BACHELOR'S DEGREE PROGRAMME

B.Tech

Choice Based Credit System

Syllabi

Batch-2018-2022

Department Mechanical Engineering

RAFFLES
UNIVERSITY

Raffles University, Neemrana, Rajasthan [INDIA]-301705

www.rafflesuniversity.edu.in

Mechanical Engineering (B. Tech.) III Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
04	3	1	0	BSC201	MATHEMATICS-III	BSC

Unit -I

Fourier transform: Discrete and Fast Fourier transform Complex form of Fourier transform and its inverse, Fourier sine and cosine transform and their inversion. Properties of F-transform, Convolution theorem for F-transform, Parse Val's identity of for F-transforms Applications of Fourier transform for the solution of partial differential equations having constant coefficients with special reference to heat equation and wave equation.

Unit -II

Laplace transform, Inverse transform, properties, Transforms of derivatives and integrals, Unit step function, Dirac's delta function, Differentiation and integration of transforms, Applications to differential equations.

Unit -III

Statistical Techniques: Discrete and Continuous random variables–Moments–Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions, Moments, Moment generating functions, Curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves etc., Correlation, Linear, non – linear

Unit -IV

Functions of Complex Variable: Definition, Exponential function, Trigonometric and Hyperbolic functions, Logarithmic functions. Limit and Continuity of a function, Differentiability and Analyticity.

Unit -V

Cauchy-Riemann equations: Necessary and sufficient conditions for a function to be analytic, polar form of the Cauchy-Riemann equations. Harmonic functions, application to flow problems. Integration of complex functions.

Text and Reference books:

1. Chandrika Prasad, Mathematics for Engineers, Prasad Mudralaya
2. Jeffrey, Advanced Engineering Mathematics , ELSEVIER
3. Chandrika Prasad , Advanced Mathematics for Engineers, Prasad Mudralaya
4. Grewal B. S., Higher engineering Mathematics, Khanna Publication, New Delhi
5. Keyszig E., Advanced Engineering Mathematics, Wiley Eastern Publication
6. Peter V. O. Neil, Advanced Engineering mathematics, Thomson Publication
7. Gerald, C.F., and Wheatley, P.O., Applied Numerical Analysis, Addison Wesley.

Mechanical Engineering (B. Tech.) III Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
04	3	1	0	PCC-ME 201	Strength of Material	PCC

Unit -I

Deformation in solids- Hooke's law, stress and strain- tension, Concept of factor of safety, compression and shear stresses- elastic constants and their relations- volumetric, linear, Equations of static equilibrium, Concept of free body diagram, Composite bars, Thermal stresses and principal stresses and principal planes- Mohr's circle

Unit –II

Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

Unit -III

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.

Unit –IV

Torsion: Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capacity, Strain energy in torsion, Stresses in members subjected to combined axial, bending and torsional loads.

Unit –V

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure

Columns and struts: Equilibrium, buckling and stability, Short, long and intermediate columns, Euler's formula for crippling load for columns, different end conditions, equivalent length, Eccentric loading Rankine formula and other empirical relations.

Text and Reference books:

1. James M. Gere, Mechanics of Materials, Cengage Learning (Brooks\Cole).
2. Ryder G.H.,Strength of Materials, Macmillan India.
3. Sadhu Singh, Strength of Materials, Khanna Publishers.

Mechanical Engineering (B. Tech.) III Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
04	3	1	0	PCC-ME 202	THERMODYNAMICS	PCC

Unit -I

Definition of thermodynamics, Fundamental concepts and definitions: Dimensions and units, Microscopic and Macroscopic approaches, Systems, Surroundings and Universe, Concept of Continuum, Control system boundary, Control volume, Thermodynamic properties, Thermodynamic Equilibrium types, Thermodynamic state, path, process and cycle, Reversibility and Irreversibility, Quasi static process, Energy and its forms, Work and Heat, Ideal gas, Real gas, Ideal Gas laws, Law of corresponding states, Dalton's law, Amagat's law, Property of mixture of gases.

Zeroth law of thermodynamics: Zeroth law of thermodynamics, Temperature and it's Measurement, Temperature scales.

Unit -II

First law of thermodynamics: Thermodynamic definition of work, Thermodynamic processes, Calculation of work in various processes and sign convention, Non-flow work and flow work, Joules' experiment, First law of thermodynamics, Internal energy and enthalpy, First law of thermodynamics applied to open systems, Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc. First law analysis for closed system (non-flow processes), Analysis of unsteady processes such as filling and evacuation of vessels with and without heat transfer, Limitations of first law of thermodynamics, PMM-I.

Unit -III

Second law: Devices converting heat to work, Thermal reservoir, Heat engines, Efficiency, Devices converting work to heat, Heat pump, refrigerator, Coefficient of Performance, Reversed heat engine, Kelvin Planck statement of second law of thermodynamics, Clausius statement of second law of thermodynamics, Equivalence of two statements of second law of thermodynamics, Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and it's corollaries, thermodynamic temperature scale, PMM-II.

Unit -IV

Entropy : Clausius inequality, Concept of Entropy, Entropy change in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics.

Availability and Irreversibility: Available and unavailable energy, Availability and Irreversibility, Second law efficiency, Helmholtz & Gibb's function.

Unit -V

Properties of steam and thermodynamics cycles: Pure substance, Property of steam, Triplepoint, Critical point, Sub-cooled liquid, Saturation states, Superheated states, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T & P-V diagrams, T-S and H-S diagrams, use of property diagram, Steam-Tables & Mollier charts, Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties.

Text and Reference books:

1. Engineering Thermodynamics by P.K.Nag, Tata McGraw Hill Pub.
2. Thermodynamics by J. P. Holman, McGraw Hill.
3. Engineering Thermodynamics by Jones and Dugans, PHI Learning Pvt. Ltd.
4. Fundamentals of Thermodynamics by Sonntag, Wiley India Pvt. Ltd.
5. Fundamentals of Classical Thermodynamics by Van Wylen, John wiley& sons.
6. Engineering Thermodynamics by R.K.Rajput.
7. Engineering Thermodynamic, Moran, M. J. and Shapiro, H. N., 1999, John Wiley and Sons.

Mechanical Engineering (B. Tech.) III Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
3	3	0	0	PCC-ME 203	Material Science & Engineering	PCC

Unit-I

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Unit - II

Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

Unit -III

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

Unit - IV

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening

UNIT - V

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys

Text and Reference books:

1. W.D. Callister, Jr, - Material Science & Engineering Addition, Wiley Publishing Co.
2. Van Vlash - Elements of Material Science & Engineering, John Wiley & Sons.
3.S. K. Hazra Choudhary– Material Science & Processes, Media Promoters & Publishers

4.Van Vlash - Elements of Material Science & Engineering, John Wiley & Sons.
3. V. Raghvan Material Science, Prentice Hall of India

Mechanical Engineering (B. Tech.) III Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	PCC-ME 204	MANUFACTURING PROCESSES- I	PCC

Unit-I

Metal Casting Processes: Advantages and limitations, sand mold making procedure. Patterns: Pattern materials, pattern allowances, types of pattern, color coding. Molding materials: Molding sand composition, sand preparation, Sand molding processes. Cores: Types of cores, core prints, chaplets, and chills. Gating systems: Gates and risers. Melting practice: Cupola furnace, Defects in castings and their remedies, Precision Investment Casting, Centrifugal Casting, and Continuous Casting.

