

SMEA2101	COMPUTER AIDED DESIGN LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To gain practical experience in engineering modeling through computer aided systems.
- To understand the functioning of 2D drafting and 3D modeling software systems.

INTRODUCTION TO CAD

Basics, Fundamentals of feature-based modeling

TWO DIMENSIONAL OBJECTS

Create basic drawing objects: Points, Lines, Circles, Arcs, Planes and their combinations.

Layout and sketching

Setup a drawing with correct scales. Draw with precision using Coordinate input and object Snaps,

Isometric drawings, Orthographic projections, Auxiliary views.

Dimensioning, Dimension styles

Various other AutoCAD commands and relevant keyboard shortcuts

THREE DIMENSIONAL OBJECTS

Creating and editing 3D solid objects.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the fundamentals of computer aided design.

CO2 - Implement their knowledge in designing a model.

CO3 - Understand the various limits and tolerances.

CO4 - Understand various dimensioning styles.

CO5 - Implement their knowledge to model various 2D and 3D models.

CO6 - Understand various commands and keyboard shortcuts for faster modelling skills.

SAUA1201	MATERIALS AND MESEAUUREMENTS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the design, selection and processing of materials for a wide range of applications in engineering and other applications
- To understand how and why the properties of materials are controlled by structure and bonding at the atomic scale and by features at the microscopic and macroscopic levels.
- To understand how and why the structure and properties of a material may be controlled by processing.
- To understand the basic principles of measurements
- To learn the various linear and angular measuring equipments, their principle of operation and applications.

UNIT 1 INTRODUCTION TO MATERIALS**9 Hrs.**

Basic Principles: Crystal structure: BCC -FCC -HCP -Methods to determine crystal structure - Atomic radius - Atomic Packing Factor - Allotropy -Solid solutions, Intermetallic compounds, Atomic Diffusion - Laws of diffusion -Factors affecting diffusion. Phase diagrams: Solidification of metals, phase rules, construction of phase diagram, Isomorphous diagram, Eutectic diagram showing partial solid solubility, Peritectic system.

UNIT 2 FERROUS AND NON – FERROUS ALLOYS**9 Hrs.**

Iron - Iron carbide equilibrium diagram, Cooling curves of pure Fe, Critical points in Fe - Fe₃C equilibrium diagrams, Steels – types of plain carbon steels, stainless steels - their typical compositions, properties and applications, effects of alloying elements on steel, IS designation of steels - Cast iron and its types - their typical compositions, properties and applications. Aluminium and its alloys, Ti & its alloys, Nickel & its alloys - Composition, Properties & applications.

UNIT 3 HEAT TREATMENT OF STEEL**9 Hrs.**

Annealing - Full annealing - Stress relief - Recrystallization - Spheroidizing, Normalizing, Hardening, Tempering, Austempering, Martempering - Hardenability and its determination, TTT diagram and CCT diagram. Case hardening techniques - Carburizing, Nitriding, Cyaniding, Carbonitriding, Flame and Induction hardening, Agehardening, Precipitation hardening

UNIT 4 INTRODUCTION TO METROLOGY AND LINEAR MEASUREMENT**9 Hrs.**

Accuracy, precision, resolution and sensitivity of measuring instruments, classification of errors in measurements, alignment errors. Linear Measuring Instruments - Evolution - Types - Classification - gauge design - concepts of interchangeability and selective assembly - Comparators, slip gauges - Types - Angular measuring instruments - Sine bar, angle gauges, autocollimator, angle dekkor, tool maker's microscope, Bevel protractor, clinometers, spirit levels- Alignment telescope - Applications, Surface roughness measurement.

