DEPARTMENT OF MECHANICAL ENGINEERING
ANDHRA UNIVERSITY COLLEGE OF ENGINEERING
VISAKHAPATNAM-530003, ANDHRA PRADESH, INDIA

Program Educational Objectives (PEO's)

PEO1: The graduates of the mechanical engineering program will have solid fundamental technical knowledge and will be able to use software tools to expand their knowledge horizon and cultivate a lifelong learning culture while also developing core competencies in a variety of fields, including design, production, thermal, industrial, and allied fields.

PEO2 : The Graduates will maintain ethical conduct, sense of responsibility to serve the society and protect the environment.

PEO3: The Graduates will be able to work in project teams with effective communication skills, soft skills, managerial skills, leadership qualities and knowledge of contemporary issues for successful professional career and for higher studies too.

PEO4: Graduates will demonstrate professional development by pursing higher education and professional certification in the areas of mechanical engineering

Program Outcomes (POs)

PO1: Engineering Knowledge – Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis-Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3:Design/Development of solutions – Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems – Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage – Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6:The engineer and society – Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and Sustainability – Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics – Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and teamwork – Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication – Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance – Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning – Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PPROGRAM SPECIFIC OUTCOME (PSOs)

After successful completion of programe, the students should be able to

PSO 1: Apply knowledge of basic engineering, mechanical engineering, mathematics, physical sciences and engineering management to develop simple to complex mechanical engineering systems.

PSO 2: Identify, investigate, model and analyze engineering challenges and problems in the diverse fields of mechanical engineering e.g. thermo-fluid, manufacturing, design, industrial management and in interdisciplinary fields including research, with career options in the fields as stated.

PSO 3: Smoothly dovetail into the real world of Mechanical Engineering as a finished product.

PSO 4: An ability to develop and implement new ideas on product design with the help of modern computer aided tools(CAD,CAM) and programming language(PYTHON) for ensuring best manufacturing practices.

SCHEME AND SYLLABI
(with effect from 2021-22)

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

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
MC1101	BS	Mathematics – I	4	0	30	70	100	3
MC1102	BS	Physics	4	0	30	70	100	3
MC1103	ES	Engineering Graphics	2	3	30	70	100	3
MC1104	ES	Engineering Mechanics	4	0	30	70	100	3
MC1105	ES	Electrical Technology	4	0	30	70	100	3
MC1106	ES	Workshop	0	3	50	50	100	1.5
MC1107	BS	Physics Lab	0	3	50	50	100	1.5
MC1108	ES	Electrical Technology Lab	0	3	50	50	100	1.5
							Total Credits	**19.5**

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

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
MC1201	BS	Mathematics – II	4	0	30	70	100	3
MC1202	BS	Chemistry	4	0	30	70	100	3
MC1203	HSS	English	4	0	30	70	100	3
MC1204	ES	Computer Programming and Numerical Methods	4	0	30	70	100	3
MC1205	ES	Strength of Materials	4	0	30	70	100	3
MC1206	HSS	English Language Lab	0	3	50	50	100	1.5
MC1207	BS	Chemistry Lab	0	3	50	50	100	1.5
MC1208	ES	Computer Programming and Numerical Methods Lab	0	3	50	50	100	1.5
							Total Credits	**19.5**

B.Tech & B.Tech+M.Tech (with effect from 2021-22)

II Year - I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
		Thermodynamics	4	0	30	70	100	3
MC2104	PC	Manufacturing Processes	4	0	30	70	100	3
MC2105	HSS	Managerial Economics	4	0	30	70	100	3
MC2106	PC	Strength of Materials Lab	0	3	50	50	100	1.5
MC2107	PC	Manufacturing Technology -I Lab	0	3	50	50	100	1.5
MC2108	PC	Machine Drawing	0	3	50	50	100	1.5
MC2109	SC	Problem Solving and Programming Skills Using Technical Computing	1	2	50	50	100	2
MC2110	MC	Professional Ethics and Universal Human Values	0	0	00	100	100	0
MC2111	MC	NCC/NSS	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	P				
MC2201	ES	Metal Cutting and Machine Tools	4	0	30	70	100	3
MC2202	PC	Dynamics of Machinery	4	0	30	70	100	3
MC2203	PC	Applied Thermodynamics	4	0	30	70	100	3
MC2204	PC	Industrial Engineering and Management	4	0	30	70	100	3
MC2205	PC	Design of Machine Elements-I	4	0	30	70	100	3
MC2206	PC	Fuels and Internal Combustion Engines Lab	0	3	50	50	100	1.5
MC2207	PC	Manufacturing Technology -II Lab	0	3	50	50	100	1.5
MC2208	SC	Computer Aided Modelling	1	2	50	50	100	2
MC2209	MC	Environmental Science	0	0	00	100	100	0
							Total Credits	**20**
Internship-I								

B.Tech & B.Tech+M.Tech (with effect from 2021-22)
III Year - I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
		Analysis						
MC3102	PC	Metrology and Computer Numerical Control (CNC)	4	0	30	70	100	3
MC3103	PC	Production Planning and Control	4	0	30	70	100	3
MC3104	PE	Professional Elective-I	4	0	30	70	100	3
MC3105	OE	Open Elective-I	4	0	30	70	100	3
MC3106	PC	Dynamics of						
MC3107	PC	Industrial Engineering Lab	0	3	50	50	100	1.5
MC3108	SC	Python Programming	1	2	50	50	100	2
MC3109	INT	Internship-I			50	50	100	2
							Total Credits	**22**

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

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
MC3201	PC	Design of Machine	4	0	30	70	100	3
MC3202	PC	Fluid Mechanics and Machinery	4	0	30	70	100	3
MC3203	PC	Heat Transfer	4	0	30	70	100	3
MC3204	PE	Professional Elective-II	4	0	30	70	100	3
MC3205	OE	Open Elective-II	4	0	30	70	100	3
MC3206	PC	Metrology & Mechatronics Lab	0	3	50	50	100	1.5
MC3207	PC	Fluid Mechanics and Machinery Lab	0	3	50	50	100	1.5
MC3208	PC	Heat Transfer Lab	0	3	50	50	100	1.5
MC3209	SC	Soft Skills	1	2	50	50	100	2
							Total Credits	**21.5**
Internship-II								

B.Tech & B.Tech+M.Tech (with effect from 2021-22)
IV Year - I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
MC4101	PE	Professional Elective-III						
MC4102	PE	Professional Elective-IV						
MC4103	PE	Professional Elective-V	4	0	30	70	100	3
MC4104	OE	Open Elective-III	4	0	30	70	100	3
MC4105	OE	Open Elective-IV	4	0	30	70	100	3
MC4106	HSSE	HSS-Elective	4	0	30	70	100	3
MC4107	SC	Simulation of Engineering Structures	1	2	50	50	100	2
MC4108	INT	Internship-II			50	50	100	2
							Total Credits	**22**

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

Course code	Category	Course Title	Internal Marks	External Marks	Total Marks	Credits
MC4201	PROJ	Project work	100	100	200	14
					Total Credits	**14**

PROFESSIONAL ELECTIVES

1. Mechanics of Materials
2. Mechanical Vibrations
3. Composite Materials
4. Work-Study and Ergonomics
5. Condition Monitoring
6. Automobile Engineering
7. Maintenance Engineering and Management
8. Vehicle Dynamics
9. Computer Aided Design / Computer Aided Manufacturing (CAD/CAM)
10. Refrigeration and Air-conditioning
11. Statistical Quality Control
12. Tool Design

13. Power Plant Engineering
14. Turbo Machinery
15. Gas Dynamics and Space Propulsion

OPEN ELECTIVES

1. Additive Manufacturing
2. Reliability Engineering
3. Structural Health Monitoring
4. Tribology
5. Total Quality Management
6. Solar Energy- Technology and Applications
7. Computational Fluid Dynamics
8. Artificial Neural Networks
9. Instrumentation and Control Systems
10. Renewable Sources of Energy
11. Energy Conservation in Industries
12. Artificial Intelligence and Machine Learning

HSS ELECTIVES

1. Organizational Behaviour
2. Industrial Management and Entrepreneurship
3. Operations Research

FIRST YEAR 1ST SEMESTER
MC 1101 - MATHEMATICS -I

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

Course Objectives:

The contents of this course fulfill the fundamental requirements of knowledge of Mathematics for learning Engineering subjects. The main objectives of student learning are:

1. To transmit the knowledge of Partial differentiation.
2. To know of getting maxima and minima of function of two variables and finding errors and approximations.
3. To evaluate double and triple integrals, volumes of solids and area of curved surfaces.
4. To expand a periodical function as Fourier series and half-range Fourier series.

SYLLABUS :

Partial Differentiation: Introduction - Functions of two or more variables - Partial derivatives - Homogeneous functions – Euler's theorem - Total derivative - Change of variables – Jacobins. Mean value Theorems (without proofs)

Learning out comes:

After the completion of this topic, the student will be able to

1. Understand partial derivatives.
2. Understand to evaluate Euler's theorem and total derivatives.
3. Understand to find Jacobian's and problems regarding to mean value theorems.

Applications of Partial Differentiation: Geometrical interpretation -Tangent plane and Normal to a surface -Taylor's theorem for functions of two variables - Errors and approximations -Total differential. Maxima and Minima of functions of two variables - Lagrange's method of undetermined multipliers - Differentiation under the integral Sign - Leibnitz's rule.

Learning out comes:

After the completion of this topic, the student will be able to

1. Understand the concepts of geometric interpretation, tangent plane and normal to the surface.
2. Understand the concepts of Taylor,s theorem for function of two variables, errors and approximations.
3. Understand the concepts of maximas, minimas, Lagrange's method of undetermined multipliers and Leibniz rule.

Multiple Integrals: Introduction - Double Integrals - Change of Order of Integration - Double Integrals in Polar Coordinates - Triple Integrals - Change of Variables.

Learning out comes:

After the completion of this topic, the student will be able to

1. Understand to solve problems in range of mathematical application using the integral. To evaluate double and triple integrals for area and volumes.
2. Understand the concepts of change the order of integration in double integrals.
3. Understand the concept of change of variables.

Multiple Integrals-Applications: Area enclosed by plane curves - Volumes of solids - Area of a curved surface - Calculation of Mass - Center of gravity - Moment of inertia - product of inertia –

principal axes- Beta Function - Gamma Function - Relation between Beta and Gamma Functions. Error Function or Probability Integral.

Learning out comes:

After the completion of this topic, the student will be able to

1. Understand the concept of areas by plane curves, volume of solids and areas of curved surfaces.
2. Understand the concept of moment of inertia, product of inertia, calculation of mass and centre of gravity.

To understand the concept of special functions, beta and gamma functions, error function of probability integrals

Fourier Series: Introduction - Euler's Formulae - Conditions for a Fourier Expansion - Functions having points of discontinuity - Change of Interval - Odd and Even Functions - Expansions of Odd or Even Periodic Functions, Half-Range Series - Parseval's Formula. Practical Harmonic analysis.

Learning out comes:

After the completion of this topic, the student will be able to

1. Understand Euler's formula to evaluate Fourier expansion.
2. Understand the concept of Fourier series expansion about change of intervals.
3. Understand the concepts of Fourier expansion about odd or even functions, Half range series and Parseval's formula.

Course Outcomes:

At the end of this course, the student will understand and be able to apply the basic principles of differential and integral calculus to various engineering problems. Particularly, the student will be able to

1. Find the partial derivatives of functions of two or more variables.
2. Evaluate maxima and minima, errors and approximations.
3. Evaluate double and triple integrals, volumes of solids and area of curved surfaces.
4. To expand a periodical function as Fourier series and half-range Fourier series.
5. Have a fundamental understanding of Fourier series and be able to give Fourier expansions of a given function.

Text Book:

1. Scope and Treatment as in "Higher Engineering Mathematics", Dr. B.S. Grewal, 43rd Edition, Khanna publishers,2017.

Reference Books:

1. Graduate Engineering Mathematics , V B Kumar Vatti., I.K.International publishing house Pvt. Ltd,2020.
2. Advanced Engineering Mathematics , Erwin Kreyszig,2015.
3. A text book of Engineering Mathematics, N.P. Bali and Dr. Manish Goyal, Lakshmi Publications Pvt Ltd,2017.
4. Advanced Engineering Mathematics ,H.K. Dass. S. Chand Company,2007.
5. Higher Engineering Mathematics , B.V. Ramana, Tata Mc Graw Hill Company,2006.

6. Higher Engineering Mathematics , Dr. M.K.Venkataraman,2015.

MC1102- PHYSICS

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

Course Objectives:

1. To impart knowledge in basic concept of physics of Thermodynamics relevant to engineering applications.
2. To grasp the concepts of physics for electromagnetism and its application to engineering. Learn production of Ultrasonics and their applications in engineering.
3. To Develop understanding of interference, diffraction and polarization: connect it to a few engineering applications.
4. To Learn basics of lasers and optical fibers and their use in some applications.
5. To Understand concepts and principles in quantum mechanics and Nanopahse Materials. Relate them to some applications.

SYLLABUS :

Thermodynamics: Introduction, Heat and Work, First law of thermodynamics and applications, Reversible and Irreversible process, Carnot cycle and Efficiency, Second law of thermodynamics, Carnot's Theorem, Entropy, Second law in terms of entropy, Entropy and disorder, Third law of thermodynamics (statement only).

Electromagnetism: Concept of electric flux, Gauss's law - some applications, Magnetic field - Magnetic force on current, torque on current loop, The Biot-Savart's Law, B near a long wire, B for a circular Current loop, Ampere's law, B for a solenoid, Hall effect, Faraday's law of induction, Lenz's law, Induced magnetic fields, Displacement current, Maxwell's equations (no derivation), Magnetic materials: Classification of magnetic materials and properties.

Ultrasonics : Introduction, Production of Ultrasonics – Piezoelectric and Magnetostriction methods, acoustic grating, applications of ultrasonics.

Optics: Interference: Principles of superposition – Young's Experiment – Coherence - Interference in thin films (reflected light), Newton's Rings, Michelson Interferometer and its applications.

Diffraction: Introduction, Differences between interference and diffraction, Fresnel and Fraunhofer diffraction, Fraunhofer diffraction at a single slit (Qualitative and quantitative treatment).

Polarisation: Polarisation by reflection, refraction and double refraction in uniaxial crystals, Nicol prism, Quarter and Half wave plate, circular and elliptical polarization.

Lasers And Fibre Optics: Introduction, characteristics of a laser beam, spontaneous and stimulated emission of radiation, population inversion, Ruby laser, He-Ne laser, Semiconductor laser, applications of lasers.

Introduction to optical fibers, principle of propagation of light in optical fibers, Acceptance Angle and cone of a fibre, Numerical aperture, Modes of propagations, classification of fibers, Fibre optics in communications, Application of optical fibers.

Modern Physics: Introduction, De Broglie concept of matter waves, Heisenberg uncertainty principle, Schrodinger time independent wave equation, application to a particle in a box. Free electron theory of metals, Kronig - Penney model (qualitative treatment), Origin of energy band formation in solids, Classification of materials into conductors, semi conductors and insulators.

Nanophase Materials: Introduction, properties, Top-down and bottom up approaches, Synthesis - Ball milling, Chemical vapour deposition method , sol-gel methods, Applications of nano materials.

Learning outcomes:

The students will be able to

1. Gains knowledge about laws of thermodynamics , its application.
2. Understand concept of entropy and disorder along with reversible and irreversible process.
3. Familiarise the concept and laws of electromagnetism and its applications.
4. To understand the principle of magnetic field and its applications.
5. Gains knowledge about ultrasonics ans its applications.
6. Analyse the concept of optics Along with interference, diffraction and polarisation.
7. Obtain knowledge about principle of superposition and application of interference.
8. Understand the characteristics of laser beam and applications of laser.
9. Familiarise the principle of optical fibre and its application in communication technology.
10. Gains knowledge about modern physics and nano-phase materials with its applications

Course Outcomes:

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

1. Understand the fundamentals of Thermodynamics and Laws of thermodynamics. Understand the working of Carnot cycle and concept of entropy.
2. Gain Knowledge on the basic concepts of electric and magnetic fields. Understand the concept of the nature of magnetic materials. Gain knowledge on electromagnetic induction and its applications .
3. Understand the Theory of Superposition of waves. Understand the formation of Newton's rings and the working of Michelson's interferometer. Remember the basics of diffraction, Evaluate the path difference. Analysis of Fraunhofer Diffraction due to a single slit
4. Understand the interaction of matter with radiation, Characteristics of Lasers, Principle, working schemes of Laser and Principle of Optical Fiber. Realize their role in optical fiber communication.
5. Understand the intuitive ideas of the Quantum physics and understand dual nature of matter. Compute Eigen values, Eigen functions, momentum of Atomic and subatomic particles using Time independent one Dimensional Schrodinger's wave equation. Understand the fundamentals and synthesis processes of Nanophase materials.

Text Books:

1. Physics, David Halliday and Robert Resnick – Part I and Part II - Wiley.
2. A textbook of Engineering Physics, Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar - S. Chand
3. Engineering Physics, R.K. Gaur and S.L. Gupta –Dhanpat Rai

Reference Books:

1. Modern Engineering Physics, A.S. Vadudeva
2. University Physics, Young and Freedman

MC1103 ENGINEERING GRAPHICS

(Effective from the batch admitted during 2021-2022 APSCHE)

Periods/week : 2Th+3Lab Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits :3

Course Objectives:

The main objectives of the course are to

1. Understand the basics of Engineering Graphics and BIS conventions.
2. Develop the graphical skills for communication of concepts, ideas and design of engineering products through technical drawings
3. Demonstrate and practice the various profiles/curves used in engineering practice through standard procedures.
4. Demonstrate and practice the orthographic projections of points, lines, planes, solids and section of solids
5. Demonstrate and practice the development of surfaces of simple solids
6. Familiarize the basic concept of isometric views clearly.

SYLLABUS :

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions, and Scales.

Curves: Conic sections: General construction of ellipse, parabola and hyperbola. Construction of involutes of circle and polygons only. Normal and tangent to curves.

Projections of Points: Principal or Reference Planes, Projections of a point situated in any one of the four quadrants.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to Both the Reference Planes

Projections of Planes: Projection of Perpendicular planes: Perpendicular to both reference planes, perpendicular to one reference plane and parallel to other reference plane and perpendicular to one reference plane and inclined to other reference plane. Projection of Oblique planes. Introduction to Auxiliary Planes.

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to other and axes inclined to both the reference planes.

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids (Prism, Pyramid, Cylinder and Cone) in simple position only.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

Isometric Views: Isometric projection, Isometric scale and Isometric view. Isometric view of Prisms, Pyramids, cylinder, cone, and their combinations.

Course Outcomes:

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

1. Develop simple engineering drawings by considering BIS standards.
2. Able to draw different engineering curves with standard Procedures
3. Comprehend the basics of orthographic projections and deduce orthographic projections of points, lines, planes and solids at different orientations in real life environment.
4. Visualize clearly the sections of solids.
5. Apply the concepts of development of surfaces while designing/analyzing any product.
6. Recognize the significance of isometric drawing to relate 2D environment with 3D environment.

Text Book:

1.Engineering Drawing , N.D.Bhatt ,Charotar Publishing House, 2016.

Reference Books:

1. Engineering Drawing , K.L. Narayana and P. Kannaiah, Tata Mc-Graw Hill, 2013.
2. Engineering Drawing , P M.B.Shah and B.C. Rana, Pearson Education Inc,2009.
3. Engineering Drawing with an Introduction to AutoCAD , Dhananjay Jolhe, Tata Mc-Graw Hill, 2017.

MC 1104 ENGINEERING MECHANICS

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

Course Objectives

1. To make the students to know the importance of this subject in the field of engineering particularly related to Mechanical Engineering.
2. To make them learn the fundamentals of Mechanics, equation of static equilibrium & Dynamic equilibrium of particles and rigid bodies.
3. To learn the effect of friction on equilibrium.
4. To learn kinematics, kinetics of particle and rigid body, related principles.
5. To implement the above concepts to solve practical engineering problems.

SYLLABUS :

Forces in a plane: Concepts, concurrent forces, static equilibrium equations, concept of friction, parallel forces, concept of distributed forces, couples in a plane, distributed forces, centroids.

Analysis of trusses and Frames: Method of joints and method of sections only, frames

Forces in space: Concurrent and parallel forces in a plane, couples in space, principle of virtual work.

Rectilinear Motion: Kinematics of rectilinear translation, Differential equation of rectilinear translation, force proportional to displacement, free vibrations, D'Alembert's principle, momentum, impulse, work and energy,

Curvilinear translation: Kinematics of curvilinear motion, differential equations of curvilinear motion, projectiles, D'Alembert's principle, Work and energy in curvilinear motion.

Rotation of rigid body about a fixed axis: Kinematics of rotation, equation of motion for a rigid body, rotation under the action of a constant moment, torsional vibrations, compound pendulum, general case of moment proportional to angle of rotation, D'Alembert's principle of rotation.

Plane motion of rigid body: Kinematics of plane motion, instantaneous centre, equations of plane motion, D'Alembert's principle in plane motion, the principle of angular momentum in plane motion, energy equation for plane motion.

Course Outcome

1. At the end of this course, student must be in a position to analysis and solve the practical problems of statics and dynamics.
2. Enables the students better understand the subjects like Theory of Machines, Strength of Materials, Design of machine elements etc.

Text Books:

1. Engineering Mechanics by Timoshenko and Young

Reference Books:

1. Engineering mechanics – Statics & Dynamics by James L. meriam, L.G. Kraige
2. Engineering Mechanics Statics and dynamics, by Tayal, A.K
3. Engineering Mechanics by SS Bhavikkati
4. A textbook of Engineering Mechanics by RS Khurmi

MC 1105 ELECTRICAL TECHNOLOGY

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

Course Objectives:

1. Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context.
2. Provide working knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices.
3. To explain the working principle, construction, applications of DC machines, AC machines & measuring instruments.
4. Highlight the importance of transformers in transmission and distribution of electric power.

SYLLABUS:

Magnetic Circuits: Definitions of magnetic circuit, Reluctance, Magnetomotive force (m.m.f), Magnetic flux, Simple problems on magnetic circuits, Hysteresis loss.

Electromagnetic Induction: Faraday's laws of Electromagnetic induction, Induced E.M.F., Dynamically induced E.M.F., Statically induced E.M.F., Self inductance, Mutual inductance.

D.C. Generators: D.C. generator principle, Construction of D.C. generator, E.M.F. equation of D.C. generator, Types of D.C. generators, Armature reaction, Losses in D.C. generator, Efficiency, Characteristics of D.C. generators, Applications of D.C. generator.

D.C. Motors: D.C. motor principle, Working of D.C. motors, Significance of back E.M.F., Torque equation of D.C. motors, Types of D.C. motors, Characteristics of D.C. motors, Speed

control methods of D.C. motors, Applications of D.C. motor. Testing of D.C. machines: Losses and efficiency, Direct load test and Swinburne's test.

A.C. Circuits: Introduction of steady state analysis of A.C. circuits, Single and balanced 3-phase circuits.

Transformers: Transformer principle, E.M.F. equation of transformer, Transformer on load, Equivalent circuit of transformer, Voltage regulation of transformer, Losses in a transformer, Calculation of efficiency and regulation by open circuit and short circuit tests.

Three Phase Induction Motor: Induction motor working principle, Construction of 3-phase induction motor, Principle of operation, Types of 3-phase induction motor, Torque equation of induction motor, Slip-torque characteristics, Starting torque, Torque under running condition, Maximum torque equation, Power stages of induction motor, Efficiency calculation of induction motor by direct loading.

Alternator: Alternator working principle, E.M.F. equation of alternator, Voltage regulation by sync, impedance method.

Synchronous Motor: Synchronous motor principle of operation, Construction. Methods of starting of synchronous motor.

Electrical Measurements: Principles of measurement of current, voltage, power and energy. Types of Ammeters, Voltmeters, Watt-meters, Energy meters, Electrical conductivity meter. Potentiometer, Megger.

Learning Outcomes:

1. Classify various DC motors and demonstrate their characteristics
2. Compare distribution and power transformers
3. Understand concept of harmonics
4. Testing of induction motors, analyze methods of speed control
5. Understand concepts of fractional HP motors
6. Explain principle and characteristics of synchronous machines

Course Outcomes:

On completion of the course students will be able to

1. Predict the behavior of any electrical and magnetic circuits.
2. Formulate and solve complex AC, Dc circuits.
3. Identify the type of electrical machine used for that particular application.
4. Realize the requirement of transformers in transmission and distribution of electric power
    a. and other applications.
5. Function on multi-disciplinary teams.

Text Book:

1. Elements of Electrical Engineering and Electronics by V.K. Mehta, S. Chand & Co.

Reference Book:

1. A First Course in Electrical Engineering by Kothari.

MC 1106 WORKSHOP

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Lab): 3hrs. Credits :1.5

Course Objectives:

The engineering work shop practice is included to introduce some common shop practices and on hands on experience to appreciate the use of skill, tools, equipment and general practices to all the engineering students. This laboratory course is aimed to provide the practical exposure to the students in the fields of Carpentry, Fitting, Sheet Metal and house electrical wiring works to

1. Get hands on experience with the working skills in Carpentry trade.
2. Know how to work with Sheet Metal tools.
3. Get familiar with the working skills of Metal Fitting operations.
4. Get hands on experience with house hold electrical wiring.

Course Outcomes:

By the end of this laboratory, the student can be able to

1. Work with Wood Materials in real time applications.
2. Build various parts with Sheet Metal in day-to-day life.
3. Apply Metal Fitting skills in various applications.
4. Apply this knowledge to basic house electrical wiring and repairs.

SYLLABUS:

Carpentry: Any three jobs from – Half lap joint, Mortise and Tenon joint, Half – lap Dovetail joint, Corner Dovetail joint, Central Bridle joint.

Sheet Metal: Any three jobs from – Square tray, Taper tray(sides), Funnel, Elbow pipe joint.

Fitting: Any three jobs from – Square, Hexagon, Rectangular fit, Circular fit and Triangular fit.

House wiring: Any three jobs from – Tube light wiring, Ceiling fan wiring, Stair-case wiring, Corridor wiring.

Hands-on Experiences in Engineering: Assembling and Disassembling of

- Bicycle / Two Wheeler
- Mobile Phone
- Desktop Computer / Laptop

Reference Books:

1. Elements of workshop technology, Vol.1 by S. K. and H. K. Choudary.
2. Work shop Manual / P.Kannaiah/ K.L.Narayana/ SciTech Publishers.
3. Engineering Practices Lab Manual, Jeyapoovan, Saravana Pandian, 4/e Vikas.

MC 1107 PHYSICS LABORATORY

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Lab): 3hrs. Credits :1.5

Course Objectives:

This subject is common to all first year branches of UG engineering. At the end of the course the student is expected to

1. To enable the students to acquire skill, technique and utilization of the Instruments
2. Draw the relevance between the theoretical knowledge and to imply it in a practical manner with respect to analyze various electronic circuits and its components.
3. To impart the practical knowledge in basic concepts of Wave optics, Lasers and Fiber optics.
4. To familiarize the handling of basic physical apparatus like Vernier callipers, screw gauge, spectrometers, travelling microscope, laser device, optical fibre, etc.

List of Experiments:

1. Determination of Radius of Curvature of a given Convex Lens By forming Newton's Rings.
2. Determination of Wavelength of Spectral Lines in the Mercury Spectrum by Normal Incidence method.
3. Study the Intensity Variation of the Magnetic Field along axis of Current Carrying Circular Coil.
4. Determination of Cauchy's Constants of a Given Material of the Prism using Spectrometer.
5. Determination of Refractive Index of Ordinary ray μ_o and Extraordinary μ_e ray.
6. Determination of Thickness Given Paper Strip by Wedge Method.
7. Calibration of Low Range Voltmeter.
8. Calibration of Low Range Ammeter.
9. Determination of Magnetic Moment and Horizontal Component of Earth's Magnetic Field.
10. Lees Method - Coefficient of thermal Conductivity of a Bad Conductor.

11. Carey Foster's Bridge – Verification of laws of Resistance and Determination Of Specific Resistance.
12. Melde's Apparatus – Frequency of electrically maintained Tuning Fork.
13. Photoelectric cell-Characteristics.
14. Planks Constants.
15. Laser- Diffraction.

Learning outcomes:

The students will be able to

1. Gain knowledge the experimental evidence of interference in thin films and wavelength of different colours by diffraction grating.
2. Understand the concept of magnetic field due to current carrying circular coil and compare theoretical values with experimental values
3. Knowledge on Calibration of Voltmeter/Ammeter enable to handle any instrument in future in the industry.
4. Obtain knowledge about Laser diffraction and Hall effect studies
5. Gain knowledge about various applications of semiconductors in engineering field.

Course Outcomes:

1. Ability to design and conduct experiments as well as to analyze and interpret
2. Ability to apply experimental skills to determine the physical quantities related to Heat, Electromagnetism and Optics
3. The student will learn to draw the relevance between theoretical knowledge and the means to imply it in a practical manner by performing various relative experiments.

