DEPARTMENT OF MECHANICAL ENGINEERING
A.U. COLLEGE OF ENGINEERING (A), ANDHRA UNIVERSITY, VISAKHAPATNAM
SCHEME OF INSTRUCTION AND EXAMINATION FOR B.TECH MECHANICAL ENGINEERING
(From 2020-2021 Admitted Batches)

B.Tech & B.Tech+M.Tech II Year - I Semester

Course code	Category	Course Title	Hours per week			Internal Marks	External Marks	Total Marks	Credits
			L	T	P				
MC2101	BS	Metallurgy & Material Science	4	0	0	30	70	100	3
MC2102	PC	Kinematics of Machinery	4	0	0	30	70	100	3
MC2103	PC	Basic Thermodynamics	4	0	0	30	70	100	3
MC2104	PC	Manufacturing Processes	4	0	0	30	70	100	3
MC2105	HSS	Managerial Economics	4	0	0	30	70	100	3
MC2106	PC	Strength of Materials Lab	0	0	3	50	50	100	1.5
MC2107	PC	M.T-I LAB	0	0	3	50	50	100	1.5
MC2108	PC	Machine Drawing	0	0	3	50	50	100	1.5
MC2109	SC	MAT Lab	1	0	2	50	50	100	2
MC2110	MC	Professional Ethics and Universal Human Values	0	0	0	00	100	100	0
MC2111	MC	NCC/NSS	0	0	2	-	-	-	0
								Total Credits	**21.5**

B.Tech & B.Tech+M.Tech II Year - II Semester

Course code	Category	Course Title	Hours per week			Internal Marks	External Marks	Total Marks	Credits
			L	T	P				
MC2201	ES	Strength of Materials-II	4	0	0	30	70	100	3
MC2202	BS/PC	Dynamics of Machinery	4	0	0	30	70	100	3
MC2203	PC	Applied Thermodynamics	4	0	0	30	70	100	3
MC2204	PC	Metal Cutting & Machine Tools	4	0	0	30	70	100	3
MC2205	PC	Design of Machine Elements	4	0	0	30	70	100	3
MC2206	PC	I.C Engines Lab	0	0	3	50	50	100	1.5
MC2207	PC	Dynamics of Machinery Lab	0	0	3	50	50	100	1.5
MC2208	SC	Computer Aided Modelling	1	0	2	50	50	100	2
MC2209	MC	Environmental Science	0	0	0	00	100	100	0
								Total Credits	**20**

MC- 2101 METALLURGY AND MATERIAL SCIENCE

(Effective from the batch admitted during 2020-2021-APSCHE)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits :3

Course Objectives:

- Give basic knowledge of science behind materials & physical metallurgy.
- Introduce the concept of structure property relations. Provide an understanding of basic structure and crystal arrangement of materials
- Knowledge about different phases & phase diagram. Knowledge about classification, applications of Ferrous & non-ferrous alloys.
- Introduction to heat treatment techniques.
- Develop intuitive understanding of the subject to present a wealth of real world engineering examples to give students a feel of how material science is useful in engineering practices.

Course Outcomes:

- Analyze the Structure of materials at different levels, basic concepts of crystalline materials like unit cell, FCC, BCC, HCP, APF (Atomic Packing Factor), Co-ordination Number etc.
- Explain the concept of phase & phase diagram & understand the basic terminologies associated with metallurgy. Construction and identification of phase diagrams and reactions.
- Understand the Fe- C Phase diagram & analyze the microstructures of different cast iron and steels.
- Explain features, classification, applications of various Ferrous & Non-Ferrous alloys.
- Understand and suggest the heat treatment process & types. Significance of properties Vs microstructure. Introduce the concept of hardenability & demonstrate the test used to find hardenability of steels.

Syllabus

Structure of crystalline solids: Atomic structure & bonding in solids- Crystal structures- calculations of radius, Crysrallography: Classification of Crystals-Bravi"s lattices-Miller Indices Coordination Number and Atomic Packing Factor for different cubic structures - Imperfection in solids, point defects, Linear defects, Planar defects and Volume defects- Concept of Slip & twinning.

Phase diagrams: Basic terms- phase rule- Lever rule & free energy of phase mixtures cooling curves- Phase diagram & phase transformation - construction of phase diagrams- binary phase diagrams - Brass, Bronze, Al-Cu and AlSi phase diagrams- Invariant reactions, eutectic, , peritectic, eutectoid, peritectoid, metatectic & monotectic reactions, Iron carbon phase diagram & microstructures of plain carbon steel & cast iron

Heat treatment: Heat treatment of steel- Annealing, and its types, normalizing, hardening, tempering, martemering, austempering - TTT diagrams, drawing of TTT diagram, TTTdiagram for hypo-& hypereutectoid steels, effect of alloying elements, CCT diagram- Martensitic transformation, nature of martensitic transformation- Surface hardening processes like case hardening, carburizing, cyaniding, nitriding Induction hardening, hardenabilty, Jominy end-quench test, Age hardening of Al & Cu alloys Precipitation Hardening

Engineering Alloys: Properties, composition, microstructure and uses of low carbon, mild medium & high carbon steels. stainless steels, high speed steels, Hadfield steels, tool steels - Cast irons, gray CI, white CI, malleable CI, SC iron-The light alloys- Al & Mg & Titanium alloys- Copper & its alloys: brasses & bronzes- super alloys, Smart materials- Nano materials.

Composite Materials: Classification of composite materials, dispersion strengthened, particle reinforced and fiber reinforced composite laminates properties of matrix and reinforcement materials and structural applications of different types of composite materials.

Nano-Materials- Introduction and Applications.

Powder Metallurgy: Powder Metallurgy process, Preparation of powders, Characteristics of Metal powders, mixing , compacting, sintering, Applications of Powder Metallurgy. Formingand shaping of plastics-Extrusion and Injection moulding. Ferrous And Non –Ferrous Materials: Composition, properties and application of ferrous and Non ferrous metals and their alloys. Breif study of cast iron, steels, copper and aluminum

Text Books:

1. "Materials Science & Engineering- An Introduction", William D.Callister Jr. Wiley IndiaPvt. Ltd. 6th Edition, 2006, New Delhi.

2. Physical Metallurgy, Principles & Practices", V Raghavan.PHI 2nd Edition 2006, NewDelhi.

References

1. Introduction to Physical Metallurgy by Sidney H Avner Tata McGraw-Hill Education 1997

2. Materials Science And Engineering: A First Course By V. Raghavan Phi 5th Edition 2011,New Delhi

MC- 2102 KINEMATICS OF MACHINERY

(Effective from the batch admitted during 2020-2021-APSCHE)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 3

COURSE OBJECTIVES:

- To know the basics of Machine and mechanism.
- To know the degrees of freedom of machine
- Kinematic pairs and kinematic inversion
- To know the Kinematic analysis of mechanism and cams
- To know velocity polygons, instantaneous centre method,
- To know the synthesis of mechanism by graphical method
- To know lower pair mechanism.
- To know the Friction and motion
- To understand the drive mechanism
- To understand the Dynamic Force Analysis.
- To understand the governors
- Static and dynamic analysis

COURSE OUTCOMES:

- Understanding of machine and mechanism.
- How the static and dynamic strength parameters for a material are measured in standardized tests.
- Ability to draw the kinematic analysis by displacement, velocity and acceleration diagrams.
- Understanding the geometric analysis of various mechanism by instantaneous centre, Kennedy,s theorem.
- Understanding the four bar mechanism, slider crank mechanism Grashof's criterion of movability and synthesis of mechanism by graphical method.
- Understanding the lower pair mechanism by straight line motion mechanism, pantographs, engine indicator mechanisms, Automobile steering mechanism and

Hooke's joint.
- Understanding various types of friction and friction on bearings and clutches.
- Understanding various drives like gears, gear trains,
- Understanding D'Alembert's principle, Dynamically equivalent system and Turning-moment diagrams.
- Understanding principle of governors its types and Sensitiveness of a governor

SYLLABUS

Mechanisms and Machines: Introduction; Mechanism and machine; Rigid and resistant bodies; Link; Kinematic pair; Degrees of freedom; Classification of kinematic pairs; Kinematic chain; Linkage, mechanism and structure; Mobility of mechanisms; The four-bar chain; Mechanical advantage; Transmission angle; The slider-crank chain; Double slidercrank chain; Miscellaneous mechanisms.

