineers - Vol I & II", 9th Edition, Tata McGraw Hill, 2010.
- Sharma, D.P., Engineering Mechanics, Pearson, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A : 10 Question of 2 marks each – No choice

20 Marks

PART B : 2 Questions from each unit with internal choice, each carrying 16 marks

80 Marks

Skill Development

SMEA1302	ENGINEERING THERMODYNAMICS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- Y To understand the basic concepts of thermodynamics.
- Y To comprehend laws of thermodynamics and apply it to the related processes.
- Y Perform thermal analysis on behavior and performance of systems.

UNIT 1 BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS

9 Hrs.

Basic concepts - concept of continuum, microscopic and macroscopic approach. Thermodynamic systems - closed, open and isolated. Thermodynamic Equilibrium, Property, state, path and process, quasi-static process and irreversible processes, heat and work, modes of work. Zeroth law of thermodynamics- concept of temperature and thermal equilibrium. Concept of ideal and real gases. First law of thermodynamics - application to closed and open systems, internal energy, specific heat capacities, enthalpy, steady flow process with reference to various thermal equipments.

UNIT 2 SECOND LAW OF THERMODYNAMICS AND ENTROPY

9 Hrs.

Second law of thermodynamics - Kelvin's and Clausius statements. Reversibility and irreversibility. Heat Engine, Refrigerator, Heat pump, Carnot theorem, Carnot cycle, reversed Carnot cycle, efficiency, COP. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy. Available and Unavailable energy -Availability of non-flow and steady flow systems-Irreversibility and second law efficiency.

UNIT 3 PROPERTIES OF PURE SUBSTANCES

9 Hrs.

Properties of pure substances - Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces. Thermodynamic properties of steam, Dryness fraction and its determination by separating and throttling calorimeter, Calculations of work done and heat transfer in non-flow and flow processes.

UNIT 4 IDEAL AND REAL GASES, GAS MIXTURES AND THERMODYNAMIC RELATIONS

9 Hrs.

Properties of ideal and real gases - Equations of state for ideal and real gases - compressibility factor - compressibility chart. Properties of gas mixture. Exact differentials - Maxwell's relations-T-ds relations - Difference and ratio of heat capacities- Clausius Clapeyron equations - Joule Thomson effect.

UNIT 5 PSYCHROMETRY

9 Hrs.

Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process - adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Calculations & Applications.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply the first law of thermodynamics for simple open and closed systems under steady and unsteady conditions.
- CO2 - Apply second law of thermodynamics to open and closed systems and calculate entropy and availability.
- CO3 - Summarize the thermodynamic properties of gases and steam and apply it to related system analysis.
- CO4 - Derive simple thermodynamic relations of ideal and real gases.
- CO5 - Calculate the properties of gas mixtures and apply it to related system analysis.
- CO6 - Calculate the properties of moist air and its use in psychrometric processes.

TEXT / REFERENCE BOOKS

- Nag.P.K, Engineering Thermodynamics, 6th Edition, Tata McGraw-Hill, 2017.
- R.K.Rajput, A Textbook of Engineering Thermodynamics, 5th Edition, Laxmi Publications, 2016.
- Onkar Singh, Applied Thermodynamics, 4th Edition, New Age International Private Limited, 2018.
- Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2016.
- Yunus A Cengel and Michael A Boles, Thermodynamics: An Engineering Approach, 8th Edition, McGraw Hill, 2017.
- Claus Borgnakke, Richard E. Sonntag, Fundamentals of Thermodynamics, 8th Edition, Wiley, 2016.
- Lynn D. Russell, George A. Adebisi, Engineering Thermodynamics, 6th Edition, Oxford University Press, New Delhi, 2008.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100

PART A : 10 Questions of 2 marks each - No choice

PART B : 2 Questions from each unit with internal choice, each carrying 16 marks

Exam Duration : 3 Hrs.

20 Marks

80 Marks

Skill Development

SMEA1404	THERMAL ENGINEERING	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- Y To incorporate the laws, processes and cycles from the basics of thermodynamics to the different gas power cycles.
- Y To evaluate the Internal combustion engine performance with the application of thermodynamic concepts.
- Y To examine the significance of Steam nozzles, Turbines, Compressors, Refrigeration and Air conditioning systems in the field of Thermal Engineering.

UNIT 1 GAS AND VAPOUR POWER CYCLES

9 Hrs.

Air Standard Cycle analysis - Otto, Diesel, Dual, Brayton cycle, Simple Rankine, Reheat and Regeneration cycles performance.

UNIT 2 INTERNAL COMBUSTION ENGINE PERFORMANCE AND SYSTEMS

9 Hrs.

Working of S.I. and C.I engines, two stroke and four stroke engines – Valve timing, port timing and PV diagrams of S.I and C.I engines - Estimation of brake power indicated power, thermal efficiency, Heat balance sheet. Electronic and Common Rail Direct injection systems. Magneto and Battery coil ignition systems, Lubrication and Cooling systems. Supercharging and turbocharging systems.

UNIT 3 AIR COMPRESSORS

9 Hrs.

Classification and working of air compressors - Classification of compressors and their comparison - Reciprocating air compressor-principle of operation, work requirement, isothermal efficiency, volumetric efficiency and effect of clearance, Multi stage compression with inter cooling, saving work, Working of Rotary Compressors and comparison with reciprocating air compressors.