UNIT 5 TEMPERATURE, FLOW AND ADVANCED MEASUREMENT TECHNIQUES**9 Hrs.**

Temperature - thermo couple, RTD, thermistor-electrical resistance thermometer- pyrometers. Flow - Turbine type flow meter, magnetic flow meter, ultra sonic flow meter, thermalflow meter and hot wire anemometer. : Venturimeter, Orifice meter, Rotameter, Pitot tube - Temperature: bimetallic strip. Interferometry - laser interferometers - types - applications - Computer Aided Inspection-Basic concept of Coordinate Measuring Machines(CMM)- Types of CMM - Constructional features-Probes- laser interferometer, 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 - Acquire knowledge of physical and mechanical properties of materials including heat treatment, destructive and non-destructive testing of materials.
- CO2 - Recognize and state the Iron-Carbide phase diagram and TTT Diagrams sufficiently to visualize them in discussions of heat treatment of steels and cast irons.
- CO3 - Select appropriate materials for specific engineering applications considering manufacturing and working conditions
- CO4 - Describe structures of metallic materials and their effects on mechanical properties
- CO5 - Understand the significance of measurement system, errors.
- CO6 - Check alignment of various components in various mechanisms using advanced measurement tools.

TEXT / REFERENCE BOOKS

1. Avener S.H, "Introduction to Physical Metallurgy", 2nd Edition, McGraw Hill, Indian Edition, 2017.
2. Raghavan V, "Material Science and Engineering", 5th Edition, Prentice Hall, 2005.
3. William D Callister "Material Science and Engineering", John Wiley and Sons 2007.
4. Khurmi.R.S, Sedha R.S, "Material Science", 4th Edition, S.Chand & Co., 2009
5. Dieter.G.E, "Mechanical Metallurgy", 3rd Edition, McGraw Hill, 1988.
6. Beckwith T.G. and Marangoni, "Mechanical Measurements", Addison Wesley, 2000.
7. Gupta I C, "Text Book of Engineering Metrology", Dhanpat Rai Publishers, 2003.
8. Jain R.K., "Engineering Metrology", Khanna Publishers, 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**

SAUA1301	APPLIED THERMODYNAMICS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To understand the basic concepts of thermodynamics
- To understand the air standard cycles and working principles of four stroke and stroke engines
- To familiarize with the types of air compressors and their working principle
- To understand the working principles of refrigeration and air conditioning systems

UNIT 1 FIRST LAW OF THERMODYNAMICS**9 Hrs.**

Concepts - concept of continuum, macroscopic approach, thermodynamic systems - closed, open and isolated. Property, state, path and process, quasi-static process, work, modes of work, Zeroth law of thermodynamics - concept of temperature and heat. Concept of ideal gas. 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**9 Hrs.**

Second law of thermodynamics - Kelvin's and Clausius statements of second law. Reversibility and irreversibility. Carnot theorem, Carnot cycle, reversed Carnot cycle, efficiency, COP, Clausius inequality, concept of entropy, change of property of ideal gas, principle of increase of entropy.

UNIT 3 GAS POWER CYCLES AND INTERNAL COMBUSTION ENGINES**9 Hrs.**

Air standard cycles - Otto, Diesel and Dual cycles. Derivation of expression for air standard efficiency and mean effective pressure. I.C Engines- Introduction-Classification, Comparison between four stroke and two stroke, petrol & diesel engines. Performance testing on internal combustion engines, Performance curves.

UNIT 4 AIR COMPRESSORS**9 Hrs.**

Positive displacement compressor - reciprocating air compressor, work done, volumetric efficiency, Effect of clearance volume- for qualitative treatment- rotary compressors - vane type, roots blower-centrifugal compressor

UNIT 5 REFRIGERATION AND AIR CONDITIONING**9 Hrs.**

Simple vapour compression refrigeration cycle, cycle with superheat & subcooling, Performance calculations, Working principle of basic vapour absorption system (Qualitative treatment only). Psychrometry and psychrometric properties, Psychrometric processes, Air conditioning systems- winter and summer. (Qualitative treatment only).

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand the thermodynamic systems and thermodynamic properties.
- CO2 - Apply first law of thermodynamics in engineering applications.
- CO3 - Understand the second law of thermodynamics and concept of entropy.
- CO4 - Analyze gas power cycles and develop understanding of I.C engines.
- CO5 - Analyze the performance of reciprocating and rotary compressors.
- CO6 - Understand the concepts of refrigeration cycles and air conditioning systems.