Velocity Analysis: Introduction; Absolute and relative motions; Vectors; Additional and subtraction of vectors; Motion of a link; Four-link mechanism; Velocity images; Angular velocity of links; Velocity of rubbing; Slider-crank mechanism; Crank and slotted lever mechanism; Algebraic methods; Instantaneous center (I-center); Kennedy's theorem; Locating I-centers; Angular velocity ratio theorem; centrode.

Acceleration Analysis: Introduction; Acceleration; Four-link mechanism; Four-link mechanism; Acceleration of intermediate and offset points; Slider-crank mechanism; Corriolis acceleration component; Crank and slotted lever mechanism; Algebraic methods; Klein's construction; Velocity and acceleration from displacement-time curve.

Lower Pairs: Introduction; Pantograph; Straight line mechanisms; Engine indicators; Automobile steering gears; Types of steering gears; Hooke's joint; Double Hooke's joint.

Friction: Introduction; Kinds of friction; Laws of friction; Coefficient of friction; Inclined plane; Screw threads; Wedge; Pivots and collars; Friction clutches; Rolling friction; Antifriction bearings; Greasy friction; Greasy friction at a journal; Friction axis of a link; Film friction; Mitchell thrust bearing.

Dynamic Force Analysis: Introduction; D'Alembert's principle; Equivalent offset inertia force; Dynamic analysis of four-link mechanism; Dynamic analysis of slider-crank mechanism; Velocity and acceleration of piston; Angular velocity and angular acceleration of connecting rod; Engine force analysis; Turning moment on crankshaft; Dynamically equivalent system; Inertia of the connecting rod; Inertia force in reciprocating engines (Graphical method); Turning-moment diagrams; Fluctuations of energy; Flywheels.

Governors: Introduction; Types of governors; Wait governor (simple conical governor); Portor governor; Proell governor; Hartnell governor; Hartung governor; Wilson-Hartnell governor (radial-spring governor); Pickering governor; Spring-controlled gravity governor; Inertia governor; Sensitiveness of a governor; Hunting; Isochronism; Stability; Effort of a governor; Power of a governor; Controlling force.

Text Book:
1. Theory of Machines by R.S.Khurmi&J.K.Gupta

Reference books:
1. Theory of Machines by Thomas Bevan.
2. Theory of Machines by S.S. Rattan.

MC- 2103 BASIC THERMODYNAMICS

(Effective from the batch admitted during 2020-2021- APSCHE)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits :3

OBJECTIVES COURSE

- To educate students about the behavior of real gases and the significance of ideal gas theory
- To educate the students about the properties of ideal gas and their relationship
- To familiarize the students about the behavior of ideal gases under heating, cooling, compression and expansion processes
- To educate the students about the working principle of combustion engines (internal and external) and their cycles such as Otto, Diesel, Atkinson, Ericson, Brayton, etc., and their comparison

OUTCOMES COURSE

- Students realize the practical importance of ideal gas theory and the use of real gases in combustion engines such as IC Engines and Gas turbines
- Students are able to calculate the properties of the gases such as internal energy, enthalpy and entropy.
- Students are able to estimate the losses which occur during operation of the heat engines, and their maximum possible operating efficiencies under STP conditions.
- Students can estimate the maximum work-output delivered by the heat engines and maximum work consumed by the reversed heat engines

SYLLABUS

Introduction: Basic concepts; Thermodynamic systems; Micro & Macro systems; Homogeneous and heterogeneous systems; Concept of continuum; Pure substance; Thermodynamic equilibrium; State; Property; Path; Process; Reversible and irreversible cycles; Work; Heat; Point function; Path function; Heat transfer.

Zeroth law of thermodynamics; Concept of equality of temperatures- Joule's experiments- First law of thermodynamics- Isolated systems and steady flow systems- Specific heats at constant volume and pressure - Enthalpy- First law applied to flow systems- Systems undergoing a cycle and change of state- First law applied to steady flow processes-Limitationsof first law of thermodynamics.

Perfect gas laws- Equation of state- Universal gas constant, various non-flow processes- Properties of end states- Heat transfer and work transfer- Change in internal energy-throttling and free expansion- Flow processes- Deviations from perfect gas model-Vanderwall's equationof state- Compressibility charts- Variable specific heats.

Second law of thermodynamics- Kelvin Plank statement and Clasius statement and their equivalence, Corollaries- Perpetual motion machines of first kind and second kind- Reversibility and irreversibility- Cause of irreversibility- Carnot cycle- Heat engines and heat pumps- Carnot efficiency- Clasius theorem- Clasius inequality- Concept of entropy-Principlesof increase of entropy- Entropy and disorder.

Availability and irreversibility- Helmholtz function and Gibbs function- Availability in steady flow- Entropy equation for flow process- Maxwell's equations- Tds relations- Heat capacities.

I.C. engines: classification-comparison of two stroke and four stroke engines- comparison of

S.I. and C.I. engines-Air cycles-Otto, Diesel, Dual, Stirling, Ericson and Atkinson cycles and their analysis-Valve timing and port timing diagrams- Efficiencies- air standard efficiency, indicated thermal efficiency, brake thermal efficiency, mechanical efficiency, volumetric efficiency and relative efficiency-Testing and performances of I.C. engines

Combustion in I.C. Engines: S.I. engines- Normal combustion and abnormal combustion-Importance of flame speed and effect of engine variables-types of abnormal combustion pre-ignition and knock, Fuel requirements and fuel rating, anti-knock additions.

Text Books:

1. Engineering Thermodynamics, by P.K. Nag, Tata McGraw-Hill Publications Company.
2. Applied Thermodynamics-I by R. Yadav, Central Book House.
3. Engineering Thermodynamics by K. Ramakrishna, Anuradha agencies.
4. I.C. Engines by V. Ganesan
5. I.C. Engines, by Mathur and Sharma

References Books:

1. Engineering Thermodynamics by Rathakrishnan, Prentice - Hall India.
2. Engineering Thermodynamics by Y.V.C. Rao.
3. Thermal Engineering by R.K. Rajput, S.Chand& Co.
4. Engineering Thermodynamics Work and Heat Transfer, by G.F.C Rogers and Y.R.Mayhew, ELBS publication
5. Engineering Thermodynamics by Zemansky.

MC- 2104 MANUFACTURING PROCESSES

(Effective from the batch admitted during 2020-2021-APSCHE)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits :3

Course Objectives:

- To emphasize the importance of manufacturing sciences in the day-to-day life.
- To study the principles of manufacturing processes like casting.
- To acquaint gating design for different metal casting processes
- To impart knowledge about principles and criteria of yielding during forming of metals,
- To inculcate the principle, thermal and metallurgical aspects of welding processes.
- To impart knowledge about analysis of common and newer welding techniques.

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

- Designate casting process, interpret pattern, core and mold making.
- Evaluate gating system design and acquire knowledge on various furnaces.
- Elucidate various bulk metal forming processes and categorize various sheet metal operations.
- Study the welding process behavior for common and newer welding techniques
- Analyze different casting, forming and weld defects.
- Interpret casting, forming and welding processes and their applications.

