DEPARTMENT OF MECHANICAL ENGINEERING
ANDHRA UNIVERSITY

Minutes of the Board of studies meeting is held on **1-11-2022 (Tuesday) at 2.30 P.M**. in the Seminar Hall of the Department of Mechanical Engineering, A.U. College of Engineering, Visakhapatnam. As per the BoS resolutions the finalized Scheme and Syllabi of 1st and 2nd year B.Tech. Mechanical Engineering for the Admitted batch 2022-23 are given below.

SCHEME AND SYLLABI OF B.TECH AND B.TECH+M.TECH MECHANICAL ENGINEERING

B.Tech & B.Tech+M.Tech (For admitted Batches 2022-23)

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	Strength of Materials	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	Strength of Materials Lab	0	3	50	50	100	1.5
							Total Credits	**19.5**

B.Tech & B.Tech+M.Tech (For admitted Batches 2022-23)

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	Green 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	Industry 4.0	4	0	30	70	100	3
MC1206	HSS	English Language Lab	0	3	50	50	100	1.5
MC1207	ES	Machine Drawing 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 (For admitted Batches 2022-23)

II Year - I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
MC2101	BS/ES	Python Programming	4	0	30	70	100	3
MC2102	PC	Theory of Machines	4	0	30	70	100	3
MC2103	PC	Engineering 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	Python Programming Lab	0	3	50	50	100	1.5
MC2107	PC	Manufacturing Technology -I Lab	0	3	50	50	100	1.5
MC2108	PC	Production Drawing Lab	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 (For admitted Batches 2022-23)

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	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								

FIRST YEAR 1ST SEMESTER

MC 1101 - MATHEMATICS-I

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:

- To transmit the knowledge of Partial differentiation.
- To know of getting maxima and minima of function of two variables and finding errors and approximations.
- To evaluate double and triple integrals, volumes of solids and area of curved surfaces.

- To expand a periodical function as Fourier series and half-range Fourier series.

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

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

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)

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.

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

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.

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

Course Objectives:

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

Course Outcomes:

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

- Understand the fundamentals of Thermodynamics and Laws of thermodynamics. Understand the working of Carnot cycle and concept of entropy.
- 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 .
- 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
- 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.
- 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.

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.

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

Course Objectives:

The main objectives of the course are to

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

Course Outcomes:

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

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

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.

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

Course Objectives

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

Course Outcome

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

SYLLABUS

Concurrent Forces in a Plane: Principles of statics- Equilibrium of concurrent forces in a plane- Method of projections- Equilibrium of three forces in a plane-Method of moments- Friction**.**

Parallel Forces in a Plane: Two parallel forces- General case of parallel forces in a plane- Centre of parallel forces and centre of gravity- Centroids of composite plane figures and curves- Distributed force in a plane.

General Case of Forces in a Plane: Composition of forces in a plane- Equilibrium of forces in a plane- Plane trusses, method of joints, method of sections-
Forces in space: Concurrent and parallel forces in a plane, couples in space.

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.

Text Book:

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 STRENGTH OF MATERIALS

Course Objectives:

- 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.
- To make students to calculate shearing force and bending moments of different types of beams.
- To apply the knowledge of determining moment of inertias of different cross sections and identify the stresses and deflections induced in beams
- To enable the students to understand stresses induced in the transmission shafts and helical coil springs against different types of loading conditions.
- To develop knowledge in calculation of stresses and identifying the type of failure in cylinders and spherical shells.

Course Outcomes:

The student will be able to

- Determine stresses and strains induced in a mechanical component for various types of loads. Further, the student can also determine principal stresses and strains.
- Calculate shear force and bending moments induced in beams for different types of loading conditions
- 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.
- Identify the mode of failure in transmission shafts and determine stresses induced in shaft and springs subjected to complex loading conditions
- Apply the principles of stresses and strains in thin cylinders and shells and evaluate longitudinal and circumferential stresses.

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.

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.

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.

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.

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.

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

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.