UNIT 4 STEAM NOZZLES AND STEAM TURBINES

9 Hrs.

Flow of steam through nozzles, Isentropic flow, ideal and actual expansion in nozzle, condition for maximum discharge, critical pressure ratio, Meta stable flow. Steam turbines, impulse and Reaction principles, Compounding, Velocity diagrams for impulse and reaction blades, Work done on turbine blades, optimization and efficiency.

UNIT 5 REFRIGERATION AND AIR CONDITIONING SYSTEMS

9 Hrs.

Bell Coleman and vapour compression refrigeration systems, Performance calculations, vapour absorption refrigeration system, Air conditioning systems and types, working principle-Estimation of cooling load.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

- CO1 - Demonstrate the different gas and vapour power cycles.
- CO2 - Evaluate the thermal performance and heat balance sheet of I.C. Engines
- CO3 - Identify the type of compressors based on different classifications.
- CO4 - Apply the steam tables with mollier chart to different conditions of steam
- CO5 - Calculate the minimum work requirement of reciprocating compressors.
- CO6 - Estimation of refrigeration system performance and cooling load for air conditioning systems.

TEXT / REFERENCE BOOKS

1. Rajput, R.K, Thermal Engineering, 10th Edition, Laxmi Publications, 2017.
2. Ajoy kumar, G.N. Sah, Thermal Engineering, 2nd Edition, Narosa Publications, 2010.
3. Ballaney, P.L., Thermal Engineering, 24th Edition, khanna Publishers, 2003.
4. Kothandaraman C.P., Khajuria P.R and Domkundwar.S., 4th Edition, A Course in Thermal Engineering. Dhanpat Raj & Sons, 2004.
5. Sarkar B.K, Thermal Engineering, McGraw Hill, 2004.
6. Sarao. A.S, Thermal Engineering, Satya Prakashan, New Delhi. 2004.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice each carrying 16 marks

80 Marks

Skill Development

SMEA1502	DESIGN OF MACHINE ELEMENTS (FOR MECH AND MECHATRONICS)	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- Y To understand the various procedures involved in the design process based on strength requirements.
- Y To understand the design steps involved in evaluating the dimensions of a component to satisfy functional operation.
- Y To learn standard practices and standard data by using design data book and catalogues.
- Y To familiarize the use of data books and various codes for practice.

UNIT 1 STATIC STRESSES AND VARIABLE STRESSES IN MACHINE COMPONENTS

9 Hrs.

Introduction to the design process- **factors influencing machine design**, selection of materials based on mechanical properties
 - Principal stresses for various load -Factor of safety-Theories of failure- design based on strength and stiffness- stress concentration-Design for Variable loading –Gerber line, Goodman's line, and Soderberg's Line.

UNIT 2 DESIGN OF SHAFTS AND COUPLINGS

9 Hrs.

Design of solid and hollow shafts based on strength and rigidity, Keys- different types of keys- Design Keys, keyways, failures of keys-Couplings - Rigid coupling- flexible coupling

UNIT 3 TEMPORARY AND PERMANENT JOINTS

9 Hrs.

Threaded fasteners- stress in screwed threads, **Bolted joints including eccentric loading**- **Design of knuckle and cotter joints**, **Welded joints**- merits and demerits of welded joints, Types of welded joints, weld symbols, Strength of parallel and fillet weld, strength of a welded joint , **eccentrically loaded welded joints**.

UNIT 4 DESIGN OF SPRINGS AND CONNECTING ROD

9 Hrs.

Functions of springs-applications- spring materials-Design of helical, Belleville springs (disc) and torsion spring–Design of Leaf Spring – Design of connecting rod.

UNIT 5 DESIGN OF BEARINGS FLYWHEELS

9 Hrs.

Introduction -Design of bearings - Sliding contact bearing – Design of journal bearings- Mckees equation- Lubrication in journal bearings -Rolling contact bearing (antifriction bearing). Types of fly wheels- Design of flywheels involving stresses in rim and arm.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Demonstrate and understand the various steps in design process.
- CO2 - Apply the design considerations on the basis of strength, rigidity and standardization.
- CO3 - Analyze and design bolted rivets, welded joints with respect to static and dynamic loads.
- CO4 - Apply the concept of energy absorbing members and connecting rod.
- CO5 - Analyze and apply the concept of bearings and flywheel.
- CO6 - Understand the various design process of machine parts.

TEXT / REFERENCE BOOKS

- Juvinall R.C. and Marshek K.M., "Fundamentals of Machine Component Design", John Wiley & Sons, 2002.
- Bhandari V.B, "Design of Machine Elements", Tata McGraw-Hill Book Co, 2003.
- Norton R.L, "Design of Machinery", Tata McGraw-Hill Book Co., 2004.
- Spotts M.F, Shoup T.E., "Design and Machine Elements", Pearson Education, 2004.
- Kannaiah, P., Machine Design, 2nd Edition, Scitech Publication Pvt. Ltd., 2009.
- Shigley, J.E and Mischke, C. R. Mechanical Engineering Design, 6th Edition, Tata McGraw Hill, 2005.
- Sundararajamoorthy, T.V. and Shanmugam, N., Machine Design, Anuradha Agencies, 2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks

80 Marks

Skill Development

SMEA1504	HEAT AND MASS TRANSFER	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- Y To learn the various modes of heat transfer and understand the basic concepts of mass transfer.
- Y To understand the applications of various experimental heat transfer correlations in engineering applications.
- Y To discuss the thermal analysis and sizing of heat exchangers.