SYLLABUS:

Manufacturing concepts; Product cycle; Job, batch and mass production; Primary and

secondary manufacturing processes; Principle of metal casting; Terminology; Pattern; Types; Allowances; Materials; Core boxes; Selection; Testing and preparation of molding sands; Molding tools and equipment; Machine molding; Core making; Mechanism of Solidification: Design Principles of Gates, Runners and Risers. Melting and pouring the metal; Cupola and Electric furnaces, Special casting processes: Shell mold casting; Investment casting; Permanent mould casting; Casting defects.

Formability of metals: Nature of plastic deformation, hot and cold working of metals, mechanics of metal forming; Rolling: principle, types; roll size; rolling pressure distribution and rolling force. Forging processes: principle of forging, forging techniques; forging tools and presses; forging pressure distribution and forging force; Automation of forging; Swaging; Drawing; Extrusion and its types.

Sheet metal forming: Mechanics of sheet metal working, blanking, piercing, notching, bending, stamping, stretch forming, metal spinning, embossing and coining. Different types of presses and dies, Die design. Energy rate forming processes, Principles of explosive forming and electromagnetic forming

Welding: Theory of fusion and pressure welding, flow and distribution of heat in welding, Principles and processes of arc welding (SMAW, GTAW, GMAW, FCAW, PAW, SAW); Welding equipment; Weld positioners and fixtures; Oxyacetylene welding; Flame cutting; Brazing and soldering; Principle of resistance welding; Types of resistance welds; Seam welding; Projection welding; Resistance butt welding; different types of solid state welding processes; Weld inspection and testing.

Text Book:

1. Process and Materials of Manufacture (4th Edition) by Roy A. Lindberg, Prentice-Hall ofIndia Private Limited.
2. Manufacturing Technology-Foundary, Forming and Welding by P.N. Rao, Tata McGraw-Hill Publishing Company.

Reference Books:

1. Manufacturing Engineering & Technology by Kalpak Jain, Addition Wesley Edition.
2. Materials and Processes in Manufacturing by De Margo, Black and Kohsen, Prentice Hallof India.
3. Principles of Metal Casting by Hein and Rosenthal, Tata Mc-Graw Hill India.
4. Mechanical Metallurgy by George E. Dieter, 3rd Edition, Mc-Graw Hill Education, Indian Edition

MC- 2105 MANAGERIAL ECONOMICS

(Effective from the batch admitted during 2020-2021-APSCHE)

(Common for all Branches)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs.

Credits :3

Course Objectives:

- To bring about an awareness about the nature of Managerial Economics and its linkages with other disciplines.
- To understand the Micro and Macro Environment of Business.
- To familiarize the prospective engineers with the concepts and tools of Managerial Economics with an objective to understand the real world of business.

Course Outcomes:

After completion of the course, student will be able to:

- Understand the various economic activities in business and industry.
- Analyse the real world business problems.
- Make optimal business decisions for the effective and efficient management of Organisations.

SYLLABUS

Significance of Economics and Managerial Economics:

Economics: Definitions of Economics- Wealth, Welfare and Scarcity definitions Classification of Economics- Micro and Micro Economics.

Managerial Economics: Definition, Nature and Scope of Managerial Economics, Differences between Economics and Managerial Economics, Main areas of Managerial Economics, Managerial Economics with other disciplines.

Demand and Utility Analysis:

Demand - Definition, Meaning, Nature and types of demand, Demand function, Law of demand - Assumptions and limitations. Exceptional demand curve.

Elasticity of demand - Definition, Measurement of elasticity, Types of Elasticity (Price, Income, Cross and Advertisement), Practical importance of Price elasticity of demand, Role of income elasticity in business decisions, Factors governing Price Elasticity of demand.

Utility Analysis: Utility- Meaning, Types of Economic Utilities, Cardinal and Ordinal Utility, Total Utility, Marginal Utility, The law of Diminishing Marginal Utility and its Limitations**.**

Theory of Production and Cost analysis:

Production - Meaning, Production function and its assumptions, use of production function in decision making;

Cost analysis - Nature of cost, Classification of costs - Fixed vs. Variable costs, Marginal cost, Controllable vs. Non - Controllable costs, Opportunity cost, Incremental vs. Sunk costs, Explicit vs. Implicit costs, Replacement costs, Historical costs, Urgent vs. Postponable costs, Escapable vs. Unavoidable costs, Economies and Diseconomies of scale.

Market Structures : Definition of Market, Classification of markets; Salient features or conditions of different markets - Perfect Competition, Monopoly, Duopoly , Oligopoly, Importance of kinked demand curve ;Monopolistic Competition.

Pricing and Business Cycles:

Pricing Analysis : Pricing – Significance; Different Pricing methods- Cost plus pricing, Target pricing, Marginal cost pricing, Going -rate pricing, Average cost pricing, Peak load pricing , Pricing of joint Products, Pricing over the life cycle of a Product, Skimming pricing Penetration pricing, Mark- up and Mark- down pricing of retailers.

Business cycles - Definition, Characteristics, Phases, Causes and Consequences; Measures to solve problems arising from Business cycles.

Text Books:

1. Sankaran,S., **Managerial Economics,** Marghan Publications, 2015, Chennai.
2. Aryasri, A.R., **Managerial Economics and Financial Analysis,** MC Graw Hill Education, New Delhi,2015.

Reference Books:

1. Dwivedi, D.N., **Managerial Economics,** Vikhas Publishing House Pvt. Ltd. 6th Edition, New Delhi,2004.
2. Dewett, K.K., **Modern Economic Theory**, S.Chand & Company Ltd., New Delhi, 2005.

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MC- 2106 STRENGTH OF MATERIALS LAB

(Effective from the batch admitted during 2020-2021-APSCHE)

Periods/week : 3 Lab Ses. : 50 Exam : 50

Examination (Practical): 3hrs. Credits :1.5

Course Objectives:

- To understand the different types of loading and measure the loads.
- To understand the material properties of different materials and the ways of finding them.
- To understand the bulking property and fineness of sand grains and the methods of finding them.

Course Outcomes:

- Ability to identify different types of loads and measure them.
- Ability to measure material properties of different materials using different methods.
- Ability to measure bulking property and fineness of sand grains.

List of Experiments:

1. To study the stress strain characteristics (tension and compression) of metals by using UTM.
2. To study the stress strain characteristics of metals by using Hounsefield Tensometer.
3. Determination of compression strength of wood.
4. Determination of hardness using different hardness testing machines- Brinnels, Vickersand Rockwell's.

5. Impact test by using Izod and Charpy methods.
6. Deflection test on beams using UTM.
7. Tension shear test on M.S. Rods.
8. To find stiffness and modulus of rigidity by conducting compression tests on springs.
9. Torsion tests on circular shafts.
10. Bulking of sand.
11. Punch shear test, hardness test and compression test by using Hounsefield tensometer.
12. Sieve Analysis and determination of fineness number.

MC -2107 MANUFACTURING TECHNOLOGY LAB-I

(Effective from the batch admitted during 2020-2021-APSCHE)

Periods/week : 3 Lab Ses. : 50 Exam : 50

Examination (Practical): 3hrs. Credits : 1.5

Course Objectives:

- To appreciate the tools, materials, machines used for making products in Foundry, Welding and Machine shop.
- Be aware of the work and tool material relationship in machine shop.
- To recognize the different welding techniques for different materials.
- To realize the various molding sands, core sands used for making of moulds and cores .

Course Outcomes:

They have

- Ability to prepare molds, cores for a given component.
- Capability to complete different joints, welds for given component by GAS and ARC welding processes.
- Aptitude to made taper turning, thread cutting and off set turning on different materials by Lathe machine.
- Skill to made spur gears, key ways etc. by using different machines.