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 1106 WORKSHOP

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

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

Course Outcomes:

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

- Work with Wood Materials in real time applications.
- Build various parts with Sheet Metal in day-to-day life.
- Apply Metal Fitting skills in various applications.
- 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

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

- To enable the students to acquire skill, technique and utilization of the Instruments
- 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.
- To impart the practical knowledge in basic concepts of Wave optics, Lasers and Fiber optics.
- To familiarize the handling of basic physical apparatus like Vernier callipers, screw gauge, spectrometers, travelling microscope, laser device, optical fibre, etc.

Course Outcomes:

- Ability to design and conduct experiments as well as to analyze and interpret
- Ability to apply experimental skills to determine the physical quantities related to Heat, Electromagnetism and Optics
- 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.

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.

MC 1108 STRENGTH OF MATERIALS LABORATORY

Course Objectives:

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

Course Outcomes:

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

List of Experiments:

1. To study the stress strain characteristics (tension and compression) of metals by usingUTM.
2. To study the stress strain characteristics of metals by using Hounsefield Tensometer.
3. Determination of compression strength of wood.
4. Determination of hardness using different hardness testing machines- Brinnels, Vickersand Rockwell's.
5. Impact test by using Izod and Charpy methods.
6. Deflection test on beams using UTM.
7. Tension shear test on M.S. Rods.
8. To find stiffness and modulus of rigidity by conducting compression tests on springs.
9. Torsion tests on circular shafts.
10. Bulking of sand.
11. Punch shear test, hardness test and compression test by using Hounsefield tensometer.
12. Sieve Analysis and determination of fineness number.

FIRST YEAR 2ND SEMESTER

MC1201 MATHEMATICS-II

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:

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

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

- Find rank, eigen values and eigen vectors of a matrix and understand the importance of Cayley-Hamilton theorem.
- Reduce quadratic form to canonical forms and solving linear systems by direct and indirect methods.
- 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
- Discriminate among the structure and procedure of solving higher order differential equations with constant and variable coefficients.

- Understand Laplace transforms and its properties and finding the solution of ordinary differential equations.

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.

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.

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.

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.

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.

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 GREEN CHEMISTRY

Course Objectives:

- To apply the basic knowledge of Chemistry to the Engineering Discipline.

- To develop knowledge about water and its treatment for industrial and potable purposes.
- 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.

Course Outcome:

- The students are able to apply the basic concepts and principles studied in Chemistry to the field of Engineering.
- The students are able to apply chemistry to different branches of engineering
- The students are able to acquire the knowledge in the areas of Water Chemistry, Mechanism of Corrosion of Metals and Corrosion Control Methods, Batteries, Fuel Cells, Green Chemistry and Technology and Processes involving Green Chemistry and suggest innovative solutions for existing challenges in these areas.

SYLLABUS

Water Technology: 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.

Batteries: Primary batteries: The chemistry - Types: Zinc-carbon (Leclanche type), zinc alkaline (Duracell), zinc/air batteries; Lithium primary cells – liquid cathode, solid cathode and lithium-ferrous sulphide cells. Secondary batteries: Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultrathin lithium polymer cells. Advanced Batteries for electric vehicles, requirements of the battery – sodium-beta and redox batteries.

Fuel Cells: Fuel Cells: Description, working principle, anodic, cathodic and cell reactions, fabrication of electrodes and other components, applications, advantages, disadvantages and environmental aspectsof the following types of fuel cells: Proton Exchange Membrane Fuel Cells, alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells- Membranes and Fuels

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.

Green Chemistry and Technology: Green Chemistry and its 12 principles, toxicity of chemicals, material safety data sheet (MSDS), concept of zero pollution technologies, atom economy, functional toxicity vs non-functional toxicity, alternative solvents, energy minimization, microwave and sonochemical reactions, renewable feed stock, carbon dioxide as a feed stock.

Processes involving Green Chemistry: Processes involving solid catalysts – zeolites, ion exchange resins, Nafion/silica nano composites and enhanced activity. Polymer supported reagents, green oxidations using TAML catalyst, membrane reactors. Green chemistry in material science, synthesis of porous polymers, green nanotechnology.

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.
3. Dell, Ronald M Rand, David A J, 'Understanding Batteries', Royal Society of Chemistry, (2001).
4. M. Aulice Scibioh and B. Viswanathan 'Fuel Cells – principles and applications', University Press, India (2006).
5. Hand Book of Green Chemistry and Technology; by James Clarke and Duncan Macquarrie; Blakwell Publishing.
6. Anastas, P. T., Warner, J. C. Green Chemistry: Theory and Practice, Oxford University Press Inc., New York, 1998.