Unit-II

Metal Forming Processes: Nature of plastic deformation, hot working and cold working .Principles of rolling, roll passes, roll pass sequences. Forging: Forging operations, smith forging, drop forging, press forging, forging defects.

Unit-III

Extrusion and Sheet Metal Operations: Extrusion principle, hot extrusion, cold extrusion, wire drawing, swaging, tube making. Sheet metal operations: Press tools operations, shearing action, drawing dies, spinning, bending, stretch forming, embossing and coining.

Unit-IV

Welding Process: Principles of welding, brazing and soldering, Classification of Welding Processes, gas welding and cutting process, equipment. Arc welding power source and consumables. Resistance welding: Principle and equipments, resistance spot welding, resistance seam welding, electro slag welding, forge welding.

Unit-V

Advance Welding Processes: Tungsten inert gas welding (TIG), metal inert gas welding (MIG), MMAW, electron beam welding, friction welding, and diffusion welding: their working principle, equipments, parameters and applications.

Powder Metallurgy: Powder manufacturing, compaction and sintering processes. Advantages and applications of Powder Metallurgy.

Text and Reference books:

1. Principles of Manufacturing Materials & Processes – Campbell J. S., Publisher – Mc Graw Hill.

2. Manufacturing Science - Ghosh A; Mallik A.K. Affiliated East-West Press Pvt. Ltd., New Delhi

3. Manufacturing Processes- H S Shan, Cambridge University Press 2nd Edition 2017.

4. Production Technology – P C Sharma –S.Chand publications, New Delhi.

5. Elements of Manufacturing Processes – B.S. Nagendra Parasher, RK Mittal, PHI N. Delhi

MANDATORY COURSES

Mechanical Engineering (B. Tech.) III Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
0	2	0	0	MC-III	Constitutional Law	MC

Unit – I

Salient features of the Indian constitution. Preamble Definition of State (Art. 12) Doctrines of Ultra-virus, severability, eclipse, waiver (Art, 13)

Unit – II

Right to equality (Art. 14) Prohibition of discrimination, Rights to equality of opportunity (Art. 15-16) Right to freedom under Article 19: Freedom of association; Freedom of movement; Freedom of residence; Freedom of assembly; Freedom of association; Freedom of movement; Freedom of residence; Freedom of occupation, trade and business; Right to take out processions; Right of the State to impose reasonable restrictions

Unit – III

Protection in respect of Conviction under Article 20, Ex-post-facto law; Double jeopardy; Self-incrimination; Right of Life and Personal Liberty (Act. 21), Protection in respect of arrest and detention Right to freedom of Religion (Articles 25-28)

Unit – IV

Cultural and Education Rights (Articles 29-30) Enforcement of Fundamental Right, Writ Jurisdiction of the Supreme Court and High Court (Article 32, 226)

Unit – V

Right to property before and after the Constitution 42nd Amendment Act, 1976 Abolition of Untouchability, Titles (Articles 17-18) Right against exploitation (Articles 23, 24)

Text and Reference Books:

1. Austin Granville: Constitution of India: Cornerstone of a Nation; and Working A Democratic constitution
2. Narender Kumar: Constitutional Law of India.
3. Basu D. D : Shorter Constitution of India
4. Jain, M.P.: Constitutional Law of India,
5. Seervai, H.M. : Constitutional Law of India, Vols. I-III
6. Shukla, V.N. : Constitutional of India (ed. M.P.Singh)
7. B.R. Sharma : Constitutional Law and judicial Activism

Credits	L	T	P	Course Code	Course Title	Category of Course
02	0	0	3	PCC-ME 205	Machine Drawing and Auto CAD Lab	PCC

SECTION A- MACHINE DRAWING

Introduction graphic language classification of drawing, principal of drawing, IS codes for machine drawing, lines, scales, section dimensioning, standard abbreviation, – Limits , fits and Tolerance (Dimensional and Geometrical tolerance) , Surface finish, Gears : Gear terminology, I.S. convention representation of assembly of spur gears, helical gears, bevel gears , worm and worm wheel.

Orthographic projections: principle of first and third angle projection, orthographic views from isometric views of machine parts / components. Drawing of sectional views:- Coupling, Crankshaft, Pulley, Piston and Connecting rod, Cotter and Knuckle joint. Riveted Joint and Welded Joint. Free hand sketching: Need for free hand sketching of standard parts and simple machines components.

Assembly drawing with sectioning and bill of materials from given detailed drawings of assemblies: Lathe Tail stock, Machine vice, Pedestal bearing

Assembly drawing with sectioning and bill of materials from given detailed drawings of assemblies Steam stop valve, Stuffing box, Drill jigs and Milling fixture.

SECTION B- Auto CAD

1. Setting up of drawing environment by setting drawing limits, drawing units, naming the drawing, naming layers, setting line types for different layers using various type of lines in engineering drawing, saving the file with .dwg extension.

2. Layout drawing of a building using different layer and line colors indicating all Building details. Name the details using text commands, Make a title Block.

3. To Draw Orthographic projection Drawings (Front, Top and side) of boiler safety valve giving name the various components of the valve.

4. Make an Isometric dimensioned drawing of a connecting Rod using isometric grid and snap.

5. Draw quarter sectional isometric view of a cotter joint.

6. Draw different types of bolts and nuts with internal and external threading in Acme and square threading standards. Save the bolts and nuts as blocks suitable for insertion.

7. Draw 3D models by extruding simple 2D objects, dimension and name the objects.

8. Draw a spiral by extruding a circle.

Text and Reference Books:

1. Machine Drawing - N D Bhatt and V M Panchal, Charotar Publishing House.

2. A Text Book of Machine Drawing - P S Gill Pub.: S K Kataria & Sons.

3. Engineering Graphics with Auto CAD 2002 -JamesD.Bethune, Pearson Education.

4. A Text Book of Machine Drawing Laxmi Narayana and Mathur, M/s. Jain Brothers, New Delhi.

5. Machine drawing by N Sidheshwar, Kannaieh, V S Sastry, TMH., New Delhi.

Credits	L	T	P	Course Code	Course Title	Category of Course
1	**0**	**0**	**2**	**PCC-ME 206**	**THERMODYNAMICS LAB**	**PCC**

LIST OF EXPERIMENTS

1. Study of temperature and its measuring devices.
2. Study of determination of Calorific Value of Fuels by using different calorimeters
3. Determinations of exhaust gas analysis by using Orsat Apparatus
4. Study and comparison of SI and CI Engines (Cut Models).
5. To draw valve timing diagram for a single cylinder diesel engine.
6. To perform constant speed load test on a single cylinder diesel engine and to plot performance curves: indicated thermal efficiency, brake thermal efficiency, mechanical efficiency Vs. Brake power.
7. To perform constant speed load test on computerized test rig and to plot performance curves along with pressure-theta diagram.
8. Morse Test: To estimate the Indicated Power, Friction Power and Mechanical Efficiency of a multi-cylinder Petrol Engine.
9. Study of two stage reciprocating compressor.