MC 1108 ELECTRICAL TECHNOLOGY LABORATORY

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Lab): 3hrs. Credits :1.5

Course objectives:

1. To make students learn to calibrate wattmeter and energy meter and conduct a practical analysis of linear circuits by using mesh and nodal analysis.
2. To make the student to learn and predict the characteristics of DC & AC machines and rectifiers.
3. To make the students to study different meters and instruments for measurement of electrical quantities.
4. To make the students to understand 3 phase balanced and un balanced star and delta connected supply and load and to measure power in 3 phase circuits.

List of Experiments:

1. Study and Calibration of wattmeter and energy meter.
2. Measurement of armature resistance, field resistance and filament resistance.
3. Verification of KCL and KVL.
4. Superposition theorem.
5. Parameters of a choke coil.
6. O.C. and S.C. tests on transformer.
7. Load test on D.C. shunt machine.
8. O.C. test on D.C. separately excited machine.
9. Swinburne's test.
10. 3 phase induction motor (No load and rotor block tests) load tests.
11. Alternator regulation by Syn. Impedance method

Learning Outcomes:

1. Select range of apparatus based on the ratings of 1ph Induction motor, synchronousmotor and Transformers.
2. Determine equivalent circuit parameters of 3ph Induction motor
3. Evaluate the efficiency of the different machine by analyzing their test results
4. Determine regulation and perform synchronization of alternator
5. Demonstrate Scott connection on two single phase transformers

Course Outcomes:

1. Analyze linear circuits by using network theorem.
2. Predict the performance characteristics of DC machines and induction motor
3. Predict the regulation of single phase transformer & alternator
4. Observe the performance of rectifiers.

FIRST YEAR 2ND SEMESTER

MC1201 MATHEMATICS-II

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

Course Objectives:

The contents of this course fulfill the fundamental requirements of knowledge of Mathematics for learning Engineering subjects. The main objectives of student learning are :

1. The way of obtaining rank, eigen values and eigen vectors of a matrix.
2. To know the importance of Cayley-Hamilton theorem and getting canonical form from a given quadratic form.
3. To solve the system of equations by using direct and indirect methods.
4. To solve first order and higher order differential equations by various methods.
5. To obtain the Laplace transforms and inverse Laplace transforms for a given functions and their applications.

SYLLABUS:

Linear Algebra: Rank of a matrix- Echelon form, Normal Form - Solution of Linear System of Equations - Consistency of Linear System of Equations - Direct & Indirect Methods: Gauss elimination method, LU Factorization method, Gauss Seidal Method. Complex Matrices: Hermitian, Skew-Hermitian and Unitary Matrices and their Properties.

Learning Out Comes:

After the completion of this topic ,the students will be able to,

1.Understand to solve the rank by using echelon form and normal form

2. Understand to find the solutions of algebraic equations by using matrices methods

3.Understand the concepts of complex matrices

Eigen Values and Eigen Vectors: Eigen Values and Eigen Vectors of a Matrix - Cayley-Hamilton theorem - Inverse and Powers of a Matrix using Cayley-Hamilton's theorem and its applications. Diagonalization of a Matrix - Quadratic Forms - Reduction of Quadratic Form to Canonical Form - Nature of a Quadratic Form.

Learning Out Comes:

After the completion of this topic ,the students will be able to,

1.Understand the concept of eigenvalues, Cayley-Hamilton's theorem and its applications

2. Understand the concept of Diagonalization of a matrix-Quadratic forms

3.Understand the concepts of Nature of a Quadratic Form.

Ordinary Differential Equations of First Order and its Applications: Formation of ordinary differential equations (ODEs) - Solution of an ordinary differential equation - Equations of the first order and first degree - Linear differential equation - Bernoulli’s equation - Exact differential equations - Equations reducible to exact equations - Orthogonal Trajectories - Simple Electric (LR & CR) Circuits - Newton’s Law of Cooling - Law of Natural growth and decay.

Learning Out Comes:

After the completion of this topic ,the students will be able to,

1.Understand the concept of single variable and formation of differential equation

2. Understand the concept of method to find the solutions of first order and first degree differential equations

3.Understand the concepts of applications of differential equations.

Differential Equations of Higher Order: Solutions of Linear Ordinary Differential Equations with Constant Coefficients - Rules for finding the complimentary function - Rules for finding the particular integral - Method of variation of parameters - Cauchy's linear equation - Legendre's linear equation - Simultaneous linear differential equations.

Learning Out Comes:

After the completion of this topic ,the students will be able to,

1.Understand the concept of higher order differential equation

2. Understand the method to find the particular integral

3.Understand the Method of variation of parameters-Cauchy's linear equations-Legendre's linear equation-Simultaneous linear differential equations

Laplace Transforms: Introduction - Existence Conditions - Transforms of Elementary Functions - Properties of Laplace Transforms - Transforms of Derivatives - Transforms of Integrals - Multiplication by t^n - Division by t – Evaluation of integrals by Laplace Transforms - Inverse Laplace Transform - Applications of Laplace Transforms to Ordinary Differential Equations - Simultaneous Linear Differential Equations with Constant Coefficients - Second Shifting Theorem - Laplace Transforms of Unit Step Function, Unit Impulse Function and Laplace Transforms of Periodic Functions.

Learning Out Comes:

After the completion of this topic ,the students will be able to,

1.Understand the concept of Laplace transforms and its Properties

2. Understand the concepts of inverse Laplace transforms and its Properties

3.Understand the concepts to solve the linear differential equations solutions by using laplace transforms.

Course Outcomes:

At the end of this course, the student will understand and be able to apply the basic principles of Linear Algebra, ODEs and Laplace Transforms to various engineering problems. Particularly, the student will be able to

1. Find rank, eigen values and eigen vectors of a matrix and understand the importance of Cayley-Hamilton theorem.
2. Reduce quadratic form to canonical forms and solving linear systems by direct and indirect methods.
3. Demonstrate solutions to first order differential equations by various methods and solve basic applications problems related to electrical circuits, orthogonal trajectories and Newton's law of cooling

4. Discriminate among the structure and procedure of solving higher order differential equations with constant and variable coefficients.
5. Understand Laplace transforms and its properties and finding the solution of ordinary differential equations.

Text Book:

1. Scope and Treatment as in "Higher Engineering Mathematics", Dr. B.S. Grewal, 43r^{d} edition, Khanna publishers.

Reference Books:

1. Graduate Engineering Mathematics , V B Kumar Vatti., I.K. International publishing house Pvt. Ltd.
2. Advanced Engineering Mathematics , Erwin Kreyszig.
3. A text book of Engineering Mathematics, N.P. Bali and Dr. Manish Goyal. Lakshmi Publications.
4. Advanced Engineering Mathematics, H.K. Dass. S. Chand Company.
5. Higher Engineering Mathematics,B.V. Ramana, Tata Mc Graw Hill Company.

MC 1202 CHEMISTRY

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

Course Objectives:

1. To apply the basic knowledge of Chemistry to the Engineering Discipline.
2. To develop knowledge about water and its treatment for industrial and potable purposes.
3. To develop understanding in the areas of Polymers, Mechanism of Corrosion of Metals and Corrosion Control Methods, Fuels, Lubricants and Nanomaterials for of conducting polymers, bio-degradable polymers and fiber reinforced plastics and apply the knowledge for solving existing challenges faced in various engineering and societal areas.

SYLLABUS:

Water Chemistry: Sources of Water – Impurities and their influence of living systems – WHO Limits – Hardness and its Determination – Boiler Troubles and their removal – Water Softening Methods – Lime-Soda, Zeolite and Ion Exchange - Municipal Water Treatment-Break Point Chlorination – Desalination of Sea Water – Reverse Osmosis Method, Electro-dialysis.

Polymers and Plastics: Polymers: Definition – Types of Polymerization (Addition & Condensation) – Mechanisms of Addition Polymerization – Radical and Ionic – Thermodynamics

of Polymerization Process. Plastics: Thermosetting and Thermoplastics – Effect of Polymer Structure on Properties of Cellulose Derivatives – Vinyl Resins – Nylon (6,6), Reinforced Plastics – Conducting Polymers.

Corrosion: Origin and Theory – Types of Corrosion: Chemical and Electrochemical; Pitting, Inter granular, Waterline, Stress – Galvanic Series – Factors Effecting Corrosion.

Corrosion Controlling Methods: Protective Coatings: Metallic Coatings, Electroplating and Electroless Plating – Chemical conversion Coatings – Phosphate, Chromate, Anodized, Organic Coatings – Paints and Special Paints.

Fuels and Lubricants

Solid Fuels: Wood and Coal, Ranking of Coal – Analysis (Proximate and Ultimate) Coke Manufacture – Otto Hoffmann's Process – Applications; **Liquid Fuels:** Petroleum Refining – Motor Fuels – Petrol and Diesel Oil – Knocking – Octane number – Cetane Number; **Gaseous Fuels:** Biogas, LPG and CNG – Characteristics – Applications; **Rocket Fuels:** Propellants – Classification – Characteristics

Lubricants: Classification – Mechanism – Properties of Lubricating Oils – Selection of Lubricants for Engineering Applications.

Nanomaterials: Nanomaterials, Properties and application of fullerenes, fullerols, Carbon nanotubes and nanowires. Synthesis - Top-down and Bottom-up approaches - Nanocomposites - Nanoelectronics- Applications of nanomaterials in catalysis, telecommunication and medicine.

Course Outcome:

1. This course applies the basic concepts and principles studied in Chemistry to Engineering.
2. It provides an application of chemistry to different branches of engineering
3. The students will be able acquire knowledge in the areas of Water Chemistry,Polymers, Corrosion, Fuels and Lubricants and nanomaterials and suggest innovative solutions for existing challenges in these areas.

Text Books:

1. Engineering Chemistry, PC Jain and M. Jain, Dhanpath Rai and Sons, New Delhi.
2. A Text book of Engineering Chemistry, S. S. Dara, S. Chand & Co. New Delhi.

Reference Books:

1. Engineering Chemistry, B. K. Sharma, Krishna Prakashan, Meerut.
2. Introduction to Nanoscience, S. M. Lindsay , Oxford University Press
3. Engineering Chemistry , B. L. Tembe, Kamaluddin and M. S. Krishnan, (NPTEL).

MC 1203 ENGLISH

(Common for all Branches)
(Effective from the batch admitted during 2021-2022 APSCHE)

Periods/week : 4 Th | Ses. : 30 Exam : 70
Examination (Theory): 3hrs. | Credits :3

Course Objectives:

1. To make students understand the explicit and implicit meanings of a text/topic;
2. To give exposure to new words and phrases, and aid to use them in different contexts;
3. To apply relevant writing formats to draft essays, letters, emails and presentations; and
4. To adapt oneself to a given situation and develop a functional approach to finding solutions: adaptability and problem solving.

Text Books:

Language and Life: A Skills Approach Board of Editors, Orient Blackswan Publishers, India. 2018.
Topics:
On the conduct of life: William Hazlitt
Life skills: Values and Ethics
If: Rudyard Kipling

The Brook: Alfred Tennyson
Life skills: Self-Improvement
How I Became a Public Speaker: George Bernard Shaw

The Death Trap: Saki
Life skills: Time Management
On saving Time: Seneca

Chindu Yellama
Life skills: Innovation
Muhammad Yunus
Politics and the English Language: George Orwell
Life skills: Motivation
Dancer with a White Parasol: Ranjana Dave

Grammar:

Prepositions – Articles – Noun-Pronoun Agreement, Subject-Verb Agreement – Misplaced Modifiers – Clichés, Redundancies.

Vocabulary:

Introduction to Word Formation – Root Words from other Languages – Prefixes and Suffixes – Synonyms, Antonyms – Common Abbreviations

Writing:

Clauses and Sentences – Punctuation – Principals of Good Writing – Essay Writing – Writing a Summary

Course Outcomes:

1. Students will be able to analyze a given text and discover the various aspects related to language and literature;
2. Learn the various language structures, parts of speech and figures of speech;
3. Develop one's reading and writing abilities for enhanced communication; and
4. Learn to apply the topics in real-life situations for creative and critical use.

Reference Books:

1. Practical English Usage, Michael Swan. OUP. 1995.
2. Remedial English Grammar, F.T. Wood. Macmillan.2007
3. On Writing Well, William Zinsser. Harper Resource Book. 2001
4. Study Writing, Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills, Sanjay Kumar and PushpLata. Oxford University Press. 2011.
6. Exercises in Spoken English, Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

MC 1204 COMPUTER PROGRAMMING AND NUMERICAL METHODS

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

Course Objectives:

1. The course is designed to provide complete knowledge of C language.
2. To provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.
3. To provide knowledge to the Students to develop logics which will help them to create programs, applications in C.
4. This course aims to identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.
5. This course provides the fundamental knowledge which is useful in understanding the other programming languages.

SYLLABUS:

Introduction to C: Basic structure of C program, Constants, Variables and data types, Operators and Expressions, Arithmetic Precedence and associativity, Type Conversions. Managing Input and Output Operations Formatted Input, Formatted Output.

Decision Making, Branching, Looping, Arrays & Strings: Decision making with if statement, Simple if statement, The if…else statement, Nesting of if…else statement, the else..if ladder, switch statement, the (?:) operator, the GOTO statement., The while statement, the do statement, The for statement, Jumps in Loops ,One, Two-dimensional Arrays, Character Arrays. Declaration and initialization of Strings, reading and writing of strings, String handling functions, Table of strings.

Functions: Definition of Functions, Return Values and their Types, Function Calls, Function Declaration, Category of Functions: No Arguments and no Return Values, Arguments but no Return Values, Arguments with Return Values, No Argument but Returns a Value, Functions that Return Multiple Values. Nesting of functions, recursion, passing arrays to functions, passing strings to functions, the scope, visibility and lifetime of variables.

Pointers: Accessing the address of a variable, declaring pointer variables, initializing of pointer variables, accessing variables using pointers, chain of pointers, pointer expressions, pointers and arrays, pointers and character strings, array of pointes, pointers as function arguments, functions returning pointers, pointers to functions, pointers to structures-Program Applications

Structure and Unions: Defining a structure, declaring structure variables, accessing structure members, structure initialization, copying and comparing structure variables, arrays of structures, arrays within structures, structures within structures, structures and functions and unions, size of structures and bit-fields- Program applications.

File handling: Defining and opening a file, closing a file, Input/ Output operations on files, Error handling during I/O operations, random access to files and Command Line Arguments- Program Applications

Numerical Methods: Solutions of Algebraic and Transcendental Equations, Bisection Method, Newton Raphson Method. Newton's forward and backward Interpolation, Lagrange's Interpolation in unequal intervals. Numerical Integration: Trapezoidal rule, Simpson's 1/3 rules. Solutions of Ordinary First Order Differential Equations: Euler's Method, Modified Euler's Method and Runge-Kutta Method.

Course Outcomes:

1. Identify basic elements of C programming structures like data types, expressions, control statements, various simple functions and Apply them in problem solving.
2. Apply various operations on derived data types like arrays and strings in problem solving.
3. Design and Implement of modular Programming and memory management using Functions, pointers.
4. Apply Structure, Unions and File handling techniques to Design and Solve different engineering programs with minimal complexity.
5. Apply Numerical methods to Solve the complex Engineering problems.

Text Books:

1. Programming in ANSI C, E Balagurusamy, 6th Edition. McGraw Hill Education (India) Private Limited.
2. Introduction to Numerical Methods, SS Sastry, Prentice Hall

Reference Books:

1. Let Us C ,YashwantKanetkar, BPB Publications, 5th Edition.
2. Computer Science, A structured programming approach using C", B.A.Forouzan and R.F.Gilberg, " 3rd Edition, Thomson, 2007.
3. The C –Programming Language' B.W. Kernighan, Dennis M. Ritchie, PHI.
4. Scientific Programming: C-Language, Algorithms and Models in Science, Luciano M. Barone (Author), Enzo Marinari (Author), Giovanni Organtini, World Scientific.

MC 1205 STRENGTH OF MATERIALS

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

Course Objectives:

1. To make students to understand the concept of stress and strain and enable them to calculate different types of stresses and strains under simple and complex loading.
2. To make students to calculate shearing force and bending moments of different types of beams.
3. To apply the knowledge of determining moment of inertias of different cross sections and identify the stresses and deflections induced in beams
4. To enable the students to understand stresses induced in the transmission shafts and helical coil springs against different types of loading conditions.
5. To develop knowledge in calculation of stresses and identifying the type of failure in cylinders and spherical shells.

SYLLABUS:

Simple Stresses: Stress, Strain, Stress- Strain curve, Lateral strain, Relationship between elastic constants, Bars of varying cross-section, Compound bars, Temperature stresses in bars. Complex Stresses: Stresses on an inclined plane under different uniaxial and biaxial stress conditions,

Principal planes and principal stresses, Mohr's circle, Relation between elastic constants, Strain energy, Impact loading.

Learning Outcomes:

1. Fundamental understanding of the concepts of stress and strain in mechanics of solids andstructures and material properties

Bending Moments and Shear Forces: Beam - Types of loads, Types of supports, S.F. and B.M. diagrams for Cantilever, Simply supported and Over hanging beams.

Learning Outcomes:

1. Evaluating and Drawing Shear force diagrams and Bending moment diagrams for beams subjected to various loads

Moment of Inertia: Concept of Moment of Inertia , Parallel axis theorem and Perpendicular axis theorem, Moment of Inertia and Mass Moment of Inertia of simple and composite sections.

Learning Outcomes:

1. Acquiring knowledge about center of gravity and solving moment of inertia for different sections.

Stresses in Beams: Theory of bending, Flexural formula, Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections, Shear stresses in beams, Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T, angle sections.

Learning Outcomes:

1. Learning about various types of beams and applying the theory of bending on them
2. Ability to formulate slope and Deflection equations for beams subjected to various loads

Deflections of Beams: Relation between curvature, slope and deflection, double integration method, Macaulay's method, Moment area method -application to simple cases including Cantilever, Simply supported and Over hanging beams.

Learning Outcomes:

1. Ability to formulate slope and Deflection equations for beams subjected to various loads

Torsional Stresses in Shafts and Springs: Analysis of torsional stresses, Power transmitted, Combined bending and torsion, Closed and open coiled helical springs, Theories of Failure: Application to design of shafts

Learning Outcomes:

1. Understanding torsional stress and learning about various springs and their properties

Cylinders and Spherical Shells: Stresses and strains in thin cylinders, Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in dia, and volume of thin cylinders and Thin spherical shell.

Learning Outcomes:

1. Ability to illustrate principle stresses, aquiring knowledge of calculating deformation in thin cylindrical and spherical shells.

Course Outcomes:

The student will be able to

1. Determine stresses and strains induced in a mechanical component for various types of loads. Further, the student can also determine principal stresses and strains.
2. Calculate shear force and bending moments induced in beams for different types of loading conditions
3. Calculate moment of inertias of different cross sections and analyze the beams for determination of stresses and deflections using double integration, Macaulay's and moment area method.
4. Identify the mode of failure in transmission shafts and determine stresses induced in shaft and springs subjected to complex loading conditions
5. Apply the principles of stresses and strains in thin cylinders and shells and evaluate longitudinal and circumferential stresses.

Text Books:

1. Analysis of Structures, Vazirani and Ratwani, Vol. 1, 1993 edition.
2. Mechanics of Materials, James M. Gere , Stephen P. Timoshenko , CBS Publishers
3. Solid Mechanics, E.P. Popov , Pearson Education India, 2nd Edition, 2015

Reference Books:

1. Strength of Materials, Timoshenko, CBS Publishers, 3rd Edition
2. Strength of Materials, Jindal, Umesh Publications.
3. Analysis of structures, Vazirani and Ratwani.
4. Mechanics of Structures Vol-III, S.B.Junnarkar.
5. Strength of Materials, Andrew Pytel and Ferdinond L. Singer Longman

MC 1206 ENGLISH LANGUAGE LABORATORY

(Common for all branches)

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :1.5

Course Objectives:

1. To make students recognize the sounds of English through Audio-Visual aids;

2. To help students build their confidence and help them to overcome their inhibitions and self- consciousness while speaking in English;
3. To familiarize the students with stress and intonation and enable them to speak English effectively; and
4. To give learners exposure to and practice in speaking in both formal and informal contexts.

SYLLABUS:

Introduction to Phonetics: The Sounds of English (Speech sound – vowels and consonants) - Stress and Intonation - Accent and Rhythm.

Listening Skills: Listening for gist and specific information - listening for Note taking, summarizing and for opinions - Listening to the speeches of eminent personalities.

Speaking Skills: Self-introduction - Conversation Skills (Introducing and taking leave) - Giving and asking for information - Role Play - Just A Minute (JAM) session - Telephone etiquette.

Reading and Writing skills: Reading Comprehension – Précis Writing - E-Mail writing - Punctuation.

Presentation skills: Verbal and non-verbal communication - Body Language - Making a Presentation.

Course Outcomes:

1. Students will be sensitized towards recognition of English sound patterns and the fluency in their speech will be enhanced;
2. Students will be able to participate in group activities like roleplays, group discussions and debates; and
3. Students will be able to express themselves fluently and accurately in social as well professional context.

Reference Books:

1. Effective Technical Communication, Ashraf Rizvi, Tata McGraw Hill Education Private Limited, New Delhi.
2. Speak Well, Orient Blackswan Publishers, Hyderabad.
3. Allan Pease, Body Language, Manjul Publishing House, New Delhi.

MC 1207 CHEMISTRY LABORATORY

(Effective from the batch admitted during 2021-2022 APSCHE)

Periods/week : 3 Lab Ses. : 50 Exam : 50
Examination (Theory): 3hrs. Credits :1.5

Course Objectives:

1. To develop the fine skills of quantitative determination of various chemical components through titrimetric analysis
2. To prepare and use ionexchange/ zeolite columns for the removal of hardness of water
3. To develop the skill of organic synthesis through the preparation of a polymer/ drug

List of Experiments:

1. Determination of Sodium Hydroxide with HCl (Na_2CO_3 Primary Standard)
2. Determination of Alkalinity (Carbonate and Hydroxide) of water sample
3. Determination of Fe(II)/Mohr's Salt by Permanganometry
4. Determination of Oxalic Acid by Permanganometry
5. Determination of Chromium (VI) by Mohr's Salt Solution
6. Determination of Zinc by EDTA method
7. Determination of Hardness of Water sample by EDTA method
8. Determination of Chlorine in water by Iodometric Titration
9. Ionexchange/ Zeolite column for removal of hardness of water
10. Synthesis of Polymer/ drug

Course Outcomes:

1. The course provides quantitative determine the amount of various chemical species in solutions by titrations and conduct the quantitative determinations with accuracy
2. The course provides to develop novel materials to be used as zeolite and prepare columns for removal of hardness of water
3. The course provides to synthesise a polymer or a drug

Reference Books:

1. Vogel's Quantitative Chemical Analysis, V – Edition – Longman.
2. Experiments in Applied Chemistry (For Engineering Students), Sinita Rattan, S. K. Kataria & Sons, New Delhi

MC1208- COMPUTER PROGRAMMING AND NUMERICAL METHODS LABORATORY

(Effective from the batch admitted during 2021-2022 APSCHE)

Periods/week : 3 Lab Ses. : 50 Exam : 50
Examination (Theory): 3hrs. Credits :1.5

Course Objectives:

1. To impart writing skill of C programming to the students and solving problems.
2. To write and execute programs in C to solve problems such as Modularize the problems into small modules and then convert them into programs.,
3. To write and execute programs in C to solve problems such as arrays, files, strings, structures and different numerical methods.
4. This reference has been prepared for the beginners to help them understand the basic to advanced concepts related to Objective-C Programming languages.

List of Experiments:

1. Write a program to read x, y coordinates of 3 points and then calculate the area of a triangle formed by them and print the coordinates of the three points and the area of the triangle. What will be the output from your program if the three given points are in a straight line?
2. Write a program, which generates 100 random integers in the range of 1 to 100. Store them in an array and then print the arrays. Write 3 versions of the program using different loop constructs. (e.g. for, while, and do while).
3. Write a set of string manipulation functions e.g. for getting a sub-string from a given position, Copying one string to another, Reversing a string, adding one string to another.
4. Write a program which determines the largest and the smallest number that can be stored in different data types like short, int, long, float, and double. What happens when you add 1 to the largest possible integer number that can be stored?
5. Write a program, which generates 100 random real numbers in the range of 10.0 to 20.0, and sort them in descending order.
6. Write a function for transposing a square matrix in place (in place means that you are not allowed to have full temporary matrix).
7. First use an editor to create a file with some integer numbers. Now write a program, which reads these numbers and determines their mean and standard deviation.
8. Given two points on the surface of the sphere, write a program to determine the smallest arc length between them.
9. Implement bisection method to find the square root of a given number to a given accuracy.
10. Implement Newton Raphson method to det. a root of polynomial equation.
11. Given table of x and corresponding f(x) values, Write a program which will determine f(x) value at an intermediate x value by using Lagrange's interpolation/
12. Write a function which will invert a matrix.
13. Implement Simpson's rule for numerical integration.
14. Write a program to solve a set of linear algebraic equations.

Course Outcomes:

1. Understand various computer components, Installation of software. C programming development environment, compiling, debugging, and linking and executing a program using the development environment.

2. Analyzing the complexity of problems, Modularize the problems into small modules and then convert them into programs.
3. Construct programs that demonstrate effective use of C features including arrays, strings, structures, pointers and files.
4. Apply and practice logical ability to solve the real world problems.
5. Apply Numerical methods to Solve the complex Engineering problems.

SECOND YEAR 1ST SEMESTER

MC 2101 METALLURGY AND MATERIAL SCIENCE

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

Course Objectives:

1. Give basic knowledge of science behind materials & physical metallurgy.
2. Introduce the concept of structure property relations. Provide an understanding of basic structure and crystal arrangement of materials
3. Knowledge about different phases & phase diagram. Knowledge about classification, applications of Ferrous & non-ferrous alloys.
4. Introduction to heat treatment techniques.
5. 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.

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.

Learning Outcomes:

1. Examine various factors of crystal structures and its calculations
2. Identify the Coordination Number and Atomic Packing Factor for different structures
3. Learn the different imperfections in solids

Phase diagrams: Basic terms- phase rule- Lever rule & free energy of phase mixtures cooling curves- Phase diagram & phase transformation - construction of phase diagrams-binary phasediagrams - 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

Learning Outcomes:

1. Describe construction of phase diagrams and phase transformations for different metals andalloys
2. Know the different reactions and micro structure of Iron-Carbon phase diagram

Heat treatment: Heat treatment of steel- Annealing, and its types, normalizing, hardening, tempering, martemering, austempering - TTT diagrams, drawing of TTT diagram, TTT diagram 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

Learning Outcomes:

1. Discuss different Heat Treatment processes of steel
2. Learn the TTT and CCT diagrams for steels
3. Understand the Surface hardening processes

Engineering Alloys: Ferrous And Non –Ferrous Materials, microstructure, composition, properties, and uses of low carbon, 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, functionally graded materials.

Learning Outcomes:

1. Discuss the properties, composition and microstructure of different types of steels
2. Describe the different types of alloys and advanced 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.

Powder Metallurgy: Powder Metallurgy process, Preparation of powders, Characteristics of Metal powders, mixing , compacting, sintering, Applications of Powder Metallurgy. Forming and shaping of plastics-Extrusion and Injection moulding.

Nano-Materials: Introduction and Applications.

Learning Outcomes:

1. Explain the classification, properties and different applications of composite materials
2. Learn the concepts of nano materials and its applications.
3. Explains the classification, properties and different applications of composite materials

4. Learn the concepts of nano materials and its applications.

Course Outcomes:

1. 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.
2. Explain the concept of phase & phase diagram & understand the basic terminologies associated with metallurgy. Construction and identification of phase diagrams and reactions.
3. Understand the Fe- C Phase diagram & analyze the microstructures of different cast iron and steels.
4. Explain features, classification, applications of various Ferrous & Non-Ferrous alloys.
5. 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.

Text Books:

1. Materials Science & Engineering, An Introduction, William D.Callister Jr. Wiley India Pvt. Ltd. 6th Edition, 2006, New Delhi.
2. Physical Metallurgy, Principles & Practices, V Raghavan.PHI 2nd Edition 2006, New Delhi.

Reference Books:

1. Introduction to Physical Metallurgy , Sidney H Avner Tata McGraw-Hill Education 1997
2. Materials Science and Engineering: A First Course , V. Raghavan, Prentice Hall India. 5th Edition 2011,New Delhi

MC 2102 THEORY OF MACHINES

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

Course Objectives:

1. To know the basics of Machine andmechanism.
2. To know the degrees of freedom of machine, Kinematic pairs and kinematic inversion
3. To know the Kinematic analysis of mechanism
4. To know velocity polygons, instantaneous centre method,
5. To know the synthesis of mechanism by graphical method
6. To know lower pair mechanism.
7. To know the Friction and motion

8. To understand the drive mechanism
9. To understand the Dynamic Force Analysis.
10. To understand the operation of governors

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.

Learning Outcomes:

1. Understanding the machine and mechanisms, Degrees of Freedom, Inversion of mechanism

2. Analysing Velocity and acceleration diagrams of the mechanism by vector and graphical methods

3. Synthesising of slider crank mechanism and four bar mechanism by vector and graphicalmethods

4. Understanding the straight line mechanisms and steering gear mechanisms

5. Analysing the effect of friction on threads, clutches, and bearings

6. Understanding the fundamental principles of statics and dynamics to machinery,

7. Applying the knowledge design for desired kinematic or dynamic performance.

Understand the functions of Governors and types and evaluate the controlling forces.