MC 1203 ENGLISH

(Common for all Branches)

Course Objectives:

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

Course Outcomes:

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

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

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

Course Objectives:

- The course is designed to provide complete knowledge of C language.
- To provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.
- To provide knowledge to the Students to develop logics which will help them to create programs, applications in C.
- 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.
- This course provides the fundamental knowledge which is useful in understanding the other programming languages.

Course Outcomes:

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

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.

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 INDUSTRY 4.0

SYLLABUS

Introduction to Industry 4.0

Introduction, Idea of Industry 4.0, Various Industrial Revolutions, Origin concept of Industry 4.0,Industry 4.0 Production system, How is India preparing for Industry 4.0, Comparison of Industry 4.0 Factory and Today's Factory.

Trends in Industry 4.0

Introduction, Main Concepts and Components of Industry 4.0, State of Art Technologies, Proposed Framework for Industry 4.0, Trends of Industrial Big Data and Smart Business Transformation.

Roadmap for Industry 4.0

Introduction, Proposed Framework for Technology Roadmap: Strategy Phase, Development Phase, Smart Manufacturing, Types of Smart Devices, Smart Logistics, Smart Cities, Predictive Analytics.

Advances in the Era of Industry 4.0

Introduction, Recent Technological Components of Robots- Advanced Sensor Technologies, Internet of Things, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly, IIoT- Industrial IoT.

The Role of Industry 4.0 and Future Aspects

Introduction, Challenges & Future of Works and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world.

Reference Books:

1) Industry 4.0 The Industrial Internet of Things, Alasdair Gilchrist, Apress Publisher, ISBN-13 (pbk): 978-1-4842-2046-7
2) Industry 4.0: Managing The Digital Transformation, Alp Ustundag, EmreCevikcan, Springer, 2018 ISBN 978-3-319-57869-9.
3) Designing the industry - Internet of things connecting the physical, digital and virtual worlds, OvidiuVermesan and Peer Friess, Rivers Publishers, 2016 ISBN 978-87-93379-81-7
4) The concept Industry 4.0- An Empirical Analysis of Technologies and Applications in Production Logistics, Christoph Jan Bartodziej, Springer Gabler, 2017 ISBN 978-3-6581-6502-4
5) “Internet of Things- A hands on approach”, Arshdeep Bahga and Vijaya Madisetti
6) Arcthitecting for the Cloud-AWS Best Practices
7) Artificial Intelligence a modern approach by Peter Norvig, Rusell

List of Open Sources Learning Website:

1. www.nptel.ac.in/

MC 1206 ENGLISH LANGUAGE LABORATORY

(Common for all branches)

Course Objectives:

- To make students recognize the sounds of English through Audio-Visual aids;
- To help students build their confidence and help them to overcome their inhibitions and self- consciousness while speaking in English;
- To familiarize the students with stress and intonation and enable them to speak English effectively; and
- To give learners exposure to and practice in speaking in both formal and informal contexts.

Course Outcomes:

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

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.

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 –MACHINE DRAWING

Course Objectives:

The objectives of this course are

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

Course Outcomes:

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

SYLLABUS

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

Oldhamcouplings,

shaft bearings, Brackets and Hangers, Pipe joints.

Orthogonal views and Sectional views of machine parts.

Assembly drawing of various engine components and machine tool components.

Text Books:

1. Machine Drawing, by N.D.Bhatt, Charotal Publishing House.
2. Engineering Drawing, by A.C.Parkinson, Wheeler Publishing.

Reference Books:

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

MC1208- COMPUTER PROGRAMMING AND NUMERICAL METHODS LABORATORY

Course Objectives:

- To impart writing skill of C programming to the students and solving problems.
- To write and execute programs in C to solve problems such as Modularize the problems into small modules and then convert them into programs.,

- To write and execute programs in C to solve problems such as arrays, files, strings, structures and different numerical methods.
- This reference has been prepared for the beginners to help them understand the basic to advanced concepts related to Objective-C Programming languages.

