ESC 101	Engineering Graphics &Visualization	3L: 0T: 2P (05 hrs)	Credits:04

Pre requisite(s): Nil

Course Objective's:
- To know about Basics of dimensioning ,Lettering& representation of lines, different types of lines & use of different types of pencils in an Engineering Drawing
- To know about different types of projection & to know projection of points, straight lines.
- To know about projection of plane & solids.
- To know section & development of lateral surface of different solids.
- To know about isometric projection. To learn Auto CAD.

Course Content:

Module 1   **(10 hrs)**
Introduction: Need & Classification of Engineering Drawings, Drawing Instruments and their uses, Indian Standards for Drawing, Drawing Sheet Layout, Various conventions used in drawing as per BIS norms, Technical Lettering, Dimensioning, Basic Geometrical Constructions.
Scales: Engineering scale, graphical scale, plain scale, diagonal scale, comparative scale, scale of chord.
Geometric Constructions and Engineering Curves: Division of lines, curves, angles and other simple construction elements. Conic sections parabola, ellipse and hyperbola. Spiral, Involute and Cycloidal curves.

Module2   **(08 hrs)**
Orthographic Projections: Drawing orthographic projections from pictorial Projections, By using first angle projection method.
Projection of Point: Including points in all four quadrants
Projection of Lines: Line parallel to reference plane, perpendicular to reference plane, inclined to one reference plane, inclined to both reference planes, traces of line.

Module3   **(12 hrs)**
Projection Plane Surfaces: Projections of planes parallel to one of the reference planes, Projections of planes inclined to one reference plane and perpendicular to the other & Projections of oblique planes, Auxiliary planes.
Projection of Solids: Classification of solid, Projections of solids in simple and complex positions of the axis.

Module 4   **(10 hrs)**
Section of Solids: Sectional views and true shape of the section.
Development of Surfaces: Methods of developments, development of various solids, transition pieces, spheres.
Interpenetration of Solids: Interpenetration of geometrical solids Like Two prisms, two cylinders.

Module 5   **(08 hrs)**
Isometric Projections: Isometric view, Isometric scale to draw Isometric projection, Non Isometric lines, construction of isometric view from given orthographic views and to construct Isometric view of a Pyramid, Cone, Sphere.

Auto CAD: Introduction to Computer Aided Drawings, Drawing of Machine elements like Riveted Joints, Screw fasteners and Welded Joints in Auto CAD.

Course Outcomes:

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

1. Read and write the language of Engineering Graphics to study its basic theory and to be familiar with its accepted conventions and abbreviations.
2. Prepare neat orthographic drawings of points, straight lines, and regular planes and solids.
3. Prepare neat drawings of projection of regular planes and solids.
4. Understand application of section, development and penetration of solids.
5. To be able to plan and prepare neat isometric drawings of regular planes and solids and hands on practice on Auto CAD.

List of Text Book:

1. Bhatt N D, Engineering Drawing, Charoter Publishing House, Anand, Gujrat ,53rd Edition. 2014
2. Agrawal B, and Agrawal C M, Engineering Drawing, Tata McGraw-Hill Publishing Company Limited. 3rd Edition, 2019
3. Dhawan R.K. Engineering Drawing, S. Chand Publication.2012

List of References Book:

1. French T E, Vierck C J, Foster R J, Engineering. Drawing and Graphic Technology Mc Graw-Hill International, Singapore, 4th Ed., McGraw Hill,1984
2. Luzadder W J, Duff J M, Fundamentals of Engineering Drawing, Prentice- Hall India, New Delhi. Eleventh Edition, 1983.
3. Dhananjay A Jolhe, Engineering drawing, Tata McGraw Hill. 2017
4. Shah M B and Rana B C , Engineering Drawing, Pearson Education, New Delhi.2nd Edition, 2019

List of Experiment:

Preparation of drawing sheets containing the drawings for topics covered in theory.

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ESC 202	Basic Mechanical Engineering & Manufacturing Practices	3L:1T: 2P (05 hrs)	Credits:04

Prerequisite (s): 10+2 Level Physics, Chemistry

Course Objective:
To introduce and learn various aspects of Mechanical Engineering discipline and its applications to society and to inspire students to take up Mechanical Engineering as a career.

Course Content:
Module 1   **(08hrs)**
Materials: Classification of engineering material, Composition of Cast iron and Carbon steels, Iron Carbon diagram. Alloy steels their applications. Mechanical properties like strength, hardness, toughness, ductility, brittleness, malleability etc. of materials, Stress-strain diagram of ductile and brittle materials, Hooks law and modulus of elasticity, Introduction to UTM.

Module 2   **(10hrs)**
Production Engineering: Elementary theoretical aspects of production processes like casting, carpentry, welding, Black smithy, fitting, Introduction to Lathe and Drilling machines and their various operations. Concept of measurements, errors in measurement, Temperature, Pressure, Velocity, Flow strain, Force and torque measurement, Vernier caliper, Micrometer, Dial gauge, Slip gauge, Sine-bar and Combination

Module 3   **(10 hrs)**
Fluids and Thermal Science: Fluid properties. Types of fluids , Newton's law of viscosity , Pascal's law, Bernoulli's equation for incompressible fluids, Only working principle of Hydraulic machines, Thermodynamic system, properties, state, process, zeroth's, first and second law of thermodynamics.

Module 4   **(08hrs)**
Power Engineering: Classification and working of boilers, mountings and accessories of boilers, Efficiency and performance analysis, formation of steam & its properties, Working of Two stroke & Four stroke Petrol & Diesel engines.