Credits	L	T	P	Course Code	Course Title	Category of Course
1	**0**	**0**	**2**	**PCC-ME 207**	**Manufacturing Processes-I Lab**	**PCC**

LIST OF EXPERIMENTS

1. To study and observe various stages of casting through demonstration of Sand Casting Process.
2. To prepare a pattern for given object for lost form casting.
3. To study and observe through demonstration the metal forming processes (Rolling, Forging and Sheet metal forming).
4. To manufacture a small object using hot forging technique.
5. To prepare a sheet metal product (square container).
6. To study and observe the welding and brazing techniques through demonstration and practice (Gas, MIG, TIG, Plastic, Brazing)
7. To prepare a butt joint with mild steel strip using GMAW & MMAW technique.
8. To prepare a butt joint with mild steel strips using brazing technique.

Credits	L	T	P	Course Code	Course Title	Category of Course
1	**0**	**0**	**2**	**PCC-ME 208**	**STRENGTH OF MATERIAL LAB**	**PCC**

LIST OF EXPERIMENTS

1. To perform Tensile/Compressive/Shear/torsion test on a given material and to determine its various mechanical properties under tensile/compression/Shear/torsional loading
2. To determine Rockwell/Brinell hardness of a given material
3. To study the impact testing machine and perform the impact Tests (Charpy test).
4. To study the impact testing machine and perform the impact Test(Izod test)
5. To perform Bending test and to determine the Young's Modulus of Elasticity via deflection of beam.
6. Creep testing on creep testing machine
7. To draw shear Force, Bending Moment Diagrams for a simply Supported Beam under Point and Distributed Loads.
8. Compression and tensile test on helical springs.

Credits	L	T	P	Course Code	Course Title	Category of Course
1	**0**	**0**	**2**	**PCC-ME 209**	**Material Science & Engineering Lab**	**PCC**

LIST OF EXPERIMENTS

1. 1. Classification of about 25 specimens of materials/machine parts into
   (i) Metals and non-metals
   (ii) Metals and alloys
   (iii) Ferrous and nonferrous metals
   (iv) Ferrous and non-ferrous alloys
2. Study of various crystals structures and defects in crystals through models.(Bravais Lattice structures).
3. Study of brittle and ductile fracture.
4. Metallographic examination /micro structural analysis of materials.
5. Grain Size determination of a given specimen.
6. Comparative study of microstructures of different given specimens (mild steel, gray C.I.)Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.
7. Annealing of Steel -Effect of annealing temperatures and time on hardness.
8. Study of Microstructure and hardness of steel at different rates of cooling. Microstructure examination of white cast iron.
9. Study of Iron-Carbon Equilibrium Diagram and sketch the various structures present at room temperature.
10. Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.

Reference and Text Books:

1. Vander Voort, Metallography: Principles and Practice, McGraw-Hill, 1984
2. Prabhudev K.H., Handbook of Heat Treatment of Steels, Tata McGraw-Hill, 2000.
3. Sadhu Singh, Machine Design, Khanna Publishers, New delhi, 1997.
4. Abdul Mubeen, Machine Design, Khanna Publishers 1995.

Credits	L	T	P	Course Code	Course Title	Category of Course
04	**3**	**1**	**0**	**PCC-ME 210**	**KINEMATICS OF MACHINES**	**PCC**

Unit -I

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains- Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms

Unit – II

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics Coincident points- Coriolis component of acceleration- introduction to linkage synthesis three position graphical synthesis for motion and path generation

Unit – III

Classification of cams and followers- Terminology and definitions- Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers

Unit – IV

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics

Unit – V

Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication friction clutches- belt and rope drives- friction in brakes

Text and Reference Books:

1. Thomas Beven, Theory of Machines, Longman's Green & Co., London.
2. W. G. Green, Theory of Machines, Blackie & Sons, London
3. V. P. Singh, Theory of Machines, Dhanpat Rai.
4. Gosh and Malik, Theory of Mechanism and Machines, East-west Pvt. Ltd. 1988.

Credits	L	T	P	Course Code	Course Title	Category of Course
04	3	1	0	PCC-ME 211	FLUID MECHANICS	PCC

Unit -I

Fluid Properties and Fluid Statics: Definition, Distinction between solid and fluid Modules and dimensions, Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension. Pascal law, absolute, gauge and vacuum pressures, Pressure measurements by manometers and pressure gauges. Archimedes principle, Hydrostatic law, Centre of pressure, stability of floating bodies.

Fluid Kinematics: Flow visualization, Lines of flow, Types of flow, Velocity field and acceleration, Continuity equation (one and three dimensional differential forms), Equation of streamline, Stream function, Velocity potential function, Circulation, Flow net.

Unit -II

Fluid Dynamics: Definition,Equations of motion - Euler's equation along a streamline, Bernoulli's equation and its applications,Venturi-meter, Orifice meter, Pitot tube, Orifices, Mouthpieces, Notches and Weirs, Momentum theorem.

Unit -III

Dimensional Analysis: Dimensionless numbers- Reynolds, Froude, Mach, Weber and Euler, Applications of numbers, undistorted model, Distorted model, scale effect.

Incompressible Fluid Flow: Viscous flow, Navier-Stoke's equation (Statement only), Shear stress, Pressure gradient relationship, Laminar flow between parallel plates, Laminar flow through circular tubes, Hagen Poiseulle's equation.

Unit -IV

Flow Through Pipes: Friction loss, Darcy-Weisbach Formula, Minor and major losses, Hydraulic and energy grade lines, Flow through pipes in series and in parallel, Power transmission, Water hammer and cavitation.

Turbulent Flow: Variation of friction factor with Reynolds number, Moody's diagram, Shear stress in turbulent flow, Prandtl Mixing length theory, Velocity distribution in smooth pipes and rough pipes, Resistance of smooth and rough pipe.

Unit -V

The Boundary Layer: Description of the boundary layer, Boundary Layer thickness, Von-Karman momentum integral equation, Coefficient of drag, Boundary layer separation and control, Flow around a body, Drag and lift, Drag on sphere and cylinder, Development of lift on a circular cylinder, Development of lift on an airfoil.

Text and Reference Books:

1. Yunus A. Cengel and Cimbala, Fluid Mechanics, Tata McGrawHill
2. Frank M. White, Fluid Mechanics, Tata McGraw Hill.
3. Streeter V.L., K.W. Bedford and E.B.Wylie , Fluid Mechanics , Tata McGraw Hill

4. Robert W. Fox and Alan T. McDonald, Introduction to Fluid Mechanics, John Wiley &Sons.
5. Potter, Mechanics of Fluids, Cengage Learning.
6. John F. Douglas, Fluid Mechanics, Pearson Education.
7. Modi and Seth, Fluid Mechanics and Hydraulic Machinery, Standard Book House.
8. Som, S. K., &Biswas, G. Introduction to fluid mechanics and fluid machines, Tata McGraw-Hill.
9. Munson, B. R., Young, D. F., &Okiishi, T. H. Fundamentals of Fluid Mechanics, Wiley
10. Flud mechanics by R.K. B ansal

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	PCC-ME 212	Manufacturing Processes-II	PCC

Unit-I

Mechanism of Metal Cutting: Deformation of metal during machining, nomenclature of lathe, milling tools, mechanics of chip formation, built-up edges, mechanics of orthogonal and oblique cutting, Merchant cutting force circle and shear angle relationship in orthogonal cutting, factors affecting tool forces. Cutting speed, feed and depth of cut, surface finish. Temperature distribution at tool chip interface. Numerical on cutting forces and Merchant circle.