UNIT 1 CONDUCTION

9 Hrs.

General Heat Conduction Equation- Cartesian, Polar and Spherical Co-ordinate Systems – One dimensional steady state heat conduction in simple geometries – Plane wall – Cylinder and sphere – Composite walls – Composite cylinders and spheres – Critical thickness of insulation – heat generation in plane wall, cylinder and sphere – extended surfaces - unsteady state heat conduction-Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts.

UNIT 2 CONVECTION

9 Hrs.

Free and Forced Convection – Hydrodynamic and Thermal Boundary Layer – Free and Forced Convection during external flow over Plates and Cylinders – Internal flow through tubes.

UNIT 3 RADIATION

9 Hrs.

Laws of radiation - Wien's, Rayleigh-Jeans' and Planck's laws, Hemispherical Emissive Power, Stefan-Boltzmann law for the total emissive power of a black body, Emissivity and Kirchhoff's Laws – Concept of Gray, White, Opaque, Transparent and Black body radiation – shape factor - radiation exchange between surfaces -Radiations resistance network - Radiation shields.

UNIT 4 PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGER

9 Hrs.

Boiling and condensation – pool boiling regimes and correlations – critical heat flux - flow boiling correlations - Nusselt's theory – filmwise and dropwise condensation - Condensation over surfaces. Heat Exchanger Types – Overall Heat Transfer Coefficient – Fouling Factors – Analysis – LMTD method – NTU method.

UNIT 5 MASS TRANSFER

9 Hrs.

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy –Convective Mass Transfer Correlations..

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the basic modes of heat transfer and Compute temperature distribution in steady-state and unsteady-state heat conduction.
- CO2 - Understand and analyze heat transfer through extended surfaces.
- CO3 - Interpret and analyse forced and free convection heat transfer.
- CO4 - Explore the real time applications of radiation mode of heat transfer.
- CO5 - Design heat exchangers using LMTD and NTU methods.
- CO6 - Relate the mass transfer concepts for various industrial applications.

TEXT / REFERENCE BOOKS

1. Incropera, F.P. and Dewitt, D.P., Fundamentals of Heat and Mass Transfer, 7th Edition, John Wiley, 2011.
2. Holman, J.P., Heat Transfer, 10th Edition, Tata McGraw-Hill, 2010.
3. Ozisik, M.N., Heat Transfer - A Basic Approach, McGraw-Hill, 1985.
4. Cengel, Y.A., Heat Transfer - A Practical Approach, 2nd Edition, McGraw-Hill, 2002.
5. Sachedva, R.C., Fundamentals of Heat and Mass Transfer, 4th Edition, New Age International, 2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

Skill Development

SMEA1602	GAS DYNAMICS AND JET PROPULSION (Use of approved gas tables is permitted)	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- Y To discuss the concepts of compressible and incompressible fluids.
- Y To understand Mach number variation on area ratio.
- Y To impart in depth knowledge on the flow characteristics through constant area duct.

UNIT 1 FUNDAMENTALS OF COMPRESSIBLE FLUID FLOW

9 Hrs.

Concept of compressible flow, Energy and momentum equations, various regions of flow, fluid velocity, stagnation state, velocity of sound, critical states, Mach number, critical mach number, Crocco number, types of waves, mach cone, mach angle, effect of mach number on compressibility.

UNIT 2 FLOW THROUGH VARIABLE AREA DUCTS

9 Hrs.

Isentropic flow through variable area duct, T-S and h-s diagrams for nozzle and diffuser flows, area ratio as a function of Mach number, Mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles.

UNIT 3 FANNO FLOW AND RAYLEIGH FLOW

9 Hrs.

Flow in constant area duct with friction - Fanno curves, and Fanno Flow equations, variation of flow properties, variation of Mach number with duct length. Flow in constant area duct with heat transfer, Rayleigh line and Rayleigh flow equations, variation of flow properties, maximum heat transfer.

UNIT 4 NORMAL SHOCK AND OBLIQUE SHOCKS

9 Hrs.

Governing equations, variation of flow parameters, static pressure, static temperature, density, stagnation pressure, entropy across normal shock and oblique shocks. Normal shocks - stationary and moving, applications. Prandtl Meyer equation, impossibility of shock in sub-sonic flows, flow in convergent and divergent nozzles with shock, Flows with oblique shock.

UNIT 5 JET AND SPACE PROPULSION

9 Hrs.

Aircraft propulsion, types and working of jet engines - energy transfer in jet engines, thrust, thrust power, propulsive and overall efficiencies, thrust augmentations in turbo jet engines, ram jet and pulse jet engines. Rocket propulsion, types of rocket engines, Liquid and solid fuel rocket engines, Introduction to Electrical and Nuclear rockets-Space Flights, Orbital and escape velocity.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Recall the fundamental concepts of compressible fluid flow.
- CO2 - Demonstrate the significance of mach number on compressibility
- CO3 - Differentiate isothermal flow and isentropic flow.
- CO4 - Apply the concept of normal shocks to different turbo machines.
- CO5 - Estimate the heat transfer in flow through constant area ducts.
- CO6 - Calculate the propulsive power in jet engines.