LIST OF EXPERIMENTS:

Use of basic tools and operations of the following trades.

S. No.	Trade	No. of exercises
1.	Foundry	3
2.	Welding	2
3.	Lathe Step and taper turning	1
	Thread cutting	1
	Offset turning	1
4.	Milling	1 (Spur gear)
5.	Shaper	1

6. Cylindrical grinding, Surface grinding, Planing, Slotting and Capstan lathe (only demonstration in one class for the entire batch of students).
7. Dissembling and assembling of *

i. Machine Tool (Lathe)

ii. I.C. engine

iii. Pump

iv. Gear box

* Not for examination

MC-2108 MACHINE DRAWING

(Effective from the batch admitted during 2020-2021-APSCHE)

Periods/week: 3 Lab Ses.: 50 Exam : 50

Examination (Practical): 3hrs. Credits:1.5

Course Objectives:

The objectives of this course are

- To learn basic conventions adopted in machine drawing and production drawing.
- To familiarize the machine elements such as screw fasteners, keys, cotter joints and riveted joints used in design.
- To provide the knowledge of machine elements such as couplings, bearings, pipe joints used in design.
- To understand the assembly drawings of engine parts and machine parts.
- To impart the knowledge of production drawing.

Course Outcomes:

- Comprehend the basic conventions needed for machine drawing.
- Understand the geometric dimensioning and tolerances used in industry.
- Execute the drawings of various mechanical components with appropriate proportions.
- Design the assembly drawings from part drawings.
- Develop the part drawings from their assembly.

SYLLABUS:

Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs and ribs. Limits, Tolerances and Fits- Indication of surface roughness, preparation of process sheets.

Screw threads and Screw Fastenings using standard Empirical formulae. Riveted joints, Keys, Cotter-joints, Pin-joints.

Shaft couplings: Box and split muff couplings, Flanged, Flexible, Universal and Oldham couplings, shaft bearings, Brackets and Hangers, Pipe joints. Orthogonal views and Sectional views of machine parts.

Introduction to Production drawing, Component drawing, Assembly drawing, Machine shop drawing, Pattern-shop drawing, Sheet metal drawing.

Assembly drawing of Stuffing box, Connecting rod, Screws jack, Bench Vice, Plummer block, Tailstock.

Production drawings of Spur, Bevel and Helical gears, swivel bracket, main spindle, crank,revolving centre, jigs and fixtures.

Text Books:

1. Machine Drawing, by N.D.Bhatt, Charotal Publishing House.

2. Engineering Drawing, by A.C.Parkinson, Wheeler Publishing.
3. Production Drawing by K.L. Narayana, P. Kannaiah, K. Venkata Reddy, New Age International Publishing

Reference:

1. Machine Drawing by K.L Narayan, P. Kannaiah and K. Venkata Reddy, New Age

MC-2109 MAT LAB (Skill Oriented Course)

(Effective from the batch admitted during 2020-2021-APSCHE)

Periods/week: 1 Th 2 Lab — Ses.: 50 Exam : 50

Examination (Practical): 3hrs. — Credits: 2

Course Objective:

The objectives of this course are

- To Impart the knowledge to the students with MATLAB software.
- To provide a working introduction to the Matlab technical computing environment.
- To introduce the use of a high-level programming language-Matlab.

Course Outcomes:

At the end of the course the student shall be able to

(Using MATLAB programming Language)

- Perform matrix operations.
- Plot two dimensional, three dimensional graphs.
- Perform the linear and non-linear regression analysis for the given data.
- Determine the steady state, unsteady state solutions of ordinary differential equations.
- Compute two and three dimensional integrals and solve unconstrained optimization problems.

LIST OF EXERCISES:

1. To study the basic MATLAB commands like representing arrays, matrices, reading elements of a matrix, row and columns of matrices, Random numbers.
2. To determine Eigen values and Eigen vectors of a matrix.
3. To plot the 2 Dimensional and 3 Dimensional curves
4. To develop the equations for Linear Regression, interpolation, polynomial regression and Nonlinear regression
5. To develop the forward kinematics simulation in Matlab.
6. To perform the Air Standard Cycle Simulation in Matlab.
7. To solve the problems in Vibrations and Dynamics
8. To fit curves to data using regression.
9. To solve the problems of Genetic Algorithm in Matlab.

MC-2110 PROFESSIONAL ETHICS AND UNIVERSAL HUMAN VALUES

(Effective from the batch admitted during 2020-2021-APSCHE)

(Common for all Branches)

Periods/week : 0 — Ses. : 00 Exam : 100

Examination (Theory): 3hrs. — Credits :0

Course Objectives:

The objective of the course is Six fold:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.

- This course will illuminate the students in the concepts of laws and its applicability to engineers
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection, Development of commitment and courage to act and also enable the students to imbibe and internalize the Values and Ethical Behaviour in the personal and professional lives
- To enable the students to imbibe the Values and Ethical Behavior in the personal and Professional lives
- The students will learn the rights and responsibilities Individual, employee, team member and a global citizen

Course Outcomes:

By the end of the course Student will be able to:

- Grasp the meaning of the concept – Law and also Get an overview of the laws relating to Engineers and also Apprehend the importance of being a law abiding person and They would have better critical ability
- Self-explore by using different techniques to live in harmony at various levels.
- Analyze themselves and understand their position with respect to the moral and ethical character needed for a successful and satisfactory work life.
- Students are expected to become more aware of themselves and their surroundings (family, society, nature)
- They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
- They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society

SYLLABUS

Need, Basic Guidelines, Content and Process for Value Education

Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation - as the process for self-exploration, Continuous Happiness and Prosperity - A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility - the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking, Include practice sessions and case studies.

Understanding Harmony in the Human Being - Harmony in Myself!

Understanding human being as: a co-existence of the sentient 'I' and the material 'Body', the needs of Self ('I') and 'Body' - happiness and physical facility, the Body as an instrument of 'I' (I being the doer, seer and enjoyer), the characteristics and activities of 'I' and harmony in 'I', the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, P to ensure Sanyam and Health, Include practice sessions and case studies.

Understanding Harmony in the Family and Society - Harmony in Human – Human Relationship

Understanding values in human-human relationship: meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, the meaning of Trust; Difference between intention and competence, the meaning of Respect, Difference between respect and differentiation; the

other salient values in relationship, the harmony in the society (society being an extension of family), Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order from family to world family, Include practice sessions and case studies.

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all – pervasive space, Holistic perception of harmony at all levels of existence, Include practice sessions and case studies.

Concept of Law and Law of Torts

Understanding Essentials of a Valid Contract and the basics of contract law protecting rights and obligations, Introduction to the Law of Torts and the basics to protect oneself and the company Law affecting the Workplace Employers Responsibilities/Duties Hiring Practices, Introduction to Intellectual Property Law, Professional Code of Conduct for Engineers, Relationship between Law and Ethics, Include practice sessions and case studies.

Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations, Include practice sessions and case studies.

Text Books

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2
3. R. Subramanian, "Professional Ethics", Oxford University Press.
4. S.B. Srivasthva, "Professional Ethics & Human Values", SciTech Publications (India) Pvt. Ltd. New Delhi.
5. D.R. Kiran, "Professional Ethics & Human Values", TATA Mc Graw Hill Education.
6. Saroj Kumar, "Business Law" and Avtar Singh, "Law of Contract"

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. A. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book), Mohandas Karamchand Gandhi "The Story of My Experiments with Truth", E. FSchumacher. "Small is Beautiful", Slow is Beautiful –Cecile Andrews, J C Kumarappa "Economy of Permanence", Pandit Sunderlal "Bharat Mein Angreji Raj" and Dharampal, "Rediscovering India
4. G K Kapoor, "Business Law" and Sen & Mitra, "Business & Commercial Laws" and Calvin Frank Allen, "Business law for Engineers"
5. Hilgard, E. R.; Atkinson, R. C. & Atkinson, R.L. (1975). *Introduction to Psychology*. 6th Edition. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.