TEXT / REFERENCE BOOKS

1. Nag P.K., "Engineering Thermodynamics", Tata McGraw Hill Education, 2009.
2. Yunus A. Cengel, Michael A. Boles, "Thermodynamics: An Engineering Approach", McGraw Hill Education, 2014.
3. Rajput R.K., "Thermal Engineering", Laxmi Publications, 2010.
4. Khurmi R.S., Gupta J.K., "Thermal Engineering", S Chand, 2006.
5. P.L. Ballaney, "Thermal Engineering", Khanna Publisher, 2005.

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**

SAUA1302	AUTOMOTIVE PETROL ENGINES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To learn the fundamental principles and operation of Engine.
- Understand SI engine fuel feed system.
- Understand the ignition system in SI Engine
- Gain knowledge on cooling and lubrication system in SI Engine
- Understand the combustion system in SI Engines.
- Understand the abnormal combustion in SI engine

UNIT 1 ENGINE CONSTRUCTION AND OPERATION**9 Hrs.**

Constructional details of four stroke petrol engine, working principle, air standard Otto cycle, actual indicator diagram, fuel air analysis, two stroke engine construction and operation, comparison of four stroke and two stroke engines operation, firing order and its significance. Theoretical and actual Port Timing, Valve Timing of petrol engines.

UNIT 2 SI ENGINE FUEL SYSTEM**9 Hrs.**

Carburetor working principle, requirements of an automotive carburetor, Solex, S.U, Carter carburetor. starting, idling, acceleration and normal circuits of carburetors. Compensation, maximum power devices, constant choke and constant vacuum carburetors, fuel feed systems; mechanical and electrical fuel feed pumps. Petrol injection, GDI, MPFI.

UNIT 3 IGNITION SYSTEM**9 Hrs.**

Types and working of battery coil and magneto ignition systems, relative merits and demerits, centrifugal and vacuum advance mechanisms. Types and construction of spark plugs, electronic ignition systems- Transistorized coil ignition system Capacitive discharge ignition system.

UNIT 3 COOLING AND LUBRICATION SYSTEM**9 Hrs.**

Need for cooling system, Types of cooling system: air cooling system, liquid cooling system, Comparison, forced circulation system, pressure cooling system. Lubrication system- Requirements, mist, wet sump lubrication system, properties of lubricants.

UNIT 4 COMBUSTION AND COMBUSTION CHAMBERS**9 Hrs.**

Combustion in SI engine; stages of combustion, flame propagation, rate of pressure rises, abnormal combustion, detonation, effect of engine variables on knock, knock rating. Combustion chambers; different types, factors controlling combustion chamber design.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the operational principle of two stroke & four stroke engine and recall the Otto cycle process in details
- CO2 - Explain the SI engine fuel feed system.
- CO3 - Explain the battery, magneto & electronic ignition system in SI engine.
- CO4 - Explain the principle of cooling & various lubrication system in SI engine.
- CO5 - Analyse the combustion phenomena in SI engine & explain types of SI engine combustion chamber.
- CO6 - Analyse the effect of engine variables on knocking in SI engine.

TEXT / REFERENCE BOOKS

1. Ganesan V, "Internal Combustion Engines", 4th Edition, Tata McGraw Hill Publication, 2017.
2. Rajput R. K, "A textbook of Internal Combustion Engines", 3rd Edition Laxmi Publications, 2016.
3. Mathur and Sharma "Internal Combustion Engines" "Dhanpat Rai and Sons Publication, 2012.
4. John B. Heywood, "Fundamentals of Internal Combustion Engine, 2nd Edition, McGraw Hill Education; 2018.
5. Heinz Heisler, "Advanced Engine Technology", 2nd Edition SAE Publication, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 2 Questions from each unit, each carrying 2 marks**20 Marks****PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks**80 Marks**

SAUA1304	SOLID AND FLUID MECHANICS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To familiarize with the behaviour of structural components under different loading conditions
- To understand effect of component dimensions and shape on stresses and deformations.
- To understand fluid properties, flow characteristics and basic governing equations-mass, momentum, energy.
- To understand the analysis of rotor dynamic machines and Velocity Triangles.