TEXT / REFERENCE BOOKS

- Yahya S.M., "Fundamental of Compressible flow", New Age International (P) Ltd., New Delhi, 2003.
- Cohen H., Rogers R.E.C. and Sravanamuttoo, "Gas Turbine Theory", Addison Wesley Ltd., 2001.
- Hill D. and Peterson C., "Mechanics & Thermodynamics of Propulsion", Addison Wesley, 1992.
- Ganesan V., "Gas Turbines", Tata McGraw Hill Publishing Company, New Delhi. 1999.
- Sutton G.P., "Rocket Propulsion Elements", John Wiley, New York, 1975.
- J.D. Anderson, Modern compressible flow, McGraw-Hill Education; 3rd Edition, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice each carrying 16 marks

80 Marks

SMEA1701	AUTOMOBILE ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Y To understand the concepts of various components of an automobile.
- Y To learn about the working principle of various automotive components.
- Y To learn about advancements in electrical and hybrid vehicles.

UNIT 1 INTRODUCTION

9 Hrs.

Automobile history and development, classifications, vehicle layout-engine location and drive arrangement, Safety regulations, specifications of vehicles, chassis types, constructional details, frames, sub frames, frameless vehicles, vehicle dimensions, details of chassis material, Engine Components: Cylinder – piston – connecting rod - functions and materials, emissions from automobiles, pollution standards – National and International-pollution control techniques.

UNIT 2 CLUTCHES AND TRANSMISSION

9 Hrs.

Clutches: Classification of clutches, single plate, multi plate, cone diaphragm spring, centrifugal, clutch materials, Electromagnetic, vacuum operated, Necessity of gear box, manual gear box – constant mesh, Synchromesh, Transmission System: Geared automatic transmission, epicycle, continuous variable transmission, Electronic transmission control, overdrive, propeller shaft, constant velocity joint, differential and final drive, non-slip differential, Cruise system.

UNIT 3 FRONT AXLE, STEERING SYSTEM, REAR AXLE, WHEEL AND TYRES

9 Hrs.

Purpose and requirement front axle, Steering System: steering geometry- castor, camber, king pin inclination, toe-in, toe out, center point steering; types of steering mechanism, steering linkages, power steering, Axle: Universal joint - Live and dead axles, live axle arrangement, wheel construction, alloy wheel, wheel alignment and balancing, types of tyres, tyre construction, thread design.

UNIT 4 SUSPENSION SYSTEM AND BRAKES

9 Hrs.

Suspension system: Objects and principles of suspension system, types, rigid axle and independent suspension for front and rear ends, leaf spring, torsion bar, shock absorber Brakes: Types of brake systems-drum, disc, operation-mechanical, hydraulic, air brakes, servo and power braking, ABS.

UNIT 5 ELECTRICAL SYSTEM

9 Hrs.

Battery: Classification of batteries, battery construction, maintenance, testing and charging, cutout, lighting circuit, horn, indicators, sprays, wipers, starting system, instruments, sensors and actuators, electric control unit, electric stability program, traction control devices, electrical car layout, Electric and Hybrid Vehicles.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Analyze the chassis and engine for various vehicles.
- CO2 - Understand the various clutches and transmission system.
- CO3 - Identify the problems in axle and steering system.
- CO4 - Learn about suspension system and brakes.
- CO5 - Recall the concepts of Electrical system of an automobile.
- CO6 - Understand the recent advancements in automobiles.

TEXT / REFERENCE BOOKS

- Kirpal Singh, "Automobile Engineering Vol 1 and 2 " 12th Edition Standard Publishers 2015.
- Banga T.R. & Nathu Singh, "Automobile Engineering" 3rd Edition Khanna Publications. 2012.
- Rajput R.K. "A Text-Book of Automobile Engineering", Laxmi Publications Private Limited, 2015.
- Heldt.P.M. Automotive Chassis, 3rd Edition Chilton Co. Publications, New York, 2012.
- Heinz heisler "Advanced vehicle technology" 2nd Edition Edward Arnold publication 2002.
- Heitner, J. Automotive Mechanics Principle and Practice, 2nd Edition, Affiliated East-West Press Ltd., 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each – No choice

20 Marks

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks

80 Marks

SMEA1702	INDUSTRIALMECHATRONICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Y To enable the student to understand the modern mechatronics components.
- Y To present the underlying principles and alternatives for mechatronics systems design.
- Y To provide the student with the opportunity for hands-on experience with the related components of the technology for diverse domains of application.

UNIT 1 MECHATRONICS, SENSORS AND TRANSDUCERS

10 Hrs.

Introduction to **Mechatronics Systems** – Key elements, Information systems, Real time interfacing, Elements of data acquisition system - sequential controllers-Block diagram of Washing Machine-Sensors and Transducers – Performance Terminology – Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Range sensors, Light Sensors, Humidity, Vibration. Special transducers - Piezoelectric transducer - Magnetostrictive transducer - Shape memory alloy (SMA) transducer. – Selection of Sensors.