Course Outcomes:

1. Understanding of machine and mechanism.
2. How the static and dynamic strength parameters for a material are measured in standardized tests.
3. Ability to draw the kinematic analysis by displacement, velocity and acceleration diagrams.
4. Understanding the geometric analysis of various mechanism by instantaneous centre, Kennedy,s theorem.
5. Understanding the four bar mechanism, slider crank mechanism Grashof's criterion of movability and synthesis of mechanism by graphical method.
6. Understanding the lower pair mechanism by straight line motion mechanism, pantographs, engine indicator mechanisms, Automobile steering mechanism and Hooke's joint.
7. Understanding various types of friction and friction on bearings and clutches.
8. Understanding various drives like gears, gear trains,
9. Understanding D'Alembert's principle, Dynamically equivalent system and Turning-moment diagrams.
10. Understanding principle of governors its types and Sensitiveness of a governor

Text Book:

1. Theory of Machines, S.S. Rattan, Tata McGraw Hill Publications, 5th Edition ,2019.

Reference books:

1. Theory of Machines, Thomas Bevan, Pearson Education India,3rd Edition ,2009.
2. Theory of Machines, R.S. Khurmi & J.K.Gupta, S.Chand Publishing.

MC 2103 ENGINEERING THERMODYNAMICS

(Effective from the batch admitted during 2021-2022 APSCHE)

Periods/week : 4 Th Ses. : 30 Exam : 70
Examination (Theory): 3hrs. Credits :3

Course Objectives:

1. To educate students about the behavior of real gases and the significance of ideal gas theory
2. To educate the students about the properties of ideal gas and their relationship
3. To familiarize the students about the behavior of ideal gases under heating, cooling, compression and expansion processes
4. 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

SYLLABUS:

Introduction: Basic concepts; Thermodynamic systems; Micro and Macroscopic viewpoint on gases/systems; Homogeneous and heterogeneous systems; Concept of continuum; Pure substance; Thermodynamic equilibrium; State; Property; Path; Process; Specific heat capacities and Universal gas constant, Heat transfer and Work transfer. Internal energy and Enthalpy. Point and path functions; change of state and cyclic processes. Quasi-static process. Change in internal energy, Reversible and irreversible cycles. Zeroth law of thermodynamics, Joule's experiment. Open, Closed and Isolated systems.Gas laws: Ideal gas equation, Deviations from ideal gas model- Van der Waals equation Compressibility charts, Variable specific heats Systems undergoing a cycle and change of state.

Learning Outcomes:

1. Illustrate the T-v, P-T diagrams and P-v-T surfaces of pure substances.Analyze the processes on T-v diagrams to solve advanced engineering problems

2. Explain the compressibility factor and compressibility chart for nitrogen & Conclude from thischart as to when the ideal gas equation can be applied and when real gas equation is applicable

First law of thermodynamics: Application of first law to various non-flow (compression/expansion) gas processes: Constant pressure, constant volume, isothermal, adiabatic, and polytropic processes. Throttling and free-expansion processes. First law applied to steady and unsteady flow processes, Steady flow energy equation, Limitations of first law of thermodynamics.

Second law of thermodynamics: Cyclic heat engine, Reversed heat engine: heat pump and refrigerator, and reversible heat engine. Kelvin-Plank and Clausius statements and theirequivalence,Perpetualmotionmachinesoffirstkindandsecondkind, Carnot cycle-Carnot heat

engine-Carnot efficiency. Clausius theorem-Clausius inequality. Entropy and disorder, Concept of entropy-Principle of increase of entropy-Characteristics of entropy, Temperature-entropy diagrams, Entropy equation for flow process, Helmholtz and Gibbs functions, Maxwell's equations- T.ds relations- Heat capacity equation and energy equations. Reversibility and irreversibility, Causes of irreversibility, Availability and availability function.

Internal Combustion Engines: Engine components, Classification and working of four-stroke engines: Spark-ignition and compression-ignition engines, Valve timing diagrams, Air-cycles: Otto, Diesel, dual, Stirling, Ericson and Atkinson cycle and their analysis. Performances characteristics: Mean effective pressure, Volumetric efficiency, Power and torque characteristics, Indicated power, Frictional power, and brake power, Mechanical efficiency, Brake thermal efficiency, and Brake specific fuel consumption.

Combustion in Internal Combustion Engines: Four-stages of combustion in SI and CI engines: Ignition delay, Premixed combustion, Diffusion combustion, and Afterburning. Importance of flame speed and effect of engine variables. Abnormal combustion: pre-ignition and knock. Fuel requirements: Cetane and octane number. Premium petrol and Ultra-low Sulphur diesel. Engine emissions and Air-pollution.

Gas Turbine Engines: Components and working of Gas turbine engine. Brayton cycle: Pressure-volume and Temperature-entropy diagrams; Brayton-air-standard efficiency. Effect of pressure ratio on network output and efficiency.

Course Outcomes:

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

Text Books:

1. Thermodynamics, An Engineering Approach, Michael A. Boles and Younus A Cengel.
2. Engineering Thermodynamics, P.K.Nag, Tata McGraw, Hill Publications Company.
3. Internal Combustion Engines,V. Ganesan, McGraw Hill Education, 3rd Edition, 2007.

Reference Books:

1. Engineering Thermodynamics, E Rathakrishnan, Prentice-Hall India.
2. Engineering Thermodynamics, Y.V. C. Rao.
3. Engineering Thermodynamics Work and Heat Transfer, by G.F.C Rogers and Y.R. Mayhew, ELBS publication

4. Engineering Thermodynamics, Zemansky, McGraw Hill Publications Company.

MC 2104 MANUFACTURING PROCESSES

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

Course Objectives:

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

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.

Learning Outcomes:

At the end of this unit, the student will be able to

1. Select the suitable manufacturing technique for a given product.
2. Appreciate the steps involved in metal casting, preparation of Pattern, Mold and Core.
3. Have effective knowledge on designing different gating systems and risers
4. Compare the various Furnaces and Metal casting processes,
5. Identify the various destructive, nondestructive tests for cast products and 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.

Learning Outcomes:

At the end of this unit, the student will be able to

1. Understand the plastic deformation phenomena
2. Differentiate the cold working and hot working processes
3. Understand the principle of rolling, forging, swaging, drawing and extrusion process.
4. Assess the forces and power in rolling and forging processes
5. Understand the applications of rolling, forging, swaging, drawing and extrusion process inreal world.
6. Recognize the tools and dies used in rolling, forging, swaging, drawing and extrusion process.

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.

Learning Outcomes:

At the end of this unit, the student will be able to

1. Categorize the working of various welding processes
2. Relate V-I characteristics of Arc welding processes.
3. Know the difference between soldering, brazing and welding processes
4. Have knowledge on resistance and solid state welding processes.
5. Summarize the applications, advantages and limitations of various welding processes.
6. Identify the various destructive, non destructive tests for welds and weld defects

Course Outcomes:

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

1. Designate casting process, interpret pattern, core and mold making.
2. Evaluate gating system design and acquire knowledge on various furnaces.
3. Elucidate various bulk metal forming processes and categorize various sheet metal operations.

4. Study the welding process behavior for common and newer welding techniques
5. Analyze different casting, forming and weld defects.
6. Interpret casting, forming and welding processes and their applications.

Text Books:

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

Reference Books:

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

MC 2105 MANAGERIAL ECONOMICS

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

Course Objectives:

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

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.

Course Outcomes:

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

1. Understand the various economic activities in business and industry.
2. Analyze the real world business problems.
3. Make optimal business decisions for the effective and efficient management of Organizations.

Text Books:

1. Managerial Economics, Sankaran,S., Marghan Publications, 2015, Chennai.

2. Managerial Economics and Financial Analysis, Aryasri, A.R., MC Graw Hill Education, New Delhi,2015.

Reference Books:

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

MC 2106 STRENGTH OF MATERIALS LABORATORY

(Effective from the batch admitted during 2021-2022-APSCHE)

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

Examination (Practical): 3hrs. Credits :1.5

Course Objectives:

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

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, Vickers and 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.

Course Outcomes:

1. Ability to identify different types of loads and measure them.
2. Ability to measure material properties of different materials using different methods.
3. Ability to measure bulking property and fineness of sandgrains.

Learning Outcomes:

1. Analyze the behavior of the solid bodies subjected to various types of loading.
2. Apply knowledge of materials and structural elements to the analysis of simple structures.
3. Undertake problem identification, formulation and solution using a range of analyticalmethods
4. Analyze and interpret laboratory data relating to behavior of structures and the materials theyare made of, and undertake associated laboratory work individually and in teams.
5. Expectation and capacity to undertake lifelong learning

MC 2107 MANUFACTURING TECHNOLOGY LABORATORY-I

(Effective from the batch admitted during 2021-2022-APSCHE)

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

Examination (Practical): 3hrs. Credits :1.5

Course Objectives:

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

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

Course Outcomes:

They have

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

Learning Outcomes:

1. Ability to prepare molds, cores for a given component.
2. Capability to complete different joints, welds for given component by GAS and ARCwelding processes.
3. Aptitude to made taper turning, thread cutting and off set turning on different materials byLathe machine.
4. Skill to made spur gears, key ways etc. by using different machines.

MC 2108 MACHINE DRAWING

(Effective from the batch admitted during 2021-2022-APSCHE)

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

Examination (Practical): 3hrs. Credits :1.5

Course Objectives:

The objectives of this course are

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

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.

Learning Outcomes:

1. Develop the ability to create production drawing of assemblies and components of IC Engineparts, Press, Pulleys, etc.
2. Ability to create a well-documented report on designs made
3. Developing the ability to understand and apply national and international standards whiledrawing machine component.
4. Understanding the concept of various tolerances and fits used for component design
5. Familiarize in drawing assembly, orthographic and sectional views of various machinecomponents.
6. Impart knowledge of machine component and its conversion into 2D drawing.
7. Familiarize various thread forms and representation of standard thread components.
8. Make aware of structural riveted joints and couplings along with their standard empiricalrelations.
9. Model parts and create assembly using standard CAD packages like Solid edge/Solid works.
10. Familiarize with 2-D and 3-D modeling with cut section.

Course Outcomes:

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

Text Books:

1. Machine Drawing, N.D. Bhatt, Charotar Publishing House Pvt. Ltd, 2013.
2. Engineering Drawing, A.C.Parkinson, Wheeler Publishing.
3. Production Drawing, K.L. Narayana, P. Kannaiah, K. Venkata Reddy, New Age International Publishing

Reference Book:

1. Machine Drawing by K.L Narayan, P. Kannaiah and K. Venkata Reddy, New Age International (P) Ltd, Publishers, 2008

MC 2109 PROBLEM SOLVING AND PROGRAMMING SKILLS USING TECHNICAL COMPUTING (SKILL COURSE)

(Effective from the batch admitted during 2021-2022-APSCHE)

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

Examination (Practical): 3hrs. Credits :2

Course Objective:

1. The objectives of this course are
2. To Impart the knowledge to the students with MATLAB software.
3. To provide a working introduction to the MATLAB technical computing environment.
4. To introduce the use of a high-level programming language-MATLAB.

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.

Course Outcomes:

At the end of the course the student shall be able to
(Using MATLAB programming Language)

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

MC 2110 PROFESSIONAL ETHICS AND UNIVERSAL HUMAN VALUES

(Effective from the batch admitted during 2021-2022-APSCHE)

Periods/week : 0 Lab Ses. : 0 Exam : 100
Examination (Practical): 3hrs. Credits :0

Course Objectives:

The objective of the course is Six fold:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. This course will illuminate the students in the concepts of laws and its applicability to engineers
3. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
4. 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
5. To enable the students to imbibe the Values and Ethical Behavior in the personal and Professional lives
6. The students will learn the rights and responsibilities Individual, employee, team member and a global citizen

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.

Course Outcomes:

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

1. 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
2. Self-explore by using different techniques to live in harmony at various levels.
3. Analyze themselves and understand their position with respect to the moral and ethical character needed for a successful and satisfactory work life.
4. Students are expected to become more aware of themselves and their surroundings (family, society, nature)
5. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
6. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society

Text Books:

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

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. Human Values", A. N. Tripathi, " 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. Business Law, G K Kapoor, and Business & Commercial Laws, Sen & Mitra, and Business law for Engineers, Calvin Frank Allen.

5. Introduction to Psychology, Hilgard, E. R.; Atkinson, R. C. & Atkinson, R.L. (1975). 6th Edition. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.
6. Professional Ethics & Human Values, Govindarajan, M; Natarajan, G. M. & Senthilkumar, V.S. (2013). Prentice Hall: New Delhi
7. Human Values & Professional Ethics, Gogate, S. B. (2011). Vikas Publishing: New Delhi.
8. Engineering Ethics, Charles E Harris Jr., Michael S Pritchard, Michael J Rabins, Concepts Cases: 4e, Cengage learning, 2015.
9. Ethics in Engineering Practice & Research, Caroline Whitbec, 2nd Edition, Cambridge University Press 2015.

MC 2111 N S S / N C C

(Effective from the batch admitted during 2021-2022-APSCHE)

Periods/week : 2 Ses. : 0 Exam : 0
Examination (Practical): 0. Credits :0

SECOND YEAR 2ND SEMESTER

MC- 2201 METAL CUTTING AND MACHINE TOOLS

(Effective from the batch admitted during 2021-2022-APSCHE)

Periods/week : 4 Th Ses. : 30 Exam : 70
Examination (Theory): 3hrs. Credits : 3

Course Objectives:

1. To provide knowledge about the metal cutting tools, tool geometry, tool materials, mechanism of metal cutting, force relations, velocity relations and machinability.
2. To provide information about the working principle, specifications, classifications, parts, mechanisms, operations and attachments of an engine lathe machine, capstan and turret lathes.
3. 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.
4. 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.
5. To get familiar with the information about finishing operations such as lapping, honing and super finishing.
6. To feed the knowledge about the classification, working principle and construction of 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.

Learning Outcomes:

1. Can be able to understand the various aspects in mechanism of metal cutting.
2. Can solve the problems on force calculations, Tool Life calculations.
3. Can be able to have an idea of classification, different parts and their working of Lathe,Shaper, Planer and Slotting machines.
4. Can get acquainted with the mechanisms and various operations that can be performed onEngine Lathe, Shaper, Planer and Slotter machines.
5. Can be familiar with the construction, working and differences of Capstan & Turret lathes.
6. Can be able to have an idea of types, different parts and their working of drilling, milling andbroaching machines.
7. Can be acquainted with the mechanisms and various operations that can be performed ondrilling, milling and broaching machines.
8. Can be able to do indexing operation effectively on milling machine
9. be acquainted with the various finishing operations.

10. be able to know the details and types of lapping and honing operations.
11. Have knowledge of electro polishing, buffing and super finishing operations and their applications.
12. Be able to know the principle of working, construction and working of CHM, EDM, ECM,AJM, LBM, EBM and WJM operations.
13. Be acquainted with the advantages, disadvantages and applications of CHM, EDM, ECM,AJM, LBM, EBM and WJM operations.

Course Outcomes:

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

1. Imbibe the knowledge about types of tools, their specification, materials, forces, life and cutting fluids.
2. 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.
3. Get awareness on details about and also working with boring machines, shaper, slotter and planer machines
4. Get familiar with the types, parts and operations of drilling, grinding and milling machines.
5. Get the knowledge about the finishing operations like lapping, honing and super finishing.
6. Know the information about various Unconventional machining methods.

Text Books:

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

Reference Books:

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

MC 2202 DYNAMICS OF MACHINERY

(Effective from the batch admitted during 2021-2022-APSCHE)

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

Examination (Theory): 3hrs. Credits : 3

Course Objectives:

The main objectives of the course are

1. To provide the competency about the gyroscopic concepts in various vehicles and also to Calculate gyroscopic couple and analyze its effect in Aeroplane, Ship, Two and Four wheelers.
2. To impart the knowledge of cam profiles for desired motion.
3. To make the students visualize the gear working, gear contact & interference.
4. To comprehend different speed reductions of gear trains.
5. Deals with balancing of rotating & reciprocating parts and also to understand various unbalanced systems & their balancing techniques.
6. The study deals with linear, longitudinal, & torsional vibrations and also to familiarize the various types of vibrations and their response.
7. Enable the students to formulate physical and mathematical models of Mechanical systems Static and Dynamic Balancing and Vibration analysis.

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.

Learning Outcomes:

1. Learning about precessional an d angular motion and gyroscopic couple and its effects
2. The student will analyze the gyroscopic couple or effect on stabilization of Ship Aero plane and Four wheeler vehicles

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.

Learning Outcomes:

1. Ability to draw displacement, velocity and acceleration diagrams for cam motion
2. Student will be able to design cam profile for given follower motions and understand cam Jump phenomenon, advance cam curves

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 teethLength 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.

Learning Outcomes:

1. Learnng about classification of gear and their applications
2. Understanding about law of gearing and knowing about different parts of toothed gear and their uses

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.

Learning Outcomes:

1. Ablity to analyze speed and torque in of various gear trains which will be the prerequisite for gear box design.
2. Learning about tabular method and algebraic method in finding velocity ratios of epicyclic gear train

Balancing of Rotating and Reciprocating Masses: Balancing of a single rotating mass in the same plane and by two masses in different planes, balancing of several masses revolving in the same plane- Balancing of several masses revolving in different planes- Primary and secondary unbalanced 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.

Learning Outcomes:

1. Balancing of Primary and secondary unbalanced forces of rotating and reciprocating machinery
2. Partial balancing of unbalanced primary forces in a reciprocating engine, locomotives and balancing of primary and secondary forces in multi cylinder in-line engines, 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 dampingMagnification factor or dynamic magnifier.

Learning Outcomes:

1. Mapping and articulating the fundamental concepts of mechanical vibrations.
2. Ability to analyze the mathematical model of a linear vibratory system to determine its response

Transverse and Torsional Vibrations: Natural frequency of free transverse vibrations due to point 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.

Learning Outcomes:

1. Determining the natural frequency of transverse vibrations of the shaft and torsional vibrations of rotor systems.
2. Ability to solve using energy method and Dunkerley's method in vibrations.

Course Outcomes:

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

1. Analyze the gyroscopic effects on different vehicles and also to apply gyroscopic principle to Aeroplane, Ship, Two and Four wheelers.
2. Analyze cams for producing a desired motion and cams with specified contours.
3. Analyze the kinematics of toothed gears and its physical representation and physics of different gears.
4. Calculate the speeds and torques of gears used in various gear trains.
5. Comprehend the balancing of the moving parts (rotating & reciprocating) statically and dynamically.
6. Calculate the magnitude and direction of the balancing mass in rotating and reciprocating systems (shafts & locomotives).
7. Determine the dynamic response of various vibrating systems.
8. Determine the frequency & amplitude of free, forced and damped vibrations in longitudinal vibration systems.
9. Calculate the natural frequency of free vibrations in transverse and torsional vibration systems.

Text Books:

1. Theory of Machines, S.S. Rattan, 5th edition, McGraw-Hill Publications, New Delhi, 2019
2. Theory of Machines , R. S. Khurmi & J. K. Gupta. 14th edition, S Chand & CO Ltd Publisher.
3. Theory of Machines , J. E. Shigley, Eurasia Publishing House Pvt. Ltd.

Reference Books:

1. Theory of Machines , Thomas Bevan, 3rd edition, CBS publishers & distributors, 2005.
2. Theory of Machines and mechanisms, P. L. Ballaney, 25thedition, Khanna publishers, New Delhi, 2016.
3. Theory of Mechanisms & Machines, Dr. Jagadish Lal, Metropolitan Book Co. (P) Ltd., 1st Edition, 2002.
4. Mechanism and Machine Theory, J. S. Rao and R. V. Dukkipati, New Age International (P) Ltd., 2nd Edition, 2006.
5. Theory of Machines and Mechanisms, J. J. Uicker, Gordon R. Pennock, J E. Shigley, Oxford University Press, New Delhi, 3rd Edition, 2009.
6. Theory of Machines, Ghosh and Mallik, Affiliated East West Press.

7. Kinematics and Dynamics of Machinery, Robert L. Norton,Tata McGraw – Hill, 2009.

Web Resources: 1. https://nptel.ac.in/courses/112/101/112101096/
2. http://nptel.ac.in/courses/112104114/

MC- 2203 APPLIED THERMODYNAMICS

(Effective from the batch admitted during 2021-2022-APSCHE)

Periods/week : 4 Th Ses. : 30 Exam : 70
Examination (Theory): 3hrs. Credits : 3

Course Objectives:

1. To gear the student with basic principles of steam properties.
2. To prepare the student for industrial application of steam.
3. To make understand the student reciprocating as well as rotary compressors.
4. The student is taught to understand the steam equipment and compressors so that R&D in industry is improved.
5. The student is made to understand the concepts of refrigeration and air conditioning.

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 and 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. Rankine cycle- Modified Rankine cycle.

Learning Outcomes:

1. Relate various steam properties, and analyze the different types of processes using steam as workingfluid to determine the energy transfer in terms of heat and work.

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.

Learning Outcomes:

1. Understand the working of different types of steam nozzles and its applications, conditions for maximum discharge of steam through it

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 turbines- Constructional features governing of turbines.

Learning Outcomes:

1. Classify different types of steam turbines and working of impulse turbine and its

performance parameters and methods of compounding to reduce rotor speed of an impulse turbine.

2. Design the blades and impeller for impulse and reaction turbines.

Steam Condensers: Classification of condensers- 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.

Learning Outcomes:

1. Identify and make different types of condensers, cooling water calculations etc.

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 and Air Conditoning: Simple Vapor compression system- Function of parts- Classification of refrigerants. Air conditioning cycle – Central system – Window type air conditioner.

Course Outcomes:

1. The student gets complete knowledge of steam and its properties.
2. The student learns the complete calculation procedures for designing steam turbines, steam condensers, nozzles etc. used in thermal power plants.
3. The student understands the importance of reciprocating and rotary compressors.
4. The student gets knowledge of the types of refrigerants and air conditioning systems.
5. The student is prepared to work in industry immediately after this course.

Text Books:

1. Thermal Engineering, by R. K. Rajput, Laxmi Publications.
2. A Treatise on Heat Engineering by Vasandhani and Kumar.
3. Applied Thermodynamics-II by R. Yadav.

References:

1. Fluid Flow Machines, by M.S. GovindaRao, Tata McGraw Hill publishing company Ltd.
2. Fundamentals of Engineering Thermodynamics by E. Radhakrishna, PHI.
3. Thermal Science and Engineering by D.S. Kumar, S.K. Kataria and Sons.
4. Refrigeration and Air-conditioning, by Arora and Domkundwar, Dhanpat Rai Sons.

MC 2204 INDUSTRIAL ENGINEERING AND MANAGEMENT

(Effective from the batch admitted during 2021-2022-APSCHE)

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

Examination (Theory): 3hrs. Credits : 3

Course Objectives:

1. To know management practices in industry
2. To acquire capacity to handle industrial disputes
3. To know much about production activities and to improve productivity
4. To learn the work study procedures and quality concepts to get more productivity
5. To have exposure on some maintenance practices in industry.

SYLLABUS:

Concepts of Industrial Management: Principles of management- Growth of management thought, Functions of management, Principles of organization, Types of organization and committees.

Introduction to personnel management- Functions, Motivation, Theories of motivation, Haw throne studies, Discipline in industry, Promotion, Transfer, lay off and discharge, Labor turnover.

Industrial relations- Trade unions, Industrial disputes, Strikes, Lock-out, Picketing, Gherao, Settlement of industrial disputes, Collective bargaining, and Industrial dispute act 1947 and factories act 1948.

Plant Layout: Economics of plant location, Rural Vs Suburban sites, Types of layouts, Travel chart technique.

Materials Handling- Principles, Concept of unit load, Containerization, Pelletization, Selection of material handling equipment, Applications of belt conveyors, Cranes, Fork lift trucks in industry.

Plant Maintenance: Objectives, Duties, functions and responsibilities of plant maintenance department- Types of maintenance-breakdown Maintenance, Scheduled Maintenance, Preventive Maintenance.

Work Study: Concept of productivity, Method Study-Basic steps in method study, Process charts, Diagrams, Models and Templates, Principles of motion economy, Micro motion study, Therbligs, Work Measurement - Stop watch procedure of time study, Performance rating, allowances, Work sampling, Simple problems.

Materials Management: Introduction, Purchasing, Objectives of purchasing department, Buying techniques, Purchase procedure, Stores and material control,

Receipt and issue of materials, Store records.

Quality Control - Control charts of variables and attributes (Use of formulae only). Single and Double sampling plans.

Course Outcomes:

1. Students will be able to apply management theories in organization and handle personnel in organization.
2. They are able to settle the industrial disputes in organization.
3. They understand the economics of plant layout.
4. Students are aware of materials handling principles and equipment.
5. They will be able to apply maintenance practices and also material handling systems.
6. They will be able to improve the productivity by applying work study procedures.

Text Book:

1. Industrial Engineering and Management, Dr.O.P.Khanna, Dhanpat Rai Publications, 2012.

References:

1. Principles of Management, Koontz & Donnel, McGraw-Hill Inc.,US,1972.
2. Production and Operations Management , Everette Adam & Ronald Ebert , Prentice-Hall Publications,1992.
3. Operations Management, John McClain & Joseph Thames.
4. Industrial Engineering and Production Management, Martand T. Telsang ,S Chand& CO.

MC 2205 DESIGN OF MACHINE ELEMENTS -I

(Effective from the batch admitted during 2021-2022-APSCHE)

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

Examination (Theory): 3hrs. Credits : 3

Course Objectives:

1. 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.
2. 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

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.

Learning Outcomes:

- Know the different design methods and models.
- Have the importance of materials and selection of manufacturing process, standards, propertieswhile designing a machine element

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

Learning Outcomes:

1. Understand the failure modes of materials, importance of factor safety and stress concentrationwhile design a component under static loading.

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

Learning Outcomes:

1. Appreciate the terminology and types of permanent and detachable joints and design andanalyze permanent joints (riveted, welded, etc.) under static and dynamic loading conditions
2. Comprehend the design of power screws with and or without collar under different loading conditions.

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, riveted joints.

Learning Outcomes:

1. Appreciate the terminology and types of permanent and detachable joints and design andanalyze permanent joints (riveted, welded, etc.) under static and dynamic loading conditions
2. Comprehend the design of power screws with and or without collar under different loadingconditions.
3. Identify the inspection of different welds, design of welds under static and dynamic load.

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

Learning Outcomes:

1. Recognize the design, analysis and sizing of different types of springs
2. Distinguish the selection of springs for particular purpose and importance of coatings and shotpeening.

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 and shot peening.

Course Outcomes:

Students are able to

1. 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.
2. Analyze stresses, strains and deflections in a machine member
3. Know static failure criteria for different materials, in the design and analysis of machine components
4. Know about various multidimensional fatigue failure criteria, fatigue failure and load-life relation
5. 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
6. 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
7. know spring terminology, different types of springs, design and analyze coil springs(compression, tension, torsion) under various loads.

Text Book:

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

Reference Books:

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

MC 2206 FUELS AND INTERNAL COMBUSTION ENGINES LABORATORY

(Effective from the batch admitted during 2021-2022-APSCHE)

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

Examination (Practical): 3hrs. Credits : 1.5

Course Objectives:

1. Student should have hands on experience in handling different devices and equipment in the laboratory.
2. To evaluate properties of fuels and lubricating oils used in IC engines
3. Student is expected to learn and evaluate performance of stationery-constant speed engines and variable-speed automotive engines.
4. Student should learn components and working of reciprocating air compressor.
5. Student should learn components and working of Marine Gas Turbine.

List of Experiments:

1. Determination of the kinematic and absolute viscosity of lubricating oils (SAE 20, 30, 40, 60 and 90).
2. Determination of flash and fire point temperatures of liquid fuels (: kerosene, petro diesel and biodiesel).
3. Determination of higher calorific value of solid and liquid fuels by using Bomb calorimeter.
4. Determination of calorific value of gaseous fuels by using Gas-Calorimeter.
5. Study of engine components and valve timing diagrams of four-stroke engines and models.
6. Determination of performance characteristics of a single-cylinder, constant-speed, diesel engine by conducting load test.
7. Determination of indicated power(s) and mechanical efficiency of a three-cylinder MPFI engine by conducing Morse test.
8. Preparation of Sankey diagram/energy balance sheet for an automotive diesel engine by conducting energy/heat balance test.
9. Determination of air -pressures, temperatures, polytropic (compression) index, and volumetric efficiency of a two-stage reciprocating air-compressor.
10. Study of components and working of a marine gas-turbine engine.
11. Study of components and working of automotive power transmission system.

Course Outcomes:

1. Students will get hands on experience handling different types of engines available in the laboratory.
2. Students will learn to interpret the variables which can influence on performance of engines / other equipment's.
3. Students will know the safe operating regimes of different oils / equipment's available in our laboratory.
4. Student will have an exposure to a marine gas turbine which was decommissioned from

Indian Navy.