Course Outcomes:

- Understand various computer components, Installation of software. C programming development environment, compiling, debugging, and linking and executing a program using the development environment.
- Analyzing the complexity of problems, Modularize the problems into small modules and then convert them into programs.
- Construct programs that demonstrate effective use of C features including arrays, strings, structures, pointers and files.
- Apply and practice logical ability to solve the real world problems.
- Apply Numerical methods to Solve the complex Engineering problems.

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.

SECOND YEAR 1ST SEMESTER

MC 2101 - PYTHON PROGRAMMING

Course Objectives

- To develop skills on procedural oriented and object oriented programming in Python
- To understand and apply different data wrangling techniques using Python.
- To perform data analysis using python libraries like NumPy, Pandas and exploratory data analysis using Matplotlib

Course Outcomes

At the end of the course, a student should be able to:

- Acquire programming knowledge on Basics of Python
- Acquire programming knowledge on Text and File Handling
- Develop Python programs to Mean, Median, Mode, Correlation
- Acquire programming knowledge on NumPy, Pandas Library
- Acquire programming knowledge on Graph Visualizations in Python and Data Analysis using Python

SYLLABUS

Introduction to Python: Rapid Introduction to Procedular Programming, Data Types: Identifiers and Keywords, Integral Types, Floating Point Types

Strings: Strings, Comparing Strings, Slicing and Striding Strings, String Operators and Methods, String formatting with str.format

Collections Data Types: Tuples, Lists, Sets, dictionaries, Iterating and copying collections

Python Control Structures, Functions and OOP:Control Structures and Functions: Conditional Branching, Looping, Exception Handling, Custom Fuctions

Python Library Modules: random, math, time, os, shutil, sys, glob, re, statistics,creating a custom module

Object Oriented Programming: Object Oriented Concepts and Terminology, Custom Classes, Attributes and Methods, Inheritance and Polymorphism, Using Properties to Control Attribute Access

File Handling: Writing and Reading Binary Data, Writing and Parsing Text Files

NumPy Arrays and Vectorized Computation: NumPy arrays, Array creation, Indexing and slicing, Fancy indexing, Numerical operations on arrays, Array functions, Data processing using arrays, Loading and saving data, Saving an array, Loading an array, Linear algebra with NumPy, NumPy random numbers

Data Analysis with Pandas: An overview of the Pandas package, The Pandas data structure-Series, The DataFrame, The Essential Basic Functionality: Reindexing and altering labels , Head and tail, Binary operations, Functional statistics , Function application Sorting, Indexing and selecting data, Computational tools, Working with Missing Data, Advanced Uses of Pandas for Data Analysis - Hierarchical indexing, The Panel data

Data Analysis Application Examples: Data munging,Cleaning data, Filtering, Merging data, Reshaping data, Data aggregation, Grouping data

Data Visualization: The matplotlib API primer-Line properties, Figures and subplots, Exploring plot types-Scatter plots, Bar plots, Histogram plots, Legends and annotations,

Plotting functions with Pandas.

Text Books

1. Programming in Python 3: A Complete Introduction to Python Language, Mark Summerfield, Second Edition, Addison-Wesley Publications
2. Python: End-to-End Data Analysis Learning Path, Module 1: Getting Started with Python Data Analysis , Phuong VothiHong , Martin Czygan, , Packt Publishing Ltd

Reference Books

1. Learning Python, 5th Edition, Mark Lutz, Orielly Publications
2. Python for Data Analysis, Wes McKinney, Orielly Publications
3. How to Think Like a Computer Scientist: Learning with Python 3 Documentation 3rd Edition, Peter Wentworth, Jeffrey Elkner, Allen B. Downey, Chris Meyers
4. Core Python Programming, Second Edition, Wesley J. Chun, Prentice Hall
5. Python Cookbook – Recipes for Mastering Python 3,3rdEdition, David Beazley, Brian K. Jones, Oreilly

MC 2102 THEORY OF MACHINES

Course Objectives:

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

Course Outcomes:

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

- Understanding D'Alembert's principle, Dynamically equivalent system and Turning-moment diagrams.
- Understanding principle of governors its types and Sensitiveness of a governor

SYLLABUS

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

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

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

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

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

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

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

Text Book:

1. Theory of Machines, 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

Course Objectives:

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

Course Outcomes:

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

SYLLABUS

Introduction: Basic concepts; Thermodynamic systems; Micro 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.