Module5   **(8Hrs)**
Industrial Engineering and Automation: Introduction to product design, linear programming problem formulation, Break-even analysis, Introduction to forecasting, Ergonomics, Basic concepts of CAD/CAM.

Course Outcomes:
After completion of the course, the students are able to:
1. Define the Engineering Material, Properties and applications and list the various test on materials by UTM.
2. Demonstrate the working of different measuring instruments and to introduce various manufacturing processes.
3. Identify the Fluid properties, its laws and understand the basic concept of first and second Law of Thermodynamics.
4. Evaluate and analyze performance characteristics of Boilers.
5. Identify product design and significance of Ergonomics and able to perform break even analysis; understand significance of automation in manufacturing.

List of Text Book:
1. Basic Mechanical Engineering, by C.M. Agrawal, Basant Agrawal, Publisher: Wiley 2008.
2. Basic Mechanical Engineering by Sadhu Singh, Publisher : S Chand 2009

List of Reference Book:
1. Kothandaraman & Rudramoorthy, Fluid Mechanics & Machinery, New Age, 2007 .
2. Nakra & Choudhary , Instrumentation and Measurements, TMH,2003
3. Nag P.K, Engineering Thermodynamics, TMH, 2010.
4. Ganesan , Internal Combustion Engines, TMH , 2008
5. M.I. Khan, Industrial Engineering, New Age International, 2004

List of Experiment:
1. To perform a tensile test on UTM.
2. To prepare a job in a carpentry & fitting Shop.
3. To prepare a job in black smithy and welding shop.
4. To verify Bernoulli's Theorem using Bernoulli's apparatus
5. Study of Boilers, their Mounting and Accessories.
6. Study of Two and Four Stroke SI Engine.
7. Study of Two and Four Stroke CI Engine.
8. To perform Break Even Analysis of a case study.

HSMC-ME301	Industrial Psychology and Human Resource Management	03L;0T;0P (03 Hrs)	Credits: 03

Course objective: This course equips students with human resource management skills to be able to function effectively in their professional career

Course Content:

Unit I
Introduction & Overview of the course, Changes/Challenges in HRM, Management Theories, Research Methodology & Statistical Tools, Management of Change.

Unit II
Organizational Culture & Climate, Knowledge Productivity, New Leadership Motivation Theories.

Unit III
Talent Management, Training & Development, Performance Management.

Unit IV
Selection & Recruitment, Compensation, Unions, Entrepreneurship.

Suggested Readings
1) Personality and Organization., Argyris C.
2) The Essence of Leadership, Locke, Edwin A.
3) Organisational Behaviour, Robbins S
4) Managing Human Resources, Bach, S. 2005
5) Human Resource Management: A Contemporary Approach, Claydon, T and J. BeardwellFolger, R. and R.

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PCC-ME301	Material Science	2L: 1T: 2P (05hrs)	Credits:04

Prerequisite(s): Basics of organic chemistry

Course Objective's:
- Materials engineering is concerned with the use of fundamental and applied knowledge of materials.
- To know the change of crystal structure of different materials and its application.
- To understand different materials and its uses in different application.

Module 1   **(09 hrs)**
Crystallography: Atomic structure, crystal structure, miller indices, crystal defects, diffusion of solid, Dislocation, Edge dislocation, Screw dislocations, Slip planes. Stress fields of dislocations. Grain size, grain boundaries, dislocation densities, Dislocation and crystal growth.

Module 2   **(09 hrs)**
Equilibrium Diagram: Various types of phase diagrams, Allotropy structure of alloys, Lever rule, phase rule, Cooling curves, Iron carbide equilibrium diagram, Types of Cast Iron. Types of Stainless Steels, TTT diagram, CCT diagram, Heat treatment of steels and alloys, Hardening, Hardenability, Surface hardening of Steel, Defects in heat treated Parts, Strengthening mechanisms, Corrosion and its prevention.

Module 3   **(07 hrs)**
Destructive and Non- Destructive Testing: Tensile test, Compression test, shear test, bend test, Different types of Hardness tests, Impact tests, Fatigue tests, Hardenability test, NDT Methods – LPI, MPI , Ultrasonic test, Radiography test, Eddy current test.

Module 4   **(08 hrs)**
Fracture Mechanics and Powder Metallurgy: Fracture mechanics: ductile fracture, brittle fracture, ductile to brittle transition, crack propagation, Griffith Theory, fatigue fracture mechanics, Powder production methods, powder conditioning, sintering, testing of PM components.

Module 5   **(06 hrs)**
Modern Materials: Introduction, classifications of nanomaterials, Methods for creating nanostructures, Properties of nanomaterials, Applications of nanomaterials, Introduction to Rubbers & Elastomer, Introduction to Composite materials.

Course Outcomes:
After completion of this course, the students are able to:
1. Appreciate various crystal structure, miller indices and dislocations.
2. Understand the changes in phases of alloys, cooling curves and heat treatment of metals changes their properties.
3. Perform of various methods available for testing of metals destructively and non-destructively.
4. Understand fracture mechanics and powder metallurgy.
5. Know about various modern materials and significance.

List of Text Book:
1. William D. Calister "Materials Science and Engineering", "Wiley", "Second edition".
2. V Raghvan "Materials Science and Engineering" "PHI Publication" "Sixth Edition".
3. G.E. Dieter "Mechanical metallurgy" "TMH Publication" "Third Edition".