6. Govindarajan, M; Natarajan, G. M. & Senthilkumar, V.S. (2013). *Professional Ethics & Human Values*. Prentice Hall: New Delhi
7. Gogate, S. B. (2011). Human Values & Professional Ethics. Vikas Publishing: New Delhi.
8. Charles E Harris Jr., Michael S Pritchard, Michael J Rabins, "Engineering Ethics, Concepts Cases: 4e, Cengage learning, 2015.
9. Caroline Whitbec, " Ethics in Engineering Practice & Research: 2e, Cambridge University Press 2015.

MC-2111 N S S / N C C

(Effective from the batch admitted during 2020-2021-APSCHE)

Periods/week : 2 Lab Ses. : 00 Exam : 00

Examination (Practical): .----- Credits :0

B.TECH & B.TECH+ M.TECH MECHANICAL ENGINEERING II YEAR II SEMESTER
(Admitted batch 2020-2021)

MC- 2201 STRENGTH OF MATERIALS-II

(Effective from the batch admitted during 2020-2021-APSCHE)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 3

COURSE OBJECTIVES:

- To enrich the student on the concept of fixed beams with uniform Moment of inertia as well as Non uniform Moment of inertia both under stability of beam supports and under sinking & rotation of the supports
- To make the student capable of evaluating the deflection ,slope and stress of the fixed beam with uniform Moment of inertia as well as Non uniform Moment of inertia both under the stability of beam supports and under the sinking &rotation of the supports.
- To make the student understand the concept of continuous beams with uniform Moment of inertia as well as Non uniform Moment of inertia both under stability of supports as well as sinking of supports
- To make the student capable of evaluating the support moments and support reactions of the continuous beam with uniform Moment of inertia as well as Non uniform Moment of inertia.
- To make the student understand the concept of vertical compression loading on an engineering beam with four different end conditions.
- To make the student understand the concept of vertical compression loading acting on an engineering beam which is having initial curvature.
- To make the student understand the concept of eccentrical vertical compression loading acting on an engineering beam with four different end conditions.
- To make the student understand the concept of vertical compression loading acting along with central point load acting perpendicular to the axis of the engineering beam with four different end conditions.
- To make the student understand the concept of vertical compression loading acting along with Non central point load acting perpendicular to the axis of the engineering beam with four different end conditions.
- To make the student understand the concept of vertical compression loading acting along with uniformly distributed load acting perpendicular to the axis of the engineering beam with four different end conditions.
- To make the student understand the concept of curved beams having different cross sections along with calculation of bending stress at any point across the cross section of the curved

beam.

- To make the student understand the concept of circular rotating discs having uniform thickness and make him capable of calculating the stress on any point of the circular rotating disc.
- To make the student understand the concept of circular rotating discs having uniform strength and make him capable of modeling the thickness of the circular rotating disc.
- To make the student understand the concept of circular rotating cylinder having uniform thickness and make him capable of calculating the stress on any point of the circular rotating disc.
- To make the student understand the concept of thick cylinder under different pressure conditions so that the student can evaluate radial stress and circumferential stress at any radius of the thick cylinder.
- To make the student understand the concept of compound cylinder under different pressure conditions so that the student can evaluate radial stress and circumferential stress at any radius of the compound cylinder.
- To make the student capable understanding Bending axis , shear centre and unsymmetrical bending and make him capable of evaluating the stresses at any point on a both symmetrical and unsymmetrical sections
- To make the student understand the energy methods and Castigliano"s theorem-1 &2 and their application for cantilever beams and simply supported beams.

COURSE OUTCOMES:

Course Outcomes:

- The student is capable of evaluating an already existing fixed beam with uniform Moment of inertia as well as Non uniform Moment of inertia which is under different loading conditions and with different support conditions and can even able to design a fixed engineering beam for any loading conditions.
- The student is capable of evaluating an already existing continuous beam with uniform Moment of inertia as well as Non uniform Moment of inertia which is under different loading conditions and with different support conditions and can even able to design a continuous engineering beam for any loading conditions
- The student is capable of evaluating any engineering column or strut under different end conditions and under different specified variable loading conditions as mentioned under objectives
- The student is capable of evaluating curved beams of different cross sections and can able to evaluate the stresses across the cross-sections of the curved beam.
- The student is capable of calculating the radial stress and circumferential stress for rotating circular disc(both hollow and solid) of uniform thickness.
- The student is capable of modeling the thickness of circular rotating disc having uniform strength.
- The student is capable of calculating the radial stress and circumferential stress for rotating circular cylinder of uniform thickness.
- The student is capable understanding Bending axis , shear centre and unsymmetrical bending and is capable of evaluating the stresses at any point on a both symmetrical and unsymmetrical sections
- The student is capable of calculating the radial and circumferential stress for both thick and compound cylinders under different pressurized conditions.
- The student is capable of using different energy methods for evaluating the deflection and slope of simply supported beams and cantilever beams

SYLLABUS

Fixed Beams: Fixing moments for a fixed beam of uniform Moment of Inertia, Effect ofsinking support, slope and deflection.

Continuous beams: Analysis of continuous beam, Reactions at the supports, Effect of sinkingof

supports.

Energy Methods -Castigliano's theorems I

Columns and Struts: Columns with one end free and the other fixed, Both ends fixed, One end fixed and other hinged, Limitation of Euler's formula, Column with initial curvature, Column carrying eccentric load, Laterally loaded columns with Central point load

Bending of Curved Bars: Stresses in bars of circular, rectangular and trapezoidal sections.

Stresses due to rotation: Wheel rim, disc of uniform thickness, disc of uniform strength.

Thick cylinders subjected to internal and external pressure and compound cylinders.

Text Books:

1. Analysis of Structures, Vol. 1, 1993 edition, by Vazirani and Ratwani.
2. Chapter VI from Advanced Topics in Strength of Materials, by Prof. L.B.Shah and Dr.R.T.Shah.`1

References:

1. Strength of Materials, by Timoshenko.
2. Analysis of structures by Prof V.N.Vazirani &Dr MM Ratwani&Dr S.K.Duggal
3. Strength of Materials by Dr Sadhu Singh

MC- 2202 DYNAMICS OF MACHINERY

(Effective from the batch admitted during 2020-2021-APSCHE)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 3

COURSE OBJECTIVES:

The main objectives of the course are

- To provide the competency about the gyroscopic concepts in various vehicles.
- To impart the knowledge of cam profiles for desired motion.
- To make the students visualize the gear working, gear contact & interference.
- To comprehend different speed reductions of gear trains.
- To understand various unbalanced systems & their balancing techniques.
- To familiarize the various types of vibrations and their response.

COURSE OUTCOMES:

At the end of the course, the student will be able to

- Analyze the gyroscopic effects on different vehicles.
- Analyze cams for producing a desired motion and cams with specified contours.
- Analyze the kinematics of toothed gears
- Calculate the speeds and torques of gears used in various gear trains.
- Comprehend the balancing of the moving parts (rotating & reciprocating) statically and dynamically.
- Determine the dynamic response of various vibrating systems.

SYLLABUS

Gyroscopic Couple and Precessional Motion: Precessional and angular motion- gyroscopic couple- effect of gyroscopic couple on an aero plane and on a naval ship, stability of a four wheel vehicle moving in a curved path, stability of a two-wheel vehicle taking a turn.