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.

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

Course Objectives:

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

Course Outcomes:

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

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

SYLLABUS

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

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

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

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

Text Books:

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

Reference Books:

1. Manufacturing Engineering & Technology, 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

Course Objectives:

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

Course Outcomes:

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

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

SYLLABUS

Significance of Economics and Managerial Economics:

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

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

Demand and Utility Analysis:

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

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

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

Theory of Production and Cost analysis:

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

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

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

Pricing and Business Cycles:

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

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

Text Books:

1. 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 - PYTHON PROGRAMMING PRACTICE

Course Objectives

- Familiarize students with key data structures in Python including lists and dictionaries and apply them in context of searching, sorting, text and file handling
- Introduce students to calculation of statistical measures using Python such as measures of central tendency, correlation
- Familiarize students with important Python data related libraries such as Numpy and Pandas and use them to manipulate arrays and dataframes
- Introduce students to data visualization in Python through creation of line plots, histograms, scatter plots, box plots and others
- Implementation of basic machine learning tasks in Python including pre-processing data, dimensionality reduction of data using PCA, clustering, classification and cross-validation.

Course Outcomes

After completion of the course the student should be able to:

- Implement searching, sorting and handle text and files using Python data structures such as lists and dictionaries
- Calculate statistical measures using Python such as measures of central tendency, correlation
- Use Python data related libraries such as Numpy and Pandas and create data visualizations
- Implement basic machine learning tasks pre-processing data, compressing data, clustering, classification and cross-validation.

SYLLABUS

1. Python Programs on lists & Dictionaries
2. Python Programs on Searching and sorting
3. Python Programs on Text Handling
4. Python Programs on File Handling
5. Python Programs for calculating Mean, Mode, Median, Variance, Standard Deviation
6. Python Programs for Karl Pearson Coefficient of Correlation, Rank Correlation
7. Python Programs on NumPy Arrays, Linear algebra with NumPy
8. Python Programs for creation and manipulation of DataFrames using Pandas Library
9. Write a Python program for the following**.**
    - Simple Line Plots,
    - Adjusting the Plot: Line Colors and Styles, Axes Limits, Labeling Plots,

- Simple Scatter Plots,
- Histograms,
- Customizing Plot Legends,
- Choosing Elements for the Legend,
- Boxplot
- Multiple Legends,
- Customizing Colorbars,
- Multiple Subplots,
- Text and Annotation,
- Customizing Ticks

10. Python Programs for Data preprocessing: Handling missing values, handling categorical data, bringing features to same scale, selecting meaningful features
11. Python Program for Compressing data via dimensionality reduction: PCA
12. Python Programs for Data Clustering
13. Python Programs for Classification
14. Python Programs for Model Evaluation: K-fold cross validation

REFERENCE BOOKS:

1. Core Python Programming, Second Edition, Wesley J. Chun, Prentice Hall
2. Chris Albon, "Machine Learning with Python Cookbook-practical solutions from preprocessing to Deep learning", O'REILLY Publisher,2018
3. Mark Summerfield, Programming in Python 3--A Complete Introduction to the Python Language, Second Edition, Additson Wesley
4. Phuong Vo.T.H , Martin Czygan, Getting Started with Python Data Analysis, Packt Publishing Ltd
5. Armando Fandango, Python Data Analysis, Packt Publishing Ltd
6. Magnus Vilhelm Persson and Luiz Felipe Martins, Mastering Python Data Analysis, Packt Publishing Ltd
7. Sebastian Raschka& Vahid Mirjalili, "Python Machine Learning", Packt Publisher, 2017

MC 2107 MANUFACTURING TECHNOLOGY LABORATORY-I

Course Objectives:

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

Course Outcomes:

They have

- Ability to prepare molds, cores for a given component.
- Capability to complete different joints, welds for given component by GAS and

ARC welding processes.

- Aptitude to made taper turning, thread cutting and off set turning on different materials by Lathe machine.
- Skill to made spur gears, key ways etc. by using different machines.

List of Experiments:

Use of basic tools and operations of the following trades.