UNIT 2 SIGNAL CONDITIONING&8085 MICROPROCESSOR

8 Hrs.

Signal Conditioning – Analogue to Digital Convertor – Digital to Analogue Convertor- Multiplexer – De multiplexer – Interfacing Concepts – Temperature Control - Architecture of 8085 micro processor – pin configuration – addressing modes – instruction sets – timing diagram - block diagrams.

UNIT 3 SYSTEM MODELS AND CONTROLLERS

10 Hrs.

Building blocks of Mechanical, Electrical, Fluid and Thermal Systems. Rotational – Translational Systems, Electromechanical Systems – Hydraulic – Mechanical Systems. Continuous and discrete process Controllers – Control Mode – Two Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers – Digital Controllers – Velocity Control – Adaptive Control.

UNIT 4 PROGRAMMING LOGIC CONTROLLERS

9 Hrs.

PLC: Introduction to the **design and mode of operation of programmable logic control (PLC)** – Basic Structure – Input / Output Processing – Programming –Ladder programming-Cylinder sequencing problems- sequence charts- Mnemonics – Timers, Internal relays and counters – Shift Registers – Master and Jump Controls – Data Handling – Analog Input / Output – Selection of a PLC.

UNIT 5 DESIGN OF MECHATRONICS SYSTEM

8 Hrs.

Introduction to MEMS, Micro sensors in mechatronics, Sensors for condition monitoring, Artificial intelligence in mechatronics, Stages in designing Mechatronics Systems – Traditional and Mechatronic Design Possible Design Solutions. Case studies of Mechatronics systems- Pick and place Robot- piece counting system, **Autonomous mobile robot-Wireless surveillance balloon- Engine Management system- Automatic car park barrier.**

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Describe the basic concepts of Mechatronic system and sensors.
- CO2 - Implement interfacing concepts using 8085 microprocessors and Signal Conditioning.
- CO3 - Analyze and design System models and controllers.
- CO4 - Design Ladder programming and PLC interfacing.
- CO5 - Understand the Mechatronics design stages and possible design solutions.
- CO6 - Design the Mechatronics systems through case studies.

TEXT / REFERENCE BOOKS

1. Bolton, "Mechatronics", Pearson education, 2nd Edition, fifth Indian Reprint, 2003.
2. Smaili.A and Mrad.F, "Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008
3. Rajput. R.K, A textbook of mechatronics, S. Chand & Co, 2007.
4. Michael B. Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 2000.
5. Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, "Mechatronics", Chapman and Hall, 1993.
6. Dan Neculescu, "Mechatronics", Pearson Education Asia, 2002 (Indian Reprint).
7. HMT, Mechatronics, Tata McGraw-Hill Publishing Company Ltd., New Delhi 2004.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each – No choice

20 Marks

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks

80 Marks

SMEA3002	ADVANCED INTERNAL COMBUSTION ENGINES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the underlying principles of operation of different IC engines and components.
- To provide knowledge on emission formation, control, alternate fuel etc.

UNIT 1 INTRODUCTION TO I.C ENGINES

9 Hrs.

Classification of IC engines - based on fuel, working cycle, method of fuel supply - Ignition and Governing - Scavenging of two stroke engines. Fuel – air cycles and actual air cycles and their analysis. Combustion of fuels-Rating of fuels – composition of petrol and diesel fuels - importance Of valve and port timing diagrams.

UNIT 2 SPARK IGNITION ENGINES

9 Hrs.

Carburetion-mixture strength requirements. Simple carburetor -limitations, compensating arrangements. Gasoline injection systems. Flame speed-effect of turbulence and other parameters. Combustion in SI Engines-Combustion Chambers, Factors controlling combustion chamber design, stages of combustion, Fuel requirements, knock ratings - Auto ignition and Pre ignition.

UNIT 3 COMPRESSION IGNITION ENGINES

9 Hrs.

Diesel Fuel injection system, MPFI&CRDI, Function of components, jerk type pump, Distributor pump. Mechanical and pneumatic Governor, Fuel injector, Types of nozzle, importance of swirl, squish, Turbulence air motion, Combustion in CI Engines-Stages of combustion, Combustion Chambers, Factors controlling combustion chamber design, Factors affecting ignition delay, knock in CI Engines, variables affecting knocking.

UNIT4 ENGINE EMISSIONS

9 Hrs.

Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction and Particulate Traps – Methods of measurement – EURO and BHARAT emission norms.

UNIT 5 MODERN DEVELOPMENTS AND ALTERNATE FUELS

9 Hrs.

Modern developments - Wankel engine. Stratified charge engine. Dual-fuel engines. HCCI concept. Alternate Fuels For IC Engines - Need for use of alternate fuels - Use of alcohol fuels – Biodiesel - Biogas and Hydrogen in engines.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Gain the knowledge of working and performance of IC Engines through thermodynamic cycles.
- CO2 - Describe the combustion phenomena in SI engines.
- CO3 - Understand combustion phenomena CI engines and factors influencing combustion chamber design.
- CO4 - Outline emission formation mechanism of IC engines, its effects and the legislation standards.
- CO5 - Recall the working principles of instrumentation used for engine performance and emission parameters.
- CO6 - Analyze the latest developments in IC Engines and alternate fuels.