UNIT 1 STRESS STRAIN AND DEFORMATION OF SOLIDS, STATES OF STRESS**9 Hrs.**

Rigid bodies and deformable solids - stability, strength, stiffness - tension, compression and shear stresses - strain, elasticity, Hooke's law, limit of proportionately, modules of elasticity, stress-strain curve, lateral strain - temperature stresses deformation of simple and compound bars - shear modulus, bulk modulus, relationship between elastic constants - bi axial state of stress - stress at a point - stress on inclined plane - principal stresses and principal planes - Mohr's circle of stresses

UNIT 2 BENDING AND SHEAR STRESS DISTRIBUTION, TORSION AND BEAMS**9 Hrs.**

Stresses in Beams - Simple bending theory - Composite Beams - Combined bending and Direct stress - Shear stress distribution for Rectangular and I section - Simple Torsion theory - Stresses and deformations in Solid and Hollow circular shafts- Double integration method - Macaulay's method - Moment area method - Conjugate method for simply supported and cantilever beams, (only point loads & Uniformly distributed loads.)

UNIT 3 SLOPE AND DEFLECTION OF BEAMS**9 Hrs.**

Flow through orifices: Classification - Hydraulic co-efficient - Flow through rectangular orifice, Notches and weirs. Laminar and Turbulent flow: Reynolds experiment - Major and minor losses in pipes - Darcy Weisbach's equation, Chezy's formula - pipes in series and pipes in parallel - total energy line - hydraulic gradient line - Equivalent pipe

UNIT 4 FLUID PROPERTIES & EQUATIONS OF MOTION**9 Hrs.**

Fluid Properties: Density - Specific Weight - Specific Gravity - Viscosity - Surface tension - Capillarity - compressibility. Fluid Statics: Hydrostatic Law - Pressure Variation in static fluid - Hydrostatic force on 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- Basic equations of motion: Types of fluid flow - Continuity, momentum and energy equations - Euler's and Bernoulli's Equation and its applications.-Flow Measurement: Orifice meter, Venturi meter, Piezometer, Pitot Tube.

UNIT 5 PUMPS & TURBINES**9 Hrs.**

Centrifugal Pumps: Definition - Operations - Velocity Triangles - Performance curves - Cavitations - Multistaging. Reciprocating Pumps: Operation - Slip - indicator Diagram - Separation - Air vessels. Hydraulic Turbines: Classification of hydraulic turbines - Working principle of Pelton wheel, Francis and Kaplan turbines - velocity triangles - draft tube - hydraulic turbine characteristics. Dimensional Analysis: Buckingham's Theorem, Non-Dimension Numbers, Similarities of Flow- Model studies

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Analyze material strength using Stress-Strain relationships.
- CO2 - Acquire knowledge about principal stress and strain
- CO3 - Analyze Beam strength using Shear Force and Bending Moment Diagram.
- CO4 - Acquire knowledge on properties of fluids.
- CO5 - Understand the concept of kinematics and dynamics of fluids
- CO6 - Understand the concept of incompressible flow

TEXT / REFERENCE BOOKS

1. Cengel,Y.A. ,Fluid mechanics: fundamentals and applications, McGraw Hill Publishing, New Delhi, India, 2006.
2. Rajput.R.K. "Strength of Materials", 4th Edition, S.Chand & Co., New Delhi, 2002.
3. Khurmi, R.S, "Strength of Materials", 23rd Edition, S.Chand & Co, 2008.
4. Bansal.R.K., "Fluid Mechanics & Hydraulics Machines", 9th Edition, Laxmi Publications, 2005.
5. Kumar K. L., "Engineering Fluid Mechanics", 8th Edition, Eurasia Publication, 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max Mark: 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**

SAUA2301	FUELS AND LUBRICANTS LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To gain in depth knowledge of properties of fuels and lubricants
- To impart the skill of testing fuels and lubricants for their properties using various testing equipments.