MC 2207 MANUFACTURING TECHNOLOGY-II LABORATORY

(Effective from the batch admitted during 2021-2022-APSCHE)

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

Examination (Practical): 3hrs. Credits : 1.5

Course Objectives:

1. To make the student to measure the tool tip temperature and the cutting forces during turning
2. To make the student to make a single point cutting tool and to measure the tool angles
3. To make the student to measure the drilling forces.
4. To make the student to measure the surface roughness.
5. To make the student to measure the chip details.
6. To make the student to measure the different parameters of sand and sand moulds.

List of Experiments:

1. Experiments on Lathe to establish the following curves
   a) Depth of cut Vs Cutting force.
   b) Feed Vs Cutting force.
   c) Cutting speed Vs Cutting force.
2. Grinding of single point cutting tool
3. Study of chip formations on shaping machine (with lead sample).
4. Torque measurement on drilling/milling machine.
5. Measurement of surface finish.
6. Measurement of cutting tool temperature in turning.
7. Sieve analysis to evaluate G.F.No.
8. Moisture and clay content test.
9. Green compression and shear test.
10. Shatter Index & Hardness Testing

Learning Outcomes:

1. Test and experimenting the average cutting temperature in turning under different speed – feed combinations
2. Recognize chip formation mechanism and relevant matters (type, color & thickness) in turning mild steel
3. Evaluate the role of variation of cutting velocity and feed on chip reduction coefficient /cutting ratio and shear angle.

4. Measurement of tool – wear and evaluation and analysis of tool life in turning mild steel by HSS or carbide tool
5. Geometrical and kinematic test of a centre lathe or a drilling machine 5.Plan and produce i) job on shaping machine (like cast iron vee - block); ii) job on milling machine (like gear tooth cutting)

Course Outcomes:

1. The student will be in a position to measure the tool tip temperature and the cutting forces during machining.
2. The student will be in a position to fabricate a single point cutting tool and to measure the tool angles
3. The student will be in a position to measure the drilling forces.
4. The student will be in a position to measure the surfaceroughness.
5. The student will be in a position to measure the chipdetails.
6. The student will be in a position to measure the different parameters of sand and sand moulds.

MC 2208 COMPUTER AIDED MODELLING

(SKILL COURSE)

(Effective from the batch admitted during 2021-2022-APSCHE)

Periods/week : 1Th2 Lab Ses. : 50 Exam : 50

Examination (Practical): 3hrs. Credits : 2

Course Objective:

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

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

.

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

Course Outcomes:

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

1. Use the conventional representations of materials and machine components
2. Model various riveted, welded and key joints
3. Generate solid models and sectional views of machine components
4. Develop solid models of machine parts and assemble them
5. Generate the sectional views of assembled components

MC 2209 ENVIRONMENTAL SCIENCE

(Effective from the batch admitted during 2021-2022-APSCHE)

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

Examination (Theory): 3hrs. Credits : 0

Course Objectives:

The objectives of the Environmental Science course are to

1. Familiarize the fundamental aspects of environment and the environmental management'
2. Provide information of some of the important international conventions which will be useful during the future endeavors after graduation.
3. Make realize the importance of natural resources management for the sustenance of the life and the society.
4. Apprise the impact of pollution getting generated through the anthropogenic activities on the environment
5. Provide the concept of Sustainable Development, energy and environmental management
6. Impart 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.

Learning Outcomes:

1. Gaining in-depth knowledge on natural processes that sustain life and govern economy.
2. Predicting the consequences of human actions on the web of life, global economy and qualityof human life.
3. Developing critical thinking for shaping strategies (scientific, social, economic and legal) for environmental protection and conservation of biodiversity, social equity and sustainable development.
4. Acquiring values and attitudes towards understanding complex environmental-economic- social challenges, and participating actively in solving current environmental problems and preventing the future ones.
5. Adopting sustainability as a practice in life, society and industry.

Course Outcomes:

After completion of the course the students will have

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

Text Books:

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

Reference Books:

1. Ecology and environment, Sharma, P. D., & Sharma, P. D. (2005). Rastogi Publications
2. Environmental Biology, Agarwal, K.C. 2001 Nidi Publ. Ltd. Bikaner.
3. Marine Pollution, Clark R.S. (2001), Clanderson Press Oxford (TB)
4. Environmental Protection and Laws, Jadhav, H & Bhosale, V.M. (1995), 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.

THIRD YEAR 1ST SEMESTER

MC 3101 FINITE ELEMENT ANALYSIS

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

Course Objectives:

1. This subject deals with fundamentals of the finite element method for the analysis of engineering problems arising in solids and structures and also to introduce the concepts of mathematical modelling of engineering problems.
2. Emphasis an ability to apply knowledge of mathematics, science and engineering to do the analysis of simple and complex elastic structures using the finite element analysis.
3. To furnish information on the basic concepts, background and methodology of FEM.
4. To select suitable elements for Finite element modelling, deriving the necessary elemental matrices and for applying the principles to various mechanical systems
5. Demonstrate an ability to design and conduct numerical analysis as well as analyze and interpret the results.
6. It deals with ability to identify, formulate, and solve engineering problems using the finite element analysis.
7. To solve one dimensional problem in solid mechanics, heat transfer and vibrations.
8. To solve two dimensional problems in solid mechanics in terms of plane stress, plane strain and axisymmetric conditions.
9. To solve problems using isoparametric formulation and Beams and Frames.

SYLLABUS:

Fundamental Concepts: Introduction, Historical background, Outline of presentation, General procedure for FEA, Stresses and Equilibrium, Boundary conditions, Strain-Displacement relations, Stress-Strain relations, Plane stress, Plane strain problems, Temperature effects, Potential energy and equilibrium. The Rayleigh-Ritz method, Hamilton's principle.Galerkin's method, Saint Venant's principle.

One-dimensional Problems: Introduction, Finite element modeling, Coordinates and Shape functions. The potential energy approach.The Galerkin approach, Assembly of the global stiffness matrix- mass matrix and load vector, Treatment of boundary conditions, Quadratic shape functions, Temperature effects. Trusses: Introduction, Plane trusses, Three-dimensional trusses, Assembly of global stiffness matrix for the Banded and Skyline solutions.

Two-dimensional Problems Using Constant Strain Triangles: Introduction, Finite element modeling, Constant strain triangle, In plane and Bending, problem modeling and boundary conditions.

Axisymmetric Solids Subjected to Axisymmetric Loading: Introduction, Axisymmetric formulation, Finite element modeling, Triangular element, Problem modeling and boundary conditions.

Two-dimensional Isoparametric Elements and Numerical Integration: Introduction, The four-node quadrilateral, Numerical integration, requirements, h-refinement and p-refinement, Higher-order elements, Convergence

Beams and Frames: Introduction, Finite element formulation, Load vector, Boundary considerations, Shear force and bending moment, Beams on elastic supports, Plane frames.

Learning Outcomes:

1. Interpret the philosophy behind principles, design and modelling considerations in using finiteelement analysis.
2. Develop stiffness matrices for spring, truss, beam, plane stress problems and three dimensional problems using the concept of direct equilibrium and potential energy methods.
3. Develop the finite element formulations for heat transfer problems.
4. Evaluating the convergence of solutions using finite element analysis and assess the accuracyof simulated results.
5. Be proficient in the use of commercial finite element software.
6. Create and design engineering structures using finite element methods, taking into accountsafe design limits.
7. Communicate effectively through written reports on the creation of optimized design of engineering structures

Course Outcomes:

1. On completion of course students will be able to gain the knowledge and understand the basics concepts of Finite element analysis and mathematical problems and get experience for problems solving of machine members.
2. On completion of course students will be able to get understand advanced computing techniques and tools in the area develop the applications of FEA in engineering. To

gain experience in the application of FE analysis to real engineering designs/Problems.

3. On completion of course students will be able to gain experience to implement different FEA/FEM tools for solving Structural engineering problems and write code for some of them in MATLAB/PYTHON.
4. On completion of course students will be able to get exposure to build up the skills in the actual implementation of FEM methods (e.g. boundary conditions, Elements, Meshing etc.) in using commercial FEM codes. Also get exposure to solve problems by using analysis software's like ANSYS/NISA etc.
5. The students will be able to explain the concepts of Mathematical Modelling of Engineering Problems and also the students will be able to solve one-dimensional problems in solid mechanics
6. The students will be able to give solution for two-dimensional problems in solid mechanics and also calculate problems using plane stress, plane strain and axisymmetric conditions.
7. The students will be able to solve problems using isoparametric formulation, Numerical Integration and Beams and Frames.

Text Book:

1. Introduction to Finite Elements in Engineering, Tirupathi R. Chandrupatla, Ashok D.Belegundu (chapters 1 to 8 only). Pearson Education Limited,4th Edition, 2012

Reference Books:

1. Introduction to Finite Element Method, S.S.Rao, Butterworth-Heinemann, 5th Edition, 2010
2. Finite Element Method, Olek C Zienkiewicz , Robert L Taylor , J.Z. Zhu, Butterworth-Heinemann, 7th Edition .
3. Concepts and Applications of Finite Element Analysis, Robert D. Cook.
4. Introduction to Finite Element Method, J.N.Reddy

MC 3102 METROLOGY AND COMPUTER NUMERICAL CONTROL (CNC)

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

Course Objectives:

The main objectives of this module are:

1. To provide to the students an understanding and appreciation of the science of Measurement.
2. To expose the students to various mechanical and electrical engineering measuring

devices, and understand the different degree of accuracy obtained from different types of instruments.

SYLLABUS:

Automatic screw lathes, Multi spindle automatic lathes, Turret lathes, Numerical control, NC operation, Coordinate system, Data input devices, Data storage, Programme editing, Machining centres, Turning centres, Vertical turning centres, Milling centres, Advantages of NC, Computers & NC, CNC, DNC, CNC part programming: Designation of co-ordinate axes for CNC machines, Functions of machine control units, Tape format, Manual part programming and computer assisted part programming (using APT language). Exercises involving simple contours and positioning.

ISO system of limits, Fits and Tolerances, Interchangeability, Plain limit gauges, Measurementof screw threads, major diameters, Minor diameters and effective diameter, Pitch, Limit gauges for internal and external threads, Measurement of spur gears, pitch, profile, lead, backlash, tooth thickness.

Tool maker's microscope, Straightness measurement, Slip gauges, Twisted strip mechanical comparator, Optical lever comparator, Optical projector, Electric comparator, Pneumatic comparator, Squareness testing, Optical bevel protractor, Sine bar, Angle gauges, Precision level, Autocollimeter, Angle dekkor, Optical dividing heads and rotary tables, Flatness measurement, Roundness measurement. Co-ordinate measuring machines.

Surface texture: Parameters, sampling length, Specification, Stylus instruments for surface roughness measurement. Acceptance tests on machine tools: Lathe, Milling machine, Radial drill, Laser equipment.

Learning Outcomes:

1. Select a measuring instrument to inspect the dimensional and geometric features of a given component.
2. Understanding and Identify measurement errors and suggest suitable techniques to minimizethem.
3. Describe the methods and devices for dimensional metrology
4. Design limit gauges.
5. Assess surface roughness and form errors.
6. To write APT and manual part programs using G and M codes for lathe and milling m/c.
7. Describe computer controlled manufacturing such as CNC, NC, DNC, CAM & Robotics.

Course Outcomes:

1. Students will be able to program using G-codes and M-codes and feed to CNC machine to carry out the necessary process.
2. Students will be able to appreciate FMS, perform robot programming along with the

hydraulics and pneumatics Students who successfully complete this course will be able to:

1. identify the uncertainties in dimensional metrology and the define the measurement standards;
2. describe the fundamentals of dimensional and geometrical tolerances;
3. use effective methods of measuring straightness, flatness, roundness, profile, screw threads and gear teeth;
4. measure dimensions of shafts, bearings and linear surfaces in metric and imperial units using calibers, micrometers, and scales;
5. use contour projector ad coordinate measuring machine to record measurements of complex profiles with high sensitivity;
6. use gage blocks, fixed gages, pneumatic gages, gage blocks to measure various work pieces;

Text Books:

1. Process & Materials of Manufacture, R.A.Lindberg, 4th edition, Prentice-Hall of India, New Delhi.
2. A Text Book of Engineering Metrology, I.C.Gupta, Dhanpat Rai & Sons, Delhi.
3. CNC and Computer Aided Manufacturing, T.K.Kundra, P.N.Rao & N.K.Tewari, TataMcGraw-Hill Publishing Company Ltd, Delhi.

References Books:

1. A.S.T.M.E., Hand book of Industrial Metrology, Prentice-Hall of India, New Delhi.
2. A.S.T.M.E., Hand book of Manufacturing Engineering.
3. Manufacturing Processes & Materials for Engineers, L.E.Doyle & others,Prentice-Hall of India, New Delhi.

MC 3103 PRODUCTION PLANNING AND CONTROL

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

Course Objectives:

1. The objective of the course is to enable the students to study basic strategies of PPC.
2. To make the student to understand forecasting and its methods.
3. To make the student to understand different functions of PPC.
4. To make the student to understand basic concepts of Lean Manufacturing.

SYLLABUS:

Introduction: Definition–Objectives of production Planning and Control Functions of production planning and control – Types of production – Organization of production planning and control department.

Learning Outcomes:

1. Identifies different functions of PPC and know types of productio

Forecasting: Importance– Types of forecasting – Forecasting techniques–qualitative methods and quantitative methods – Delphi, simple average, simple moving average, weighted moving average, exponential smoothing, linear regression.

Learning Outcomes:

1. Students will know importance of forecasting and able to use qualitative and quantitativemethods of forecasting wherever it is necessary.

Inventory management: Functions of inventories–relevant inventory costs– EOQ model

Learning Outcomes:

1. Understands the different relevant inventory costs associated with inventory management and formulation of EOQ model.

Material Requirement Planning: Bill of material, MRPII, Master Production Scheduling.

Learning Outcomes:

1. Student learns about material requirement planning.

Aggregate planning: Chase planning, Expediting, controlling aspects.

Learning Outcomes:

1.Students can be able to understand different aggregate planning methods.

Routing: Definition– Routing procedure– Route sheets—Factors affecting routing, procedure– Difference with loading.

Learning Outcomes:

1.Students learns about routing procedure.

Scheduling: Policies – Types of scheduling- Forward and Backward Scheduling – Gantt Charts – Flow shop Scheduling – n jobs and 2 machines, n jobs and 3 machines.

Learning Outcomes:

1.Students understands more about significance of scheduling function in manufacturing industryand also their classification.

Dispatching: Activities of dispatcher – Dispatching procedure – follow up–priority rules for dispatching jobs.

Learning Outcomes:

1. Students understands dispatching function in PPC

Introduction to Lean Manufacturing

Course Outcomes:

1. Student shall be able to forecast the appropriate requirement of resources for various production processes and other shop floor activities
2. The student will be able to forecast the appropriate strategy for resource planning through appropriate MRP tool.
3. The students will be able to improve the productivity of shop floor through decision of appropriate production systems such as mass production, batch production etc within existing conditions.
4. The students will be able to identify the bottlenecks of shop floor and remove the same by appropriate design and analysis.

Text Books:

1. Elements of Production Planning and Control, Samuel Eilon, Universal Publications, 2015
2. Modern Production/operation managements, Baffa & Rakesh Sarin , Wiley Publications, 1987

References:

1. Production and Operations Management, S.N.Chary, McGraw-Hill ,2019.
2. Inventory Control Theory and Practice, MartinK. Starrand David W.Miller, Englewood Cliffs, N.J. Prentice-Hall, 1962.
3. Production Control a Quantitative Approach, JohnE.Biegel, Prentice-Hall,1971.
4. Operations Management, Joseph Monks ,McGraw-Hill, 1977.

MC 3104 PROFESIONAL ELECTIVE-I

MC 3105 OPEN ELECTIVE-I

MC 3106 DYNAMICS OF MACHINERY LABORATORY

(Effective from the batch admitted during 2021-2022 AICTE)

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

Examination (Theory): 3hrs. Credits :1.5

Course Objectives:

The objectives of this course are

1. To develop competency in conducting laboratory experiments for finding moment of inertia of rigid bodies.
2. To make the student familiar with commonly used mechanisms for industrial application.

3. To demonstrate the various unbalanced rotating systems.
4. To familiarize the various types of vibrations for spring mass system.
5. To provide the process of calibration to various 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 With worth 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

Learning Outcomes:

After completion of the above experiments the students will learn

1. To calculate the moment of inertia of a given fly wheel and connecting rod.

2. To calculate the unbalanced masses present in the system.
3. The fundamental concepts and to calculate the gyroscopic couples of different systems.
4. The idea of vibrations and to calculate the natural frequencies of a given system.
5. To calibrate the measuring instruments before going for measurements.

Course Outcomes:

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

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

MC 3107 INDUSTRIAL ENGINEERING LABORATORY

(Effective from the batch admitted during 2021-2022 AICTE)

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

Examination (Theory): 3hrs. Credits :1.5

Course Objectives:

1. To make student acquainted with the control charts and measure the quality of the product.
2. To make the students aware of the different types of process charts used for improving the method of doing the work.
3. To help students to learn the different methods of finding the standard time for a job.
4. To make the students acquainted with the probability distributions.
5. To make the students learn the impact of work on the human physiology and the physiological constraints of the body.

List of Experiments:

1. To measure the skill and dexterity in the movement of Wrist and Fingers using pinboard.

2. To measure the Heart beat using Stethoscope.

3. To show that the sample means from a normal universe follow a normal distribution.

4. To draw the control chart for fraction defective for a given lot of marble balls.

5. To determine the cycle time using PMTS.

6. To draw two handed process charts for

   i. Bolt, Washer and nut assembly

   ii. Assembly of electric tester.

7. To study the changes in heart rate for different subjects using Tread mill.

8. To draw Multiple Activity chart using an electric toaster.

9. To determine the percentage utilization using work sampling.

10. To study the process capability of a given process.

11. To measure the Heart rate during working and recovery periods of the subjects under different loads, using Bicycle ergometer.

12. To draw flow process charts on activities in Workshop/ Laboratory/Office.

13. To determine the time required to perform motion sequence using work factor system.

14. To draw SIMO charts for

    i. Ball point pen assembly

    ii. Electric plug assembly.

15. To conduct time study of the bulb holder assembly operation of the existing method.

16. To collect the anthropometrics data using `Anthropolometer'.

Learning Outcomes:

1. Students will be able to find the quality of the product using different charts.
2. Can improve the method of doing work by applying principle of motion economy and methodstudy charts.
3. Can find the standard time required for completing a job by different methods..
4. Understands the basic probability distributions.

Understands the impact of work on the human body and also the physiological constraints of the body.

Course Outcomes:

1. Students will be able to find the quality of the product using different charts.

2. Can improve the method of doing work by applying principle of motion economy and method
study charts.
3. Can find the standard time required for completing a job by different methods..
4. Understands the basic probability distributions.
5. Understands the impact of work on the human body and also the physiological constraints of the body.

MC 3108 PYTHON PROGRAMMING
(SKILL COURSE)

(Effective from the batch admitted during 2021-2022 AICTE)

Periods/week : 3 Lab Ses. : 50 Exam : 50
Examination (Theory): 3hrs. Credits :2

Course Objectives:

1. To understand computers, programming languages and their generations and essential skills for a logical thinking and for problem solving.
2. This Python course leads the students from the basics of writing and running python scripts in problem solving and also to design and implement the modules and understands the working of classes and objects in python.
3. To understand the PYTHON environment and make numerical computations and analysis.
4. Understand and write and test and debug Simple Python code using the basics of Python, Statements, Expressions,Conditional Executions, Loops and Functions.
5. Write code for Iteration, Strings, File I/O and also to understand search, sort, read and write data from/to files in Python.
6. Write Python program codes for compound data - in creating, usage of Lists, Dictionaries, Sets and Tuples.
7. Understand the concepts of object orientation, data base and write code implementing them.

List of Experiments:

Write Programs in PYTHON Programming for the following:

Course Content

Running instructions in Interactive interpreter and a Python Script, Develop Python programs using basic operations in Python, Develop Python programs that makes use of conditional and control flow structures, Develop Python programs using recursive and non-recursive functions,

Develop Python programs using suitable Data structures, Illustrate installing packages via PIP and develop python programs using modules, Application oriented Case Studies, Illustrate Class variables and instance variable and also Develop Python programs to exemplify the concepts of inheritance and overloading, Exercise Programs on Lists, Conditional execution, Iteration, Files I/O, Tuples, Sets, Dictionaries, Functions & recursion, Strings, Arrays, Searching and Sorting techniques, Object-Oriented Programming, Using Databases and Structured Query Language, Python Maps, Filters & Generators:

1. Implement Python script to print factorial of a number, to print all prime numbers within the given range and to calculate the series
2. To find the roots of non-linear equation using Bisection method and Newton Raphson's method.
3. Curve fitting by least – square approximations and Write a Python Program to Solve Quadratic Equation.
4. To solve the system of linear equations using Gauss - elimination method, Gauss - Siedal method and Gauss - Jordan method.
5. Write a Python program to strip a set of characters from a string and reverse words in a string
6. Write a python function to find the maximum and minimum of a list of numbers and Write a Python Program to Convert Decimal to Binary Using Recursion and Write a python recursive function to a find the factorial of a given number.
7. To integrate numerically using Trapezoidal rule and Simpsons rule
8. Write a Python program to find the repeated items of a tuple, to convert a list with duplicates to a tuple withoutduplicates and also to reverse the elements of a tuple.
9. To find the largest eigen value of a matrix by Power – method
10. To find numerical solution of ordinary differential equations by Euler's method and Runge-Kutta method and Milne's method
11. Write a Python class named Rectangle constructed by a length and width and a method which will compute the area of a rectangle and Write a Python class named Circle constructed by a radius and two methods which willcompute the area and the perimeter of a circle.
12. Write a query to get the highest, lowest, sum, and average salary of all employees and also Write a query to find the names (first_name, last_name), the salary of the employees whose salary is greater than the average salary.
13. Write a program to create, display, append, insert and reverse the order of the items in the array and also to Write a program to add, transpose and multiply two matrices.
14. . Write a program to perform the given operations on a list: i. add ii. Insert and iii. slicing
15. To find the numerical solution of Laplace equation
16. To find the numerical solution of Wave equation
17. To find the solution of a tri-diagonal matrix using Thomas algorithm
18. To fit a straight line using least square technique

Course Outcomes:

Students will be able to:

1. Learn the PYTHON Programming language and also Understanding of Python especially the object-oriented concepts, using databases.
2. Understanding of scripting and the contributions of python language.
3. Design and implement machine learning solutions to clustering problems andfeatures of various data.
4. Solve the different methods for linear, non-linear and differential equations
5. Write the Program scripts and functions in PYTHON to solve the methods and Familiar with the strings and matrices in PYTHON
6. Implement python programming constructs to build small to large applications and also to Implement the problems in terms of real-world objects using OOPs concept.
7. Evaluate and handle the errors during runtime involved in a program and to Extract and import packages for developing different solutions for real time problems.

Text Books:

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson India, 2017.
2. Python for Informatics- Exploring Information, Charles Severance, 1stedition Shroff Publishers, 2017.
3. A Python Book: Beginning Python, Advanced Python, and Python Exercises, Dave Kuhlman, Open Source MIT License.
4. Python for Data Analysis, Wes McKinney, O‘ Reilly.
5. Python with Machine Learning, A Krishna Mohan, T Murali Mohan & Karunakar,1 st Edition, S Chand Publications, 2019
6. Introduction to programming using Python, Y. Daniel Liang, 1 st Edition, Pearson Publications, 2017.

Reference Books:

1. Learning Python, Mark Lutz, 5th edition, Orielly, 2013.
2. Think Python, How to Think Like a Computer Scientist, Allen Downey 2nd edition, Green Tea Press, 2015.
3. Core Python Programming, W. Chun , 2nd Edition, Prentice Hall, 2006.
4. Introduction to Python, Kenneth A. Lambert, 1st edition, Cengage Learning, 2011.
5. Python Data Science Handbook-Essential Tools for Working with Data Science from Scratch, O‘Reilly, Joel Grus,
6. Python Programming A Modular Approach , Sheetal Taneja, 1st Edition Pearson Publications, 2017.
7. Effective Python: 59 Specific Ways to Write Better Python, I/C, Brett Slatkin (C), 1st Edition Pearson Publications, 2015.

8. Programming and Problem Solving with Python, Ashok Namdev Kamathane and Amit Ashok Kamathane, 1st Edition, McGraw Hill Education (India) Private Limited, 2017
9. An Introduction to Python - Revised and updated for Python 3.2, Guido Van Rossum and Fred L. Drake Jr, Network Theory Ltd., 2011.
10. Introduction to Programming inPython: An Inter-disciplinary Approach, Robert Sedgewick, Kevin Wayne, Robert Dondero, Pearson India Education Services Pvt. Ltd., 2016.
11 Exploring Python, Timothy A. Budd, Mc-Graw Hill Education (India) Private Ltd., 2015.
12. Introduction to Computer Science using Python: A Computational Problem Solving Focus, Charles Dierbach, Wiley India Edition, 2013.

E-Resources and other Digital Material

1. Charles Severance: University of Michigan,Python for Everybody [COURSERA]. (05-01-2021), Available: https://www.coursera.org/
2.Prof. SudarshanIyengar, IIT Ropar, Prof. Yayati Gupta, IIIT Dharwad, The Joy Of Computing Using Python [NPTEL], (05-01-2021),
Available:https://nptel.ac.in/courses/106/106/106106182/#
3.Charles Russell Sevarance, University of Michigan, Python for Everybody, 2019
https://www.coursera.org/learn/pytho.
4. https://onlinecourses.nptel.ac.in/noc21_cs78/preview
5. https://www.coursera.org/learn/python?specialization=python#syllabus
6. https://www.coursera.org/learn/python-data?specialization=python#syllabus
7. https://www.coursera.org/learn/python-databases?specialization=python#syllabu

MC 3109 INTERNSHIP-I

(Effective from the batch admitted during 2021-2022 AICTE)

Ses. : 50 Exam : 50 Credits :2

THIRD YEAR 2ND SEMESTER

MC 3201 DESIGN OF MACHINE ELEMENTS –II

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

Course Objectives:

1. Enable students to attain the basic knowledge required to understand, analyze, design and select the machine elements.
2. Reinforce the philosophy that real engineering design problems are open-ended and challenging
3. Impart design skills to the students to apply these skills for the problems in real life industrial applications
4. Inculcate an attitude of team work, critical thinking, communication, planning and scheduling through design projects
5. Create awareness amongst students about safety, ethical, legal, and other societal constraints in execution of their design projects.
6. Develop an holistic design approach to find out pragmatic solutions to realistic domestic and industrial problems

SYLLABUS:

Gears: Classification of gears, Terminology, Standard systems of gear tooth,Selection of materials, Design of Spur, Helical, Bevel and Worm gears, Force analysis of spur helical, bevel and worm gears, Gear tooth failure. Face width, beam strength. Lewis equation, Checking the Design for dynamic and wear loads. Thermal design considerations of worm gears.

I.C.Engine parts: I.C.engine. Stresses in engine parts, Design of cylinders and heads. Design of piston. Design of connecting rod and crank shafts.

Clutches and Brakes: Friction clutches. Torque transmitting capacity, multi-plate clutches, Design considerations. Energy considerations and Temperature rise friction materials. Cone clutches, Centrifugal clutches. Brakes. Energy equations. Band and block brakes. Internal expanding shoe brakes, Disc brakes, self-locking, brake design.

Bearings: Sliding contact bearings. Lubrication modes. Temperature effect on viscosity. Journal bearings design. Bearing modulus. McKee's equations. Heating of bearings. Collar and thrust bearings. Roller and ball bearings. Static and dynamic load capacity. Equivalent bearing load. Load-life relationships. Load factor. Selection of bearings from manufacturers catalogue.

Miscellaneous parts: Design of crane hooks, Wire rope construction, Stresses in wire ropes. Design for service like lifts and winches. Chain drives, Nomenclature: Brief outline and simple applications of composite materials.

Learning Outcomes:

1. Familiarizing the standards
2. Design the Spur. Helical, Bevel Gears and worm and worm wheel based on beam strength,wear strength & Buckingham's Equation.
3. Design and force analysis of I C Engine Parts

4. calculate the load carrying capacity of Rolling Contact Bearing and select the bearing frommanufacturer's catalog.
5. select the lubricating oil based on properties and apply the theory of lubrication to estimatevarious design parameters.
6. Design the stress analysis of cranes and wire ropes
7. Identifying the suitable composite materials for various applications.

Course Outcomes:

1. Apply knowledge of machine design for understanding, formulating and solving
2. Engineering problems of gear design and industrial gear boxes.
3. Acquire knowledge and hands-on competence in applying the concepts in the design and development of mechanical systems and proficient in Design of Gears, I.C. engine parts, brakes and clutches.
4. Demonstrate creativeness in designing new systems components and processes in the field of engineering in general and mechanical engineering in particular to develop capability to analyze Rolling contact bearing and its selection from manufacturer's Catalogue.
5. Identify, analyze, and solve mechanical engineering problems of gear boxes, engine parts and other miscellaneous parts for various industrial applications useful to the society.
7. Work effectively with engineering and science teams as well as with multidisciplinary designs and expertise in design of Sliding contact bearing in industrial applications and selection of suitable composite materials.