Unit-II

Tool Wear and Machinability: Types of tool wear, tool life, factors governing tool life, Machinability: Definition and evaluation. Economics of machining, Numerical on tool life.

Cutting Tool Materials & Cutting Fluids: Characteristics of tool materials, various types of cutting tool materials, coated tools, cutting tool selection, Purpose and types of cutting fluids, basic actions of cutting fluids, effect of cutting fluid on tool life, selections of cutting fluid

Unit-III

Gear Manufacturing: Introduction, methods of manufacture. Gear generation and forming: Gear cutting by milling, single point form tool, gear hobbling and shaping. Gear finishing operations: Gear shaving, gear burnishing, gear grinding, lapping.

Unit-IV

Jigs & Fixtures: Introduction, location and location devices, clamping and clamping devices, Drill Jigs, Milling Fixtures.

Unit-V

Unconventional Machining Processes: introduction, classification of unconventional machining processes, Abrasive jet machining: Principles, advantages, disadvantages and applications. Ultrasonic machining: Principles, advantages, disadvantages and applications. Electro-chemical machining and grinding: Principles of operation, advantages, disadvantages and applications. Electric discharge machining: Principles, advantages, disadvantages and applications. Electron beam machining: principle, advantages, disadvantages and applications. Laser beam machining: Principles and applications.

Text and Reference Books:

1. Manufacturing Technology – Metal cutting and machine Tools: P.N. Rao, T.M.H, New Delhi
2. Workshop Technology -Vol II (Machine Tools) B.S Raghuwanshi, dhanpat Rai and Company.
3. Manufacturing Processes- H S Shan, Cambridge University Press 2nd Edition 2017
4. Manufacturing Engg. & Tech, Kalpakian, Serope Addison -Wisly Publishing Co. New York.

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Mechanical Engineering (B. Tech.), IV Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
04	3	1	0	PCC-ME 213	I.C. ENGINES	PCC

Unit -I

Introduction to IC Engines: Definition of engine, classification, Application of IC engines, Air Standard Cycle and deviation from air standard actual cycle, Indicator diagram, MEP (mean effective pressure), Shaft power, Indicated power.

Unit – II

Actual working of IC engine: Introduction to fuel air cycles and their significance, Composition of cylinder gases, Variable specific heats, Comparison of air standards & fuel air cycles, Effect of operating variables- compression ratio, fuel air ratio, actual cycles and their analysis,Difference between actual and fuel-air cycle, actual and fuel-air cycles for S.I. and C.I. engines.

Working of 4-stroke petrol & diesel engines and their valve timing diagram, Working of 2-stroke petrol & diesel engines & their valve timing diagrams, Comparison of 2-stroke &4-stroke engines, Actual working of 2 & 4 stroke gas engines and their valve diagram,

Unit – III

Fuel and Combustion: Fuels for SI and CI engine, Important qualities of SI and CI engines fuels, rating of SI engines, CI engines fuels, Dopes, Combustion in CI engines, Ignition delay, Knocking phenomena and its control, Combustion chamber design for CI engines. Combustion in SI engine, Detonation, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas and Alternatives fuels for IC engines.

Unit – IV

Fuel Supply System: Fuel supply system and fuel pumps, Properties of air fuel mixture, Carburettor and its working, Actual air fuel ratio of single jet carburettor, Supercharger, Petrol injection, Fuel injection systems for C.I., Cooling and lubricants of IC engines

Classification of injection systems, Injection pump, Fuel injection systems, Fuel Injector, Nozzle, Injection of S.I. Engines and Fuel filters.

Unit – V

Measurement and Testing: Measurement of shaft power, Indicated power, Measurement of speed, Air consumption, Fuel consumption, Heat carried by cooling water, Heat carried by the exhaust gases, Morse test, Heat balance sheet, Governing of I.C. Engines, Performance characteristics of I.C. Engines, Performance parameters, Performance of S.I. Engines, Performance of C.I. Engine

Text and Reference Books:

1. V. Ganeshan, Internal Combustion Engines, Tata McGraw Hill
2. Damundwar,A Course in Internal Combustion Engines,DhanpathRai& Sons
3. Obert E. F, "Internal Combustion Engines and Air Pollution", Harper and Row Publication Inc. NY, 1973.

Credits	L	T	P	Course Code	Course Title	Category of Course
04	3	1	0	PCC-ME 214	INDUSTRIAL ENGINEERING	PCC

Unit-I

Production system and Productivity: Introduction to production systems, Aim of production systems, generalized model of Production systems, Types and characteristics of production systems, Life cycle approach to production management, Product life cycle, Plant location, Plant layout, objectives, types, comparison and application of different types of layouts. Productivity definition, various methods of measurement, Factors effecting productivity, Strategies for improving productivity.

Unit-II

Manufacturing Cost Analysis: Fixed & variable costs, Direct, indirect & overhead costs, & Job costing, Recovery of overheads, Standard costing, Cost control, Cost variance Analysis - Labour, material, overhead in volume, rate & efficiency, Break even Analysis, Numerical Problems.

Unit-III

Work Study: Definition, Objectives, Method study, Principle of motion economy, Techniques of method study – Various charts, THERBLIGS, Work measurement - various methods, Time Study - PMTS, determining time, Work sampling. Numerical Problems.

Unit-IV

Materials Management : Strategic importance of materials in manufacturing industries, Relevant costs, Inventory control models - Economic order quantity (EOQ), Economic batch quantity (EBQ) with & without shortage, Inventory control systems - P,Q,Ss Systems, determination of order point & safety stock, Selective inventory control - ABC, FSN, SDE, VED,SCM , Numerical Problems. Forecasting: Importance, Objectives, Forecasting and Prediction, Types, Classification of Forecasting Methods, Forecast Errors, Costs and Accuracy of Forecasts, Numerical Problems.

Unit-V

Production Planning & Control (PPC) : Objectives & variables of PPC, Aggregate planning - Basic Concept, its relations with other decision areas, Decision options - Basic & mixed strategies, Master production schedule (MPS), Scheduling Operations Various methods for line & intermittent production systems, Gantt chart, Sequencing - Johnson algorithm for n-Jobs- 2 machines, n- Jobs-3 machines, 2 Jobs n-machines, n-Jobs m-machines Various means of measuring effectiveness of PPC, Numerical Problems.

Text and Reference Books:

1. Production & Operations Management – Chary, TMH, New Delhi.
2. Modern Production Management – S.S. Buffa, Pub.John Wiley.
3.Operations Management - Schroeder, McGraw Hill ISE.
4. Operation Management - Monks, McGraw Hill ISE.
5. Production & Operations Management - Martinich, John Wiely SE.
6. Industrial & Systems Engineering - Turner, Mize, Case, Prentice Hall Pub.

Credits	L	T	P	Course Code	Course Title	Category of Course
04	**3**	**1**	**0**	**PCC-ME 215**	**Design of Machine Elements**	**PCC**

Unit -I

Design considerations - limits, fits and standardization, Review of failure theories for static and dynamic loading (including fatigue failure) and Design Against Static Load: Modes of failure, factor of safety, principle stresses, stresses due to bending and torsion, theory of failures.

Unit – II

Cyclic stresses, fatigue and endurance limit, stress concentration factor, stress concentration factor for various machine parts, Notch sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria.

