



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

- Bansal R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 5th Edition, 2012.
- Punmia B.C. & Jain A.K., Mechanics of Materials, Laxmi Publications, 2001.
- Ryder G.H., "Strength of Materials, Macmillan India Ltd", 3rd Edition, 2002.
- Ray Hulse, Keith Sherwin & Jack Cain, "Solid Mechanics", Palgrave ANE Books, 2004.
- 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

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

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

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, Swam 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

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

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

Exam Duration : 3 Hrs.

22 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

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

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

- Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2010.
- Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
- Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 4th Edition, Prentice Hall College Div, 1997.
- Rao, S.S., "The Finite Element Method in Engineering", 4th Edition, Butterworth Heinemann, 2005.
- 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

SMEA3011	DESIGN OF JIGS, FIXTURES AND PRESS TOOLS	L	T	P	Credits	Total Marks
		3	0	0	3	100

OBJECTIVES:

- To understand the functions and design principles of Jigs, fixtures and press tools
- To gain proficiency in the development of required views of the final design.

UNIT I LOCATING AND CLAMPING PRINCIPLES

9

Objectives of tool design- Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location – Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation – Standard parts – Drill bushes and Jig buttons – Tolerances and materials used.

UNIT II JIGS AND FIXTURES

9

Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.

UNIT III PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES

9

Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

UNIT IV BENDING AND DRAWING DIES

9

Difference between bending and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads- ironing – Design and development of bending, forming, drawing, reverse redrawing and combination dies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double action dies.

UNIT V FORMING TECHNIQUES AND EVALUATION

9

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design- computer Aids for sheet metal forming Analysis – basic introduction - tooling for numerically controlled machines- setup reduction for work holding – Single minute exchange of dies – Poka Yoke.

TOTAL: 45 PERIODS

Note: (Use of P S G Design Data Book is permitted in the University examination)

OUTCOMES:

Upon the completion of this course the students will be able to

- CO1 Summarize the different methods of Locating Jigs and Fixtures and Clamping principles
- CO2 Design and develop jigs and fixtures for given component
- CO3 Discuss the press working terminologies and elements of cutting dies
- CO4 Distinguish between Bending and Drawing dies.
- CO5 Discuss the different types of forming techniques

TEXT BOOKS:

- Joshi, P.H. "Jigs and Fixtures", Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2010.
- Joshi P.H "Press tools - Design and Construction", wheels publishing, 1996

REFERENCES:

- ASTME Fundamentals of Tool Design Prentice Hall of India.
- Design Data Hand Book, PSG College of Technology, Coimbatore.
- Donaldson, Lecain and Goold "Tool Design", 5th Edition, Tata McGraw Hill, 2017.
- Hoffman "Jigs and Fixture Design", Thomson Delmar Learning, Singapore, 2004.

END SEMESTER EXAM 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

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

1. Bhavikatti S.S., Engineering Mechanics, 1st Edition, New Age International publishers, 2017.
2. Bansal R.K., A Textbook of Engineering Mechanics, 4th Edition, Laxmi Publications, 2002.
3. Bedi D.S., Engineering Mechanics, 1st Edition, Khanna Publishing Co. (P) Ltd, 2013.
4. Khurmi R.S. and Khurmi N, Engineering Mechanics, S.Chand Publishing, 2018.
5. Beer & Johnston, "Vector Mechanics for engineers - Vol I & II", 9th Edition, Tata McGraw Hill, 2010.
6. 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

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

1. Kirpal Singh, "Automobile Engineering Vol 1 and 2" 12th Edition Standard Publishers 2015.
2. Banga T.R. & Nathu Singh, "Automobile Engineering" 3rd Edition Khanna Publications, 2012.
3. Rajput R.K. "A Text-Book of Automobile Engineering", Laxmi Publications Private Limited, 2015.
4. Heldt.P.M. Automotive Chassis, 3rd Edition Chilton Co. Publications, New York, 2012.
5. Heinz heisler "Advanced vehicle technology" 2nd Edition Edward Arnold publication 2002.
6. 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. Histan 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

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

SCIA4001	DISASTER MANAGEMENT	L	T	P	Credits	Total Marks
		3	0	0	3	100

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS

9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR)

9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority (SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT

9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA

9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness), Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS

9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

TEXT BOOKS:

1. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
2. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IAS and Sage Publishers, New Delhi, 2010.
3. Singhal J.P. "Disaster Management", Laxmi Publications, 2010, ISBN-10: 9380386427 ISBN-13: 978-9380386423
4. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012, ISBN-10: 1259007367, ISBN-13: 978-1259007361]

REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy, 2009.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100
Hrs.

Exam Duration: 3

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