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

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

   i. Machine Tool (Lathe)

   ii. I.C. engine

   iii. Pump

   iv. Gear box

* Not for examination

MC 2108 – P R O D U C T I O N D R A W I N G

SYLLABUS

Introduction to Production drawing, Component drawing, Assembly drawing, Machine shop drawing, Pattern-shop drawing, Sheet metal drawing. Limits, Tolerances and Fits-Indication of surface roughness, preparation of process sheets.

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

Drawing of Dies. Sheet metal dies. Forging dies, stock strip layouts in sheet metal work,process layout for forge and press operations.

Cutting tool layout.Single point, multi point cutting tools for conventional and CNC machinetools.

Text Book:

1. A Text Book on Production Drawing by K.L.Narayana, P.Kannaiah and K.Venkata Reddy,New age international.

Reference Books:

1. Manufacturing technology Foundry, Forming and Welding by P.N.Rao, Tata McGrawHill Publishing Company Ltd, New Delhi.

2. Production Technologies, HMT.

MC2109-PROBLEM SOLVING AND PROGRAMMING SKILLS USING TECHNICAL COMPUTING

Course Objective:

The objectives of this course are

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

Course Outcomes:

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

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

List of Exercises:

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

MC 2110 PROFESSIONAL ETHICS AND UNIVERSAL HUMAN VALUES

Course Objectives:

- To recognize the moral values that should guide the Engineering profession.
- To resolve moral issues concerning one's profession.
- To develop and exhibit a set of moral beliefs and attitudes that engineers should inculcate.
- To inculcate social values and morality in one’s life.
- To develop awareness about Professional/Engineering Ethics and Human Values.

Course Outcomes:

Students will be able to:

- Apply the conceptual understanding of ethics and values into everyday practice.
- Understand the importance of moral awareness and reasoning in life.
- Acquire professional and moral etiquette that an engineer requires.
- Develop the acumen for self-awareness and self-development.
- Develop cultural tolerance and integrity.
- Tackle real-life challenges with empathy.

SYLLABUS

HUMAN VALUES
Values - Respect - Caring - Sharing - Honesty- Courage - Self confidence - Communal Harmony Morals - Virtues

PROFESSIONAL VALUES
Integrity - Discipline - Valuing time - Cooperation - Commitment - Code of conduct - Challenges in the workplace

PROFESSIONAL ETHICS
Overview - Engineering ethics - Moral issues - Profession - Models of professional roles - Responsibility

RESPONSIBILITIES AND RIGHTS
Safety and risk - Collegiality and loyalty - Confidentiality - Occupational crime - Human rights - Employee rights - Intellectual property rights

GLOBAL ISSUES
Globalization - Environmental ethics - Computer ethics - Code of ethics - Multinational corporations - Engineers as advisors in Planning and Policy making

Text Book:

1. R.S. Nagarazan. A Textbook on Professional Ethics and Human Values. New Age International Publishers. 2006.

Reference Books:

1. Premvir Kapoor. Professional Ethics and Human Values. Khanna Publishing House. 2019.
2. B.S. Raghavan. Human Values and Professional Ethics. S.Chand Publications. 2012.
3. R.R. Gaur & Others. A Foundation Course in Human Values and Proff. Ethics. Excel Books. 2009.
4. A. N. Tripathi. Human Values. New Age International (P) Limited. 2009
5. R. Subramanian. Professional Ethics. OUP India. 2013.

MC 2111 N S S / N C C

SECOND YEAR 2ND SEMESTER

MC- 2201 METAL CUTTING AND MACHINE TOOLS

Course Objectives:

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

Course Outcomes:

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

- Imbibe the knowledge about types of tools, their specification, materials, forces, life and cutting fluids.
- Get acquainted with types, mechanisms and attachments of an engine lathe and can perform various operations on an engine lathe and capstan and turret lathes.
- Get awareness on details about and also working with boring machines, shaper, slotter and planer machines
- Get familiar with the types, parts and operations of drilling, grinding and milling machines.
- Get the knowledge about the finishing operations like lapping, honing and super finishing.
- Know the information about various Unconventional machining methods.