TEXT / REFERENCE BOOKS

1. Ganesan,V., Internal Combustion Engines, McGraw Hill, 4th Edition, 2012.
2. Mathur, M.L., and Sharma, R.P., A Course in Internal Combustion Engines, Dhanpat Rai and Sons, 2014.
3. John Heywood, Internal Combustion Engine Fundamentals, McGraw Hill, 2011.
4. Ramalingam. K.K., "Internal Combustion Engine Fundamentals", Scitech Publications, 2011.
5. R.K. Rajput, A textbook of Internal Combustion Engines, Laxmi Publications, 3rd Edition, 2016.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each – No choice

20 Marks

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks

80 Marks

Skill Development

SMEA3003	COMPUTATIONAL FLUID DYNAMICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Y To understand the various discretization techniques and solving solution methodologies.
- Y To understand the Navier stroke equation for different flow field.
- Y To learn the different grid generation methods.
- Y To understand the fluid flow and heat transfer problems and its applications.

UNIT 1 INTRODUCTION

9 Hrs.

Historical Background-One dimensional Computations -Finite Difference Methods-Finite Element Methods - Finite Volume Methods, Neumann Conditions, Dirichlet Boundary Conditions -Governing Equations-Classification of Partial Differential Equations- Introduction to Navier-Stokes System of Equations, Comparison of numerical, analytical and experimental.

UNIT 2 FINITE DIFFERENCE METHODS AND SOLUTIONS

9 Hrs.

Simple Methods -General Methods -Higher Order Derivatives- Multidimensional Finite Difference Formulas - Mixed Derivatives -Non uniform Mesh- Higher Order Accuracy Schemes- Accuracy of Finite Difference Solutions-Elliptic Equations- Parabolic Equations- Hyperbolic Equations- Burgers' Equation- Coordinate Transformation for Arbitrary Geometries.

UNIT 3 INCOMPRESSIBLE VISCOUS FLOWS AND COMPRESSIBLE FLOWS

9 Hrs.

Artificial Compressibility Method - Pressure Correction Methods -Semi-Implicit Method for Pressure-Linked Equations - Pressure Implicit with Splitting of Operators -Marker-and-Cell Method -Vortex Methods -Potential Equation-Euler Equations- Central Schemes with Combined Space and Independent Space-Explicit Schemes-Implicit Schemes-PISO Scheme for Compressible Flows-Finite Difference Volume Equations.

UNIT 4 STRUCTURED AND UNSTRUCTURED GRID GENERATION

9 Hrs.

Algebraic Methods- PDE Mapping Methods- Unidirectional Interpolation- Multidirectional Interpolation-Domain Vertex Method- Transfinite Interpolation Methods - PDE Mapping Methods- Control Functions-Hyperbolic Grid Generator- Multiblock Structured Grid Generation- Delaunay-Voronoi Methods- Advancing Front Methods- Three-Dimensional Applications- DVM in 3D- AFM in 3-D.

UNIT 5 COMPUTING TECHNIQUES AND APPLICATION

9 Hrs.

Domain Decomposition Methods- Multigrid Methods- Parallel Processing- Turbulence Models- Zero-Equation Models- One-Equation Models -Two-Equation Models -Second Order Closure Models (Reynolds Stress Models) - Algebraic Reynolds Stress Models -Compressibility Effects- Direct Numerical Simulation- RANS- LES.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the different methods used for heat transfer problems and the numerical errors associated with the first order and second order.
- CO2 - Derive discretization equation using finite difference methods for heat transfer application.
- CO3 - Derive compressible and incompressible equation for fluid flow problems.
- CO4 - Generate the grid required in the computational domain for solving the Navier-stroke equation.
- CO5 - Describe the various computing models and application.
- CO6 - Apply the knowledge gained in various heat transfer and fluid flow problems.

TEXT / REFERENCE BOOKS

- Chung T.J, "Computational fluid dynamics", Cambridge University press, 2nd Edition, 2010.
- Suhas V Patankar, "Numerical Heat Transfer and Fluid Flow", Taylor and Francis, 2nd Edition, 2017.
- M. Ramakrishna, "Elements of Computational Fluid Dynamics", Golden Jubilee Publication, 2011.
- Anderson.J.D. "Computational Fluid Dynamics: An Introduction", 3rd Edition, 2009.
- Versteeg, H.K, and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The Finite Volume Method", Longman, 2nd Edition, 2007.
- Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2nd Edition 2014.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each – No choice

20 Marks

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks

80 Marks

SMEA3008	COMPOSITE MATERIALS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Y To provide the fundamental knowledge about the composite materials, the classification, advantage and limitations.
- Y To provide the technical information about the properties, applications and manufacturing methods of metallic, ceramic and polymeric composites.
- Y To provide the material selection details of composite materials for a variety of applications.

UNIT 1 FUNDAMENTALS OF COMPOSITES

9 Hrs.

Need for composites, Role of matrix and fiber reinforcement, Rule of mixtures, Benefits of composites, Classification of composites. Fiber types, Forms of reinforcements, Fiber-matrix compatibility, Effect of reinforcements, Commercial fibers, Fiber extraction of commercial synthetic and natural fibers.