Text books:

1. Design of Machine Elements, V.B.Bhandari, TMH Publishing Co. Ltd., NewDelhi.
2. Shigley's Mechanical Engineering Design, Richard G. Budynas and J. Keith Nisbett Mc Graw Hill Publications.
3. Machine Design, R.S.Khurmi and J.K.Gupta, S.Chand Publications.

Reference Books:

1. Machine Design, R.K.Jain, Khanna Publications
2. Machine Design: An Integrated Approach, 2/e by Robert L. Norton ,Pearson Education.

MC 3202 FLUID MECHANICS AND MACHINERY

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

Course Objectives:

1. To prepare the student to get the principles and properties of fluid.
2. The student is prepared to learn viscosity, flow measurement concepts.
3. The student is made to aware of compressible fluid flow.
4. The student is educated with concepts of applications of principles of fluids to fluid machines.
5. The student is made to aware of concepts of water jets and hydraulic machines.

SYLLABUS:

Properties of Fluids- Introduction- Viscosity- Pressure and its measurement, absolute, gauge, atmospheric and vacuum pressure- Manometers, Simple manometers and differential manometers.

Learning Outcomes:

1. The student gets idea of evaluation of pressures by means of manometers.
2. The student will be able to evaluate hydrostatic forces on all different surfaces.

Fluid Kinematics and Fluid Dynamics: Types of fluid flow- Continuity equation- Velocity potential function and Stream Function - Equation of Motion- Euler's equation- Bernoulli's equation and its applications- Venturimeter, Orifice Meter, Pitot tube- Momentum Equation- Momentum of momentum Equation.

Learning Outcomes:

1. The student gets awareness of understanding various fluid flows and its calculations.
2. The student develops an interest in measuring flow rates by metres.

Viscous Flow: Couette flow- Plane Couette flow, Favourable pressure gradient and adverse pressure gradient- Power absorbed in viscous Flow- Flow through pipes- Hagen Poiseulle flow- Fanings friction factor- Darcy's Weisbach friction factor- Loss of head due to friction inpipes, minor losses and major losses - Flow through branched pipes- Power transmission through pipes.

Learning Outcomes:

1. The student gets knowledge on viscous flow calculations,
2. The student gets awareness on laminar and turbulent flow in pipe flows.

Compressible Fluid Flow: Thermodynamic relations- Continuity, Momentum and Energy equations- Velocity of sound in a compressible fluid- Mach number and its significance- Limitsof incompressibility- Pressure field due to a moving source of disturbance- Propagation of pressure waves in a compressible fluids- Stagnation properties- Stagnation pressure, Temperature and density- Area velocity relationship for compressible flow- Flow of compressible fluid through nozzles- Condition for maximum discharge through nozzles- Variation of mass flow with pressure ratio- Compressible flow through a venturimeter- Pitot static tube in a compressible flow.

Impact of Jets; Impact of jet vane on stationary surfaces- Impact of jet onhinged surfaces and

Impact of jet on stationary as well as moving curved vanes- Radial flow over the vanes.
Hydraulic Turbines: Classification- Pelton wheel- Reaction turbines- Inward and outward radial flow reaction turbines- Francis turbine- Axial flow reaction turbine- Kaplan turbine.

Centrifugal and Reciprocating Pumps: **Centrifugal pumps**: Main parts- Efficiency- Minimum speed for starting- Multistage centrifugal pumps. Reciprocating Pumps: Main parts- Classification- Velocity and acceleration variation in suction and delivery pipes -Effect of variation of velocity on friction in suction and delivery pipes.

Learning Outcomes:

1. The student is able to understand various hydraulic machines and its working
2. The student gets awareness on centrifugal and reciprocating pumps.

Course Outcomes:

1. The student gets knowledge on pressure measurement and determination of properties of fluids.
2. The student develops the concept of measurement of flow and equations in viscous flow.
3. The student develops an idea of fluid principles in the form of equations in application to fluid machines.
4. The student develops the concept of compressible fluid flow.

The student gets awareness on use of different jets to hydraulic machines.

Text Books:

1. Fluid Mechanics and Hydraulic Machines, R. K. Bansal, Laxmi publications.
2. Fluid Mechanics, A.K. Mohanty, Prentice Hall of India Pvt.Ltd.
3. Fluid Mechanics and Fluid Power Engineering , Dr. D.S. Kumar, S.K. Kataria &Sons.

Reference Books:

1. Foundations of Fluid Mechanics, Yuan, Prentice Hall of India.
2. Fluid Mechanics and its Applications, S. K.Gupta and A.K.Gupta, Tata McGraw Hill, New Delhi.
3. Fluid Mechanics and Hydraulic Machines, R. K. Rajput, S.Chand & Co.
4. Fluid Mechanics , Kothandaraman and Rudramoorthy.

MC 3203 HEAT TRANSFER

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

Course Objectives:

1. Students should familiarize with the basic concepts of conduction and extend the concepts to various geometries under different conditions
2. Students with fundamentals of boundary layer to develop logical and mathematical correlations applied for various boundary conditions and facilitate convection calculations
3. Students should have an exposure to various laws in radiation and apply the same to heat transfer influenced by radiation.
4. Student must learn about different types of heat exchangers used in industrial applications with basic knowledge of heat load calculations
5. Students to learn about apparent basics of phase change phenomenon
6. Students must have comprehensive knowledge of all modes of heat transfer

SYLLABUS:

Introduction: Basic modes of heat transfer- Rate equations- Generalized heat conduction equation in Cartesian, Cylindrical and Spherical coordinate systems.

Steady state heat conduction solution for plain and composite slabs, cylinders and spheres- Critical thickness of insulation- Heat conduction through fins of uniform and variable cross section- Fin effectiveness and efficiency.

Unsteady steady state heat conduction- Transient heat conduction- Lumped system analysis, and use of Heisler charts.

Learning Outcomes:

1. Exposure to 3 dimensional heat transfer studies in different geometries under steady and unsteady state conditions

Convection: Continuity, momentum and energy equations- Dimensional analysis- Boundary layer theory concepts- Free, and Forced convection- Approximate solution of the boundary layer equations- Laminar and turbulent heat transfer correlation- Momentum equation and

velocity profiles in turbulent boundary layers- Application of dimensional analysis to free and forced convection problems- Empirical correlation.

Learning Outcomes:

1. Application of boundary layer theory concepts in convection and solve problems related to forced convection and natural convection

Radiation: Black body radiation- radiation field, Kirchoff's laws- shape factor- Stefan Boltzman equation- Heat radiation through absorbing media- Radiant heat exchange, parallel and perpendicular surfaces- Radiation shields.

Learning Outcomes:

1. Learn basic concepts of radiation and extend the concepts for problem solving with regard tosurfaces and enclosures

Heat Exchangers: Types of heat exchangers- Parallel flow- Counter flow- Cross flow heat exchangers- Overall heat transfer coefficient- LMTD and NTU methods- Fouling in heat exchangers- Heat exchangers with phase change.

Boiling: (Qualitative treatment only) Different regimes of boiling- Nucleate, Transition and Film boiling. Condensation: (Qualitative treatment only) Laminar film condensation- Nusselt's theory- Condensation on vertical flat plate and horizontaltubes- Dropwise condensation.

Learning Outcomes:

1. Learn basics of boiling and condensation and fundamentals of mass transfer.

Course Outcomes:

1. Students would be comfortable with use of equivalent heat transfer circuits. The implications of an internally distributed energy source can be understood clearly and apply the same to various geometries under different conditions
2. Students with exposure to boundary layer theory can help them to deal with relevant dimensionless groups, boundary layer approximations and understand the fundamentals of convection
3. Students will be cognizant of basic laws of radiation and extend them to different geometries and orientations
4. Students can logically identify and estimate heat loads/area required from a given choice of heat exchangers
5. Students can identify the essential and physical process of phase change phenomenon and present correlations for approximate engineering calculations.

Text Books:

1. Heat Transfer, J.P.Holman, Int. Student edition, McGraw Hill Book Company.
2. Analysis of Heat transfer, Eckert and Drake, Int.Student edition, McGraw Hill Kogakusha Ltd.

Reference Books:

1. Heat and Mass Transfer , R.K. Rajput, S. Chand & Co.
2. Fundamentals of Engineering Heat and Mass Transfer, R C Sachdeva, New Age International Publishers
3. Fundamentals of Heat and mass transfer, C P Kothandaraman, New Age International Publishers

MC 3204 PROFESIONAL ELECTIVE-II

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

MC 3205 OPEN ELECTIVE-II

(Effective from the batch admitted during 2021-2022 APSCHE)

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

Examination (Theory): 3hrs. Credits :3

MC 3206 METROLOGY & MECHATRONICS LABORATORY

(Effective from the batch admitted during 2021-2022 AICTE)

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

Examination (Theory): 3hrs. Credits :1.5

Course Objectives:

1. To demonstrate the fundamentals of Metrology and Measurement Engineering concepts, different tools used for minute measurements, and calibrate various kinds of measuring instruments.
2. To demonstrate the involvement of sensors and electronic devices in the mechanical oriented industries by introducing PLC, and Mechatronicsequipment.
3. To demonstrate the use of logic circuits in controlling various mechanical devices including material handling equipment, lift control systems, pneumatic controller systems etc.
4. To demonstrate the techniques and processes followed for calibrating measuring instruments like Micrometer, Mechanical Comparator, and Vernier Caliper etc. and educate students about the metrology equipment.
5. To train the students on the fundamentals of logic circuit design, to write ladder logic programs and execute them to control various mechanicaldevices.

Metrology Lab. Experiments - (Any Five)

1. Calibration of the following instruments: (using slip gauges)

i. Calibration of Micrometer. ii. Calibration of Mechanical Comparator.
iii. Calibration of Vernier Caliper. iv. Calibration of Dial Gauge.

2. Measurement of taper angle using

i. Bevel Protractor ii. Dial Gauge iii. Sine-Bar iv. Auto-Collimator.

3. Alignment tests:

i. Parallelism of the spindle ii. Circularity & Concentricity of the spindle

iii..Trueness of running of the spindle.

4. Gear parameters Measurement

i. diameter, pitch/module ii. Pitch circle diameter iii. Pressure angle iv. Tooth thickness.

5. Check the flatness of a surface plate.

i. Using spirit level ii. Using Auto-collimator

6. Using light wave interference:

i. Study of flatness of slip gauges ii. To find the height of a slip gauge.

7. Tool Maker's Microscope:

i. Establish the thread details ii. To find the cutting tool angles.

8. Miscellaneous:

i. To find the diameter of a cylindrical piece ii. Taper angle of a V-block

iii. Central distance of two holes of a specimen.

Mechatronics Lab. Experiments - (Any Five)

I. Training on Programmable Logic Controller (any ONE of the Following)

i) Lift Control Using Ladder Logic Programme

ii) Traffic Signal Control using Ladder Logic Programme

II. Training on Programmable Logic Controller - Sensor Training Kit

a) Proximity Switch

b) Photo Electric Switch

c) Limit Switch

III. Training on Sensor and Transducer (any ONE of the Following)

i. Linear position or Force applications

a) LVDT (Linear variable differential transformer)

b) The strain gauge Transducer

ii. Rotational Speed or Position Measurement (The inductive Transducer) iii). Linear or Rotational Motion

a. D.C. Solenoid

b. D.C. Relay

IV. Training on Automation Studios

i. Punch Machine

operation

ii. Hydraulic Cylinder operation

V. Training on Material Handling

VI. Training on any Controller Package

VII. Training on Servo Fundamental Trainer.

Learning Outcomes:

1. Able understand the standards, concepts and terminology of mechanical metrology.
2. Learn the principles of linear and angular measurements and instrumentation.
3. Able to understand and analyze the production drawings for dimensional and geometricaltolerance

Course Outcomes:

1. Students will be able to understand the various logics involved in controlling mechanical industry equipment.
2. The student will be able to operate measurement instruments on their own and test different components for their dimensional accuracy.
3. A project involving writing ladder logic for controlling a mechanical device, executing the program is required from each student and graded by the instructor, so that the student will be able to understand the Mechatronics concept, practically and from the application point of view.

MC 3207 FLUID MECHANICS AND MACHINERY LABORATORY

(Effective from the batch admitted during 2021-2022 AICTE)

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

Examination (Theory): 3hrs. Credits :1.5

Course Objectives:

1. The student is made to understand fluid mechanics principles.
2. The student is taught to use equations applied to flow meters, jets, turbines and pumps.
3. The student is made aware related to working of various fluid machines.
4. The student is made to understand the concept of drag and discharge.
5. The student is taught to draw line diagrams to understand the function of equipment.

List of Experiments:

Cycle-1

1. Calibration of flow meters, a) Venturi meter b) Orifice meter c) Nozzle meter
2. Determination of coefficient of discharge for a) small orifice b) cylindrical mouth piece

3. Finding coefficient of discharge for a) rectangular notch b) triangular notch c) trapezoidal notch

Cycle-II

4. To find the force due to Jet of water (Impact of Jets) a) Force on Flat Plate b) Force on Curved Plate
5. To draw the performance characteristics of C.F. pump.
6. To find the specific speed of a) Pelton turbine b) Francis turbine
7. To draw the characteristic curves for reciprocating pump.
8. To draw the pressure distribution and finding coefficient of drag for a) A bluff body b) An Aero foil c) To draw the characteristic curves for the hydraulic ram

Course Outcomes:

1. The student gets an idea to use continuity, momentum and energy equation principles.
2. The students gets awareness to see, record and analyze the observations.
3. The student is able to assess the usage of flow meters and notches.
4. The student gets idea on estimation of values in jets as well as in turbines.
5. The student gets capability in estimation of performance characteristics of pumps.

MC 3208 HEAT TRANSFER LABORATORY

(Effective from the batch admitted during 2021-2022 AICTE)

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

Examination (Theory): 3hrs. Credits :1.5

Course Objectives:

1. Students to have practical approach to different modes of heat transfer
2. Students to learn about opportunities available to change boundary conditions and study their influence on heat transfer
3. Students to learn about steady state conditions and evaluate critical parameters in heat transfer applications
4. Students to learn about instrumentation used in heat transfer applications

List of Experiments:

1. Study of conduction phenomena in the composite lagged pipe system.
2. Determination of emissivity of a test plate.
3. Study of heat transfer in a shell and tube heat exchanger
4. Determination of thermal conductivity of metal rod (copper).
5. Study of heat transfer through a insulating slab
6. Study of heat transfer by free convection through a vertical cylinder
7. Study of heat transfer by forced convection through a horizontal test section.

8. Study of unsteady state conduction heat transfer and temperature distribution with time
9. Determination of free convective heat transfer coefficient from a horizontal cylinder in air.
10. Study of performance of heat pipes
11. Study of temperature distribution, effectiveness and efficiency of pin fin

Course Outcomes:

1. Students will have hands on experience handling different experiments in heat transfer
2. Students can learn the significance of boundary conditions and their influence on heat transfer
3. Students can evaluate critical parameters at steady state conditions.
4. Exposure to different measuring instruments can certainly enhance their knowledge in instrumentation also.

MC 3209 SOFT SKILLS
(SKILL COURSE)

(Effective from the batch admitted during 2021-2022 AICTE)

Periods/week : 3 Lab Ses. : 50 Exam : 50
Examination (Theory): 3hrs. Credits :2

Course Objectives:

1. To develop skills to communicate clearly.
2. To aid students in building interpersonal skills.
3. To enhance team building and time management skills.
4. To inculcate active listening and responding skills.

SYLLABUS

Introduction to Soft Skills: Communication – Verbal and Non Verbal Communication - Personal grooming (Etiquette, Attitude, Body Language), Posture, Gestures, Facial Expressions, Eye Contact, Space Distancing, Presentation Skills, Public Speaking, Just a Minute (JAM) sessions, Adaptability.

Goal Setting and Time Management: Immediate, Short term, Long term, Smart Goals, Strategies to Achieve goals, Types of Time, Identifying Time Wasters, Time Management Skills, Stress Busters.

Leadership and Team Management: Qualities of a Good Leader, Team Dynamics, Leadership Styles, Decision Making, Problem Solving, Negotiation Skills.

Group Discussions: Purpose (Intellectual ability, Creativity, Approach to a problem, Tolerance), Group Behaviour, Analysing Performance.

Job Interviews: Identifying job openings, Covering Letter and CVs / Resumes, Interview (Opening, Body-Answer Q, Close-Ask Q), Telephone Interviews, Types of Questions.

Course Outcomes:

1. Make use of techniques for self-awareness and self-development.
2. Apply the conceptual understanding of communication into everyday practice.
3. Understand the importance of teamwork and group discussions skills.
4. Develop time management and stress management.

Reference Books:

1. Nail the Resume! Great Tips for Creating Dynamite Resumes. Krannich, Caryl, and Krannich, Ronald L. United States, Impact Publications, 2005.
2. Brilliant Communication Skills. Hasson, Gill.Great Britain: Pearson Education, 2012
3. How to Prepare for Group Discussion and Interview, Prasad, H. M. New Delhi: Tata McGraw-Hill Education, 2001.
4. Body Language, Pease, Allan, Delhi: Sudha Publications, 1998.
5. Effective Technical Communication: Rizvi, Ashraf M. India, McGraw-Hill Education. 2010
6. Winning at Interviews, Thorpe, Edgar &Showick Thorpe, 2nd Edition. Delhi: Dorling Kindersley, 2006.

MC 4101 PROFESIONAL ELECTIVE-III

MC 4102 PROFESIONAL ELECTIVE-IV

MC 4103 PROFESIONAL ELECTIVE-V

MC 4104 OPEN ELECTIVE-III

MC 4105 OPEN ELECTIVE-IV

MC 4106 HSS-ELECTIVE

MC 4107 SIMULATION OF ENGINEERING STRUCTURES (SKILL COURSE)

(Effective from the batch admitted during 2021-2022 AICTE)

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

Examination (Theory): 3hrs. Credits :2

Course Objectives:

1. To impart the fundamental knowledge on using various analytical tools like ANSYS, Solid Works etc., for Engineering Simulation.
2. To know various fields of engineering where these tools can be effectively used to improve the output of a product.
3. To impart knowledge on how these tools are used in Industries by solving some real time problems using these tools
4. To provide brief introduction of Computational Fluid Dynamics along with mechanical engineering application specifically, analysis of fluid mechanics and heat transfer related problems.

List of Experiments:

1. Structural Analysis using any FEA Package for different structures that can be discretised with 1-D,2-D & 3-D elements
    a) Static Analysis
    b) Modal Analysis
    c) Harmonic Analysis
    d) Spectrum Analysis
    e) Buckling Analysis
    f) Analysis of Composites
2. Thermal Analysis using any FEA Package for different structures that can be discretized with 1-D,2-D & 3-D elements
    a) Steady state thermal analysis
    b) Transient thermal analysis
3. Transient analysis using any FEA Package for different structures that can be discritised with 1-D,2-D & 3-D elements
    a) Linear
    b) Non-Linear (Geometrical Non-linearity)
4. Computational Fluid Dynamics using any FEA package.

a) CFD modeling for Laminar & Turbulent Pipe Flow,
b) Supersonic Flow over a Wedge,
c) Venturimeter Analysis.
d) Compressible Flow in a Nozzle
e) Airfoil Analysis,
f) Compressible Flow over a Flat Plate.

Course Outcomes:

Upon successful completion of this course student should be able to:

1. The student will be able to appreciate the utility of the tools like ANSYS ,Solid Works etc in solving real time problems and day to day problems.
2. Use of these tools for any engineering and real time applications.
3. Acquire knowledge on utilizing these tools for a better project in their curriculum as well as they will be prepared to handle industry problems with confidence when it matters to use these tools in their employment.
4. Recognize the importance of CFD in Heat and Fluid flow.
5. Estimation of drag coefficient in circular pipe under laminar and turbulent flow.

MC 4108 INTERNSHIP-II

MC 4201 PROJECT WORK

LIST OF PROFESSIONAL ELECTIVES

1. MECHANICS OF MATERIALS

Course Objectives:

1. The objective is to make students learn and analyze continuous and fixed beams, columns and struts under different loading conditions, stresses in rotating discs, curved bars, thin and thick Cylinders and shells
2. To enrich the student on the concept of fixed beams with uniform Moment of inertia both under stability of beam supports and under sinking & rotation of the supports
3. To make the student understand the concept of continuous beams with uniform Moment of inertia both under stability of supports as well as sinking of supports
4. To make the student understand the concept of vertical compression loading on an

engineering beam with four different end conditions as well as when column with initial curvature , under nonaxial loading condition and along with vertical compression and lateral central point loading

5. 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.
6. To make the student understand the concept of circular rotating discs having uniform thickness and uniform strength make him capable of calculating the stress on any point of the circular rotating disc.
7. To make the student understand the concept of thick cylinder as well as compound cylinder under different pressure conditions so that the student can evaluate radial stress and circumferential stress at any radius of the thick cylinder.
8. To make the student understand the energy methods and Castigliano"s theorem-1 &2 and their application for cantilever beams and simply supported beams.

SYLLABUS:

Fixed Beams: Introduction, bending moment diagram for fixed beams - slope and deflection for a fixed beam carrying- point load at center, an eccentric point load, a uniformly distributed load over the entire length, and fixed end moments of fixed beam due to sinking of a support.

Continuous beams: Analysis of continuous beam Introduction, Reactions at the supports, Effect of sinkingof supports, bending moment diagram for continuous beams-Clapeyron's equation of three moments, Clapeyron's equation of three moments applied to beams with simply supported ends carrying point loads and uniformly distributed load – continuous beams with end supports fixed carrying point loads and uniformly distributed load

Energy Methods - Strain energy and strain energy density, strain energy due to axial load, shear, flexure and torsion – Castigliano's theorems - I & II and applications, Maxwell's reciprocal theorems.

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 and Uniformly distributed load, Empirical formulae.

Bending of Curved Bars and Concept of Shear Center: Stresses in curved bars of circular, rectangular and trapezoidal sections and Introduction to Shear Center and unsymmetrical bending and its applications.

Stresses due to rotation: Rotating Rings & Discs Introduction, Wheel rim, disc of uniform thickness, stresses in a rotating ring, stresses in a rotating thin disc- circumferential and radial stresses in a solid disc, disc of uniform strength, circumferential and radial stresses in a hollow disc with a pin hole at the center.

Thick cylinders: Lame's equations, Thick Cylinders subjected to internal and external pressure and compound cylinders and its applications.

Learning Outcomes:

1. The students can be able to get the information necessary in case of fixed beams and continuous beams regarding their suitability to the load applied from the values of bending moment at different locations.
2. The total stress computed in case of columns and struts will be useful whether they are suitable for the existing load on them.
3. From the total stress values in case or curved beams it is easy to confirm whether a cantilever beam can withstand the load or not.
4. In case of rotating discs by comparing the radial stress and hoop stress with yield stress of material, it is easy to confirm the suitability of disc for a particular speed.
5. In case of thick cylinder the value of hoop stress at inner surface is a deciding factor as it should not increase the yield stress value.
6. In case of compound cylinder the reduction of hoop stress at inner surface is a key factor in deciding whether present design of compound cylinder is suitable or not. Whether t is required to reduce further hoop stress then it is required to go for more layers in compound cylinder.

Course Outcomes:

1. Develop an understanding of methods of analysis used in treating statically indeterminate loading conditions of the beams.
2. The student is capable of evaluating an already existing fixed beam with 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.
3. The student is capable of evaluating an already existing continuous beam with 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
4. 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. Analyze and design columns and long mechanical members under compression.
5. Understand the advanced concepts of strength of materials like curved bars, applications of theories of failures in the design of thick cylindrical vessels and pressure vessels etc.

6. 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.
7. The student is capable of calculating the radial stress and circumferential stress for rotating circular disc (both hollow and solid) of uniform thickness, and is capable of modeling the thickness of circular rotating disc having uniform strength.
8. 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

Text Books:

1. Analysis of Structures, Vazirani and Ratwani, Vol. 1, 1993 edition, .
2. Chapter VI from Advanced Topics in Strength of Materials, Prof. L.B.Shah and Dr.R.T.Shah.
3. Mechanics of Materials, Gere & Timoshenko, CBS Publishers or Mechanics of Materials, Timoshenko S.P. and James Gere, 5th edition, Van Nostrand Reinhold Co., 2001.

Reference Books:

1. Strength of Materials, Timoshenko.
2. Analysis of structures, Prof V.N.Vazirani &Dr MM Ratwani & Dr S.K.Duggal
3. Strength of Materials, Dr Sadhu Singh, Khanna Publications Pvt. Ltd., 2013.
4. Strength of Materials, S.S. Ramamrutham & R, Narayanan, Dhanpat Rai Publishing Company (P) Limited, 2008.
5. Engineering Mechanics of solids, Egor P. Popov, Second edition, Prentice hall of India Pvt. Ltd, New Delhi.
6. Mechanics of materials, Jhonston Beer and Mazurek Dewol, India Pvt. Ltd, New Delhi. th Edition
7. Strength of materials, R.K.Rajput, 6th edition S.Chand Ltd. publications, 2015.
8. A Text Book of Strength of Materials, R.K.Bansal, 4th edition, Lakshmi Publications Pvt. Ltd. 2017.
9. Boresi and Sidebottom, Advanced Mechanics of Materials, Wiely International, 5/e, 1993.

Web Resources:

1. http://nptel.ac.in/courses/Webcourse-contents/IITROORKEE/ strength%20of%20materials /homepage.htm

2. http://www.aboutcivil.org/solid-mechanics.html

3. http://web.mit.edu/emech/dontindex-build/

2. MECHANICAL VIBRATIONS

Course Objectives:

1. To enrich the student on the concept of Mechanical vibrations.
2. To make the student understand the concept of single and two degree of freedom systems.
3. To make the student understand the use of damping, influence co-efficients, matrix methods and Lagrange's equations.
4. To make the student understand the concept of vibrations by A.H Church.
5. To make the student understand the concept of multiple degree of freedom systems.
6. To make the student understand the vibration problems in dailylife
7. To make the student understand the principal of orthogonality classical and energy methods by Rayleigh, Ritz and Gelerkin.
8. To make the student understand the concept of Transient (shock) vibrations.

SYLLABUS:

Single degree freedom systems -Introduction - Single degree freedom systems - free and forced vibrations - Damping classification and damped systems.

Learning Outcomes:

Upon completion of this topic the student will be able to-

1. understand the concept of single degree of freedom systems
2. understand damping and their types
3. develop mathematical equations of single degree of freedom systems for free and forcedvibrations in real time applications
4. estimate natural frequencies for single degree of freedom systems

Two degree freedom systems - Free, forced damped and undamped motions - Use of influence coefficients, Matrix methods and Lagrange's equations - Phenomenon of beat - Dynamic absorbers – Applications.

Learning Outcomes:

Upon completion of this topic the student will be able to-

1. Understand the two degree freedom systems.
2. Develop the mathematical equations of two degree freedom systems for free, forced dampedand undamped vibrations using newton's second law.
3. Construct the matrix model for two degree freedom systems using influence coefficients.

4. Understand matrix methods and lagrange's equations for solving the mathematical models

Understand the concept of dynamic absorbers and different applications of them

Transient (Shock) vibrations as applied to single and two degree freedom systems - Use of mathematics and graphical techniques in the analysis (superposition integral, Laplace transformations, phase plane techniques).

Learning Outcomes:

Upon completion of this topic the student will be able to-

1. Understand the concepts of transient vibrations and real time applications of them.
2. Know and understand different mathematical approaches to deal with transient vibrations.

Multi degree freedom systems - Free and forced motions in longitudinal, torsional and lateral modes - damped and undamped, critical speeds of rotors. Continuous systems - free and forced vibrations of string, bars and beams - Principle of orthogonality Classical and energy methods by Rayleigh, Ritz and Gelerkin.

Learning Outcomes:

Upon completion of this topic the student will be able to-

1. Understand the concept of multi degree freedom systems
2. Understand continuous systems and construct mathematical models for them
3. Understand different energy methods and their application to vibration systems

Course Outcomes:

1. The student is capable of understanding the various concepts in Mechanical vibrations.
2. The student is capable of understanding the concept of single and two degree of freedom systems.
3. The student is capable of understanding the concept of multiple degree of freedom systems.
4. The student is capable of understanding the different problems in single, two and multiple degree freedom systems.
5. The student is capable of understanding the damping, influence co-efficients, matrix methods and Lagrange's equations.
6. The student is capable of understanding the principal of orthogonality classical and energy methods by Rayleigh, Ritz and Gelerkin.
7. The student is capable of understanding the concept of Transient (shock) vibrations and problems in it.

Text Books:

1. Mechanical Vibrations, G.K.Groover,Nem Chand & Bros , Roorkee,U.K.,India,2009.
2. Mechanical Vibrations , Singiresu S. Rao,Pearson Global Publications, Sixth Edition,2009

Reference Books:

1. Mechanical Vibrations and Noise engineering, A.G.Ambekar, Printice Hall India Publishers
2. Mechanical Vibrations, J.P. Den Hartog, Dover Publications Inc.,12th Edition , 1985.
3. Mechanical Vibrations, R.Venkatachalam, Prentice Hall India Learning,1st Edition, 2014
4. Elements of Vibration Analysis, Meirovitch, Tata McGraw Hill Edition, 2001
5. Mechanical Vibrations, S.Graham Kelly, Schaum's Outline , Tata McGraw Hill Edition, 2020
6. Vibration Problems in Engineering, Timoshenko and Young.
7. Mechanical Vibrations, Debabrata Nag, Wiley Publications
8. Theory and Practice of Mechanical Vibrations, J.S Rao & K. Gupta, New Age International Publishers, 2nd Edition
9. Mechanical Vibrations, A.H. Church, John Wiley & Sons Inc,1963

3. COMPOSITE MATERIALS

Course objectives:

1. To expose the student to different types of composite materials,
2. To understand the characteristics of composite materials

SYLLABUS:

Introduction: Classifications of Engineering Materials, Concept of composite materials, Types of reinforcements, Types of matrices, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites.