List of Reference Book:
1. William F Smith "Materials Science and Engineering" TMH publication "Fifth Edition".
2. U C Jindal, Materials Science and metallurgy" Pearson Publication" First Edition"
3. Prashant Kumar "Elements of Fracture Mechanics" TMH Publication" First edition"
4. T Pradeep "A text book of Nanoscience and nanotechnology" TMH Publication" First Edition"

List of Experiment:
1. To study the Erichsen sheet metal testing machine & perform the Erichsen sheet metal test
2. Preparation of specimen for Metallographic examination and Metallographic study of given specimen through metallurgical microscope.
3. To study hardness as a function of quench rate and investigate the hardenability of steels by Jominy End Quench Apparatus.
4. To gain experience with and understanding of the types, advantages and applications of various NDT methods. To be able to choose the best NDT method for a given part and perform Test on UFD machine.
5. To determine carbon and sulphur contents in iron and steel by Strohlein's Apparatus.
6. Study of Annealing process of heat treatment and its effect on microstructure and Mechanical Properties.

Virtual Lab Experiment:
1. Material Response to Microstructural, Mechanical, Thermal and Biological Stimuli Lab
2. Microstructural analysis of Stainless Steel
3. Comparison between Mild Steel and Grey Cast Iron
4. Severity of Quenching

PCC-ME302	Manufacturing Processes	2L: 1T: 2P (05 hrs)	Credits:04

Pre requisite(s): Nil

Course Objective's:
- Get the knowledge of Foundry
- Know various Joining process
- Understand the Forging and Rolling process
- Understand the sheet metal process
- Understand the machine tools, mechanisms and accessories

Module 1 (10 hrs)
Foundry –Pattern Making, Moulding and Casting: Types of patterns, Pattern and pattern making, pattern allowances; pattern design considerations, core, core boxes .Types of casting process .Molding and Foundry core sands and their properties, runners, risers, solidification, defects and elimination, molding machines, centrifugal casting, dye casting, shell molding; Lost wax molding; continuous casting gating and gating design. Cupola, electric arc and induction furnaces description and operation.

Module 2 (10 hrs)
Joining Process: Types of welding ,Gas welding method, flames, gas cutting, Electric arc welding, AC and DC welding machines and their characteristics, flux, electrodes, submerged arc welding, TIG & MIG welding; pressure welding; electric resistance welding spot, seam and butt welding; EBW and LASER welding. Thermit chemical welding; brazing and soldering, welding defects & remedies, safety precautions. Printed circuit board design.

Module 3 (08 hrs)
Forging and Rolling: Types of forging operations theory and application of forging processes description; drop and horizontal forging machines. Forging design, Types of Rolling operations, General description of machines and process; rolling of structural section plates and sheets; hot and cold rolling techniques.

Module 4 (08 hrs)
Press Working: Description and operation of processes, process of shearing, punching, piercing, blanking, trimming, perfecting, notching, lancing, embossing, coining, bending, forging and drawing; press, tool dies, auxiliary equipment, safety devices, stock feeders, scrap cutters, forces, pressure and power requirements .

Module 5 (08 hrs)
Metal Machining: Basics of Lathe machines, operations & components, working principle of shaper & planner, Introduction to milling, grinding and drilling machines. Introduction to additive manufacturing.

Course Outcomes:
After completion of this course, the students should be able to:
1. Develop the basic knowledge of Foundry
2. Understands the knowledge of joining process
3. Understand the Forging and Rolling process.
4. Identify the sheet metal Process
5. Develop the basic knowledge of machine and manufacturing processes.

List of Text Book:
1. Raghuvanshi; Workshop Technology; Dhanpat Rai.
2. P.N Rao : Production technology Volume I&II : TMH
3. Anderson and Tetro; Shop Theory; Mc Graw Hills

List of References Book:
1. Kaushish JP; Manufacturing Processes; PHI Learning.
2. Kalpakjian Producting Engineering PEARSON Education
3. Chapman; Workshop Technology
4. Philip F Ostwald ; Manufacturing Process & systems : John Wiley

List of Experiment:
1. Plain and Taper turning – one job
2. Wooden pattern - one job
3. Mold making (green sand mould) – one job
4. Welding (gas or arc) – one job
5. PCB Making -one job

PCC-ME303	Strength of Materials	2L:1T:2P (05 hrs)	Credits:04

Pre requisite(s): Engineering Mechanics

Course Objective's:

- To establish an understanding of the fundamental concepts of mechanics of deformable solids; including static equilibrium, geometry of deformation, and material constitutive behavior.
- To provide students with exposure to the systematic methods for solving engineering problems in solid mechanics.
- To discuss the basic mechanical principles underlying modern approaches for design of various types of structural members subjected to axial load, torsion, bending, transverse shear, and combined loading.

Module 1 (10 hrs)

Stress and Strain: stresses in members of a structure, axial loading, normal stress, shear stress, analysis of simple structures, stepped rods, members in series and parallel: stress strain diagram, Hooke's law, stress due to temperature, Poisson's ratio, Bulk modulus, shear strain, relation among elastic constants, residual stress, fiber reinforced composite materials, strain energy under axial loads and stresses due to impact of falling weights.

Module 2 (09 hrs)

Transformation of Stress and Strain, principal stresses, normal and shear stress, Mohr's circle and its application to two and three dimensional analysis. Thin Pressure vessel, hoop stress, longitudinal stress and radial stress.

Module 3 (11 hrs)

Bending: Pure bending, symmetric member, deformation and stress, bending of composite sections, eccentric axial loading, shear force and BM diagram, relationship among load, shear and BM, shear stresses in beams, strain energy in bending, deflection of beams, equation of elastic curve, Macaulay's method and Area moment method for deflection of beams.

Module 4 (08 hrs)

Torsion in Shafts: Tensional stresses in shafts, deformation in circular shaft, angle of twist, stepped and hollow transmission shafts, combined bending and torsion.