UNIT 2 METALLIC COMPOSITES

9 Hrs.

Engineering metallic materials, Popular MMCs, Composition, Properties, Advantages, Limitations and Applications. Fabrication Methods, such as Powder metallurgy, Slurry casting, Spray deposition and infiltration.

UNIT 3 CERAMIC COMPOSITES

9 Hrs.

Engineering ceramic materials, Popular CMCs, Composition, Properties, Advantages, Limitations and Applications. Fabrication Methods, such as Sintering, Hot pressing, Cold isostatic pressing, and Hot isostatic pressing.

UNIT 4 POLYMERIC COMPOSITES

9 Hrs.

Engineering polymeric materials, Popular PMCs, Composition, Properties, Advantages, Limitations and Applications. Fabrication Methods, such as Layup processes Filament winding, Liquid molding, Resin film infusion, Pultrusion, Thermoforming, Injection moulding.

UNIT 5 MODERN COMPOSITES AND SELECTION

9 Hrs.

Recent trends of composite materials, such as nanocomposites, green composites, biocompatible composites, etc. Selection of composites: Factors affecting the selection of composites, measurement of properties, mechanical, electrical and thermal properties of composites, selection of composites for tailor-made applications. Case studies related to selection of composite materials for a variety of applications, such as aerospace, automobile, packaging, structures, etc.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the fundamental knowledge about the composite materials, the classification, advantage and limitations.
- CO2 - Compare the technical information about the properties, applications and manufacturing methods of metallic composites.
- CO3 - Compare the technical information about the properties, applications and manufacturing methods of ceramic composites.
- CO4 - Compare the technical information about the properties, applications and manufacturing methods of polymeric composites.
- CO5 - Examine the technical information about the recent trends in the field of composites.
- CO6 - Choose the suitable composite materials for a variety of applications.

TEXT / REFERENCE BOOKS

1. F.C. Campbell, "Structural Composite Materials", ASM International, 2010, 612 pages.
2. Ever J. Barbero, "Introduction to Composite Materials Design", 3rd Edition, CRC Press, 2017, 534 pages.
3. Frank L. Matthews, R D Rawlings, "Composite Materials: Engineering and Science", CRC Press, 1999, 480 pages.
4. P.K. Mallick, "Fiber-Reinforced Composites: Materials, Manufacturing, and Design", 3rd Edition, CRC Press, 2007, 638 pages.
5. Navinchandra Gopal Shimpi, "Biodegradable and Biocompatible Polymer Composites: Processing, Properties and Applications", Woodhead Publishing, 2017, 438 pages.

Skill Development

SPRA5201	MECHANICAL BEHAVIOUR OF ENGINEERING MATERIALS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Y To structure of material over the effects of mechanical properties Comprehension of the defects inside.
- Y To structure and their effects on the mechanical properties Comprehension of the failure mechanisms.
- Y To description of the physical mechanisms and/or mechanical behaviour of monocrystals and polycrystals under plastic deformation.

UNIT 1 STRUCTURE OF SOLID MATERIAL & MECHANICAL BEHAVIOUR

9 Hrs.

Structure of metals: Point, line and surface imperfection, relationship between structure and properties, theory of dislocations, strengthening mechanisms. Mechanical properties: Strength, hardness, toughness, ductility, stress-strain relationship, strains, true strains, strain hardening.

UNIT 2 STATIC MECHANICAL BEHAVIOUR FOR MULTIAXIAL STRESSES

9 Hrs.

Stresses, Strains and Strain Energy for Combined Stresses, Theories of Strength, Application to Design.

UNIT 3 FATIGUE BEHAVIOR

9 Hrs.

Introduction to fatigue. Characteristics and theories of fatigue failures. Fatigue testing machines, specimens, test procedures, method of presenting data, statistical analysis of fatigue results, structural changes accompanying fatigue, factors affecting fatigue strength. Low cycle fatigue phenomenon, difference between low and high cycle fatigues, parameters influencing low cycle fatigue behavior. Cumulative fatigue damage, Effect of mean stress, combined stress fatigue, corrosion fatigue - current trends in fatigue testing.

UNIT 4 CREEP

9 Hrs.

Introduction to creep - creep mechanisms, creep curve – Relaxation - Parameters influencing creep - metallurgical factors affecting creep, high temperature alloys, stress rupture testing, Qualitative study of creep in tension, bending, torsion, buckling and combined stress.

UNIT 5 FRACTURE

9 Hrs.

Linear elastic fracture mechanics, Griffith theory, Irwin- Orowan theory, ductile to brittle transition, fracture toughness, different modes of crack extension, concept of stress intensity factor, analysis of some typical crack problems, non-linear fracture on crack extension, concept of modified stress intensity factor, crack opening displacement and J- integrals, Fracture Resistance of Materials, Application of Fracture mechanics.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understanding of the mechanical properties and behaviour of materials.
- CO2 - Know the behavior of multi axial stress on materials.
- CO3 - Describe the fatigue phenomena of material and recent trends in fatigue testing.
- CO4 - Understand the linear elastic fracture mechanics and estimate the effects of cracks in material and structure.
- CO5 - Identify engineering problem in using plastic deformation, fatigue, fracture and creep.
- CO6 - Study the fracture resistance of materials and crack displacement.