Cams: Classification of followers and cams- Definitions- Motions of the follower- Uniform velocity- Simple harmonic motion- Uniform acceleration and retardation- Displacement- Velocity and acceleration diagrams. Construction of cam profiles- Cam with knife edged follower and roller follower- Cams with specified contours- Tangent cam with roller follower-Circular arc cam with flat faced follower.

Toothed gearing: Classification of toothed wheels, technical terms, conditions for constant velocity ratio of toothed wheels- Law of gearing- Velocity of sliding of teeth, forms of teeth- Length of contact, arc of contact, interference in involute gears, minimum number of teeth required on pinion to avoid interference- Methods of avoiding interference- Helical gears, Spiral gears- Efficiency of spiral gears.

Gear Trains: Types of gear trains- Simple, compound, reverted and epicyclic gear trains- Velocity ratio of epicyclic gear train- Tabular method- Algebraic method- Torques and tooth loads in epicyclic gear trains.

Balancing of Rotating and Reciprocating Masses: Balancing of a single rotating mass in thesame plane and by two masses in different planes, balancing of several masses revolving in thesame plane- Balancing of several masses revolving in different planes- Primary and secondaryunbalanced forces of reciprocating masses, Partial balancing of unbalanced primary forces in a reciprocating engine, Partial balancing of locomotives- Effect of partial balancing of reciprocating parts of two cylinder locomotives- Variation of tractive force, Swaying couple and hammer blow- Balancing of primary and secondary forces in multi cylinder in-line engines- Direct and reverse cranks- Balancing of V-Engines.

Vibrations: Definitions- Types of vibrations- Natural frequencies of free longitudinal vibrations of systems having single degree of freedom- Equilibrium method- Energy method and Rayleghy's method. Frequency of damped vibration and forced vibration with damping- Magnification factor or dynamic magnifier.

Transverse and Torsional Vibrations: Natural frequency of free transverse vibrations due topoint load and uniformly distributed load acting over a simply supported shaft- Transverse vibrations for a shaft subjected to number of point loads- Energy method- Dunkerley's method, Critical speed of a shaft. Natural frequency of free torsional vibrations- Free torsional vibrations of single rotor system, two rotor system, three rotor system and gear system.

Text Book:

1. Theory of Machines by S.S. Rattan.
2. Theory of Machines by R.S.Khurmi&J.K.Gupta.

Reference books:

1. Theory of Machines by Thomas Bevan.

MC- 2203 APPLIED THERMODYNAMICS

(Effective from the batch admitted during 2020-2021-APSCHE)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits :3

COURSE OBJECTIVES:

- To gear the student with basic principles of steam properties.
- To prepare the student for industrial application of steam.
- The student is taught to design the steam equipment so that R&D in industry is improved.

COURSE OUTCOMES:

- The student gets complete knowledge of steam and its properties.
- The student learns the complete calculation procedures for designing steam turbines, steam condensers, nozzles etc. used in thermal power plants, steam engines, water turbines and many other industrial applications.
- The student is prepared to work in industry immediately after his course

SYLLABUS

Properties of Pure Substance: Definition of pure substance, phase change of a pure substance, p-T (Pressure-Temperature) diagram for a pure substance, p-V-T(Pressure-Volume- Temperature) surface, phase change terminology and definitions, property Diagrams in common use, Formation of steam, Important terms relating to steam formation, Thermodynamic properties of steam and steam tables, External work done during evaporation, Internal latent heat, Internal energy of steam, Entropy of water, Entropy of evaporation, Entropy of wet steam, Entropy of superheated steam, Enthalpy-Entropy (h-s) charts for Mollier diagram, Determination of dryness fraction-Tank or bucket calorimeter, throttling calorimeter,separating and throttling calorimeter.

Gases and Vapour Mixtures and Vapor Power Cycles : Introduction, Daltons law and Gibbs-Dalton law, Volumetric Analysis of gas mixtures, Apparent molecular weight and gas constant, specific heats of gas mixture, Adaibatic mixing of perfect gases, Gas and vapour mixtures.Vapor power cycle- Rankine cycle- Reheat cycle- Regenerative cycle-Thermodynamic variables effecting efficiency and output of Rankine and Regenerative cycles-Improvements of efficiency, Binary vapor power cycle.

Steam Nozzles: Type of nozzles- Flowthrough nozzles- Condition for maximum discharge-Nozzle efficiency- Super saturated flow in nozzles- Relationship between area velocity and pressure in nozzle flow- Steam injectors.

Steam Turbines: Classification of steam turbines- Impulse turbine and reaction turbine-Compounding in turbines- Velocity diagrams in impulse and reaction turbines- Degree of reaction- Condition for maximum efficiency of reaction turbines- Effect of friction on turbinesconstructional features governing of turbines.

Condensers: Classification of condenser- Jet, Evaporative and surface condensers- Vacuum and its measurement- Vacuum efficiency- Sources of air leakage in condensers- Condenser efficiency- Daltons law of partial pressures- Determination of mass of cooling water- Air pumps.

Reciprocating and Rotary Compressors: Reciprocating compressors-effect of clearance in compressors, volumetric efficiency-single stage and multi stage compressors-effect of inter cooling in multi stage compressors-Vane type blower-centrifugal compressor-

Adiabatic efficiency- Diffuser- Axial flow compressors- Velocity diagrams, degree of reaction, performance characteristics.

Refrigeration: Bell Colemen cycle, Vapor compression cycle- effect of suction and condensing temperature on cycle performance, Properties of common refrigerants, Vapor absorption system, Electrolux refrigerator. Principles of psychrometry and Air conditioning - Psychrometric terms, psychrometric process, air conditioning systems.

Text Books:

1. A Treatise on Heat Engineering by Vasandhani and Kumar.
2. Applied Thermodynamics-II by R. Yadav.
3. Fundamentals of Engineering Thermodynamics by E. Radhakrishna, PHI.

References:

1. Thermal Engineering, by R. K. Rajput.
2. Fluid Flow Machines, by M.S. GovindaRao, Tata McGraw Hill publishing company Ltd.
3. Refrigeration and Air-conditioning, by C.P.Arora and Domokundwar.
4. Thermal Science and Engineering by D.S. Kumar, S.K. Kataria and Sons
5. Refrigeration and Air-conditioning, by Arora and Domkundwar, Dhanpat Rai

MC- 2204 METAL CUTTING AND MACHINE TOOLS

(Effective from the batch admitted during 2020-2021-APSCHE)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 3

Course Objectives:

- To provide knowledge about the metal cutting tools, tool geometry, tool materials, mechanism of metal cutting, force relations, velocity relations and machinability.
- To provide information about the working principle, specifications, classifications, parts, mechanisms, operations and attachments of an engine lathe machine, capstan and turret lathes.
- To provide awareness on the working principle, specifications, classifications, parts and operations of machine tools using single point cutting tools such as boring machines, shaper, slotter and planer machines.
- To provide understanding on the working principle, specifications, classifications, parts and operations of machine tools using multi point cutting tools such as drilling machines, grinding, and milling machines.
- To get familiar with the information about finishing operations such as lapping, honing and super finishing.
- To feed the knowledge about the classification, working principle and construction of various unconventional machining methods.

Course Outcomes:

After successful completion of this course, the student will be able to:

- Imbibe the knowledge about types of tools, their specification, materials, forces, life and cutting fluids.
- Get acquainted with types, mechanisms and attachments of an engine lathe and can perform various operations on an engine lathe and capstan and turret lathes.

- Get awareness on details about and also working with boring machines, shaper, slotter and planer machines
- Get familiar with the types, parts and operations of drilling, grinding and milling machines.
- Get the knowledge about the finishing operations like lapping, honing and super finishing.
- Know the information about various Unconventional machining methods.