Module 5 (10 hrs)

Theories of Failures: maximum normal stress & shear stress theory; maximum normal and shear

Strain energy theory, maximum distortion energy theory; application of theories to different materials and loading conditions.

Columns & Struts: Buckling of columns, Euler's formula for columns with different end conditions and Rankine's formula.

Course Outcomes:

After completion of this course, the students are able to:

1. Illustrate the deformation of material under load by various approaches.
2. Evaluate the principal stresses.

3. Analyze the deformations of beam within elastic limit against bending.
4. Analyze and identify the deformation of rotating element within elastic limit.
5. Apply and analyze various theories of failures for different materials and evaluate the stresses in columns under buckling.

List of Text Book:
1. Ramamurtham, Strength of Materials, Dhanpat Rai Publication
2. S. S. Rattan, Strength of Materials, Tata McGraw Hill Publication
3. R. K. Rajput, Strength of Materials, S. Chand Publication

List of Reference Book:
1. R. C. Hibbeler, Mechanics of Materials, Pearson Education
2. Sadhu Singh; Strength of Materials; Khanna Pub
3. Beer and Johnston, Mechanics of Material, Mc Graw Hill publication
4. J.B. Popov, Introduction to Mechanics of Solids, Prentice – Hall publication
5. F. L. Singer and Pytel, Strength of Material, Harper and Row publication

List of Experiment:
1. To Study The Universal Testing Machine (U.T.M.)
2. To perform tensile test on Universal Testing Machine.
3. To determine Impact strength of steel by Izod test.
4. To determine Impact strength of steel by Charpy test.
5. To determine Hardness of Mild Steel (Rockwell Hardness Test).
6. To determine Hardness of Mild Steel (Brinell Hardness Test).
7. To determine Hardness of Mild Steel (Vicker's Hardness Test).
8. To determine Modulus of rigidity by torsion test of mild steel and aluminum rod.
9. To determine .Modulus of Elasticity of different materials of beam simply supported at ends.
10. To perform Shear test on Mild Steel.

PCC-ME304	Thermodynamics	2L:1T:2P (05hrs)	Credits:04

Pre requisite(s): Nil

Course Objective's:
- Apply conservation principles to evaluate the performance of thermodynamics systems and cycles.
- Analyze processes and cycles using the second law of thermodynamics to determine maximum efficiency and coefficient of performance.
- Evaluate thermodynamic properties of pure substances.

Course Content:

Module 1 (08 hrs)
Basic Concepts & First Law of Thermodynamics: Thermodynamics, Property, Equilibrium, State, Process, Cycle, Zeroth law of thermodynamics statement and significance, Heat and work transfer. First law of thermodynamics- Statement of first law of thermodynamics, first law applied to closed system, first law applied to a closed system undergoing a cycle, processes analysis of closed system, flow process, flow energy, steady flow process, Relations for flow processes, limitations of first law of thermodynamics.

Module 2 (09 hrs)
Second Law of Thermodynamics: heat engine, heat reservoir, Refrigerator, heat pump, COP, Available energy, Carnot's theorem, Carnot's cycle, efficiency of Carnot's cycle, statement of second law Reversible and irreversible processes, consequence of second law, Entropy, Entropy change for ideal gas, T-S diagrams, Availability and Irreversibility.

Module 3 (08 hrs)
Real & Ideal Gases: Deviation with ideal gas, Vander-wall's equation, evaluation of its constants, limitations of the equation. Generalized, compressibility chart, P-V-T surface of a Real gas, Thermodynamics relations T-ds Equations, Maxwell relations and their applications. Gibbs and Helmholtz functions.

Module 4 (09 hrs)
Pure Substance: Phase, Phase-transformations, formation of steam, properties of steam, PVT surface, HS,TS,PV,PH,TV diagram, processes of vapor measurement of dryness fraction, Use of steam table and Mollier chart with Numerical Problem.

Module 5 (07 hrs)
Air standard cycles: Carnot, Otto, Diesel, Dual cycles and there comparison with P-V And T-S Diagram, two stroke and four stroke engines, non reactive gas mixture, PVT relationship, mixture of ideal gases, properties of mixture of ideal gases, internal energy, Enthalpy and specific heat of gas mixtures, Enthalpy of gas- mixtures.

Course Outcomes:
After completion of this course, the students are able to:
1. Explain the concepts of thermodynamics and analyze the different applications of first law of thermodynamics.

2. Evaluate entropy change in wide range of processes and determine the reversibility or irreversibility of a process from such Calculation.
3. Understand the various thermodynamic Equation and their Significance
4. Evaluate various properties of a steam with the help of steam table and Mollier charts.
5. Compare the different types Air standard cycles and explain the behavior of Ideal and Real gases mixture.

List of Reference Book:
1. P. K. Nag; Engineering Thermodynamics;TMH
2. Van GJ; Thermodynamics; JohnWylen
3. CengelY; Thermodynamics;TMH
4. Arora CP; Thermodynamics;TMH
5. Mahesh M Rathore; Thermodynamics;TMH
6. Thermal Engineering by RYadav
7. Engineering Thermodynamics by Omkar Singh New AgeInternational.

List of Experiment:
1. Study of Boiler terminology and their Classification.
2. Study of working Low Pressure Boilers with demonstrate model.
3. Verify Joule's Experiments on Mechanical Equivalent of Heat.
4. Study of Temperature Measuring devices.
5. To Calculate the dryness fraction of Steam using Combined separating Throttling calorimeter
6. Determine the COP of Simple Vapour Compression Refrigeration System.
7. Find the calorific value of fuel by using Bomb Calorimeter.
8. Study of valve timing diagram for two and four stroke engines.