SUGGESTED LIST OF EXPERIMENTS

1. Study of International and National standards for fuels and lubricants.
2. Study of Octane and Cetane Number of fuels.
3. ASTM distillation test of liquid fuels
4. Aniline point test of diesel.
5. Calorific value of liquid fuel.
6. Calorific value of gaseous fuel.
7. Reid vapour pressure test.
8. Flash and fire points of petrol and diesel.
9. Copper strip corrosion Test
10. Cloud & pour point Test.
11. Temperature dependence of viscosity of lubricants & fuels by Redwood Viscometer.
12. Viscosity Index of lubricants & fuels by Saybolt Viscometer.
13. Ash content and carbon residue Test.
14. Drop point of grease and mechanical penetration in grease.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the International and National standards for fuels and lubricants.
- CO2 - Understand distillation of liquid fuels.
- CO3 - Understand the different properties of fuels and lubricants.
- CO4 - Determine the properties of fuels and lubricants using various testing equipments.
- CO5 - Analyze important fuel and lubricant properties for the application in specific conditions.
- CO6 - Compare the values of important physical properties of fuels and lubricants.

SAUA1401	AUTOMOTIVE DIESEL ENGINES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Understand the diesel engine construction and its operation.
- Understand the fuel injection system in CI Engine.
- Gain knowledge on air motion & combustion phenomena in CI Engine.
- Understand turbo charging and engine management system in IC Engines.
- Understand CI engine performance.
- Understand the principle of modern engine technology.

UNIT 1 BASIC THEORY**9 Hrs.**

Diesel engine construction and operation, two stroke and four stroke diesel dual cycle engines, diesel cycle, fuel-air and actual cycle analysis, diesel fuel, ignition quality, cetane number, laboratory tests for diesel fuels, standards and specifications.

UNIT 2 FUEL INJECTION SYSTEM**9 Hrs.**

Requirements, air and solid injection, functions of components, jerk and distributor type pumps common rail system, PTFI system pressure waves, injection lag, unit injector, mechanical and pneumatic governors, fuel injector, types of injection nozzle, nozzle tests, spray characteristics, injection timing, pump calibration.

UNIT 3 AIR MOTION, COMBUSTION AND COMBUSTION CHAMBER**9 Hrs.**

Importance of air motion, swirl, squish and turbulence, swirl ratio, fuel air mixing, stages of combustion, delay period, factors affecting delay period, knock in CI engines. Combustion chamber: design requirements, direct and indirect injection combustion chambers, M type combustion chamber.

UNIT 4 AUXILIARY SYSTEM**9 Hrs.**

Necessity and limitations, types of supercharging and turbocharging, relative merits, matching of turbocharger, exhaust gas recirculation, charge cooling. Introduction to engine electronics, Engine Management systems, Types of Sensors- piezoelectric, thermistor, hot wire, vortex, Exhaust oxygen, knocking sensor

UNIT 5 PERFORMANCE TESTING AND MODERN ENGINE TECHNOLOGY**9 Hrs.**

Necessity and limitations, charge cooling, basic performance parameters, performance characteristics, factors affecting performance characteristics, performance maps - CI engines, heat balance test, Morse test, introduction to modern engine technologies - lean burn engines, stratified charged engines, low heat rejection engines, homogeneously charged compression ignition engines engine management systems.

Max.45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand the operational principle of CI engine and recall the Diesel cycle & Dual cycle in detail.
- CO2 - Explain the working principle of fuel injection pump, governor in CI engine.
- CO3 - Analyse the combustion phenomena in CI engine & explain types of CI engine combustion chamber.
- CO4 - Explain the principle of turbocharging, Engine management systems.
- CO5 - Analyse the performance characteristic of IC engine.
- CO6 - Familiarize with modern engine technologies.