SYLLABUS

Mechanics of Metal Cutting; Single point cutting tool geometry and tool signature; ASA&ISO systems; Types of chips and types of cutting; Tool materials; Cutting forces, power, velocities and temperatures; Machinability; Tool wear, tool failure and tool life; Economics of metal cutting; problems on cutting forces, tool life and economics; Cutting fluids.

Machine tools using Single Point Cutting Tools: Specifications, Classifications, Constructional details, Mechanisms, Operations, Cutting parameters and Machining time calculations of an Engine Lathe, Shaper, Slotter and Planer; Work holding and Tool holding devices on Lathe machine; Capstan and Turret lathes; Boring machines and operations;

Machine tools using Multi Point Cutting Tools: Types and geometry of Drills, Milling Cutters and Grinding wheels; Specifications, Classifications, Constructional details, Operations, Cutting parameters, Machining time and Power calculations of Drilling, Milling and Grinding machines; Indexing heads and methods; Method of specification, Selection, Loading, Glazing, Dressing and Trueing of Grinding wheels; Broaching types, tools, machines and Broach time.

Finishing Operations: Operating Principle, Types and Working of Lapping, Honing, Super Finishing, Electro Polishing and Buffing operations.

Unconventional Machining Methods: Classification of unconventional machining methods, Working Principle, Constructional details, advantages, disadvantages and applications of CHM, ECM, EDM, EBM, LBM, USM, AJM and WJM.

Text Books:

1. Process and Materials of Manufacture (4th Edition) by Roy A. Lindberg, PHI Private Limited.
2. A course in Workshop Technology Vol. II by B.S.Raghuvanshi, Dhanpat Rai &co.

Reference Books:

1. Fundamentals of Metal Machining and Machine Tools by Geoffrey Boothroyd, International Student Edition, McGraw-Hill Book Company.
2. Metal Cutting Principles by M.C. Shaw, MIT Press, Cambridge.
3. Metal Cutting-Theory and Practice by Amitabha Bhattacharya, Central Book publishers.
4. Production Engineering by P.C. Sharma, S. Chand and Company.
5. Manufacturing Engineering & Technology by Kalpak Jain, PHI.
6. Elements of Workshop Technology Vol. II by Hazra Chowdary.

MC- 2205 DESIGN OF MACHINE ELEMENTS

(Effective from the batch admitted during 2020-2021-APSCHE)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits :3

COURSE OBJECTIVES:

- The main objectives are: Students will be acquainted with standards like ASTM, ASME etc., safety, reliability, importance of dimensional parameters, manufacturing aspects in mechanical design.
- Students will understand to formulate and analyze stresses and strains in machine elements like shafts, springs etc. and structures under static and/ or dynamic load conditions

COURSE OUTCOMES:

Students are able to

- Understand the standard are used for machine elements, safety and reliability concepts in the design of machine elements and the influence of manufacturing processes in the design of machine elements.
- Analyze stresses, strains and deflections in a machine member
- Know static failure criteria for different materials, in the design and analysis of machine components
- Know about various multidimensional fatigue failure criteria, fatigue failure and load-life relation
- Know the terminology, and types of permanent and detachable joints and design and analyze permanent joints (riveted, welded, etc.) under concentric and eccentric loading conditions and power screws
- Know design and analyze shafts with different geometrical features under various Loading conditions and ability to calculate critical speed of shafts and make the design decisions accordingly
- know spring terminology, different types of springs, design and analyze coil springs(compression, tension, torsion) under various loads.

SYLLABUS

Introduction to Mechanical engineering design: traditional design methods, different design models, Problem formulation, Design considerations, engineering materials and processes and their selection, BIS designation of steels, Mechanical properties, Load determination, manufacturing considerations in design.

Design against static loads: Modes of failure, Factory of safety, Axial, bending and torsional stresses, Stress concentration factors. Static failure theories.

Fluctuations and fatigue stresses, Soderberg, Goodman and modified Goodman diagrams, fatigue failure, design consideration in fatigue

Threaded and welded joints: forms of threads, basic types of screw fastenings, ISO metric screw threads, eccentrically loaded bolted joints, Torque requirement for bolt tightening, Fluctuations loads on bolted joints, fasteners, Joints with combined stresses. Power screws, Force analysis. Collar friction, Differential and compound screws design. Types and strength of weld joints subjected to bending and fluctuating loads, cotter and knuckle joints, welded joints, different types welded joints and their design aspects, welding inspection

Shafts, keys and couplings: shafts design on strength basis, torsional rigidity basis, Design of hollow shafts, flexible shafts, ASME codes for shafts, Keys and cotter design, Flat, square keys, Splines, Rigid and flange couplings, Flexible couplings

Spring Design: classification and spring materials, Spring end formation, Design of helical compression springs, helical extension springs, torsion springs, laminated springs, Protective coatings, Equalized stress in spring leaves. Multi - leaf springs. Surge in springs, Nipping andshot peening.

Text Books:

1. Design of Machine Elements by V.B.Bhandari, TMH Publishing Co. Ltd., New Delhi

References:

1. Machine Design by Jain, Khanna Publications.
2. Machine Design by Pandya and Shaw, Charotar publications
3. Machine design , an integrated approach by R.L.Norton, 2nd edition, Pearson Education

MEC- 2206 I.C ENGINES LAB

((Effective from the batch admitted during 2020-2021-APSCHE)

Periods/week : 3 Lab Ses. : 50 Exam : 50

Examination (Practical): 3hrs. Credits : 1.5

Course Objectives:

- Student should have hands on experience in handling different equipment's in the laboratory
- To evaluate properties of fuels and lubricating oils used in engines
- Student should learn components and functioning of compressors
- Student is expected to learn and evaluate performance of IC engines for a given set of conditions

Course Outcomes:

- Students will get hands on experience handling different types of engines available in the lab
- Students will learn to interpret the variables which can influence performance of engines / equipment's
- Students will know the safe operating regimes of different oils / equipment's available in our lab
- Student will have an exposure to a real time gas turbine which was decommissioned from Indian naval ship

List of Experiments:

1. Study and valve timing diagrams for four-stroke and study & PTD of two-stroke engines.
2. Determination of volumetric efficiency of the given air compressor by (i) plate orificemethod and (ii) tank capacity method.
3. a) Determination of flash and fire points and
4. b) Canradsons carbon residue test.
5. Determination of calorific value of flues (solid, liquid and gaseous) by Bomb calorimeter/Gas calorimeter.

6. Determination of the kinematic and absolute viscosity of the given sample oils.
7. Load test and smoke test on I.C. Engines.
8. Morse test on multi-cylinder engine.
9. Heat balance sheet on I.C. Engines.
10. Study of multi-cylinder engines and determination of its firing order.
11. Study of boilers
12. Study of gas turbines

MC- 2107 DYNAMICS OF MACHINERY LAB

(Effective from the batch admitted during 2020-2021- APSCHE)

Periods/week: 3 Lab Ses.:50 Exam : 50

Examination (Practical): 3hrs. Credits:1.5

Course Objectives:

The objectives of this course are

- To develop competency in conducting laboratory experiments for finding moment of inertia of rigid bodies.
- To make the student familiar with commonly used mechanisms for industrial application.
- To demonstrate the various unbalanced rotating systems.
- To familiarize the various types of vibrations for spring mass system.
- To provide the process of calibration to various measuring instruments.

Course Outcomes:

At the end of the course, the student shall be able to

- Determine the moment of inertia of various machine components.
- Perform the kinematic analysis of the mechanisms.
- Analyze the moving parts (rotating parts) for dynamic and static balance.
- Evaluate the natural frequencies of various vibrating systems.
- Apply the principles of calibration for measuring instruments.