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MC-3	Energy & Environmental Engineering	2L;0T;0P	Credits: 00

Course Objective's:
To provide an introduction to energy resources and an emphasis on alternative energy sources and their application. To study the interrelationship between the living organism and environment. To understand the transformation and degradation of organic pollutants in the environment

Course Content:

MODULE 1 (06 Hrs)
Energy:Introduction, conventional and non-conventional energy resources - coal, oil, gas, solar energy, wind energy,geothermal energy, Hydropower, Bio-energy, Nuclear energy. Energy survey in India. Current and futureenergy requirements in India and across the world including associated environmental problems.

MODULE 2 (08 Hrs)
Ecosystem and Biodiversity: Introduction of an ecosystem, Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, rivers, oceans),Biodiversity at global, national and local levels. Threats to bio diversity,Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic andoption values; Endangered and endemic species of India. Conservation of biodiversity: In-Situ and Ex-Situ.

MODULE 3 (08 Hrs)
Air pollution and Water Pollution: Definition, Cause, effects and control measures of Air pollution;Mobile and stationary sources of air pollutants,effective stack height concept, CO, CO_2, H_2S, SO_x, NO_x emissions, and its control. Definition, Classification, Cause, effects and control measures of water pollution, Measurement of levels of pollution such as DO, BOD, COD.

MODULE 4 (06 Hrs)
E-Waste: Definition, Classification, Cause, effects and control measures of e-waste, global trade issues of e-waste, Recycling method of e-waste & its benefit.

MODULE 5 (08 Hrs)
Environment Impact & Protection ActEnvironment: Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation; Public awareness. Environmental Impact Assessment. Measuring environmental impacts and policies for the regulation of environmental impacts.

Course Outcome-
CO 1: Ability to understand basic concepts conventional and non-conventional energy resources.
CO2: Ability to understand Ecosystem& Biodiversity.
CO3: To provide knowledgeabout Air pollution & Water Pollution.
CO4: To provide knowledge & reuse of E-Waste.
CO5: Ability to understand basic concepts of Environment Impact & Protection Act.

Text/Reference Book-

1. Environmental Engineering - H.S. Peavy & D.R. Rowe-Mc Graw Hill Book Company, New Delhi
2. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai,
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.
5. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards', Vol I and II, Enviro Media (R)

BSC- ME401	Numerical Methods, Probability and Transform Calculus Engineering	3L:1T:0P (4 Hrs)	4 Credits

Course Objectives: The objective of this course is to fulfill the needs of mechanical engineers to understand the applications of Numerical analysis, Transform calculus and Statistical techniques in order to acquire mathematical knowledge and to solve a wide range of practical problems appearing in mechanical engineering.

Course Content:
Module-1: Numerical Methods - I (09 Hours)
Solution of algebraic and transcendental equations: Regula - Falsi method, Newton-Raphson method, Finite difference operators, Relations between finite difference operators, Interpolation using Newton's forward and backward difference formulae, Interpolation with unequal intervals: Newton's divided difference formula, Lagrange's formula.

Module-2: Numerical Methods - II (09 Hours)
Numerical differentiation, Numerical integration: Trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rules, Solution of simultaneous linear algebraic equations: Gauss-Jordan, Crout's factorization, Gauss–Jacobi, Gauss–Seidal method.

Module-3: Numerical Methods - III (09 Hours)
Solution of first order ordinary differential equations: Euler's method, Euler's modified method, Runge – Kutta method, Milne's predictor – corrector method, Solution of partial differential equations: Finite difference solution of Laplace and Poisson's equations.

Module-4: Fourier Series & Laplace Transform (10 Hours)
Fourier series, Fourier series for even and odd functions, Half-range Fourier series, Laplace transform, Properties of Laplace transform, Inverse Laplace transform by different methods, Convolution theorem, Evaluation of integrals by Laplace transform, Solving ordinary differential equations by Laplace transform.

Module-5: Concept of Probability (08 Hours)
Probability mass function, Probability density function, Discrete distribution: Binomial distribution, Poisson's distribution, Continuous distribution: Normal distribution, Exponential distribution.

Course Outcomes:
After completion of this course, students will be able:
CO1: To identify and apply the mathematical tools for solution of equations and interpolation in different practical problems of Mechanical engineering.
CO2: To recognize and solve differentiation, integrations and system of equations numerically in different problems of Mechanical branch.
CO3:   To understand and solve ordinary and partial differential equations numerically.
CO4: To recognize and apply the concept of Fourier series and Laplace transform in engineering problems.
CO5: To identify and apply the concept of probability in different engineering problems.

Textbooks/References:
1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th Edition, 2018.
2. S. R. K. Iyenger, R. K. Jain, Numerical Methods, New Age International Publisher, 1st edition, 2020.

3. R. W. Hamming, Numerical Methods for Scientist and Engineers, Dover Publications, 2nd edition, New York, 2016.

4. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd edition, 2012.

5. Chandrika Prasad & Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Co. (P) Ltd., Delhi, 2018.

6. B. V. Ramanna, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 2017.

7. S. Ross, A First Course in Probability, Pearson Education India, 9th Edition, 2019.

8. D. C. Montgomery and G. C. Runjer ,Applied Statistics & Probability for Engineers, Wiley Publication, 6th edition.

9. N.P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications, 9th edition, 2016.

10.P. G. Hoel, S. C. Port, C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003.

PCC-ME401	Machine Drawing	2L:1T :2P (05hrs)	Credits:04

Pre requisite(s): Engineering Graphics

Course Objective's:
Enable the students to prepare a detailed assembly drawing for machine components.