TEXT / REFERENCE BOOKS

1. Joseph Marin. "Mechanical behavior of engineering materials", prentice – Hall of India Pvt. Ltd.,1966.
2. Kennedy, A.J., "Process of Creep and Fatigue of Metals", Industrial Press,1958.
3. Forrest, P.G., "Fatigue of Metals", Pregaman Press, 1961.
4. Knott, J.F., "Fundamentals of fracture mechanics ", Worths, 1979.
5. Fracture Mechanics Application - T. L. Anderson, CRC Press 1998.
6. Mechanical Metallurgy, GE Dieter, McGraw-Hill, 1961.
7. Mechanical Behavior of Materials, by William F. Hosford; Cambridge; Cambridge University Press, New York, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration : 3 Hrs.

PART A: 5 Questions of 6 marks each – No choice

30 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 14marks

70 Marks

SPRA5202	ADVANCED VIBRATIONS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand theoretically the various systems of vibration.
- To understand the practical approaches of different vibration systems.

UNIT 1 FUNDAMENTALS OF VIBRATION

9 Hrs.

Introduction -Sources of Vibration-Mathematical Models- Displacement, velocity and Acceleration-Introduction to Single Degree of Freedom Systems: Free, Forced, Damped and Undamped systems. Two Degree Freedom System: Free, Damped and Undamped systems -Forced Vibration with Harmonic Excitation System – Coordinate Couplings and Principal Coordinates.

UNIT 2 MULTI-DEGREE OF FREEDOM SYSTEMS

9 Hrs.

Introduction - Modeling of Continuous Systems as Multidegree of Freedom Systems - Using Newton's Second Law to Derive Equations of Motion- Influence Coefficients – Based on Stiffness, Flexibility and Inertia – Eigen value Problem and its solution - Free and Forced Vibration of Un damped Systems Using Modal Analysis-Forced Vibration of Viscously Damped Systems - Self-Excitation and Stability Analysis.

UNIT 3 CONTINUOUS SYSTEMS

9 Hrs.

Introduction - Transverse Vibration of a String or Cable and their Equations of Motion -Initial and Boundary Conditions - Free Vibration of a Uniform String-Free Vibration of a String with Both Ends Fixed -Longitudinal Vibration of a Bar or Rod - Equation of Motion and Solution - Orthogonality of Normal Functions.

UNIT 4 VIBRATION CONTROL

9 Hrs.

Introduction - Vibration Nomograph and Vibration Criteria - Reduction of Vibration at the Source - Balancing of Rotating Machines- Single-Plane Balancing - Two-Plane Balancing - Whirling of Rotating Shafts-Equations of Motion-Critical Speeds-Response of the System - Stability Analysis - Control of Vibration- Control of Natural Frequencies-Introduction of Damping - Vibration Isolation - Vibration Isolation System with Rigid Foundation , Base Motion and Flexible Foundation- Vibration Absorbers – Damped and Un damped Dynamic Vibration Absorber.

UNIT 5 VIBRATION MEASUREMENT AND APPLICATIONS

9 Hrs.

Introduction- Transducers - Piezoelectric Transducers- Electrodynamic Transducers - Linear Variable Differential Transformer Transducer- Vibration Pickups -Vibrometer -Accelerometer - Frequency-Measuring Instruments - Vibration Exciters -Mechanical Exciters -Electrodynamic Shaker - Signal Analysis - Spectrum Analyzers - Experimental Modal Analysis -Determination of Modal Data from Observed Peaks- Determination of Modal Data from Nyquist Plot - Measurement of Mode Shapes- Machine Condition Monitoring and Diagnosis - Machine Maintenance Techniques -Machine Condition Monitoring Techniques -Vibration Monitoring Techniques.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - To study the fundamentals of free and forced vibration with damped and undamped vibrations.
- CO2 - To analyze the mathematical modeling of the two degrees of freedom systems and explain about the working principle of vibration absorber.
- CO3 - To describe the vibration measurement by using transducers and vibration exciters.
- CO4 - To analyze the vibration control technique and vibration absorbers.
- CO5 - To study and analyze the various instruments used to measure the vibrations.
- CO6 - To monitor the vibration analysis technique, Condition Monitoring and Diagnosis.

TEXT / REFERENCE BOOKS

1. Rao S.S., "Mechanical Vibrations", 4th Edition, Pearson Education Inc., 2004.
2. G.K. Grover, "Mechanical Vibrations", Nemchand & Bros, Roorkee, 8th Edition, 2009.
3. William T Thomson & Marie Dillon Dahleh, "Theory of Vibrations with application", 5th Edition, Pearson Edition. Publication, 2007.
4. Tse, Morse and Hinkel, "Mechanical Vibrations", Chapman and Hall, 1991.
5. Den Hartog J.P., "Mechanical Vibrations", McGraw Hill, 1986.
6. V.P.Singh, "Mechanical vibrations", 3th Edition, Dhanpat Rai & Co., 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100

PART A: 5 Questions of 6 marks each – No choice

PART B: 2 Questions from each unit of internal choice; each carrying 14marks

Exam Duration: 3 Hrs.

30 Marks

70 Marks

Skill Development