Types of Composites: Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC); Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites, Advantages & limitations of Composites

Manufacturing Methods: Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting. Fiber/Matrix Interface, mechanical. Measurement of interface strength. Characterization of systems; carbon fibre/epoxy, glass fibre/polyester, etc.

Mechanical Properties -Stiffness and Strength: Geometrical aspects – volume and weight fraction. Unidirectional continuous fibre, discontinuous fibers, Short fiber systems, woven reinforcements –Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear.

Laminates: Plate Stiffness and Compliance, Assumptions, Strains, Stress Resultants, Plate Stiffness and Compliance, Computation of Stresses, Types of Laminates -, Symmetric Laminates, Antisymmetric Laminate, Balanced Laminate, Quasi-isotropic Laminates, Cross-ply Laminate, Angle ply Laminate. Orthotropic Laminate, Laminate Moduli, Hygrothermal Stresses.

Course Outcome:

1. Understand the significance of composite materials.
2. Distinguish the construction, constituent's phases & characteristics of the composite materials.
3. Explain the fabrication techniques of different types of composite materials.

Text Books:

1. Composite Materials- Science & Engineering, K.K. Chawla, Springer-Verlag, New York, 1987.
2. An Introduction to Composite Materials, Hull, Cambridge, 2nd Edt. 1997.

Reference Books:

1. Materials characterization, Vol. 10, ASM hand book.
2. Engineered Materials Handbook, Vol. 1, ASM International, Ohio, 1988.
3. Composite Materials: Engineering and Science, F.L. Matthews and R.D. Rawlings, Chapman & Hall, London, 1994
4. Engineering Materials: Polymers, Ceramics and Composites A.K Bhargava Prentice Hall India.

4. WORKSTUDY AND ERGONOMICS

Course Objectives:

1. To understand the meaning of productivity and the means of increasing the productivity.
2. To know about work study and method study. To get acquainted with different methods of recording the work and ways to improve the method of doing work.

3. To know the different methods of measuring the work done and compute standard time.
4. To know the principles of motion economy.
5. To learn about job evaluation and merit rating.
6. To understand the meaning of Ergonomics and Anthropometry.

SYLLABUS:

Introduction to work study: Scientific management – Productivity - Advantages of work study to management, Supervisors and workers.

Method Study: Introduction - Process charts, Critical Examination, Identification of key activities on process charts, Diagrams and Templates, Therbligs, Micro motion analysis, Memo motion study. Developing new method - Job survey report writing.

Principles of Motion Economy: Related to human body, work place, equipment.

Work Measurement: Work measurement techniques – Rating - Measuring the job –Allowances - Standard time - Synthetic data - Analytical estimating – PMTS ,Work factor, MTM, Activity Sampling, Its applications.

Job Evaluation, Techniques of job evaluation - Merit rating - Incentive plans.

Ergonomics: Basics of Ergonomics, Anthropometry.

Learning Outcomes:

1. Develop a case for productivity improvement in any manufacturing or service industry scenario
2. Independently conduct a method study in any organization with the objective of improving aprocess, material movement system or design of a work place
3. Develop time standards for operations, identify production bottlenecks and improvise operations
4. Apply principles of good ergonomic design of work areas and equipment
5. Identify, explain and evaluate the impact of various personal attributes (anatomical, physiological and anthropometric) on proper safe working practice

Course Outcomes:

1. Understand the factors for low productivity, eliminate them and improve productivity.
2. Analyze the existing method of doing work, improve the method by eliminating unwanted steps in the process.
3. Will be able to measure the work and find the standard time required for doing the work.
4. Will be able to apply principles of motion economy and make work easier and improve the performance of the workers.

5. Will be able to analyze the job and fix the monitory benefits.
6. Will be able to evaluate the performance of the workers.

Will be able to understand the importance of ergonomic and measure anthropometric data.

Text Books:

1. Introduction to Work Study - International Labour Organization.
2. Elements of Work Study and Ergonomics, Dalela et al, Standard Publications.

Reference Book:

1. Motion and Time Study, Barnes, John Wiely.

5. CONDITION MONITORING

Course Objective:

1. The objective of the course is to study the Basics of condition monitoring techniques and the signal processing techniques associated with the instruments used in vibration monitoring, oil analysis etc., its application in industries, case studies related to the condition monitoring of machines and its advantages.

SYLLABUS:

Maintenance and Condition Monitoring: Importance and necessity of maintenance, Different maintenance strategies.

Techniques of condition monitoring: Different Nondestructive techniques – Visual, Dye Penetration, Acoustic Emission and its applications, X-ray, Radiographic, Magnetic Flux test, Temperature monitoring, Vibration analysis, Oil analysis.

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Oil Analysis: Oil degradation analysis, Abrasive Particle in oil, counters, Particle classification and counter, Spectrometric oil analysis, Performance trend monitoring – Primary and secondary parameters, Ferrography, Corrosion monitoring techniques.

Vibration Measurement: Different sensors for sound and vibration measurement, Data acquisition, Noise and vibration analyzers, Laser vibrometer, Vibration limits & Standards.

Basic signal processing techniques: Fourier analysis, Hilbert Transform, Cepstrum analysis, Digital filtering, Time-frequency analysis, Shock pulse method, Kurtosis.

Condition monitoring of rotating machines: Bearing condition monitoring, gear condition monitoring, Critical speed analysis, Orbit Analysis, Wear behaviour monitoring, Faults in reciprocating machines, Case studies and failure analyses.

Course Outcomes:

1. Be able familiar to condition monitoring technique and its methods.
2. Be able to identify the instruments which may be employed for diagnosis of failures.
3. Be able to understand diagnose the failures and its consequences and therefore importance of condition monitoring techniques.
4. Be able to use the instruments and basic signal processing terminology used while handling the instruments.
5. Be able to diagnose a particular failures and will be able to reach to root cause of the failures in machines

Text Books:

1. Vibration based condition monitoring: Industrial aerospace and automotive applications, Robert Bond Randall, Willey publication 2010.
2. Machinery Vibration Analysis & Predictive Maintenance, Cornelius Scheffer, Paresh Girdhar (2004), Elsevier Publication

Reference Books:

1. Handbook of condition monitoring, Rao, B. (1996), Elsevier advanced technology, Oxford.
2. Amiya Ranjan Mohanty, Machinery Condition Monitoring and Principles.(1st edition) 2014
3. Computational Fluid Mechanics and Heat Transfer: D.A. Anderson, J.C. Tannehill and R. H. Pletcher, Hemisphere Publishing Corporation.

6. AUTOMOBILE ENGINEERING

Course Objectives:

1. To create awareness about vehicle layout and power transmission from engine to wheels.
2. To create awareness about various types of automotive engines and working of conventional and modern automotive / multi-cylinder engines.
3. To understand how clutch and gearbox/transmission systems are functioning.
4. Able to learn about constructional features of drive shaft, differential, wheels, and tires.

5. To understand how electronic sensors and engine management system are useful for optimum performance of modern automotive engines/vehicles.
6. To understand the layout and working of electric vehicles.
7. To apply the concepts of flexi-fuels in hybrid vehicles.
8. To create awareness on vehicle troubles, maintenance, and the motor vehicle act.

SYLLABUS:

Introduction: Automobile Layout, Chassis and Transmission: Introduction to Drive Train: Clutch, Gearbox, Hook's Joint, Propeller /Drive Shaft, Slip Joint, Final Drive and Differential, Front and Rear Axles, Wheels and Tires. Control systems: Introduction to Steering and Brakes. Electrical system: Introduction to Starting System, Flywheel-Battery-Ignition, dynamo/alternator, cut-out and wiring. Automobile Body: Parts and Streamlining, Automobile types: Front, Rear and Four-wheel drive, and Automotive materials.

Multi-Cylinder Engines: In-line and V type, Multi-Valve Engines, VCR Engines, Turbocharging, Petrol Engines: Carburetted and MPFI, Electronic Ignition, Diesel Engines: Conventional, CRDI, and Dual-Fuel engines. Performance characteristics, Exhaust Emissions and their controlling techniques: EGR and Catalytic Converters, EURO/Bharat Stage Norms: I-VI, Manifolds and Mufflers, Engine Cooling and Lubrication.

Clutch: Clutch Assembly: Construction and Working Principle, Types: Single and Multiple Plates, Fluid coupling/Torque converter, Clutch Troubles and Remedies. **Gearbox:** Necessity of Transmission and Transaxle, Construction and Working Principle of Synchromesh (Five and Six Speed) Gearbox, Overdrive, Automatic Gearbox (seven and eight speed) and Epicyclical gear trains. Gearbox Troubles and Remedies.

Drive shaft and Final Drive: Drive Shaft: Constructional Features: Universal/Hooks Joints Constant Velocity Joint, Slip Joint, and Working Principle. Types of Propeller shafts, Final drive and Differential: Necessity, Constructional Features and Working Principle, Front/Rear Axles: Constructional Features. Types of Rear Axle Floating, Wheels: Disc and Drum type, Tires: Tire Construction, Tube and Tubeless Tires, Radial Tires, Tire inflation and nitrogen filling, Tire specification, Tire rotation and Tire Maintenance.

Suspension System and Vehicle Control: Coil and Leaf Springs, Shock absorbers, Wheel alignment: Kingpin angle, Caster, Camber, Toe-in, and Toe-out, Steering Mechanism and its Elements: Steering gear box and its types, Steering gear ratio, Steering linkages. Power Steering, Brake system: Parking and Power Brakes, Parts and Working Principle of Mechanical, Air and Hydraulic Brakes: Mater and Wheel cylinder, Properties of Brake (DOT) Fluids, Brake Diagnostics and Service: Brake Bleeding, Anti-lock Braking System (ABS), Automobile Accessories and Tips for Safe Driving.

Electrical and Electronic Systems: Basics of Electrical/Electronic Systems: Battery, starting system, Charging System, Lighting and Signalling System, Electronic Engine Management system, Automotive Embedded Systems: Vehicle Security System. Working Principle of Computer Sensors: Temperature, Flow, Cam, knock, and Oxygen, and ECU/ ECM. Engine Management system.

Electric Vehicles: Layout of electric vehicle, Battery (Lithium-Ion), Traction Battery Pack, Battery Management System, Battery charging optimization, Power Train (electric): Battery Pack, DC-to-AC converter, Electric Traction Motor, Transmission (single ratio), On-Board Charger, Power Electronic Converters, Power Electronics Controller, Electronic Control Unit, Battery cooling system and Safety of electric vehicle. Performance characteristics of electric vehicle.

Hybrid Vehicles and Flexible Fuels: Layout of hybrid vehicles, Performance and emission characteristics of hybrid vehicles. Alcohol -based fuels and Biofuels.

Trouble Shooting and Maintenance: Engine, Battery and Vehicle Troubles: Diagnostic Information: Symptom descriptions and their Causes and Remedies, Periodic, Preventive and Brake down Maintenance: Engine tuning, Fuel and Air filters, Lubricants, Maintenance of Battery and Electrical/Electronic System, and Tires. The Motor Vehicles Act 2019.

Learning Outcomes:

1. Identify the different parts of the automobile
2. Explain the working of various parts like engine, transmission, clutch, brakes
3. Describe how the steering and the suspension systems operate.
4. Understand the environmental implications of automobile emissions
5. Develop a strong base for understanding future developments in the automobile industry.

Course Outcomes:

1. Students gets the basic knowledge on power transmission system-components in automotive vehicles: from well (engine) to wheels.
2. The students can learn the developments in engine technology (: technologies related to emission reduction and increase of fuel efficiency): Emission reduction stages: Euro-I to Euro-VI.
3. The students are familiar with the constructional features of major components/devices: Engine - Clutch- Gearbox/transmission – Driveshaft Differential - Axles and Wheels (including tires).
4. The students can learn the working principle of major automotive components
5. Students are familiar with the working of various control systems of automotive vehicles: Power steering, anti-lock braking system, etc.

6. Students can understand the power transmission in electric and hybrid vehicles and their safety features.
7. Students are familiar with the Indian Motor Vehicle Act.
8. The students are prepared to work in automotive industry.

Text Books:

1. Automotive Mechanics, William H. Crouse and Donald L. Anglin, Tata McGraw-Hill Publishing Company Limited, ISBN: 0-07-059054-0
2. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles; Fundamentals, Theory, and Design, Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi, Muhammad H. Rashid, CRC Press, Washington
3. Automotive Engines, S Srinivasan, Tata McGraw-Hill Publishing Company Limited, ISBN: 0-07-040265-5

Reference Books:

1. Automotive Mechanics, S. Srinivasan, Tata McGraw-Hill Publishing company Limited, ISBN: 0-07-044941-6
2. Automobile Engineering, KK Jain/ RB Asthana, Tata McGraw-Hill Publishing Company Limited, ISBN: 0-07-044529-X
3. Electric and Hybrid Vehicles, Gianfranco Pistoia, Elsevier
4. Electric and Hybrid Vehicles, Tom Denton.
5. Internal Combustion Engines and Air Pollution, E.F. Obert, Harper & Row International Publishers Inc., ISBN: 0-06-350561-4
6. Internal Combustion Engines, Heywood, John, B. McGraw-Hill Publications Limited.

7. MAINTENANCE ENGINEERING AND MANAGEMENT

Course Objectives:

1. To explain maintenance objectives and functions, need for maintenance plan in an organization.
2. To explain different maintenance systems and the steps involved in establishing a maintenance plan.
3. To explain the maintenance budgeting, Classification of spares & Costs associated with spares inventory.
4. To determine the optimal inspection frequency for maximization of profit and minimization of down time.
5. To introduce various real time problems with constraints and to make understanding the applications of Reliability and Maintenance analysis in different types of systems.

SYLLABUS:

Introduction: Characteristics, Benefits, Objectives and Policies of maintenance, Organization and structure of maintenance system, Mechanics of maintenance system, Planning and scheduling maintenance activities.

Types Of Maintenance: Preventive maintenance - Development of preventive maintenance schedule - Planned prevention of breakdowns, Predictive maintenance, Condition monitoring, Reliability maintenance, reliability models.

Maintenance Management: Maintenance budgeting and cost control, Production maintenance integration, Maintenance manpower planning, Spare parts management.

Total Productive Maintenance: Philosophy, Six Major Losses, Overall equipment effectiveness, TPM Pillars, Computerized maintenance system, Implementation and Operation of an integrated maintenance system, Tero - Technology.

Maintenance Quality: Five Zero Concept, FMEA, Root Cause Analysis, Maintenance Strategies, maintainability, Availability & Criteria.

Course Outcomes:

1. Able to implement the objectives and policies of maintenance.
2. Able to establish maintenance strategies for maximizing the profit.
3. Able to improve uptime of machines by effective budgeting and cost control.
4. Able to improve the overall equipment effectiveness.
5. Able to apply concept of FMEA & make a diagnosis of maintenance problems.

Text Books:

1. Maintenance Engineering and Management, Mishra, R.C. and Pathak K, PHI Publication,2002
2. Maintenance, Replacement and Reliability, Andrew K.S. Jardine and Albert H.C. Tsan, Taylor and Francis, 2006

Reference Books:

1. Maintenance Management, Carder, A.S, McGraw Hill, NY, 1976.
2. Maintainability Principles and Practices, Blanchard, B.S, McGraw Hill, NY, 1969

8. VEHICLE DYNAMICS

Course Objectives:

1. To impart knowledge about the various forces acting on tires and performance of tire
2. To study about the various vertical forces acting on a vehicle
3. To identify the various longitudinal forces acting and control on a vehicle
4. To impart knowledge on various lateral forces acting on a vehicle
5. To study the concept of vibration and types of vibration measuring instruments

SYLLABUS:

Introduction to Vehicle Dynamics: Various kinds of vehicles, Motions, Mathematical modelling methods, Multi-body system approach, Lagrangian formulations, Methods of investigations, Stability concepts. Introduction to Modelling and Simulation.

Mechanics of Pneumatic Tyres: Tyre construction, SAE recommended practice, Tyre forces and moments, Rolling resistance of tyres, Tractive effort and longitudinal slip, Cornering properties of tyres, Performance of tyre traction on dry and wet surfaces, Ride properties of tyres.

Longitudinal Performance characteristics of road vehicle: Aerodynamic forces and moments. Equation of motion. Load distribution for four wheeler. Calculation of Maximum acceleration, Reaction forces for Different drives. Braking and Driving torque. Prediction of Vehicle performance. ABS, stability control, Traction control, stability of vehicle on slope.

Handling and stability characteristics of road vehicles: Steering geometry, Steady state handling characteristics, Steady state response to steering input, Testing of handling characteristics, Transient response characteristics, Directional stability, Effects of tyre factors, Mass distribution and engine location on stability of handling.

Vehicle ride characteristics: Human response to vibration, Vehicle ride models, Introduction to random vibration - 1) Road surface profile as a random function, 2) Frequency response function, 3) Evaluation of vehicle vertical vibration in relation to ride comfort criteria, 4) Active and semi active systems, 5) Optimum design for ride comfort and road holding.

Course Outcomes:

1. The students will be able to explain the various forces acting on tyres and their performance.
2. The students will be able to explain the concepts involved in vehicle vibration. The students will be able to calculate the natural frequency of Vehicle system with few DOF by considering free and forced vibrations using MATLAB/ Python.

3. The students will be able to calculate the various vertical forces acting on a vehicle. The students will be able to perform the simulation of Quarter car model and Half car model for step input using MATLAB/Python.
4. The students will be able to describe the various longitudinal forces acting on a vehicle.
5. The students will be able to calculate the various lateral forces acting on a vehicle. The students will be able to simulate the steady state handling characteristics of a vehicle based on steering input, vehicle stability on a banked road and curved road-using MATLAB/Python.

Text Book:

1. Theory of Ground Vehicles, Wong, J.Y., John Wiley and Sons, NY, 1993.

Reference Books:

1. Fundamentals of Vehicle Dynamics, Gillespie, T.D., SAE Publication, Warrendal, USA, 1992.
2. Tyres, Suspension and Handling, Dixon, J.C., SAE Publication, Warrendal, USA and Arnold Publication, London, 1997.
3. Vehicle Dynamics and Control‖, Rajesh Rajamani, 2nd edition, Springer, 2012.
4. Vehicle Dynamics: Theory and Application‖, Reza N. Jazar, 3rd Edition, Springer, 2017.
5. Tire and Vehicle Dynamics‖, Hans B Pacejka, 3rd Edition, Butterworth-Heinemann, Elsevier, 2012.
6. Tires, Suspension, and Handling‖, John C. Dixon, 2nd edition, Society of Automotive Engineers Inc, 1996.

Web Link:

1. Introduction to Vehicle Dynamics, Department of Engineering design, R. Krishnakumar, IITM. https://nptel.ac.in/courses/107106080/

9. COMPUTER AIDED DESIGN /COMPUTER AIDED MANUFACTURING (CAD/CAM)

Course Objectives:

1. General Objectives -

- Understand the importance of the computer aided designing and manufacturing techniques
- Know the development of the various design steps to manufacture the products with high quality in less time

2. Specific Objectives –

- Introduction of the different hardware devices, benefits of display methods in computer aided design (CAD)
- Know the different modelling techniques, finite element analysis procedures to analyse and develop the products
- Application of CAD/CAM packages to solving the real life applications in modeling, analysis and manufacturing
- Motivation of students towards the innovative product development which leads to produce the newly developed automobile and aircraft components.

SYLLABUS:

Computer Aided Design

Fundamentals of CAD - Introduction - The design process - Application of computers for design - Operating systems - Hardware in CAD: The design work station - I/O Devices - CAD system configuration - Creating database for manufacturing - Benefits of CAD.

Interactive Computer Graphics - Graphic display devices- Graphics system- Graphics standards - Graphical user interface- Transformation systems- 2D and 3D transformations - Linear transformation- windowing – clipping - Geometric Modeling - Modeling Techniques - Wire frame Modeling - Surface Modeling - 3 D Solid Modeling.

Introduction to Finite Element Analysis – Steps of FEM for solving physical problem, CAD techniques to finite element data preparation- Automatic mesh generation- Presentation of results - CAD applications of FEM.

Learning Outcomes:

1. Introduction of the different hardware devices, benefits of display methods in computer aideddesign (CAD)
2. Visualizing and applying basic drafting fundamentals in computer graphics.
3. Know the different modelling techniques, finite element analysis procedures to analyse anddevelop the products.
4. Creating CAD drawings using computer graphics techniques and geometric modelling
5. Calculating product optimization using different analysis techniques in FEA.

Computer Aided Manufacturing

Group technology: Merits & demerits, Organization, Classification and Coding systems, Cellular manufacturing.

Computer aided process planning: Introduction to process planning, Methods of process planning, Computer aided process planning, CAPP systems

Computer aided material handling: Robots: Structure and operation of Robots, robot sensors and applications. Automatic conveyor systems. Automated guided vehicles.

Computer aided inspection and quality control: Quality assurance and quality control. Contact and Non-contact inspection -Coordinate measuring machine.

FMS & CIMS: Building blocks of Flexible Manufacturing Systems (FMS), Machining systems of FMS, Tool management systems, Advantages of FMS, Computer integrated manufacturing systems (CIMS), Introduction to Additive Manufacturing.

Learning Outcomes:

1. Introduction of computer aided productivity improved techniques like G.T. CAPP and CAQC.
2. Students acquire the knowledge of robots and AGV's in computer aided material handling applications.
3. Application of CAD/CAM packages to solving the real life applications in modeling, analysisand manufacturing
4. Understand the concepts of FMS and CIM.

Course Outcomes:

The main purpose of this course is to make the students aware of :

1. Application of computer in design and manufacturing of different products
2. From the basic principles of production drawing the CAD/CAM techniques were utilized for the different engineering applications
3. Students will able to understand the industrial products by fundamental knowledge of geometric modeling and advanced manufacturing concepts
4. After successful completion of this course student can know the prerequisites to do the job in CAD/CAM industrye the newly developed automobile and aircraft components

Text Books:

1. CAD/CAM- Computer Aided Design & Manufacturing, M.D.Groover & E.W.Zimmer.
2. Computer Aided Design and Manufacturing, Dr.Sadhu Singh, Khanna Publishers.

Reference Books:

1. Computer Aided Design in Mechanical Engineering, V.Rama Murthy.
2. Elements of Computer Aided Design & Manufacturing, Y.C.Pao.
3. Computer Aided Kinetics for Machine Design, D.L.Ryan.

4. Computer Aided Design and Manufacturing, C.B.Besant & C.W.K.Lui.
5. Computer-Aided Analysis & Design, S. Ghosal, Prentice Hall of India.
6. CAD/CAM/CIM, Radhakrishna, New age international.
7. Computer Integrated Design and Manufacturing, David D.Bedworth, Mark R.Henderson & Philip M.Wolfe, McGraw-Hill Book Company, Singapore.
8. Computer Aided Manufacturing, P.N.Rao, N.K.Tewari & T.K.Kundra, Tata McGraw-Hill publishing company Ltd, NewtDelhi

10.REFRIGERATION AND AIR - CONDITIONING

Course Objectives:

1. Students to understand the basic cycles and concepts of refrigeration
2. Students to learn about variables influencing performance of vapor compression systems used in industrial and domestic applications
3. Students to have an exposure to different types of refrigerants and components vapor compression refrigeration systems
4. Student must learn about different types of absorption refrigeration system
5. Students to have an exposure to psychrometry and air conditioning systems..
6. Students must have comprehensive knowledge of Refrigeration & Air-conditioning systems

SYLLABUS:

Principles of Refrigeration: Refrigeration and II law of thermodynamics- Methods of Refrigeration- Unit of Refrigeration- Applications of Refrigeration. Air cycle Refrigeration: Reversal Carnot cycle- Bell Colman cycle- Selection of Refrigeration systems for air crafts- Boot strap system- Regenerative cycle- Reduced ambient type- Comparisons of different systems.

Learning Outcomes:

1. Understand fundamentals of components and working of air refrigeration systems

Vapour Compression Refrigeration: Wet versus Dry compression- Effect of evaporator pressures and temperatures. Simple vapour compression Refrigeration cycle and its analysis. Advantages and disadvantages of vapour compression Refrigeration system over Air compression Refrigeration system- Methods of improving C.O.P.

Learning Outcomes:

1. Learn basics of vapour compression cycles and methods to improve COP of refrigeration

cycles.

Classification of Refrigerants: Nomenclature- Properties- Secondary refrigerants- Selection of refrigerants- **Condensers-** Air cooled, Water cooled and evaporative type- Evaporators- Once through, flooded, shell and tube Baudelot cooler- **Expansion devices**- Capillary expansion device, Thermostatic expansion device.

Learning Outcomes:

1. Exposure to different types of refrigerants available and working of condensers & expansion devices

Absorption Refrigeration System: Basic absorption system- Aqua ammonia absorption system- Li-Br absorption refrigeration system- Electrolux refrigeration- C.O.P. of absorption refrigeration system- Comparison of vapour compression and vapour absorption system. Steamjet refrigeration system and analysis- Advantages and limitation- Ejector compression system.

Learning Outcomes:

1. Learn working of different absorption refrigeration systems and compare with vapour compression refrigeration systems

Psychrometry: Psychrometric properties and relations- Psy chart- Psy processes- Human comfort and comfort chart- Effective temperature and factors governing effective temperature. **Air conditioning**: Summer, Winter and year round air conditioning- Different types of Air conditioning load - By pass factor, RSHP, GSHF- Fresh air quantity- Cooling coils and Dehumidity- Air washers.

Learning Outcomes:

1. Learn fundamentals of psychrometry and extend the concept to air conditioning systems

Course Outcomes:

1. Students can extend the concepts of thermodynamics and apply to air refrigeration cycles
2. Students with exposure to vapor compression system can solve problems on vapor compression refrigeration systems
3. Students can understand the importance of eco friendly refrigerants and functioning other vital components in refrigeration systems
4. Students can understand and compare working of different types of vapor absorption systems
5. Students with basic knowledge of psychrometry can understand working of air conditioning systems

Text Books:

1. A text book of Refrigeration and Air conditioning, R.S. Khurmi and J.K. Gupta Eurasia publishing house (P) Ltd,
2. Arora C P, Refrigeration and Air Conditioning, 3rd Edition, Tata McGraw-Hill, 2017
3. Stoecker W.F and Jones J.W, Refrigeration and Air Conditioning, 2nd Edition, Tata

McGrawHill, 1982

Reference Books:

1. ASHRAE Handbook Series: Fundamentals, Refrigeration, Systems and Equipments and HVAC Applications, 2014-18, ASHRAE Inc, Atlanta, USA.
2. Refrigeration and Air conditioning, Jordan R.C. and Priester G.B.
3. Principles of Refrigeration, Dossat Roy J., 4th Edition, Pearson Education Asia,
4. Refrigeration and Air Conditioning, Arora R.C, Prentice Hall India, 2010

11. STATISTICAL QUALITY CONTROL

Course Objectives:

1. The different concepts of quality and the present philosophy of quality
2. The causes of variation and how they lead to inferior quality
3. Use of control charts for both variable type and attribute type of quality characteristics
4. The meaning of statistical six-sigma and six sigma procedure
5. The difference between the process control and process capability
6. The need for concurrent engineering
7. The different ways of taking random samples to accept a lot
8. The design of sampling plans for required protection
9. That there exist different types sampling plans to adopt

SYLLABUS:

Introduction to quality, definitions, Taguchi's loss function, examples of off-line and on-line quality control techniques, quality costs, Deming's philosophy, introduction to six sigma concept.

Learning outcomes
Student will be acquainted with offline and online quality control appreciates the essence of deming quality philosophy. Able to apply six sigma concep

Shewart's normal bowl, control charts for variables, □X , R and sigma control charts, theory of runs, ARL and ATS, Type-I and Type-II errors

Learning outcomes
Student distinguishes the difference between variable and attribute control charts and will

be able to apply appropriate control chart for the process

Control charts for attributes, p-chart, standardized p –chart, np-chart, c-chart, u-chart, demerit control chart.

Learning outcomes

Understands the importance of controlling the type-1 and type-2 errors and will be able to measure the for both valuable and attribute control charts

Process capability analysis: using frequency distribution and control charts. Process capability ratios, Cp and CpkProcess capability ratios for nominal the batter type, smaller the better type and larger the better type product specifications.

Learning outcomes

Learns the methods to measure the process capabilities for centered and off-centered process

Sampling plans: single, double, multiple and sequential sampling plans, rectifying inspection, AOQ, AOQL, and ATI. Use of Dodge Romig Tables, Design of single and sequential sampling plans.