Course Content:

Module 1 (10 hrs)

Drawing conventions; drawing and dimensioning IS codes, sectional views and sectioning, representation of machine parts such as external and internal threads, slotted heads, square ends, and flat radial ribs, slotted shaft, splined shafts, bearings, springs, gears, surface finish and tolerances, Rivet heads and Riveted joints, types of welded joints and representation. Drawing of threaded fasteners.

Module 2 (20 hrs)

Assembly Machine Drawing, Basic concept of assembly drawing ,bill of materials, Assembly drawing of Cotter and Knuckle joints, pedestal and footstep bearings, Engine parts- crosshead and stuffing box, IC engines parts - piston and connecting rods; lathe machine parts-Tool post and Tail Stock.

Module 3 (10 hrs)

Basic design concepts, design process, stages/phases in design, flowchart, problem formulation, design considerations (strength, manufacturing, maintenance, environment, economics and safety); design for recycle and reuse, Design and safety factors for steady and variable loads, impact and fatigue considerations, reliability and optimization, standardization in design.

Module 4 (10 hrs)

Limits, Fit and Tolerances: Basics of Limits, Fit and Tolerances, Introduction, Importance, Conventions, concept of standardization and applications.

Course Outcomes:
After completion of this course, the students are able to:
1. Understand Indian standards for machine drawing.
2. Use drawing conventions for machine drawing.
3. Prepare assembly drawing of joints, couplings and machine elements.
4. Understand basic design concepts and considerations for machine design.
5. Conceptualize

List of Text Book:
1. "Machine Drawing, N.D. Bhatt", "Charotar", "Edition of Year" .
2. "Machine Drawing, Singh A", "Charotar", "TMH"
3. "Machine Drawing, Narayana and Reddy", "New age, Delhi", "Edition of Year"
4. "Mechanical Engineering Design, Shigley JE et al", "TMH", "Edition of Year"
5. "Machine Design, Kulkarni SG", "TMH", "Edition of Year"
6. "Machine Design, Sharma PC, Agarwal DK", "Katson
7. "Design data book, PSG
8. "Mechanical design data book, Mahadevan and Reddy"

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List of Reference Book:
1. "Machine Design, Mubeen and Mubeen",
2. "Design of Machine elements, Bhandari VB", "TMH".

List of Experiment:
1. To draw the conventional symbols used in machine drawing.
2. To draw the orthographic projections of the given pictorial view of the mechanical components.
3. To assemble and draw full sectional Elevation, Plan and Bill of Material of Cotter joint.
4. To assemble and draw full sectional Elevation, Plan and Bill of Material of Knuckle joint.
5. To assemble and draw full sectional Elevation, Plan and Bill of Material of Foot-Step Bearing.
6. To assemble and draw full sectional Elevation, Plan and Bill of Material of Plummer Block.
7. To assemble and draw full sectional Elevation, Plan and Bill of Material of Cross Head.
8. To assemble and draw full sectional Elevation, Plan and Bill of Material of Stuffing Box.
9. To assemble and draw full sectional Elevation, Plan and Bill of Material of Connecting Rod.
10. To assemble and draw full sectional Elevation, Plan and Bill of Material of Tool Post.

PCC-ME402	Applied Thermodynamics	2L: 1T:2P (05 hrs)	Credits:04

Prerequisite (s): Thermodynamics

Course Objective's:
This course aims to provide a good platform to mechanical engineering students to apply basic knowledge of thermodynamics & concept of dynamics involved in thermal energy transformation.

Module 1 (08 hrs)
Steam Generators: classification, conventional boilers, high-pressure boilers like Lamont, Benson, performance and rating of boilers, equivalent evaporation, boiler efficiency, heat balance sheet, combustion in boilers, super critical boilers, fuel and ash handling, boiler draught, overview of boiler codes.

Module 2 (09 hrs)
Phase Change Cycles: Vapor Carnot cycle and its limitation, Rankine cycle, effect of boiler and Condenser pressure and superheat on end moisture and efficiency of ranking cycle, modified Rankine cycle, reheat cycle, perfect regenerative cycle, Ideal and actual regenerative cycle with single and multiple heaters, open and closed type of feed water heaters, regenerative-reheat cycle, supercritical pressure and binary-vapor cycle, work done and efficiency calculations.

Module 3 (10 hrs)
Steam Turbines: impulse staging, velocity and pressure compounding, utilization factor, analysis for optimum U.F Curtis stage, and Rateau stage, include qualitative analysis, effect of blade and nozzle losses on vane efficiency, stage efficiency, analysis for optimum efficiency, mass flow and blade height. Reactions staging: Parson's stages, degree of reaction, nozzle efficiency, velocity coefficient, stator efficiency, carry over efficiency, stage efficiency, vane efficiency, conditions for optimum efficiency, speed ratio, axial thrust, reheat factor in turbines, problem of radial equilibrium, free and forced vortex types of flow, flow with constant reaction, governing and performance characteristics of steam turbines.

Module 4 (08 hrs)
Air Compressors: Working of reciprocating compressor, work input for single stage compression different, compression processes, effect of clearance, volumetric efficiency real indicator diagram, isentropic & isothermal and mechanical efficiency, multistage compression, inter- cooling, condition for minimum work done, classification and working of rotary compressors.

Module 5 (10 hrs)
Steam Condensers: Introduction, types of condensers, back pressure and its effect on plant performance air leakage and its effect on performance of condensers, various types of cooling towers, design of cooling towers.
Steam Nozzles: Steam Nozzles and their types, isentropic flow of vapors, flow of steam through nozzles, condition for maximum discharge, Effect of friction, super-saturated flow.