Unit – III

Riveting methods, materials, types of rivet heads, types of riveted joints, failure of riveted joints, efficiency of riveted joints, design of boiler joints, eccentric loaded riveted joint, Welded joints and Screwed fasteners.

Unit – IV

Cause of failure in shaft, materials for shaft, stress in shaft, and design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, shaft subjected to fatigue loads, design for rigidity.

Design of springs: helical compression, tension, torsional and leaf springs

Unit – V

Design of transmission elements: spur, helical, bevel and worm gears; belt and chain drives. Analysis and applications of power screws and couplings.Analysis of clutches and brakes

Text and Reference Books

1. Design of Machine Elements by V. B. Bhandari, TMH Publishing Co. Ltd., New Delhi
2. Machine Design by Norton, Prentice Hall.
3. Machine Design by Shigley Tata McGraw hill
4. Sharma PC and Aggarwal DK, “Machine Design”, Kataria Publishers (2002)

Credits	L	T	P	Course Code	Course Title	Category of Course
01	**0**	**0**	**2**	**PCC-ME 216**	**KINEMATICS OF MACHINES LAB**	**PCC**

LIST OF EXPERIMENTS

1. To study inversions of four bar chain: Coupling Rod, Beam Engine
2. To study Steering Mechanisms; Davis and Ackerman.
3. Study of quick return mechanism and draw velocity and acceleration diagram.
4. Study of inversion of Double slider chain Oldham Coupling, Scotch Yoke and Elliptical Trammel.
5. Study of various cam-follower arrangements.
6. To plot displacement v/s angle of rotation curve for various cams
7. To determine co-efficient of friction using two roller oscillating arrangement.
8. Study of various types of dynamometers, Brakes and Clutches.
9. Study of a lathe gear box.
10. Study of a sliding mesh automobile gear box.
11. Study of various gear trains.

Credits	L	T	P	Course Code	Course Title	Category of Course
01	**0**	**0**	**2**	**PCC-ME 217**	**FLUID MECHANICS LAB**	**PCC**

LIST OF EXPERIMENTS

1. Determination of Metacentre height of a given body.
2. Determination of C_d, C_v& C_c for given orifice.
3. Calibration of contracted Rectangular Notch and / Triangular Notch and determination of flow rate.
4. Determination of velocity of water by Pitot tube.
5. Verification of Bernoulli's theorem.
6. Determination of Coefficient for minor losses in pipes.
7. Calibration and flow rate determination using Venturimeter& Orifice meter and Nozzle meter
8. Determination of head loss in given length of pipe.
9. Determination of the Reynold's number for laminar, turbulent and transient flow in pipe.
10. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
11. To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.

Credits	L	T	P	Course Code	Course Title	Category of Course
01	**0**	**0**	**2**	**PCC-ME 218**	**Manufacturing processes –II Lab**	**PCC**

LIST OF EXPERIMENTS

1. Produce a rectangular block by face milling and prepare a slot on one face with a slotting cutter / side and face cutter.
2. Gear manufacturing by some indexing device on a milling machine
3. Job on grinding using - Surface grinding - Cylindrical grinding - Centreless grinding
4. Grinding and sharpening of lathe tool, drills.
5. Grinding of surface at 45°, 60°, 75° on tool and cutter grinder.
6. Milling cutter grinding on tool and cutter grinder.
7. Prepare a V-block to ± 0.2 mm accuracy on shaper machine.
8. Exercise on key way cutting and spline cutting.
9. Preparation of job through eccentric turning.
10. Practice of taper turning.
11. Exercise on EDM for preparation of electrodes (male and female).

Credits	L	T	P	Course Code	Course Title	Category of Course
01	**0**	**0**	**2**	**PCC-ME 219**	**I. C. ENGINES LAB**	**PCC**

LIST OF EXPERIMENTS

1. Study of IC Engine models
2. Study of working of two stroke petrol engine and four stroke petrol engine with the help of cut section models.
3. Study of working of two stroke diesel and four stroke diesel engine with the help of cut section models.
4. Study of fuel supply system of a petrol engine (fuel pump and simple carburettor)
5. Study of complete carburettor
6. Study of Diesel Injection System.
7. Study of fuel supply system of a Diesel engine (fuel pump and fuel injector)
8. Study of Ignition systems of an IC Engine (Battery and Magneto ignition system) and Electronic ignition system.
9. Study of Lubrication system of an IC Engine (mist, splash and pressure lubrication)
10. Study of cooling systems of an IC Engine (air cooling and water cooling)
11. To conduct a performance test on diesel engine to draw heat balance sheet for given load and speed
12. To determine friction power of diesel engine by Willan's line or fuel rate extrapolation method.
13. To conduct a performance test on the variable compression ratio engine and to draw the heat balance sheet for given compression ratio, speed and load and plot the performance curves.
14. To conduct a performance test on a four cylinder four stroke petrol engine and to draw the heat balance sheet and performance curves.

Credits	L	T	P	Course Code	Course Title	Category of Course
04	3	1	0	PCC-ME 301	DYNAMICS OF MACHINES	PCC

Unit -I

Force Analysis and Flywheels: Static force analysis of mechanisms, D'Alemberts principle, inertia force and inertia torque, dynamic force analysis, dynamic analysis in reciprocating engines, gas forces, equivalent masses, bearing loads, crank shaft torque, engine shaking forces, turning moment diagrams, flywheels of engines and punch press

Unit -II

Analysis Gear Trains: Force analysis on Simple, compound, reverted and epicyclical gear trains, analytical, tabular, and graphical and vector methods for velocity ratio, gear boxes-sliding and constant mesh for automobile.

Unit -III

Governors: classification of centrifugal governor, Porter, Proell, Hartnell and spring controlled governors, governor effort, power, stability, sensitivity,.

Unit -IV

Gyroscope: Principle of gyroscopic couple, effect of gyroscopic couple and centrifugal force on vehicle taking a turn, stabilization of sea vessels. Inertia force analysis, Velocity and acceleration of slider crank and four bar mechanism, inertia force, piston thrust and forces on connecting rod, turning moment diagram, flywheel.

Unit -V

Dynamometers: absorption and transmission type dynamometers, prony, rope and hydraulic dynamometers braking system of automobiles.

Balancing: Balancing of rotating masses, balancing of reciprocating masses, locomotives, IC Engines, balancing machines.

Text and Reference Books:

1.Theory of Machines and Mechanisms, Uicker, Pennocle and Shigley, Oxford University Press.
2. Mechanism And Machine Theory, Ambekar A. G., Prentice-hall Of India
3. Theory of Mechanisms and Machines, Sharma and Purohit, Prentice-hall Of India
4. Theory of Mechanisms and Machines, Ghosh A., Affiliated East West Press.
5. Theory of Machines, Abdulla Shariff, DhanpatRai Publications.
6. Theory of Machines,S.S. RATAN TATAMcGraw Hill.

Credits	L	T	P	Course Code	Course Title	Category of Course
04	3	1	0	PCC-ME 302	HYDRAULIC MACHINES	PCC

Unit -I

General Concepts : Euler's turbo machinery equation, Specific speed, impulse and reaction principle, Impulse momentum principle, jet impingement on stationary and moving flat plates and vanes, calculations for force exerted, work done and efficiency of jet. Basic components of a turbo machine and its classification.