Learning outcomes

Learns to select the different sampling plan used in rectifying samplings student designs a single sampling plan and also sequential sampling plans for given risks

Course Outcomes:

1. Understands that quality is caused by variation
2. Understands to recognize and eliminate the causes of variation
3. Designs control charts for both variable and attribute quality characteristics
4. Understands the need of six sigma quality
5. Performs process capability analysis for process with N-type, L-type and S-type of quality characteristics
6. Understands the concept and need for rectifying inspection
7. Develops the ability to design different types of sampling plans
8. Understands the use of standard sampling plans
9. Becomes confident to work in any quality related teams in any type of industry

Text Books:

1. Introduction to statistical quality control, E.L. Grant
2. Introduction to statistical quality control, D.C. Montgomery

12. TOOL DESIGN

Course Objectives:

1. To know what is meant by designing a tool.
2. To acquire knowledge on principles and types of locating elements and clamping devices.
3. To attain knowledge on the various types of jigs and fixtures.
4. To get the knowledge on press tools.
5. To obtain familiarity with fixture design of NC machine tools.
6. To accomplish awareness on limit gauges.

SYLLABUS:

Locating and Clamping Devices: Principles of Jigs and Fixtures design; locating principles; locating elements; standard parts; clamping devices; mechanical actuation, pneumatic & hydraulic actuation; analysis of clamping forces; tolerance and error analysis.

Jigs & Fixtures: Drill bushes; different types of Jigs : plate, latch, channel, box, post, angle plate, angular post, turnover, pot jigs; automatic drill jigs, rack & pinion operated, air operated Jigs.
General principles of lathe, milling, grinding, drilling and welding fixtures; design and development of Jigs and fixtures for simple components.

Press Tools: Press working terminology; presses and press accessories; computation of capacities and tonnage requirements; design and development of various types of forming and drawing dies.

Design and Manufacturing of cutting tools: Types of cutting tools, general problems in cutting tool design, single point cutting tools, drills, milling cutters, form tools, manufacture of cutting tools.

Design of Limit Gauges: Elements, types and application of limit gauges, gauge materials, their selection, Taylor's principles of gauge design, types and methods to provide gauge tolerances; design of plug & ring / snap gauge for given dimension and application.

Learning Outcomes:

1. Ability enhancement for the design of various components of structures, guideways, spindlesof machine tools
2. Ability enhancement to adopt & implement the recent trends required as per the applications
3. The students will be in a position to know about jigs and fixtures in detail.
4. The students can work with jigs and fixtures.
5. They will be effecitively work in mass production type industries.
6. The students will be in a position to work with press and press tools
7. They can design tooling for production on NC machines

8. They can effectively work with gauges and also in guage design.

Course Outcomes:

Students will be able to have thorough knowledge on locating and clamping devices and their applications.

1. They will be able to identify the types of jigs and fixtures and their application.
2. They will understand the press tool terminology and designing of dies.
3. They acquire information regarding tool design for NC machine tools.
4. They attain the knowledge of NC cutting tools and their holding methods.
5. Students are aware of types and applications of limit gauges.
6. They will be familiar with the principles of gauge design and also design of plug gauge,
7. ring gauge and snap gauges
8. Having good knowledge on the course, the student will be confident to work with the
9. manufacturing industries.

Text Books:

1. Tool Design, Donaldson. C, Tata McGraw-Hill, 1986.
2. A Text Book of Production Engineering, Dr.P.C.Sharma, S.Chand publishers.
3. Tool Engineering And Design, G.R.Nagpal, Khanna Publishers.
4. Fundamentals of Tool Engg. Design, Basu, Mukherjee, Mishra, Oxford & IBH Publishing, N. Delhi.

Reference Books:

1. Jigs and Fixtures Handbook , A. K. Goroshkin, Mir Publishers, Moscow, 1983.
2. ASTME Handbook of Fixture Design . Prentice Hall of India Pvt. Ltd.
3. Die Design Handbook , Ivana Suchy, McGraw Hill Book Co., 2005.
4. Production technology, HMT, Tata McGraw Hill.
5. Basic Die Making, P. Eugene Ostergaard, Mc Graw Hill Book, 1963.
6. Principles of Machine Tool, Sen & Bhattacharya, New Central Book Agencies, 1975.
7. Production tooling equipments, S. N. Parsons, Macmillan, 1966.

13. POWER PLANT ENGINEERING

Course Objectives:

1. To create awareness about various sources of energy, working of various power plants.

2. To create awareness about various sources of energy, working of various thermal power plants and combustion process
3. To understand how Diesel and gas power plants are functioning
4. Able to learn about nuclear power plants
5. To understand how power is achieved from renewable sources of energy and functions of hydroelectric power plants. Also, to apply the concepts of economics in power plants
6. To understand how electric power is achieved from solar energy and working principle of photovoltaic solar cells.

Introduction: Introduction to sources of energy in India, Current energy scenario, the need for alternate energy sources, Introduction to various types of power plants, Environmental aspects, and Recent developments in power generation.

Coal Based Thermal / Steam Power Plants: Introduction of thermal power, The Rankine cycle, Thermodynamic processes, Layout and working of coal-thermal/steam power plant, Four Circuits: Coal and ash handling systems/circuits, Air and flue gas circuit; Water and steam circuit: Cooling water circuit. Steam and Heat rate, Subsystems of thermal power plants: Combustion equipment, combustion of coal, Draught system/chimney draught, and Feed water treatment. Dust collectors, fuels and combustion Flue gas analysis, Fossil fuel steam generators: Types, Accessories, Feed water heaters, high pressure boilers, Performance of Boilers, steam turbines: Impulse turbines and Reaction turbines, Compounding of turbines, Steam condensers: Condensers classification: Steam Condensers: jet and surface condensers. Cooling towers, Binary cycles and cogeneration systems. Layout and working of modern coal-fired steam power plants, Super Critical Boilers: FBC boilers. Fluidized Bed Combustion and its types.

Diesel, Gas-Turbine and Combined Cycle Power Plants: Components and working of diesel engine plants: Air-intake, fuel, exhaust system and gas turbine power plants: Compressor, combustor, and gas turbine. Analysis of Otto, Diesel, dual and Brayton cycles, Cogeneration, Combined cycle power plants, and Integrated gasifier based combined cycle (IGCC) power plants/ systems.

Nuclear Power Plants: Basics nuclear energy: Methods of enriching Uranium, Fusion and Fission, chain reaction, and uncontrolled chain reactions. Layout, components, and subsystems of nuclear power plants, Working and classification of various nuclear reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), Canada Deuterium-Uranium (CANDU) Reactor, Fast Breeder Reactors, Gas Cooled and Liquid Metal Cooled Reactors. Main components of nuclear reactor: Moderators, Reflectors, Shielding, Cladding, and Coolants. Applications of nuclear power plants. Safety measures for nuclear power plants.

Alternative and Other Renewable Sources of Energy: Hydro-Power: Components and working of hydro-electric power plants, hydraulic-turbines, and hydro-plant controls. Geothermal energy, Wind energy, Bioenergy, Hydrogen energy, Energy from oceans, Energy storage, Performance and operating characteristics of power plants. Load factor, Criteria for optimum loading, Energy rates and Economics of power generation.

Solar Power Plants: Basics of Solar Energy: The Sun and solar energy, solar radiation fundamentals, Spectrum of solar radiation, the Earth, Sun-Earth geometry and relationship, role of atmosphere on solar radiation, estimation of solar radiation on Earth. Solar spectrum, Direct and Diffuse radiation, Solar irradiation, solar irradiance, solar constant, Solar insolation, global horizontal irradiance, Number of sunshine hours at a location (peak sun hours), Measurement of solar radiation; Actinometers: Pyranometers and Pyrheliometers.

Solar Photovoltaic Cells: Basics of photovoltaic effect /photovoltaic generation, Constructional features and efficiency of PV cell, Effect of temperature on PV cell efficiency, Types of PV cells: First, second, and third generation solar cells; mono-crystalline, poly-crystalline, multi-junction concentrators, and thin-film solar cells, Arrangement of PV cells on PV System: cell-module-string/panel-array. Rating and efficiency of PV module. Current-voltage characteristics PV arrays. Estimation and measurement of PV Module power. Storage Batteries: Types of batteries, Application of batteries in solar PV system, Battery maintenance and measurements, Battery Installation for PV system. DC to AC and AC to DC Converter. Installation of standalone solar PV System, Maintenance of solar PV system, Trouble shooting of 1KWP on/off-Grid solar power plant.

Course Outcomes:

1. Students are familiar with the basic knowledge on various energy-resources, energy conversion systems and air -pollution caused by the conventional thermal power plants.
2. The students can learn the developments in conventional thermal power plants such as fluidized bed combustion and super critical boiler technologies.
3. The students are familiar with the constructional and safety features of nuclear power plants and also the working principle of nuclear power plants.
4. Students are familiar renewable energy resources and their advantages.
5. Students are familiar with the constructional features of photovoltaic solar cells and their working.
6. Students are familiar with the installation of solar power plants on rooftops and on water bodies.

Text Books:

1. Modern Power Station Practice: Incorporating Modern Power System Practice-V(8), British Electricity International; Pergamon Press, 1990
2. Power Plant Engineering, Black and Veatch, CBS Publishers
3. Photovoltaic Solar Energy: From Fundamentals to Applications; Angele Reinders, Pierre Ver linden, Wilfried van Sark, Alexandre Freundlich; ISBN:9781118927465

References Books:

1. Power Plant Technology, M. M. EI-Wakil, Mc-Graw Hill Education.
2. Nuclear Power Plant Engineering, Rust, J.H., *Haralson* Publishing Company.
3. Power Plant Theory & Design, Potter P.J. Krieger Publishing.
4. Power Plant Engineering, P K Nag.

14. TURBO MACHINERY

Course Objectives:

1. Students to expose to various turbo machines and their energy transfer mechanism.
2. Students to understand the working of fans, blowers, compressors and turbines
3. Students to get exposed to velocity triangles of prime movers and evaluate their performance.
4. Understand critical parameters influencing performance of prime movers

Working Principles: Classification of Turbomachines. Energy transfer between fluid and rotor - Euler equation and its interpretation. Velocity triangles. Efficiencies in Compressor and Turbine stages. Degree of reaction. Dimensionless parameters for Turbomachines.

Centrifugal Fans and Blowers: Types – components – working. Flow analysis in impeller blades-volute and diffusers. Velocity triangles - h-s diagram. Stage parameters in fans and blowers. Performance characteristic curves – various losses. Fan – bearings, drives and noise.

Centrifugal Compressor: Components - blade types. Velocity triangles - h-s diagram, stage work. Slip factor and Degree of Reaction. Performance characteristics and various losses. Geometry and performance calculation.

Axial Flow Compressor: Construction details. Work done factor. Velocity triangles - h-s diagram, stage work. Work done factor. Performance characteristics, efficiency and stage losses – Stalling and Surging. Free and Forced vortex flow.

Axial And Radial Flow Turbines: Axial flow turbines - Types – Elements - Stage velocity diagrams - h-s diagram, stage work - impulse and reaction stages. Compounding of turbines. Performance coefficients and losses. Radial flow turbines: Types – Elements - Stage velocity diagrams - h-s diagram, stage work Performance coefficients and losses.

Course Outcomes:

1. Students can understand the energy transfer mechanism in turbo machines.
2. Students can understand working of various components in turbo machines
3. Analyse the velocity triangles and h-s diagrams and evaluate their performance
4. Understand the importance of stalling and surging in compressors

Text Books:

1. Gas Turbines, V.Ganesan, 3rd Edition, Tata McGraw Hill, 2011.
2. Turbines, Compressor and Fans, Yahya, S.M., 4th Edition, Tata McGraw Hill, 2011.

Reference Books:

1. Fluid Mechanics and Thermodynamics of Turbomachinery, Dixon, S.L., 7th Edition, Butterworth-Heinemann, 2014.
2. A Treatise on Turbomachines, Gopalakrishnan .G and Prithvi Raj .D, Scitech Publications (India) Pvt. Ltd., 2nd Edition, 2008.
3. Turbomachinery Performance Analysis, Lewis, R.I., 1st Edition, Arnold Publisher, 1996.
4. Gas Turbine Theory, Saravanamutto, Rogers, Cohen, Straznicky., 6th Edition, Pearson Education Ltd, 2009.
5. Fundamentals of Turbo machinery, Venkanna, B.K., PHI Learning Pvt. Ltd., 2009.

15.GAS DYNAMICS AND SPACE PROPULSION

Course Objectives:

1. Students to understand concepts of compressible flow and use of gas tables.
2. Students to understand the flow behaviour of fluids in constant area ducts with friction and heat transfer.
3. Students to study the formation of shock waves and its effect on flow parameters.
4. To study about different types and working of jet propulsion systems
5. Exposure to different types of propellants and performance calculations of rocket engines

Basic Concepts And Isentropic Flows: Energy and momentum equations of compressible fluid flows, Concepts of compressible flow – Mach waves and Mach cone. Flow regimes, effect of Mach number on compressibility. Stagnation, static, critical properties and their interrelationship. Isentropic flow and its relations. Isentropic flow through variable area ducts – nozzles and diffusers. Use of Gas tables.

Compressible Flow Through Ducts: Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties. Choking. Isothermal flow with friction. Use of Gas tables.

Normal And Oblique Shocks: Governing equations - Rankine-Hugoniot Relation. Variation of flow parameters across the normal and oblique shocks. Prandtl – Meyer expansion and relation. Use of Gas tables.

Jet Propulsion: Theory of jet propulsion – thrust equation – Performance parameters - thrust, power and efficiency. Operation, cycle analysis and performance of ram jet, turbojet, turbofan, turbo prop and pulse jet engines.

Space Propulsion: Types of rocket engines and propellants. Characteristic velocity – thrust equation. Theory of single and multistage rocket propulsion. Liquid fuel feeding systems. Solid propellant geometries. Orbital and escape velocity. Rocket performance calculations.

Course Outcomes:

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

1. Understand the concepts of compressible flow and influence of Mach number.
2. Evaluate the flow behaviour in constant area ducts with heat transfer., friction and for isothermal flows
3. Understand the formation and influence of shock on flow behaviour
4. Understand the different types of jet engines and their performance parameters.
5. Students will have an understanding about different types of rocket propulsion systems

Text Books:

1. Modern Compressible flow, Anderson, J.D., Third Edition, McGraw Hill, 2003.
2.Fundamentals of Compressible Flow with Aircraft and Rocket propulsion, S.M. Yahya, New Age International (P) Limited, 4th Edition, 2012.

Reference Books:

1. Fundamentals of Gas Dynamics, R. D. Zucker and O Biblarz, 2nd edition, Wiley, 2011.
2. Fundamentals of Compressible Fluid Dynamics, Balachandran, P., Prentice-Hall of India, 2007.
3. Gas Dynamics, Radhakrishnan, E., Printice Hall of India, 2006.
4. Mechanics and Thermodynamics of Propulsion, Hill and Peterson, Addison – Wesley, 1965.
5 Fundamentals of Compressible Flow, . Babu, V., CRC Press, 1st Edition, 2008.

LIST OF OPEN ELECTIVES

1. ADDITIVE MANUFACTURING

Course Objectives:

1. Importance of AM in Manufacturing
2. Different AM Technologies
3. Select suitable materials for AM
4. Different methods for Post-processing of AM parts
5. Design for manufacture of AM Products
6. Process Analysis
7. Applications of AM in Automobile, Aerospace, Bio-medical etc.
8. Future Directions of AM

SYLLABUS:

Introduction to Additive Manufacturing: Introduction to AM, AM evolution, Distinction between AM & CNC machining, Advantages of AM, AM process chain: Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup, build , removal and clean up, post processing.

Classification of AM processes: Liquid polymer system, discrete particle system, molten material systems, solid sheet system.

Design for AM: Motivation, DFMA concepts and objectives, AM unique capabilities, Exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers etc.

Guidelines for process selection: Introduction, selection methods for a part, challenges of selection, example system for preliminary selection, production planning and control AM

Applications: Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models, Rapid tooling, new materials development, Bi- metallic parts, Re-manufacturing.

Application examples for Aerospace, defense, automobile, Bio-medical and general engineering industries Post processing of AM parts: Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques.

Future Directions of AM: Introduction, new types of products and employment and digiproneurship.

Course Outcomes:

The main purpose of this course is to make the students aware of :

1. Application of computer in design and manufacturing of different products
2. From the basic principles of additive manufacturing techniques were utilized for the different engineering applications
3. Students will able to understand the industrial products by fundamental knowledge of geometric modeling and advanced manufacturing concepts in additive manufacturing

After successful completion of this course student can know the prerequisites to do the job in Automobile, Aerospace, Bio-medical industry etc.

Text Book:

1. Additive Manufacturing Principles, Technologies and Applications, C. P. Paul & A. N. Jinoop, McGrawHill Publications, June 2021

Reference Books:

1. Rapid Prototyping: Principles & Applications, Chua Chee Kai, Leong Kah Fai, World Scientific, 2003.
2. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Ian Gibson, David W Rosen, Brent Stucker., Springer, 2010
3. Rapid Prototyping: Theory & Practice, Ali K. Kamrani, Emand Abouel Nasr, Springer, 2006.
4. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, D.T. Pham, S.S. Dimov, Springer 2001

2. RELIABILITY ENGINEERING

Course Objectives:

1. The interrelation between quality and reliability and importance of reliability
2. Basic terminology used in reliability engineering and the difference between failure rate and failure densities
3. Modeling of failures of engineering equipment/product/systems using different types of failure rates using a bath tub curve
4. Modeling of random failures using exponential distribution
5. Modeling of time-dependent failures using Weibull distribution
6. Modeling of time dependent failures using normal and lognormal distributions
7. Modeling the systems as series, parallel and combined configurations. Also, to find the reliability of k-out-of-n : G systems and complex configurations
8. To specify reliability, system effectiveness and life cycle costs concepts, reliability allocation methods
9. To incorporate reliability into designs using

SYLLABUS:

Introduction: Concepts of quality and reliability, a brief history, terms, definitions, reliability function, MTTF, Hazard rate function, bath tub curve, conditional reliability.

Constant failure rate models: Exponential reliability, failure modes, failure modes with exponential distribution, applications, two parameter exponential distribution, Poisson process.

Time dependent failure models: Weibull distribution, burn-in screening for Weibull, three parameter Weibull distribution, Normal and Lognormal distributions

Reliability of systems: Series, parallel configurations, combined systems, k-out-of-n systems, complex configurations, common failure modes, minimal cuts and minimal paths.

State dependent systems: Markov analysis, load sharing, standby systems, degraded systems

Physical reliability models: Static models- random stress and random strength, dynamic models- periodic models, random loads.

Design for reliability: Reliability specification, Lifecycle costs, reliability allocation, design methods, failure analysis, FTA.

Reliability testing: Life testing, burn-in testing, acceptance testing-binomial acceptance testing.

Reliability growth testing: Reliability growth process, idealized growth curve, Duane growth model.

Learning Outcomes:

1. Attain the basic techniques of quality improvement, fundamental knowledge ofstatistics and probability
2. Use control charts to analyze for improving the process quality.
3. Describe different sampling plans
4. Acquire basic knowledge of total quality management
5. Understand the concepts of reliability and maintainability.

Course Outcomes:

1. Understands that reliability is concerned with time based performance but a subset of quality
2. Understands the general terminology used in reliability engineering and also understands their limitations
3. Understands the different types of failures encountered in engineering failure analysis and the probable failure types for different types of products like electronic products, mechanical products, software products etc.,

4. Understands the lack of memory property of exponential distribution and its significance in modeling random failures
5. Understands that all types of failures- namely DFR , CFR and IFR can be efficiently modeled by a general distribution i.e. Weibull distribution
6. Understands the suitability of Normal distribution in reliability engineering and also as a foundation to study the lognormal failures. Also understands the interrelation between normal and lognormal distributions.
7. Understands the different configurations used in system reliability modeling.
8. Understands the importance of life-cycle costs in the design of reliable products and also understands the methods to allocate reliability to different components.

Understands the methods to incorporate reliability into products at design stage.

Text Book:

1. Introduction to Reliability and Maintenance engineering, Charles E Ebeling, Tata McGrawhill, India.

Reference Books:

1. Introduction to Reliability Engineering, E.E. Lewis, John Wiley& Sons, NewYork
2. Reliability based design, S.S.Rao, McGraw-Hill, New York.

3. STRUCTURAL HEALTH MONITORING

Course Objectives:

1. To get a in depth knowledge of technologies in structural health monitoring using smart materials as sensing and actuating elements to interrogate the structures.

2. Damage detection techniques such as wave, impedance, and vibration-based damage detection techniques will be discussed and applied to different types of structures.

3. Advanced signal processing techniques such as wavelet, neural network, principal component analysis will be used to make the damage more quantifiable.

SYLLABUS:

Introduction: Definition, Principles, Significance of SHM, Potential Applications in Civil, Naval, Aerospace and Manufacturing Engineering.

Operational evaluation: Sensor technology, Piezoelectric wafer active sensors, Data acquisition and cleansing procedures, Elastic waves in solid structures, Guided waves.

Feature extraction methods: Identify damage sensitive properties, Signal Processing, Fourier and short term Fourier transform, Wavelet analysis.

Pattern recognition: State –of –Art damage identification and pattern recognition Methods, Neural networks, Feature extraction algorithm.

Case studies: SHM based Flaw detection in mechanical structures - Integrity and damage recognition in plates and pipes, defect identification in weld joints, Wear monitoring in cutting tools.

Course Outcomes:

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

1. Diagnosis the distress in the structure understanding the causes and factors.
2. Assess the health of structure using static field methods.
3. Assess the health of structure using dynamic field tests.
4. Suggest repairs and rehabilitation measures of the structure

Text Books:

1. Structural Health Monitoring, Daniel Balageas, Claus_Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006
2. Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.

Reference Books:

1. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D.Duan, Taylor and Francis Group, London, UK, 2006.
2. Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc,2007.
3. A Review of Structural Health Monitoring Literature: 1996-2001/ Hoon Sohn/ Chales R.Farrar/Francois M.Hemez/Devin D.Shunk/Daniel W.Stinemates/Brett R. Nadler/Jerry J.Czarnecki*/Los Alamos National Laboratory
4. Damage Identification and Helath Monitoring of Structural and Mechanical Systems from Changes in Their Vibration Characteristics: A Literature Review/ Scott W. Doebling/Charles R. Farrar/Michael B.Prime/Daniel W.Shevitz

4. TRIBOLOGY

Course objectives:

To expose the student to different types of bearings, bearing materials,
To understand friction characteristics and power losses in journal bearings
To learn theory and concepts about different types of lubrication.

SYLLABUS:

Introduction: Tribology, Bearings, Historical Background, Lubricants: Types, selection of lubricants and specific field of applications, Properties and Testing of Lubricants: Viscosity, viscometry, Effect of temperature and pressure on viscosity.

Basic Equations: introduction, generalized Reynolds equation, flow and shear stress, Idealized Hydrodynamic Bearing: Mechanism of pressure development, Plane-slider bearing, idealized Journal Bearing-Infinitely long journal bearing, Petroff equation, Narrow bearing.

Bearing Design: Design of journal bearings, Squeeze film bearings-parallel surface and step bearings, Some situations under squeeze film lubrication and the mechanism of hydrodynamic instability. Introduction to ball bearings.

Surface Engineering: Surface topography, surface characterization, apparent and real area of contact, Surface modification – transformation hardening, surface melting, thermo chemical processes. Surface Coating – plating, fusion processes, vapor phase processes.

Friction and Wear of Metals: Laws of friction, friction theories, measurement methods, friction of metals, surface contaminants, frictional heating, classification and mechanisms of wear, quantitative laws of wear, testing methods and standards, wear resistance materials.

Course Outcomes:
1. Understanding friction characteristics in journal bearings.
2. Knowledge about different theories of lubrication to reduce friction and wear.

Text Books:

1. Introduction to Tribology of Bearing , B. C. Majumdar.
2. Engineering Tribology, Prasanta Sahoo, PHI Learning Private Ltd, New Delhi, 2011.

Reference Books:

1. Engineering Tribology, J. A. Williams, Oxford Univ. Press, 2005.

2. Handbook of tribology: materials, coatings and surface treatments, B.Bhushan, B.K. Gupta, McGraw-Hill,1997.
3. Friction and Wear of Materials, Ernest Rabinowicz, John Wiley & sons,1995.
4. Tribology, Friction and Wear of Engineering Material, I. M.Hutchings, Edward Arnold, London,1992

5. TOTAL QUALITY MANAGEMENT

Course Objectives:

1. To understand the concept and philosophy of TQM.
2. To get acquainted with the tools of quality control.
3. To understand the quality function Quality function deployment, Designing for quality, Manufacturing for quality.
4. To learn the importance and use of quality systems-ISO standards.
5. To understand the process of implementing the quality tools like KAIZEN,5S,JIT,POKAYOKE,Taguchimethods and the difficulties in implementing them.

SYLLABUS:

Concepts of TQM: Philosophy of TQM, Customer focus, Organization, Top management commitment, Team work, Quality philosophies of Deming, Cross by and Muller.

TQM process: QC tools, Problem solving methodologies, New management tools, Work habits, Quality circles, Bench marking, Strategic quality planning.

TQM Systems: Quality policy deployment, Quality function deployment, Standardization, Designing for quality, Manufacturing for quality.

Quality System: Need for ISO9000 system, Advantages, Clauses of ISO9000, Implementation of ISO9000,Quality costs, Quality auditing, Case studies.

Implementation of TQM: Steps, KAIZEN, 5S, JIT, POKAYOKE, Taguchi methods, Case studies.

Course Outcomes:

- Students will have knowledge of quality and the contributions of quality gurus 'like Deming, Cross by and Miller.
- Canapplythequalityandmanagementtoolsandmethodologiesforsolvingtheproblems.

- Will be able to apply and use functions like quality function deployment, standardization, designing and manufacturing for quality.
- Get acquainted with ISO series and the process of implementing it.
- WillbeabletoapplyqualitytoolslikeKAIZEN,5S,JIT,POKAYOKE,Taguchimethods.

Reference Books:

1. Total Quality Management, Rose, J.E., Kogan Page Ltd.,1993.
2. The Essence of Total Quality Management, John Bank, PHI,1993.
3. Beyond Total Quality Management, Greg Bounds, Lyle Yorksetal, McGraw Hill, 1994.
4. The Asian Productivity Organization, Takashi Osada,1991.5.KA
5. ZEN , Masaki Imami, McGrawHill,1986. wari, Sultan Chand & Sons, New Delhi.

6.SOLAR ENERGY - TECHNOLOGY AND APPLICATIONS

Course Objectives:

1. To create awareness about various sources of energy.
2. To understand the basic characteristics of solar energy, and the measurement of solar radiation on horizontal and inclined surfaces on earth.
3. To understand the characteristics of semi-conductive materials and how photo-voltaic cells are functioning
4. Able to learn about working of storage batteries.
5. Able to learn about constructional features of concentric and non-concentric solar collectors.
6. To understand how electric power is achieved from solar energy and working principle of photovoltaic solar cells.
7. To understand the working of thermal energy storage systems and their applications.

SYLLABUS:

Basics of Solar Energy: Energy, the need for alternate energy sources, the Sun and solar energy, solar radiation fundamentals, solar energy-wavelength-frequency, extraterrestrial radiation, Spectrum of solar radiation, the Earth, latitude and longitude, Sun-Earth geometry and relationship, seasons, role of atmosphere on solar radiation, solar angles, air mass and zenith angle, estimation of solar radiation on Earth. Solar spectrum, Direct and Diffuse radiation, Solar irradiation, solar irradiance, solar constant, Solar insolation, global horizontal irradiance, Number of sunshine hours at a location (peak sun hours), Solar radiation on tilted surfaces.

Measurement of solar radiation and instruments; Actinometers: Pyranometers and Pyrheliometers.

Solar Photovoltaic Cells: Basic physics of semiconductor materials, P-type and N-type materials, semiconductor junctions; Electron-hole carrier formation and motion, Basics of photovoltaic effect /photovoltaic generation, Constructional features of PV cells,efficiency of PV cell, Effect of temperature intensity on PV cell efficiency, Types of PV cells: First, second, and third generation solar cells;mono-crystalline/poly-crystalline, multi-junction concentrators, and thin-film solar cells, Arrangement of PV cells on PV System: cell-module-string/panel-array. Rating and efficiency of PV module. I-V characteristics PV arrays. Estimation and measurement of PV Module power.

Storage Batteries: Types of batteries, Application of batteries in solar PV system, Battery maintenance and measurements, Battery Installation for PV system. DC to AC and AC to DC Converter. Installation of standalone solar PV System, Maintenance of solar PV system, Trouble shooting of 1KWP on/off-Grid solar power plant.

Solar Collectors and Applications: Flat plate collectors: Liquid based and air-based collectors, different configurations; thermal analysis, heat removal factor, overall loss coefficient, temperature distributions, efficiency factor, optical and thermal efficiency; Experimental determination of efficiency, Performance of solar flat plate collectors and Heat capacity effects. Concentrating collectors: Concentration ratio, Tubular absorbers (diffuse back and specular cusp reflectors), Evacuated tube collectors, dish collectors/concentrators, V-troughs/Parabolic troughs, compound parabolic collectors, Linear Fresnel reflector collectors, Fresnel lens for cooking, multi-sectional planar concentrators, Array reflectors (heliostats) with central receiver system (power tower), and thermal performance of concentrating collectors.