Course Outcomes:

After completion of this course, the students are able to:

1. Demonstrate the knowledge of operating characteristics of steam generator and their working performance.
2. Recognize the Rankine cycles and their types on pressure - volume and Temperature – Entropy diagram and evaluate their efficiencies.
3. Evaluate the performance of various steam turbines and their staging.
4. Explain the working of various types of air compressors and evaluate their performance.
5. Evaluate the Performance of steam condenser, steam nozzle and cooling towers.

List of Reference Book:

1. Nag PK; Power plant Engineering;TMH
2. Thermodynamics by Gordon J. VanWylen
3. P.K.Nag; Basic and applied Thermodynamics;TMH
4. Mahesh M Rathore; Thermodynamics TMH
5. Ganesan; Gas turbines;TMH
6. Heat Engines by V.P. Vasandani& D. S.Kumar
7. R. Yadav Steam and GasTurbines
8. Kadambi&Manohar;anIntroductiontoEnergyConversion–VolII.Energyconversioncycles

List of Experiment:

1. Study of Boiler draught and their classification.
2. Study of Subcritical boiler with demonstrate model.
3. Study of Supercritical boiler with demonstrate model.
4. Numerical Problem Based on Heat balance sheet for a Boiler.
5. To Determine the Volumetric efficiency of a single acting, double stage reciprocating air compressor.
6. To Determine the Nozzle coefficient of the given Nozzle meter.
7. To Determination of efficiency of condenser.
8. Numerical Problem Based on Steam Power Plant (Rankine Cycle).
9. Determination of airflow in duct and pipes.
10. Industrial Visit of Thermal power plant.

PCC-ME403	Fluid Mechanics	02L:01T:02P (05 hrs)	Credits: 04

Prerequisite(s): Basic Mechanical Engineering, Engineering Mathematics.

Course Objective's:
- To understand the fundamentals of fluid properties and to develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body.
- To be able to apply fundamental knowledge of fluid flow and behavior under various conditions.
- To understand different fluid flow principles and to deduct expression for energy and momentum equations.
- To develop and interpret for flow of fluids and solve fundamental pipe network problems.
- To be able to experiment with the behavior of fluid and boundary layer theory under various conditions.

Course Content:
Module 1   **(08 hrs)**
Introduction: fluid and the continuum, fluid properties, surface tension, bulk modulus and thermodynamic properties, Newton's laws of viscosity and it's coefficients, Newtonian and non Newtonian fluids, hydrostatics and buoyancy, metacenter and metacentric height, stability of floating bodies.

Module 2   **(10 hrs)**
Fluid Kinematics: Langragian and Eularian method, description of fluid flow, stream line, path line and streak line, types of flow and types of motion, local and connective acceleration, continuity equation, potential flow, circulation, velocity potential, stream function, Laplace equation, flow nets.

Module 3   **(10 hrs)**
Fluid Dynamics: system and control volume, Reynold's transport theorem, Euler's equation, Bernoulli's equation & applications, momentum and moment of momentum equation, their applications, forces on immersed bodies, lift and drag,
Dimensional Analysis: Buckingham Pi and Rayleigh method, Kinematic and dynamic similarities and dimensionless numbers and their significance.

Module 4   **(08 hrs)**
Flow through Pipes: Reynold's number, laminar and turbulent flow, viscous flow through parallel plates and pipes, pressure gradient, head loss in turbulent flow (Darcy's equation), friction factor, minor losses, hydraulic and energy gradient, pipe networks. Basics of compressible fluid flow.

Module 5   **(12 hrs)**
Boundary Layer Theory: Introduction
Turbulent Boundary Layer: Two-dimensional equation; Prandtl's mixing layer theory; Karman's hypothesis; Universal velocity distribution; flow over a flat plate; skin friction drag.
Thermal Boundary Layer: Two-dimensional equations; forced and natural convection over flat plate; natural convective flow over a vertical plate; effect of Prandt'l number.

Course Outcomes:

After completion of this course, the students are able to:

1. Define the fundamentals of fluid properties and to develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body.
2. To apply fundamental knowledge of fluid flow and behavior under various conditions.
3. Illustrate different fluid flow principles and to deduct expression for energy and momentum equations.
4. Develop and interpret for flow of fluids and solve fundamental pipe network problems.
5. Experiment with the behavior of fluid and boundary layer theory under various conditions.

List of Text Book:

1. Fluid Mechanics - Hydraulics & Hydraulic Machines, Modi & Seth, Standard Publications, New Delhi 2002.
2. Engineering Fluid Mechanics by K. L. Kumar, S. Chand & Co.2009

List of Reference Book:

1. Fluid Mechanics-Fundamentals &Applications ,Yunus A. Cengel& John M Cimbala, McGraw Hill,2007

List of Experiment:

1. To determine the Meta centric height.
2. To determine the co-efficient of discharge C_d for orifice meter and venturimeter.
3. To measure discharge through nozzle meter.
4. To study the losses due to friction in pipes.
5. To study the losses in pipe fitting sudden enlargement and sudden contraction.
6. To determine the Reynolds's number and the type of flow either laminar or turbulent flow.
7. To verify Bernoulli's Theorem.
8. To find the co-efficient of pitot tube.
9. To determine the coefficient of discharge through broad crested weir.
10. To study Viscosity, Velocity & Pressure measuring device.
11. Determine Coefficient of discharge, contraction & velocity of an Orifice.

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PCC-ME404	Kinematics of Machines	L: 2, T: 1, P: 2 (05 hrs)	Credits:04

Pre-requisite(s): Nil

Course Objective:
To expose the students to learn the fundamentals of various laws governing rigid bodies and its motions.