TEXT / REFERENCE BOOKS

1. Ganesan V, "Internal Combustion Engines" 4th edition, Tata McGraw Hill publication 2017.
2. Rajput R. K, "A textbook of Internal Combustion Engines", Third edition Laxmi Publications, 2016.
3. Mathur and Sharma "Internal Combustion Engines" "Dhanpat Rai and Sons Publication, 2012
4. John B. Heywood, "Fundamentals of Internal Combustion Engine, 2nd edition, McGraw-Hill Education; 2018.
5. Heinz Heisler "Advanced Engine Technology", 2nd edition SAE Publication, 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 with internal choice, each carrying 16 marks**80 Marks**

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 Willey 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	3	100

COURSE OBJECTIVES

- Provide the insights of the fundamentals of knowledge Mechanisms and Cams.
- Provide basic of Flywheels and Balancing of Rotating and Reciprocating unbalance systems.
- Enhance knowledge in fundamentals of Single degree Free and Damped Vibrations.
- Provide the detailed overview of Forced Vibrations.
- 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 basic of Flywheels, balancing of Rotating and Reciprocating unbalance systems.
- CO3 - Conceive the fundamentals of Single degree Free and Damped Vibrations.
- CO4 - Conceive the fundamentals of 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", First Edition, PHI Learning Private limited, 2009.
5. Rattan S. S, Theory of Machines, 3rd Ed., 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:** 2 Questions from each unit, each carrying 2 marks**20 Marks****PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks**80 Marks**

SAUA2401	THERMAL ENGINEERING LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To conduct experiments and report result on I.C. Engine performance.
- To understand the importance of heat balance sheet in I.C. Engines.
- To study the performance of Refrigeration cycle

SUGGESTED LIST OF EXPERIMENTS

1. Valve timing diagram of a four stroke engine, Port timing diagram of a two stroke engine.
2. Performance test on a four stroke diesel engine.
3. Heat balance test on a four stroke diesel engine.
4. Performance test on a multi cylinder diesel engine
5. Performance characteristics of a two stroke petrol engine.
6. Performance characteristics of a four stroke multi -cylinder petrol engine.
7. Determination of mechanical efficiency using retardation test.
8. Determination of indicated power of multi cylinder petrol engine - Morse test.
9. Determination of mechanical efficiency using negative horse power method
10. Performance test on refrigeration test rig
11. Performance test on air-conditioning test rig

COURSE OUTCOMES

On completion of the course, students will be able to

- CO1 - Demonstrate the significance of valve timing and port timing in I.C. Engine working.
- CO2 - Calculate performance parameters I.C. Engines by conducting experiments.
- CO3 - Develop heat balance sheet for I.C.Engine.
- CO4 - Determine the friction power of I.C Engine.
- CO5 - Determine indicated power of multi cylinder petrol engine.
- CO6 - Estimate the COP of vapour compression refrigeration cycle.

SMEA4004	ENGINEERING ECONOMICS AND COST ANALYSIS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

To learn about the basics of economics and cost analysis related to engineering so as to take economically sound decisions.

UNIT 1 INTRODUCTION**9 HRS**

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics - Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis- V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.

UNIT 2 VALUE ENGINEERING**9 HRS**

Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

UNIT 3 CASH FLOW**9 HRS**

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

UNIT 4 REPLACEMENT AND MAINTENANCE ANALYSIS**9 HRS**

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely – Case study based on replacement and maintenance in automobile components.

UNIT 5 DEPRECIATION**9 HRS**

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

- Mini project on Production of Automobile parts / vehicle for studying about Engineering Economics and cost analysis

Max. 45 HRS**COURSE OUTCOMES**

On completion of the course, student will be able to

CO1 - Understand different cost, selection of materials in engineering economics. CO2

- Understand the major capabilities and limitations of cash flow analysis

CO3 - Recognise, formulate, analyse and solve cash flow models in practical situations

CO4 - Develop the ability to account for time value of money using engineering economy factors CO5

- Implications and importance of considering taxes, depreciation, and inflation

CO6 - Apply engineering economic techniques on solving engineering problems

TEXT BOOK

1. Panneer Selvam, R, Engineering Economics, Prentice Hall of India Ltd, New Delhi, 2013.
2. Suma Damodaran, " Managerial economics", Oxford university press 2006.

REFERENCES

1. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.
2. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2002
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 1984
4. Grant.E.L., Ireson.W.G., and Leavenworth, R.S, "Principles of Engineering Economy", Ronald Press, New York, 1976.
5. Smith, G.W., "Engineering Economy", Iowa State Press, Iowa, 1973.

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