List of Experiments:

1. Determination of inertia of the given flywheel and connecting rod.
2. Determination of modulus of rigidity of the given wire with torsion pendulum.
3. Verification of laws of balancing.
4. a) Determination of ratios of angular speeds of shafts connected by Hooke's joint.
   b) Determination of the ratio of times and ram velocities of Withworth quick return motion mechanism.
5. To draw curves of slider displacement and crank angle and linear velocities w.r.t. time for a slider crank mechanism and compare with theoretical values.
6. To determine the relation of gyroscopic couple and compare with the theoretical values
7. To determine the radius of gyration of given bar by using bifilar and Trifiller suspension.
8. Find the CG of a connecting rod using free vibration techniques.
9. To determine natural frequency of free torsional vibrations of single rotor system.
10. Find the Natural frequency of the free un-damped vibrations of equivalent spring mass system.
11. Find the Natural frequency of the free damped vibrations of equivalent spring mass system.
12. Find the Natural frequency of the forced damped vibrations of equivalent spring mass system.
13. Find the Natural frequency of the forced un-damped vibrations of equivalent spring mass system.
14. Experiments with piezo-electric pick-up, Inductive pick-ups. Determination of characteristics-Displacement, Velocity and Acceleration.
15. Calibration of the given pressure gauge.

16. Calibration of Rotameter.
17. Calibration of Strain Gauges
    a) Full Bridge
    b) Half Bridge
    c) Quarter Bridge

MC -2208 COMPUTER AIDED MODELLING (Skill Oriented Course)

(Effective from the batch admitted during 2020-2021-APSCHE)

Periods/week : 1 Th 2 Lab Ses. : 50 Exam : 50

Examination (Practical): 3hrs. Credits : 2

Course Objective:

- The course introduces to the student to the CATIA V5 environment with emphasis on the use of the Sketcher Workbench. It also presents an overview of the Part Design, Generative Shape Design, and Assembly Design

Course Outcomes:

At the end of the course, the student will be able to

- Use the conventional representations of materials and machine components
- Model various riveted, welded and key joints
- Generate solid models and sectional views of machine components
- Develop solid models of machine parts and assemble them
- Generate the sectional views of assembled components

List of Experiments:

1. Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs, dimensioning types, lines and rules of dimensioning
2. Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned
3. Popular forms of Screw threads, bolts, and nuts
4. Protected Flange Coupling
5. Cotter joint and knuckle joint
6. Riveted joints for plates
7. Spigot and socket pipe joint
8. Journal bearing and foot step bearing
9. Part modelling & views
10. Assembly of stuffing box
11. Assembly of Universal coupling
12. Assembly of screw jack
13. Assembly of engine connecting rod and piston assembly
14. Assembly of feed check valve
15. Drafting of assembled components showing various views and sections

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Software Packages: CATIA, Solidworks, Creo, AutoCAD etc.,

MC- 2209 ENVIRONMENTAL SCIENCE

(Effective from the batch admitted during 2020-2021-APSCHE)

(Common to all Branches)

Periods/week : 0 Ses. : 0 Exam : 100

Examination (Theory): 3hrs. Credits : 0

Course Objectives

The objectives of the Environmental Science course are to

- Familiarize the fundamental aspects of environment and the environmental management'
- Provide information of some of the important international conventions which will be useful during the future endeavors after graduation.
- Make realize the importance of natural resources management for the sustenance of the life and the society.
- Apprise the impact of pollution getting generated through the anthropogenic activities on the environment
- Provide the concept of Sustainable Development, energy and environmental management
- Impart knowledge on the new generation waste like e-waste and plastic waste.

Course Outcomes

After completion of the course the students will have

- Knowledge on the fundamental aspects of environment and the environmental management
- The knowledge on the salient features of the important international conventions
- Understanding of the importance of natural resources management for the sustenance of the life and the society.
- Familiarity on various forms of pollution and its impact on the environment.
- Understand the elements of Sustainable Development, energy and environmental management
- Knowledge on the new generation waste like e-waste and plastic waste.

SYLLABUS

Introduction: Structure and functions of Ecosystems-Ecosystems and its Dynamics-Value of Biodiversity-impact of loss of biodiversity, Conservation of bio-diversity. Environmental indicators - Global environmental issues and their impact on the ecosystems.
Salient features of International conventions on Environment: Montreal Protocol, Kyoto protocol, Ramsar Convention on Wetlands, Stockholm Convention on Persistent Organic Pollutants, United Nations Framework Convention on Climate Change (UNFCCC),

Natural Resources Management: Importance of natural resources management-Land as resource, Land degradation, Soil erosion and desertification, Effects of usage of fertilizer, herbicides and pesticide- watershed management.

Forest resources: Use and over-exploitation, Mining and dams – their effects on forest ecosystems and the living beings.

Water resources: Exploitation of surface and groundwater, Floods, droughts, Dams:benefits and costs.

Mineral Resources: Impact of mining on the environment and possible environmental management options in mining and processing of the minerals.
Sustainable resource management (land, water, and energy), and resilient design under the changing environment.
Environmental Pollution: Local and Global Issues. Causes, effects and control measures. Engineering aspects of environmental pollution control systems.

Air pollution: impacts of ambient and indoor air pollution on human health. Water pollution: impacts water pollution on human health and loss of fresh water resources. Soil pollution and its impact on environment. Marine pollution and its impact on blue economy. Noise pollution.

Solid waste management: Important elements in solid waste management- Waste to energy concepts. Air (prevention and control of pollution) Act, Water (prevention and control of pollution) Act and their amendments. Salient features of Environmental protection Act, 1986.

Sustainable Development: Fundamentals of Sustainable Development– Sustainability Strategies and Barriers – Industrialization and sustainable development. Circular economy concepts in waste (solid and fluid) management.

Energy and Environment: Environmental Benefits and challenges, Availability and need of conventional energy resources, major environmental problems related to the conventional energy resources, future possibilities of energy need and availability. Solar Energy: process of photovoltaic energy conversion, solar energy conversion technologies and devices, their principles, working and applications, disposal of solar panel after their usage. Biomass energy: Concept of biomass energy utilization, types of biomass energy, conversion processes, Wind Energy, energy conversion technologies, their principles, equipment and suitability in context of India.

Management of plastic waste and E-waste: Sources, generation and characteristics of various e- and plastic wastes generated from various industrial and commercial activities; Waste management practices including onsite handling, storage, collection and transfer. E-waste and plastic waste processing alternatives. E-Waste management rules and Plastic waste management rules, 2016 and their subsequent amendments.

Text Books:

1. Bharucha,Erach (2004). Textbook for Environmental Studies for Undergraduate Courses of all Branches of Higher Education, University Grants Commission, New Delhi.
2. Basu, M., Xavier, S. (2016). Fundamentals of Environmental Studies, Cambridge University Press, India
3. Masters, G. M., &Ela, W. P. (1991). Introduction to environmental engineering and science. Englewood Cliffs, NJ: Prentice Hall.
4. Enger, E. and Smith, B., Environmental Science: A Study of Interrelationships, Publisher: McGraw-Hill Higher Education; 12th edition, 2010.

Reference Books:

1. Sharma, P. D., & Sharma, P. D. (2005). Ecology and environment. Rastogi Publications
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
3. Clark R.S. (2001). Marine Pollution, Clanderson Press Oxford (TB)
4. Jadhav, H & Bhosale, V.M. (1995). Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.
5. MoEF&CC, Govt. of India, CPCB: E-waste management rules, 2016 and its amendments 2018.
6. MoEF&CC, Govt. of India, CPCB: Plastic waste management rules, 2016.