Hydraulic Devices: Description, operation and application of hydraulic systems – hydraulic ram, hydraulic jack, hydraulic brake, hydraulic accumulator, hydraulic door closer, hydraulic press, selection of specification of above systems for different applications

Unit – II

Pelton Turbine :Components and operation; velocity triangles, work output; Effective head, available power and efficiency; design aspects such as mean diameter of wheel, jet ratio, number of jets, number of buckets with working proportions

Unit – III

Francis and Kaplan Turbines: Components and operation, velocity triangles and work output; working proportions and design parameters for the runner; Degree of reaction; Draft tubes, its function and types. Function and brief description of commonly used surge tanks

Unit – IV

Centrifugal Pumps : Main elements and their functions; Various types and classification; Pressure changes in a pump, suction, delivery and manometric heads; vane shape and its effect on head-capacity relationships; Departure from Euler's theory and losses; pump output and efficiency; Minimum starting speed and impeller diameters at the inner and outer periphery;

Unit – V

Reciprocating Pumps: Components, working principle; pressure variations due to piston acceleration; acceleration effects in suction and delivery pipes; work done against friction; maximum permissible vacuum during suction stroke; Air vessels

Text and Reference Books:

1.Hydraulic Machines by R. K. Rajput, S. Chand publication.

2.Fluid Mechanics and Fluid Power Engineering by Kumar D S, S K Kataria and Sons, Delhi

3. Hydraulic Machines by JagdishLal, Metropolitan Book Co Pvt. Ltd.

4. Sharma PC and Aggarwal DK, "Machine Design", Kataria Publishers (2002)

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	HSMC301	Principles of Management	HSMC

Unit -I

Introduction to Management and Organizations:

Definition of Management – Science or Art – Manager Vs Entrepreneur – types of managers – managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization – Sole proprietorship, partnership, company-public and private sector enterprises – Organization culture and Environment – Current trends and issues in Management.

Unit- II

Planning:

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

Unit-III

Organising:

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design – Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

Unit-IV

Directing:

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication –communication and IT.

Unit- V

Controlling:

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

Text and Reference Books:

1. P C Tripathi and P N Reddy , ‘Principles of management’
2. Davis and H. Olison, ‘Management Information System,Gordan’, McGraw Hill Pub.
3. William Werther and Keith Davis, ‘ Human Resources and Personal Management’

4. V S Ramaswamy and S Namakumari, 'Marketing Management'
5. High Arnold and Daniel Feldman, 'Organization Behavior', McGraw Hill.
6. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management" 7th Edition, Pearson Education, 2011.
7. Robert Kreitner & Mamata Mohapatra, " Management", Biztantra, 2008.
8. Harold Koontz & Heinz Weihrich "Essentials of management" Tata McGraw Hill,1998.

Tripathy PC & Reddy PN, "Principles of Management", Tata McGraw Hill, 1

Credits	L	T	P	Course Code	Course Title	Category of Course
04	3	1	0	PCC-ME 303	HEAT TRANSFER	PCC

Unit -I

Introduction to Heat Transfer Processes: Introduction to three modes of heat transfer, Fourier's law of heat conduction, thermal conductivity, thermal conductivity of solids, liquids and gases, Effect of temperature on thermal conductivity, Newton's law of cooling, Definition of overall heat transfer coefficient, General parameters influence the value of heat transfer coefficient.

Conduction : General 3-Dimensoinal conduction equation in Cartesian, Cylindrical and spherical coordinates, Different kinds of boundary conditions, Nature of differential equations, One-dimensional heat conduction with and without heat generation, Electrical analogy, Heat conduction through composite walls, Critical thickness of insulation.

Unit -II

Heat Transfer from Finned Surfaces: Types of fin, Fin efficiency and effectiveness, Biot number, two dimensional steady state heat conduction using analytical and numerical methods, Periodic heat conduction.

Convection: Review of Navier–Stokes and energy equation, Hydrodynamic and thermal boundary layers, Laminar boundary layer equations, Forced convection appropriate non-dimensional members, Effect of prandtl number, Empirical relations for flow over a flat plate and flow through pipes.

Unit -III

Natural Convection: Dimensional analysis, Grashof number, Boundary layers in external flows (flow over a flat plate only), Boundary layer equations and their solutions, Heat transfer correlations.

Heat Transfer with Change of Phase: Nature of vaporization phenomena, Boiling and Condensation heat transfer, Pool boiling curve, Different regimes of boiling heat transfer, Correlations for saturated liquid vaporization, condensation on flat plates, Correlation of experimental results, Drop wise condensation.

Unit-IV

Heat Exchanger: Different types of heat exchangers, LMTD,Heat transfer coefficient for parallel, Counter and cross flow type heat exchanger, Effectiveness of heat exchanger, N.T.U. method, Fouling factor, Constructional and manufacturing aspects of heat exchangers.

Unit -V

Thermal Radiation: Plank distribution law, Kirchhoff's law, Radiation properties, Diffuse radiations, Lambert's law, Radiation intensity, Heat exchange between two black bodies heat exchanger between gray bodies, Reradiating surfaces heat transfer in presence of radiating surfaces, Shape factor, view factors and the radiosity method.

Text and References Books:

1. Heat Transfer, Holman J.P., Tata McGraw-Hill, New Delhi.

2. Heat and Mass Transfer, Cengel, Tata McGraw-Hill, New Delhi.
3. Heat Transfer , R. S. Khurmi, S. Chand Publication.
4. Heat and Mass Transfer, Kumar D.S., Kataria and Sons.
5. Heat Transfer, Sharma and Lal, Vardhan Publisher Jaipur.
6. Heat and Mass Transfer, Nag P.K., Tata McGraw-Hill, New Delhi.
7. Fundamental of Heat and Mass Transfer, Thirumaleshwar M., Pearson Education.
8. Heat Transfer, Rajput R.K., S. Chand Publication.

Credits	L	T	P	Course Code	Course Title	Category of Course
04	**3**	**1**	**0**	**PCC-ME 304**	**Design of Transmission Systems**	**PCC**

Unit –I

Flexible transmission elements- design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets

Unit – II

Gear transmission- speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears.

Unit – III

Straight bevel gear- tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears; Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pair of helical gears.

Unit – IV

Gear box- geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-seed gear box for machine tool applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications.

Unit – V

Cam design, types: pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes, external shoe brakes, internal expanding shoe brake.

Text and References Books:

1. Shigley, J. E., Mechanical Engineering Design, 5th ed., McGraw-Hill, 1989.
2. Bhandari, V. B., "Design of Machine Element" Tata McGraw-Hill
3. Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill, 2010.

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	PCC-ME 305	MEASUREMENT & METROLOGY	PCC

Unit-I

STANDARD AND MEASUREMENTS; Need of standards, classification primary, secondary and tertiary standards tractability of standards, length standard, line and end standards, derivation of end standards from line standards gauges and their calibration, wave length standards, angle standards, angle, slip gauges , precision polygons and div. circles.

Unit-II

LIMITS, FITS AND TOLERENCES: Concept of interchangeability, type of interchangeability, needs standards system of limits, fits and tolerances, BIS 919, 1963 standard system, selection of limits and exercise on limit, fits and tolerances, design principle for limit gauges. Taylor's principle, types of gauges, tolerances on limit gauges.