SYLLABUS

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

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

Machine tools using Multi Point Cutting Tools: Types and geometry of Drills, Milling Cutters and Grinding wheels; Specifications, Classifications, Constructional details, Operations, Cutting parameters, Machining time and Power calculations of

Drilling, Milling and Grinding machines; Indexing heads and methods; Method of specification, Selection, Loading, Glazing, Dressing and Trueing of Grinding wheels; Broaching types, tools, machines and Broach time.

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

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

Text Books:

1. Process and Materials of Manufacture, 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 Book publishers.
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

Course Objectives:

The main objectives of the course are

- 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.
- To impart the knowledge of cam profiles for desired motion.
- To make the students visualize the gear working, gear contact & interference.
- To comprehend different speed reductions of gear trains.
- Deals with balancing of rotating & reciprocating parts and also to understand various unbalanced systems & their balancing techniques.
- The study deals with linear, longitudinal, & torsional vibrations and also to familiarize the various types of vibrations and their response.
- Enable the students to formulate physical and mathematical models of Mechanical systems for Static and Dynamic Balancing and Vibration analysis.

Course Outcomes:

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

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

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

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

Toothed gearing: Classification of toothed wheels, technical terms, conditions for constant velocity ratio of toothed wheels- Law of gearing- Velocity of sliding of teeth, forms of 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.

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

Balancing of Rotating and Reciprocating Masses: Balancing of a single rotating mass in 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.

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.

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.

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

Course Objectives:

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

Course Outcomes:

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

SYLLABUS

Properties of Pure Substance: Definition of pure substance, phase change of a pure substance, p-T (Pressure-Temperature) diagram for a pure substance, p-V-T(Pressure-Volume- Temperature) surface, phase change terminology and definitions, property diagrams in common use, formation of steam, important terms relating to steam formation. Thermodynamic properties of steam and steam tables, external work done during evaporation, internal latent heat 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 Mollierdiagram. Rankine cycle- Modified Rankine cycle.

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

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

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.

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.

Reference Books:
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

Course Objectives:

- To know management practices in industry
- To acquire capacity to handle industrial disputes
- To know much about production activities and to improve productivity
- To learn the work study procedures and quality concepts to get more productivity

- To have exposure on some maintenance practices in industry.

Course Outcomes:

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

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.

Text Book:

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

Reference Books:

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

Course Objectives:

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

Course Outcomes:

Students are able to

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

SYLLABUS

Introduction to Mechanical engineering design: traditional design methods, different design models, Problem formulation, Design considerations, engineering materials and

processes and their selection, BIS designation of steels, Mechanical properties, Load determination,manufacturing considerations in design.

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

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

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

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

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

Text 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

Course Objectives:

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

Course Outcomes:

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

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.

MC 2207 MANUFACTURING TECHNOLOGY-II LABORATORY

Course Objectives:

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

Course Outcomes:

- The student will be in a position to measure the tool tip temperature and the cutting forces during machining.
- The student will be in a position to fabricate a single point cutting tool and to measure the tool angles

- The student will be in a position to measure the drilling forces.
- The student will be in a position to measure the surface roughness.
- The student will be in a position to measure the chip details.
- The student will be in a position 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

MC 2208 COMPUTER AIDED MODELLING

Course Objective:

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

Course Outcomes:

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

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

List of Experiments:

1. Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs, dimensioning types, lines and rules of dimensioning

2. Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned

3. Popular forms of Screw threads, bolts, and nuts

4. Protected Flange Coupling

5. Cotter joint and knuckle joint

6. Riveted joints for plates

7. Spigot and socket pipe joint
8. Journal bearing and foot step bearing
9. Part modelling & views
10. Assembly of stuffing box
11. Assembly of Universal coupling
12. Assembly of screw jack
13. Assembly of engine connecting rod and piston assembly
14. Assembly of feed check valve
15. Drafting of assembled components showing various views and sections
16. Assembly of Toolpost
17. Assembly of Tailstock
18. Assembly of Eccentric

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

MC 2209 ENVIRONMENTAL SCIENCE

Course Objectives:

The objectives of the Environmental Science course are to

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

Course Outcomes:

After completion of the course the students will have

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

SYLLABUS

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

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

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

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

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

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

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

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

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

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

Text Books:

1. 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.