Solar Energy Utilizations Methods and Storage Systems: Low Temperature Applications: water heating, air heating, drying, industrial process heat; desalination, green houses, solar ponds, and solar cookers. High Temperature Applications: Schemes for process steam, power generation, air conditioning and refrigeration, cold storages and solar furnaces. Solar energy Applications in Building Design: heating: illuminance, shading and passive cooling, Trombe wall construction.

Course Outcomes:

1. Students are familiar with the basic knowledge on the characteristics of solar energy and various energy losses during transmission from Sun to Earth.
2. The students can learn the developments in photovoltaic technology (: technologies to increase in conversion efficiency): First, second and third generation PV cells.
3. The students are familiar with the constructional features and working principle of photo voltaic cells.

4. Students are familiar with the constructional features and working of various types of solar collectors.
5. Students can understand the various storage systems for storing solar energy.

Students are familiar with the installation of on/off gird solar power plants.

Text Books:

1. Principles of Solar Engineering, Keith, F. and Kreider J. F.
2. Photovoltaic Solar Energy: From Fundamentals to Applications, Angèle Reinders, Pierre Verlinden, Wilfried van Sark, Alexandre Freundlich, ISBN:9781118927465.
3. Solar Engineering of Thermal Processes, John A. Duffie, William A. Beckman, ISBN: 9781118671603

Reference Books:

1. Solar Energy Thermal Technology, Brian Norton, ISBN: 9781447117445
2. Solar Energy: Fundamentals and Applications, H Garg, J Prakash. Tata McGraw-Hill Education
3. Solar Electric Handbook: Photovoltaic Fundamentals and Applications; Solar Energy International, Pearson Education Publishing

7. COMPUTATIONAL FLUID DYNAMICS

Course Objectives:

To make the learners to

1. To provide basic understanding of fundamental concepts involved in CFD and also to comprehend numerical techniques involved in CFD.
2. Understand the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the fluid flow.
3. Describe the finite difference method and the finite element method with emphasis on fluid dynamics on various computational problems in fluid dynamics such as boundary conditions and meshing.
4. Provide the essential numerical background for solving the partial differential equations governing the fluid flow.
5. Develop student‘s skills by using a commercial software package.

SYLLABUS:

Introduction: Historical Background of CFD, Basics of computational fluid dynamics, Philosophy of Computational Fluid Dynamics: Computational fluid dynamics: Why? – Computational fluid dynamics as a research tool – Computational fluid dynamics as a design tool – The impact of Computational fluid dynamics, Applications, Models of flow and Boundary conditions and steps in CFD.

Governing Equations: Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations - Well posed problems, Continuity, Momentum and Energy equations in 3 Dimensions, Navier-Stokes equations, Single Generic Integral form equations for Continuity, Momentum and Energy.

Grid Discretization: Basic aspects of discretization, Techniques used--Finite Difference, Finite Volume and Finite Element, Derivation of finite difference equations – Simple Methods – Explicit and Implicit time dependent methods. Stability properties of explicit and implicit methods Finite Volume Techniques - Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Accuracy

Grid Generation And Transformation: Generation of grid. Types and transformations. Generation of structured grids. Unstructured grids – Mesh refinement – Adaptive mesh. Transformation of non- uniform grids, General transformation of equations, form of governing equations suitable for CFD, Compressed grids, Boundary filled coordinate systems – Elliptic grid generation, Adaptive grids, Modern developments in grid generation.

CFD Techniques: Introduction, CRANK-NICHOLSON technique, Relaxation technique, ADI technique, suitability for different conditions. Errors due to approximation and their analysis-Consistency, Convergence, Stability Analysis.

Course Outcomes:

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

1. Able to describe the concepts involved in CFD simulation and also to develop CFD model for simple flow systems, simulate and better understand underlying physics.
2. Should be able to use the various discretization methods, solution procedures and to solve different problems.
3. To know the various applications of CFD and basic governing equations of fluid flow and the classification of PDE and discretization techniques and the implicit and explicit methods.
4. Understand the philosophy of CFD and derive governing equations of fluid flow and also to Formulate solution techniques for parabolic and hyperbolic equations.
5. Familiar with the differential equations for flow phenomena and numerical methods for their solution.

6. Use and develop flow simulation software for the most important classes of flows in engineering and science.
7. Analyze the different mathematical models and computational methods for flow simulations.
8. Define the relevant engineering flow problems and analyzes the CFD results by CFD software. Compare with available data, and discuss the findings.

Text Books:

1. Computational Fluid Mechanics, Anderson, D.C., J.C, Tannehil, and R.H. Fletcher, Hemisphere Publishing Corporation, New York.
2. Computational Fluid Dynamics, T.J.Chung, Cambridge University Press 2002

Reference Books:

1. Computational Methods for Fluid Dynamics, Ferziger, J.H. and M.Peric, Springer, 3rd Edition, 2002.
2. An Introduction to Computational Fluid Dynamics, The Finite Volume Method – Versteeg, H.K. and W.Malalasekera, Second Edition, 2007.
3. Text book of fluid dynamics, Frank Chorlton, CBS Publishers & distributors, 1985.
4. Numerical heat transfer and fluid flow, Suhas V. Patankar, Hema shava Mc Graw Hill. Publishers corporation.
5. Computational Fluid Flow and Heat Transfer, Muralidaran, Narosa Publications
6. Fundamentals of Computational Fluid Dynamics,Tapan K. Sengupta, Universities Press.
7. Introduction to Theoretical and Computational Fluid Dynamics,C. Pozrikidis , Oxford University Press, 2nd Edition.
8. Computational Fluid Dynamics, John D. Anderson, JR, McGraw-Hill Book Co., Inc., New Delhi.
9. Introduction to Computational Fluid Dynamics,A.A. Hirsch, McGraw-Hill, 1989.

Web References:

1. http://ocw.mit.edu/courses/mecharlical-engineering/2-29-numerigalfluidmechanicsfall2011/
2. http:/inptel.ac.in/courses/112105045/ (IIT Kharagpur)
3. http://nptel.ac.in/courses/112107080/ (IIT Roorkee)
4. http://nptel.ac.in/courses/112104030/ (IIT Kanpur)

8.ARTIFICIAL NEURAL NETWORKS (ANN)

Course Objectives:

1. Understand the context of neural networks and learning process

2. Know how to use a neural network to design algorithms for a specific problem.
3. Understand the data needs of deep learning.
4. Explore the parameters for neural networks.
5. Understand the neural networks for mechanical Engineering applications.

SYLLABUS:

Introduction: Neural network, Human Brain, Models of a Neuron, Neural networks viewed as Directed Graphs, Feedback, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks

Learning Processes: Error Correction learning, Memory based learning, Hebbian learning, Competitive learning, Boltzmann learning, Credit Assignment Problem, Learning with a Teacher, Learning without a Teacher, Memory, Adaptation, Statistical nature of the learning process.

Single Layer Perceptions: Adaptive filtering problem, Unconstrained Organization Techniques, Linear least square filters, least mean square algorithm, learning curves, Learning rate annealing techniques, perceptron — convergence theorem, Relation between perceptron and Bayes classifier for a Gaussian Environment Multilayer Perceptron.

Back Propagation: Back propagation algorithm, back propagation and differentiation, Hessian matrix, Generalization, Cross validation, Network pruning Techniques, Virtues and limitations of back propagation learning, Accelerated convergence, supervised learning.

Radial basis function networks; SOM; Recurrent neural networks; Training of neural network; Applications of neural networks in mechanical engineering.

Course Outcomes:

1. Identify and describe ANN structure and their roles in building intelligent machines.
2. Identify Learning of perceptions, Feed forward, multi layer forward networks
3. Apply Learning process and reasoning to handle uncertainty and solve various engineering problems.
4. Apply algorithms to combinatorial optimization problems.
5. Evaluate and compare solutions by various soft computing approaches for a given problem.
6. Use various tools to solve soft computing problems.

Text Book:

1. Neural Networks and Learning Machines , Simon Haykin , Prentice Hall India Publications.

Reference Books:

1. Neural Networks in Computer intelligence, Li Min Fu, Tata McGraw Hill Publications
2. Neural Networks, James A. Freeman and David M. Sapura, Pearson education .
3. Introduction to Neural Networks using MATLAB 6.0, S.N.Sivananam, McGraw Hill.

9. INSTRUMENTATION AND CONTROL SYSTEMS (ICS)

Course Objectives:

1. Understand the importance of the Instrumentation methods, Principles and its applications.
2. Introduction of the different instrumentation devices, benefits and applications of instrumentation.
3. Know the latest development of the various design steps in control systems used in industrial applications.
4. Applications of instrumentation devices to solving the real life applications in industries.
5. Motivation of students towards the innovative instruments which leads to produce the newly developed automobile and aircraft applications

Instrumentation

Instrumentations: Concepts of measurements, static performance, characteristics accuracy of measurement and its analysis. Instrumentation, for measurement: Force, torque, strain. pressure, flow, temperature and vibration.

Optical Methods of Measurement: Introduction, Laser beam as a light pointer, length/displacement measurement, temperature sensors, seismographic measurement. Introduction to fiber optics, fiber types, properties of optical fibres and a fibre optic sensor configuration.

Control Systems

Introduction: Control systems, Feedback and its effects. Transfer Function, Block Diagram and Signal Flow Graph: Impulse response and Transfer functions of linear systems, Block diagrams.

Learning Outcomes:

1. Develop the mathematical model of the physical systems.

2. Analyze the response of the closed and open loop systems by construction and reduction ofBlock diagrams and signal flow graphs.

Mathematical Modeling of Physical Systems: Equations of electrical networks, Modeling of mechanical system elements, Equations of mechanical systems. State-variable Analysis of Linear Dynamic Systems: Matrix representation of state equations, State transition matrix, State transition equation, relationship between state equations and high-order differential equations, relationship between state equations and transfer functions, Characteristic equation, eigen values and eigen vectors.

Learning Outcomes:

1. Develop the mathematical models for mechanical and electrical systems.
2. Representation of the matrices for different equations and develop relationships of these equations.

Time-Domain Analysis of Control Systems: Typical test signals for the time response of control systems, Time- domain performance of control systems- The steady- state error, Time-domain performance of control systems- Stability of control systems- stability, Characteristic equation and the state transition matrix, Methods of determining stability of linear control systems, Routh- Hurwitz criterion.

Frequency-domain Analysis of Control Systems: Introduction, Nyquist stability criterion, Application of the Nyquist criterion, Stability of multi loop systems, Stability of linear control systems with time delays.

Learning Outcomes:

1. Learn the different test signals for the time response of control systems.
2. Understand the methods of determining stability for time – domain and frequency – domainanalysis of control systems.

Course Outcomes:

The main purpose of this course is to make the students aware of :

1. Application of instrumentation and control systems in industry
2. From the basic principles of instrumentation techniques were utilized for the different engineering applications
3. Students will able to understand the industrial products by fundamental knowledge of instrumentation in fibre optics used in defense applications
4. After successful completion of this course student can know the prerequisites to do the job in any industry

Text Books:

1. Automatic Control Systems, , Benjamin C. Kuo.
2. Mechanical Measurements, R.S.Sirohi, H.G. Radha Krishna, Wiley Eastern, New Delhi.

Reference Books:

1. Experimental Methods for Engineers, J.P.Holman, McGraw-Hill Publications.
2. Instrumentation for Engineering Measurements, R.H. Cerni and L.E.Foster, J.Wiley & Sons, New York.
3. Mechanical and Industrial Measurement, R.K.Jain, Khanna publishers, Delhi.
4. Modern Control Engineering, Katsuhiko Ogata, 5th Edition, Pearson Publications, 2010
5. Control Systems Engineering, Nagrath and Gopal , New age International.

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10. RENEWABLE SOURCES OF ENERGY

Course Objectives:

1. Understand the necessity for renewable energy source as alternate to fossil fuels
2. Exposure to extended applications of solar energy storage systems
3. Exposure to harnessing of wind energy using wind turbines
4. An insight to biomass energy and conversion techniques.
5. Exposure to methods of harnessing energy from oceans and geothermal energy .

Energy Scenario: Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status Potential of various renewable energy sources-Global energy status-Per capita energy consumption in various countries - Future energy plans

Solar Energy: Solar radiation – Measurements of solar radiation and sunshine – Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

Wind Energy: Wind data and energy estimation – Betz limit - Site selection for wind farms – characteristics Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.

Bio-Energy: Bio resources – Biomass direct combustion – thermo-chemical conversion - biochemical conversion mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration –- Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.

Ocean And Geothermal Energy: Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.

. **Course Outcomes:**

1. Students will realize the importance of renewable energy as alternate to fossil fuels
2. Students can enhance their knowledge by taking up projects in solar energy .
3. Students can understand the critical parameters influencing performance of wind turbines
4. Students can further explore energy generation opportunities from biomass by taking up projects.
5. Students will have an insight to energy recovery opportunities using ocean and geothermal energy

Text Books:

1. Non-Conventional Energy Sources, G.D. Rai, Standard Publishers Distributors, 1992.
2. Renewable Energy Resources, John Twidell, Tony Weir, and Anthony D. Weir, Taylor & Francis, 2006.

Reference Books:

1. Non-Conventional Energy Resources, B.H. Khan,McGraw Hill, 2009.
2. Solar Energy – Fundamentals Design, Modelling and applications, G.N. Tiwari, Alpha Science, 2015.
3. Renewable Energy, Power for a Sustainable Future, Godfrey Boyle, Oxford University Press, 2012.
4. Non-Conventional Energy Resources, N.K. Bansal, Vikas Publishing House, 2014.
5. Solar Energy: Principles of Thermal Collection and Storage, S.P. Sukhatme, Tata McGraw Hill, 2009.

11. ENERGY CONSERVATION IN INDUSTRIES

Course Objectives:

1. An insight to energy scenario and emphasis need for energy conservation.
2. Analyze factors in tariff structure and educate opportunities for energy conservation in transformers
3. Exposure to energy conservation opportunities in major thermal utilities
4. Exposure to energy conservation opportunities in major electrical utilities and illumination systems
5. Apply CUSUM and other financial evaluation techniques and exposure to ESCO concept

Introduction: Energy scenario of World, India and AP - Environmental aspects of Energy Generation – Material and Energy balancing - Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Basic instruments for Energy Auditing.

Electrical Supply Systems: Electricity Tariff structures – Typical Billing - Demand Side Management - HT and LT supply - Power Factor – Energy conservation in Transformers – Harmonics

Energy Conservation in Major Thermal Utilities: Stoichiometry - Combustion principles. Energy conservation in Boilers - Steam Distribution Systems - Furnaces - Thermic Fluid Heaters – Cooling Towers – D.G. sets. Insulation and Refractories - Waste Heat Recovery Devices.

Energy Conservation In Major Electrical Utilities: Energy conservation in : Motors - Pumps – Fans – Blowers - Compressed Air Systems - Refrigeration and Air Conditioning Systems - Illumination systems

Energy Monitoring, Targeting, Labelling And Economics: Elements of Monitoring & Targeting System – CUSUM - Energy / Cost index diagram – Energy Labelling - Energy Economics – Cost of production and Life Cycle Costing - Economic evaluation techniques – Discounting and Non Discounting - ESCO concept – PAT scheme

Course Outcomes:

1. Global and Indian energy scenario will emphasis the need for energy conservation and auditing
2. Factors behind energy billing can help to optimize the concept of demand side management for lowering energy costs
3. Student will understand avenues available for energy conservation in major thermal utilities
4. Student will understand avenues available for energy conservation in major electrical utilities
5. Understand CUSUM and other financial evaluation techniques and expose students about energy labelling

Text Books:

1. Guide book for National Certification Examination for "Energy Managers and Energy Auditors" (4 Volumes). Available at http://www.em-ea.org/gbook1.asp. This website is administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.
2. Industrial Energy Conservation Techniques: (concepts, Applications and Case Studies), K. NagabhushanRaju, Atlantic Publishers &Dist, 2007.

Reference Books:

1. Handbook on Energy Audit and Environment Management, Abbi Y P, Shashank Jain., TERI Press, 2006. 2. Albert Thumann and Paul Mehta D, "Handbook of Energy Engineering", 7thEdition, The Fairmont Press, 2013.

3 Energy Management, . Murphy.W.R. andMcKay.G, Butterworth, London 1982.

4. Design and management for energy conservation: A handbook for energy managers, plant engineers, and designers, Paul W.O'Callaghan, Pergamon Press, 1981.

5. Energy Management Handbook, Steve Doty, Wayne Turner C, 7th Edition, The Fairmont Press, 2009.

12. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Course Objectives:

1. To provide exposure to students with real time experience on Artificial Intelligence (AI) in Mechanical Engineering Domain by using Heuristic Search Techniques & Game Playing and Logic and Knowledge Representation.
2. To deploy various Applications of AI and Machine Learning (ML) to the various core mechanical engineering application development framework.
3. To acquire the basic and important design concepts and issues of development of AI and ML language.
4. To develop the AI and ML language programmes using internal and external databases.
5. To know the fundamentals of AI and ML and also be familiar with basic supervised learning algorithms.
6. To understand AI and ML algorithms and also to learn and apply different learning techniques.
7. To learn more about artificial learning and deep learning and its application to Mechanical Engineering problems.
8. To lay the foundation of AI and ML and its practical applications and prepare students for acquiring skills to solve realtime problems.

Introduction: Artificial Intelligence (AI) and its importance, AI techniques, AI Problems (tic tac toe problem, water jug problems, Chess problem), Application area of AI, Defining problem as a state space search, Control Strategies. Overview of Machine Learning, Learning: Types of Machine Learning, Hypothesis Formulation and Model Selection, Phases of ML: Training, Testing and Validation-Splitting, Cross Validation; Machine Learning – Differentiating algorithmic and model based frameworks, High Dimensional Data.

Heuristic Search Techniques and Game Playing: Heuristic Search Techniques : AI and search process, brute force search, depth-first search, breadth-first search, time and space complexities, heuristics search, hill climbing, best first search, A* algorithm and beam search, AO search, constraint satisfaction. Game Playing: AI and game playing, plausible move generator, static evaluation move generator, game playing strategies, problems in game playing - Learning - Navigation – Manipulation - Robot Architecture.

Logic and Knowledge Representation: Knowledge Representation and Structured Knowledge: Associative networks, frame structures, conceptual dependencies and scripts, ontologies. Logic: Prepositional logic: syntax and semantics, First Order Predicate Logic (FOPL): Syntax and semantics, conversion to clausal form, inference rules, unification, and the resolution principles. Knowledge Acquisition and Expert System: Type of learning, Knowledge Acquisition, Early work in machine learning, learning by induction. Introduction to expert system, Phases of expert system, characteristics of expert system and a case study;

Unsupervised learning/Clustering: Similarity and Distance Measures, Clustering Techniques: K-Means Algorithm, Hierarchical Clustering, Clustering of Categorical Attributes; Dimensionality Reduction: Linear Discriminant Analysis, Principal Component Analysis; Ensemble Learning: Boosting, Bagging, Stacking.

Artificial Neural Networks: Introduction to Neural Networks, Model, Activation functions, Perceptron, The Multilayer Perceptron (MLP), Error Propagation, Delta Rule, Back Propagation Algorithm, Supervised, Unsupervised and Semi-Supervised Learning, introduction to Reinforcement learning, Deep Learning: layers, activation functions, optimizers, Convolutional Neural Networks (CNN), Applications, A case study on Object Recognition using CNN

Course Outcomes:

1. Describe human intelligence and AI Explain how intelligent system works.
2. Illustrate the Concepts of Heuristic Search Techniques and apply basics of neural networks.
3. Explain Expert System and Game Playing Algorithms and its implementation.
4. Apply Knowledge representation and semantic in Knowledge representation.
5. Develop some familiarity with current research problems and research methods in AI.
6. Classify the variety of learning algorithms and popular machine learning approaches.
7. Identify mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.

Textbooks

1. Artificial Intelligence Modern Approach, Russell Stuart, Norvig Peter, Pearson Education series in AI, 3rd Edition, 2019.

2. Introduction to Artificial Intelligence and Expert Systems, Dan.W.Patterson, PHI Learning, 2009.

3. Applied Machine Learning, M.Gopal, McGraw-Hill Education, 2018

4. Machine Learning in Production Developing and Optimizing Data Science Workflows and Applications, Andrew Kelleher & Adam Kelleher · 2019

5. Introduction to Machine Learning, Ethem Alpaydin, 4th Edition, The MIT Press, 2020.

6. Machine Learning, V.K. Jain, Khanna Book Publishing Co. (P) Ltd., 2019

7. Artificial Intelligence, E. Rich K .Knight, and B. Nair, 3rdEdition, TMH, 1 July 2017

8. Machine Learning , Tom M. Mitchell, Tata McGraw Hill, New Delhi, 2017

9. Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2, Raschka Sebastian and Mirjalili Vahid, Packt Publishing Ltd., Mumbai, 3rd Edition, 2019

Reference Books

1. Foundations of Artificial Intelligence and Expert Systems, V S Janakiraman, K Sarukesi, P Gopalakrishan, Macmillan India Ltd.
2. Introduction to AI and Expert System, Dan W. Patterson , Prentice Hall India, 2017

3. A guide to Expert Systems, Donald. A. Waterman, Pearson, 2018.

4. Applied Machine Learning, David Forsyth, Springer International Publishing, 2019

5. Probabilistic Machine Learning: An Introduction, Kevin P. Murphy, MIT Press, 2021.

6. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, 2006

7. Artificial Intelligence, Patrick henry Winston, third edition, Pearson Education Asia, 2005

8. Artificial Intelligence A modern Approach, Russel Norvig, 3rd Edition, Pearson Education, 2010.

9. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, The MIT Press, 2016.

10. Machine Learning – An Algorithmic Perspective, Stephen Marsland, Second Edition, Chapman and Hall, CRC Machine Learning and Pattern Recognition Series, 2014

HSS ELECTIVE

1 . ORGANIZATIONAL BEHAVIOUR

Course Objectives:

1. To understand the basic concepts of organisational behaviour, its foundations and importance.
2. To enable students to have a basic perspective of Motivation and Motivation theories.
3. To acquaint the students about group behaviour in organizations, including communication, leadership conflicts and organizational change and how these are linked to and impact organizational performance.

SYLLABUS:

Organizational Behaviour : Concept of Organisation - Concept of Organisational Behaviour - Nature of Organisational Behaviour - Role of Organisational behaviour - Disciplines contributing to Organisational Behaviour.

Motivation: Definition - Nature of Motivation - Role of Motivation - Theories of Motivation : Maslow's Need Hierarchy Theory, Herzberg's Motivation Hygiene Theory and Mc Gregor's Theory X and Theory Y.

Group Dynamics: Meaning - Concept of Group - Types of groups -Formal and Informal groups - Group development - Group cohesiveness and factors affecting group cohesiveness.
Leadership: Concept of Leadership - Difference between Leadership and Management - Importance of Leadership - Leadership styles: Autocratic leadership, Participative leadership and Free Rein leadership.
Communication: Meaning - Communication Process - Forms of communication: Oral, Written and Non- Verbal communication - Direction of communication : Downward, Upward and Horizontal communication.

Organisational conflits : Concept of conflict - Reasons for conflict - Types of Conflict: Intrapersonal conflict, Interpersonal conflict, Intragroup conflict, Intergroup conflict, Inter organisational conflict - Conflict management.

Organisational Change: Nature - Factors in Organizational change -Planned change: Process of planned change - Resistance to change: Factors in resistance to change - Overcoming resistance to change.

Course Outcomes:

1. Indentifying fundamental aspects of organizational dynamics.
2. Evaluate main theories of motivation and formulating suitable motivational strategies.
3. Analyze the behaviour of individuals and groups in organizations.
4. Understanding of Leadership theories and Leadership behaviour.
5. Apply relevant theories, concepts to address important Organizational Behaviour questions.

Text Books:

1. Organisational Beaviour, L.M.Prasad, Sultan Chand & Sons, New Delhi -110002
2. Organisational Behaviour, K. Aswathappa, Himalaya Publishing House, New Delhi

Reference Book:

1. Organisational Behaviour, Stephen Robbins, Pearsons Education, New Delhi.

2. INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP

Course Objectives:

1. To familiarize the students with the concepts of Management.
2. To relate the concepts of Management with industrial organizations.
3. To explain the factors affecting productivity and how productivity can be increased in an Industrial undertaking.
4. To set forth a basic framework for understanding Entrepreneurship.

SYLLABUS :

Basic Concepts of Management:

Management :- Definition, Nature and Importance ; Functions of the Management; Levels of Management; F.W Taylor's Scientific Management; Henry Fayol's Principles of Management;

Forms of Business Organizations: Introduction, **Types of Business organizations: Private Sector**- Individual Ownership , Partnership, Joint stock companies and Co-Operative organizations**; Public sector**- Departmental Organizations, Public Corporations and Government Companies; The Joint sector Management.

Production and operations Management: Plant location- Factors to be considered in the selection of Plant location; Break - even analysis- Significance and managerial applications; Importance of Production Planning and Control and its Functions; Human Resource Management and Functions of Human Resource Manager (in brief); Functions of Marketing; Methods of Raising Finance.

Entrepreneurship : Definition, Characteristics and Skills , Types of Entrepreneurs, Entrepreneur vs. Professional Managers, , Growth of Entrepreneurs, Nature and Importance of Entrepreneurs, Women Entrepreneurs, Problems of Entrepreneurship.

Entrepreneurial Development and Project Management: Institutions in aid of Entrepreneurship Development, Idea generation: Sources and Techniques;, Stages in Project formulation ; Steps for starting a small enterprise - Incentives for Small Scale Industries by Government.

Course Outcomes:

On completion of the course, the students will be able to:

1. Understand the roles, skills and functions of management.
2. Distinguish the different types of business organizations.
3. Identify the factors involved in Production Operations Management.
4. Diagnose organizational problems and take suitable decisions.
5. Establish good Human Resource Management practices.
6. Acquire necessary knowledge and skills required for organizing and carrying out entrepreneurial activities.

Text Books:

1. Industrial Organization & Engineering Economics, Sharma,S.C, and Banga, T.R., Khanna Publishers, Delhi, 2000.
2 .The Dynamics of Entrepreneurial Development and Management (Planning for future Sustainable growth), Vasant Desai , Himalayan Publishing House, 2018.

Reference Books:

1. Management Science**,** Aryasri , A.R., McGraw HIll Education (India Private Limited , New Delhi 2014.
2. Entrepreneurship, Sheela, P. , and Jagadeswara Rao, K., Shree Publishing House, Guntur, Andhra Pradesh, 2017.

3. OPERATIONS RESEARCH

Course Objectives:

1. Formulate a real world problem as a mathematical programming model.
2. Provide knowledge of optimization techniques and approaches.
3. Understand and study inventory problems.
4. Know the network models.
5. Put on knowledge in solving replacement problems and different queueing models

SYLLABUS:

Introduction: Definitions of Operations Research; Phases of Operations Research; Types of Operations Research models; applications, merits and demerits of Operations Research.

Allocation: Linear Programming problem formulation; Basic assumptions; Graphical solution; Simplex method; Artificial variable technique; Two phase method; Big M method; Duality principle; Primal and Dual relation.

Transportation: Formulation; Solution methods; Unbalanced transportation problems - North west corner rule; Least cost entry method; Vogel's approximation method; Optimal solution; degeneracy.

Assignment: Formulation; Variations in Assignment problem; Travelling salesman problem.

Sequencing: Sequencing of - *n* jobs through two machines; *n* jobs through three machines; *n* jobs through *m* machines; 2 jobs through *m* machines.

Inventory Control: Introduction; Types of Inventory; Inventory costs; Deterministic models - Economic order quantity (EOQ) and Economic Production Quantity (EPQ) with and without shortages; Quantity discounts; P system; Q system; Inventory control Techniques.

Network Analysis: Network definitions; Time estimates in network analysis; Labeling using

Fulkerson's rule; Forward pass computations; Backward pass computations; Project management using Critical Path Method(CPM) and Programme Evaluation and Review Technique(PERT).

Replacement: Introduction, Replacement of items that deteriorate with time - Value of money unchanging and changing, Replacement of items that fail completely.

Queueing models: Introduction; Single channel poisson arrivals; Exponential service times; Unrestricted queuewith infinite population and finite population models; Multi channel poisson arrivals; Exponential service times with infinite population and restricted queue.

Course Outcomes:

1. Learned to translate a real-world problem into a mathematical formulation.
2. Formulate and Solve Transportation, Assignment and sequencing problems.
3. Resolve inventory problems.
4. Able to solve maximum flow and shortest path problems.
5. Capable to solve replacement problems and analyze queueing models.

Text Books:

1. Operations Research- An Introduction, TAHA , Prentice Hall, 2009.
2. Introduction to Operations Research , F.S. Hiller, G.J. Liberman,B. Nag and P.Basu ", Mc Graw Hill Education(India), 2012.
3. Operations Research , S.D.Sharma, Kedarnadh Ramnadh & Co.,2017

Reference Books:

1. Operations Research, R. Pannerselvam PHI..
2. Operations Research, Richard Bronson, Schaum's Series, Mc Graw Hill
3. Operations Research- Theory and Practice, N.V.S.Raju, BS publications.
4. Operations Research, V.K. Kapoor , Sultan Chand & Sons.