Unit-III

MEASURING AND GAUGING INSTRUMENTS; Design principle of measuring instruments,kinematics design, principle of alignment pivots and bearing , sources of error in measurement, calibration of measuring instruments,mechanical linear and angle measuring instrument, vernier callipers, micrometres, dial gauge, bevel protector, sine bar, spirit level , optical instruments, autocollimator tool room microscope, length measuring machines, comperator megnification principles, types of compoerators, mechanical optical pneumatic electrical and electronic comperator.

GEOMETRICAL METROLOGY: Concept of form error, straightness, roundness, squareness and concentricity error and their measurement.

Unit-IV

SCREW THREAD AND GEAR METROLOGY; Element of screw metrology, measurement of major, minor and effective diameters of external and internal screw thread, measurement of pitch and screw thread angel, effect of pitch error , element of gear metrology, measurement of gear tool thickness, gear profile, gear concentricity, pitch and run out for involute gears , gear rolling test.

MACHINE TOOL METROLOGY; alignment tests of machine tools, lathe, drilling machines and milling machine performance test lathe

Unit-V

MEASUREMENT OF SURFACE FINISH: Concept of macro and micro errors , scales, surface roughness measures, datum for surface roughness measurement, M and E system, measurement of surface roughness stylus methods using, mechanical, optical and electrical(talysurf) magnification(Tomlinson testers) (foster)

Text and Reference Books;

1. metrology by R.K.JAIN,
2. khanna publication statistical quality control by M. MAHAJAN, dhanpat rai publication
3. statistical quality control by R.S NAGARAJAN
4. total quality managementby dale H. Bester field publication pearson education
5. metrology ASTM hand book

Credits	L	T	P	Course Code	Course Title	Category of Course
01	**0**	**0**	**2**	**PCC-ME 306**	**HYDRAULIC MACHINES LAB**	**PCC**

LIST OF EXPERIMENTS

1. To Study the Constructional details of Kaplan Turbine and draw Its Fluid Flow Chart.
2. To Study the Constructional details of Francis Turbine and draw Its Fluid Flow Chart
3. To Study the Constructional details of Pelton Turbine and draw Its Fluid Flow Chart
4. To Study the Constructional details of Hydraulic Ram and determine It's Various Efficiencies.
5. To Study the Constructional details of Centrifugal Pump and draw Its Characteristic Curve.
6. To Draw the Following Performance Characteristics of pelton turbine Constant Head, Constant Speed And Constant Efficiency Curve
7. To Draw the Following Performance Characteristics of Francis Turbine Constant Head, Constant Speed and Constant Efficiency Curve.
8. Performance Test on two stage centrifugal pump

Credits	L	T	P	Course Code	Course Title	Category of Course
01	**0**	**0**	**2**	**PCC-ME 307**	**DYNAMICS OF MACHINES LAB**	**PCC**

LIST OF EXPERIMENTS

1. To find experimentally the Gyroscopic couple on Motorized Gyroscope and compare with applied couple
2. To plot force vs. radius and lift vs. speed curves for Governors of Proel.
3. To plot force vs. radius and lift vs. speed curves for Governors of Porter.
4. To plot force vs. radius and lift vs. speed curves for Governors of Hartnell.
5. To plot pressure distribution curves on a journal bearing.
6. To perform wheel balancing.
7. To perform static and dynamic balancing on balancing set up.
8. To determine mass moment of inertia of a flywheel.
9. To study the different types of brakes.
10. To study the various types of dynamometers.

Credits	L	T	P	Course Code	Course Title	Category of Course
01	**0**	**0**	**2**	**PCC-ME 308**	**HEAT TRANSFER LAB**	**PCC**

LIST OF EXPERIMENTS

1. To determine thermal conductivity of Insulating Powders.
2. To determine thermal conductivity of a Good Conductor of Heat (Metal Rod).
3. To Measure the thermal conductivity of Liquid.
4. To determine the transfer Rate and Temperature Distribution for a Pin Fin.
5. To Determine Stefan Boltzmann Constant of Radiation Heat Transfer.
6. To Determine Heat Transfer Coefficient For Heated Vertical Cylinder in Natural Convection.
7. Determination of Heat Transfer Coefficient in Drop Wise and Film Wise condensation.
8. To Determine Critical Heat Flux in Saturated Pool Boiling.
9. To Study Performance of Simple Heat Pipes by force convection air flowing through it for different flow rate and heat flow rate.
10. To Study and Compare LMTD and Effectiveness in Parallel and Counter Flow Heat Exchangers.
11. To Find the Heat transfer Coefficient in Forced Convection in a tube. .
12. To find out the thermal conductivity of given slab.
13. To study the rates of heat transfer for different materials and geometries
14. To study the heat transfer through the insulating medium.

Credits	L	T	P	Course Code	Course Title	Category of Course
01	**0**	**0**	**2**	**PCC-ME 309**	**MEASUREMENT& METROLOGY LAB**	**PCC**

LIST OF EXPERIMENTS

1. Calibration of Pressure Gauge
2. Calibration of Thermocouple
3. Calibration of LVDT
4. Calibration of Load cell
5. Determination of modulus of elasticity of a mild steel specimen using strain gauges.
6. Measurements using Optical Projector / Toolmaker Microscope.
7. Measurement of angle using Sine Center / Sine bar / bevel protractor
8. Measurement of alignment using Autocollimator / Roller set
9. Measurement of Screw threads Parameters using Two wire or Three wire method.
10. Measurements of Surface roughness, Using Tally Surf/Mechanical Comparator
11. Measurement of gear tooth profile using gear tooth vernier / flange micrometer
12. Calibration of Micrometer using slip gauges.
13. Measurement using Optical Flats.
14. Use of dial indicator for measuring taper.
15. Use of combination set, bevel protector and sine bar for measuring taper.
16. Measurement of thread characteristic using vernier and gauges.
17. Use of slip gauge in measurement of centre distance between two pins.
18. Study of tolerance-limt-fit.

Mechanical Engineering (B. Tech.), V Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
01	**0**	**0**	**2**	**PROJ-ME 301**	**INDUSTRIAL TRAINING-I SEMINAR**	**PROJ**

Objective of Industrial Training: The objective of industrial training is to provide work experience so that students engineering knowledge is enhanced and employment prospects are improved. The student should take this course as a window to the real World and should try to learn as much as possible from real life experiences by involving and interacting with industry staff. Industrial training also provides an opportunity to students to select an engineering problem and possibly an industry guide for their Major Project in final semester.

Scheme of Studies: Duration 4 weeks in summer break after IV semester, assessment to be done in V semester practical examination .During training students will prepare a first draft of training report in consultation with section in charge. After training they will prepare final draft with the help of Faculty of the concern Department of mechanical engineering. Then they will present a seminar on their training and present it in the institute in front of the committee headed by the HOD/Faculty Member.

Learning through Industrial Training: During industrial training students must observe following to enrich their learning:

- Industrial environment and work culture.
- Organizational structure and inter personal communication.
- Machines/equipment/instrument-their working and specifications.
- Product development procedure and phases.
- Project Planning, monitoring and control.
- Quality control and assurance.
- Maintenance system Costing system Stores and purchase systems.
- Layout of Computer/EDP/MIS centres.
- Problems related to various areas of work etc.
- Students are supposed to acquire the knowledge on above by Direct Observations without disturbing personnel at work.
- Interaction with officials at the workplace in free/ tea time Study of Literature at the workplace (e.g. User Manual, standards, processes, schedules, etc.)
- Hands on" experience Undertaking/assisting project work. Solving problems at the work place.
- Presenting a seminar participating in group meeting/discussion.
- Consulting current technical journals and periodicals in the library.