Course Content:

Module 1 (12 hrs)
Fundamentals of Kinematics and Mechanisms: Introduction, kinematics and kinetics, mechanisms and machines, degree of freedom, types of motions, kinematic concept of links, basic terminology and definitions, joints and kinematic chains, inversions, absolute and relative motions, displacement, velocity and acceleration diagrams, different mechanisms and applications.

Module 2 (12 hrs)
Velocity and Acceleration Analysis: Relative velocity acceleration methods, Corioli's component of acceleration, instantaneous center of Rotation method, Kennedy theorem of three center in line, body and space centrode, Klein's construction, kinematic synthesis of linkages, dynamic motion analysis of mechanisms and machines, D'Alembert's principle, number synthesis, free body diagrams, kinematic and dynamic quantities and their relationships, analytical method and graphical method.

Module 3 (08 hrs)
Theory of Gears: Gears, laws of gearing, classification and basic terminology, tooth profiles, kinematic considerations, fundamental law of toothed gearing, involute and cycloidal profile, conjugate action, contact ratio, minimum number of teeth, interference and under cutting. Helical gears: Nomenclatures, center distance, force analysis.

Module 4 (08 hrs)
Power Transmission and Gyroscope: Power transmission, kinematics of belt- pulley, flat and v –belt, rope, condition of maximum power transmission, efficiency,
Gyroscope: Introduction, Angular acceleration, gyroscopic couple, Effect of gyroscopic couple on aero plane, naval ship, Stability of vehicles.

Module 5 (08 hrs)
Cam and Followers: Cams, introduction, classifications of cams and followers, nomenclature, various cam profiles, analysis of cam and follower motion, analytical cam design with specific contours, pressure angle, radius and undercutting, motion constrains, critical path motion, torque on cam shaft.

Course Outcome:
After completion of this course, the students are able to:
1. Explain the definitions of mechanism, machines, and able to calculate the degrees of freedom of a mechanism and machine.
2. Determine kinematic analysis (Velocity and acceleration) for a given of a given mechanism using analytically and graphically method.
3. Understand and recognize different types of gears with their field of application and working.

4. Understand and analyze the power transmission modes like belt, rope and chain drives and understand the gyroscopic action in machines.
5. Design cam according to desired motion.

List of Text Book:
1. R.L. Norton, kinematics& dynamics of machinery, Tata McGraw Hill, ISBN13 978 0 07 014480 4.
2. A. Ghosh & A. Malik, Theory of Mechanisms and Machines, EWP Pvt Ltd, ISB 81 85095 72 8.
3. Ballaney, P., "Theory if Machines and Mechanisms", 2005, ISBN 9788174091222 / 817409122X Khanna Publications.
4. Ratan S. S. "Theory of Machines", Tata McGraw Hills.

List of Reference Books:
1. Uicker Jr, J. J. , Penock G. R. and Shigley, J. E., "Theory of Machines and Mechanisms' 2003, Tata McGraw Hill.
2. Ramamurthy V., "Mechanisms of Machines", 3rd edition, ISBN 978-1842654569, Narosa Publishing House.
3. Bevan Thomas, "The Theory of Machines", 3rd edition, CBS publication.
4. Bansal, R. K., "Theory of machines", Laxmi Publications Pvt. Ltd, New Delhi
5. Ghosh Amitabha & Mallik Asok Kumar, "Theory of Mechanisms and Machines" east-West Press Pvt. Ltd. New Delhi
6. Kimbrell J.T., "Kinematics Analysis and Synthesis" McGraw – Hill International Editons.
7. Rao J.S. & Dukkipati R.V. , "Mechanisms and Machine Theory" New Age International Pvt. Ltd.

List of Experiment:
1. To study various types of kinematics links, pairs, chains & mechanisms.
2. To study different types of chains and their inversions.
3. To find the velocity and acceleration of various links/points in slider-crank Mechanism using Klein's construction method.
4. To measure the various parameters comprising the Corioli's component of acceleration.
5. To find out jump phenomenon of cam and follower with the help of test kit and to study various types of cams and followers arrangements.
6. To plot the n - θ (follower displacement vs. angle of cam rotation) curves for different cam follower pairs.
7. To study various kinds of belt drives.
8. To construct involute profile of a gear by generating method and to study various types of gear and gear trains.
9. Experimental justification of the equation $T = I_{\omega\omega} P$ for calculating the gyroscopic couple by observation and measurement of results for independent variation in applied couple C and angular velocity of precession ω_p.
10. To draw cam profile for various types of followers motion.

MC-4	Constitution of India	2L:0T:0P (2 Hrs)	Credits: 00

Course Objective: The objective of this course is to familiarize the students with the feature of the Indian constitution, laws, democracy etc.

Unit I Historical Background: Formation and working of constituent Assembly, Formation and working of Drafting committee, Commencement of Indian Constitution, Dr. Ambedkar's ideas of reservation in constitution

Unit II Important Feature of the Constitution: Preamble, Fundamental Rights, Directive Principles of state policy, Fundamental Duties, Centre State Relation

Unit III Parliamentary Democracy: Loksabha, Rajsabha Central Exclusive President, Prime minister, and Central Ministry, Vidhan Sabha, Vidhan Parishad and State Executive (Governor, Chief Minister, Minister of State)

Unit IV Special Provisions in Indian Constitution: Finance Commission Contingency Fund, Consolidated Fund, Public Service Commissions, Election Commission, Safeguards for S.C. S.T. and Backward Classes, Provisions for Emergency and Constitutional Amendments, Indian Judiciary Supreme court and High court

Suggested Reading
1) The Indian Constitution - Granville Austin
2) India's Constitution - M.V. Pylee, S. Chand Publication
3) Ambedkar and Constitution, Raj Kumar, Commonwealth Publication Pvt. Ltd., New Delhi, 2011.