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	PCC-ME 310	AUTOMOBILE ENGINEERING	PCC

UNIT-I

Introduction to Automobiles : Classification, Components, Requirements of Automobile Body; Vehicle Frame, Separate Body & Frame, Unitised Body, Car Body Styles, Bus Body & Commercial Vehicle Body Types; Front Engine Rear Drive & Front Engine Front Drive Vehicles, Four Wheel Drive Vehicles, Safety considerations; Safety features of latest vehicle; Future trends in automobiles.

UNIT-II

Clutches : Requirement of Clutches – Principle of Friction Clutch – Wet Type & Dry Types; Cone Clutch, Single Plate Clutch, Diaphragm Spring Clutch, Multi plate Clutch, Centrifugal Clutches, Electromagnetic Clutch, Over Running Clutch; Clutch Linkages.

Power Transmission : Requirements of transmission system; General Arrangement of Power Transmission system; Object of the Gear Box; Different types of Gear Boxes; Sliding Mesh, Constant Mesh, Synchro- mesh Gear Boxes; Epi-cyclic Gear Box, Freewheel Unit. Overdrive unit-Principle of Overdrive, Advantage of Overdrive, Transaxle, Transfer cases.

UNIT-III

Drive Lines, Universal Joint, Differential and Drive Axles: Effect of driving thrust and torque reactions; Hotchkiss Drive, Torque Tube Drive and radius Rods; Propeller Shaft, Universal Joints, Slip Joint; Constant Velocity Universal Joints; Front Wheel Drive; Principle, Function, Construction & Operation of Differential; Rear Axles, Types of load coming on Rear Axles, Full Floating, Three quarter Floating and Semi Floating Rear Axles.

Suspension Systems: Need of Suspension System, Types of Suspension; factors influencing ride comfort, Suspension Spring; Constructional details and characteristics of leaf springs.

UNIT-IV

Steering System : Front Wheel geometry & Wheel alignment viz. Caster, Camber, King pin Inclination, Toe-in/Toe-out; Conditions for true rolling motions of Wheels during steering; Different types of Steering Gear Boxes; Steering linkages and layout; Power steering – Rack & Pinion Power Steering Gear, Electronics steering.

UNIT-V

Automotive Brakes, Tyres & Wheels : Classification of Brakes; Principle and constructional details of Drum Brakes, Disc Brakes; Brake actuating systems; Mechanical, Hydraulic, Pneumatic Brakes; Factors affecting Brake performance, Power & Power Assisted Brakes; Tyres

of Wheels; Types of Tyre & their constructional details, Wheel Balancing, Tyre Rotation; Types of Tyre wear & their causes.

Text and Reference books:

1. Automobile Engineering by Anil Chhikara, Satya Prakashan, New Delhi.

2. Automobile Engineering by Dr. Kirpal Singh, standard Publishers Distributors.

3. Automobile Engineering by D.S.Kumar, S.K.Kataria and Sons, New DelhiMechanical Engineering

(B. Tech.), VI Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
04	3	1	0	PCC-ME 311	MECHNAICAL VIBRATION	PCC

Unit-I

INTRODUCTION: Study of Vibrations, Mathematical Modelling, Degree of Freedom, Classification of Vibration, Simple Harmonic Motion,

SINGLE DEGREE OF FREEDOM (SDOF) SYSTEMS: Springs, Elastic Elements as Springs, Parallel, Series and General Combination of Springs, Other Sources of Potential Energy, Viscous Damping, Inertia Elements, Equivalent Mass, Inertia Effects of Springs, Free-Body Diagram Method, Small Angle or Displacement Assumption, Equivalent Systems Method

Unit-II

FREE VIBRATIONS OF SDOF SYSTEMS: Standard Form of Differential Equation, Free Vibrations of an Undammed System, Under damped, Critically Damped, over damped Free Vibrations, Coulomb Damping, Hysteretic Damping,

Unit-III

HARMONIC EXCITATION OF SDOF SYSTEMS: Forced Response of a Viscously Damped System Subject to a Single-Frequency Harmonic Excitation, Frequency-Squared Excitations, Rotating Unbalance, Response Due to Harmonic Excitation of Support, Vibration Isolation, Vibration Isolation from Frequency-Squared Excitations, Practical Aspects of Vibration Isolation, Seismic Vibration Measuring Instruments, Seismometers, Accelerometers

Unit-IV

TWO DEGREE-OF-FREEDOM SYSTEMS: Derivation of the Equations of Motion, Natural Frequencies and Mode Shapes, Free Response of Undamped Systems, Free Vibrations of a System with Viscous Damping, Harmonic Response of Two Degree-Of-Freedom Systems, Frequency Response , Dynamic Vibration Absorbers

Unit-V

NOISE: Effects, Ratings and Regulations, Non-auditory effects of noise on people, Auditory Effects of noise, Noise standards and limits in India, Major sources of the noise, Industrial noise sources, Industrial noise control-strategies, Noise control at the source, Noise control along the path, Acoustic barriers, Noise control at the receiver.

SOUND LEVEL AND SUBJECTIVE RESPONSE TO SOUND: Frequency dependent human response to sound, Sound pressure dependent human response, Decibel scale, Decibel addition, subtraction and averaging, Relationship among sound power, sound intensity and sound pressure level, Sound spectra, Octave band analysis, Loudness.

Text and Reference Books:

1. S. Graham Kelly: Mechanical Vibrations: Theory and Applications
2. Den Hartog, J. P.: Mechanical Vibrations
3. Rao, S. S.: Mechanical Vibrations
4. J. S. Rao, Dr. K. Gupta: Introductory Course on Theory and Practice of Mechanical Vibrations
5. Mechanical Vibrations: G.K.Grover

Mechanical Engineering (B. Tech.), VI Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
04	3	1	0	PCC-ME 312	OPERATION RESEACH	PCC

Unit-I

Basics of operations research, linear programming, scope, problem formulation, graphical method, simplex methods, primal and dual problem sensitivity analysis.

Unit-II

Transportation and assignment problems, deterministic dynamic programming, multistage decision problems and solution, principle of optimality.

Unit-III

Decision theory, decision under various conditions, game theory, two person zero sum game, solution with/without saddle point, dominance rule, methods like algebraic, graphical, liner programming sequencing basic assumption, *n* jobs through two/three machines, jobs on *m* machines.

Unit-IV

Stochastic inventory models - single and multi-period models with continuous and discrete demands, service level and reorder policy simulations - use, advantages& limitations, Monte-Carlo simulation, application to queuing, inventory and other problems.

Unit-V

Queuing models, characteristics of queuing model, M/M/1 and M/M/S system, cost consideration, project management concepts, rules for drawing the network diagram, Applications of CPM and PERT in project planning and control; crashing of operations; resource allocation.

Text and References Books:

1. Operations Research, Wangner
2. Operations Research, Taha
3. Introduction to Management Science, Hiller & Hiller
4. Operations Research by, Wayne L. Winston

PROFESSIONAL ELECTIVE COURSE (PEC)

Professional Elective-I

Mechanical Engineering (B. Tech.), VI Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
04	3	1	0	PEC-ME-301	Applied Thermodynamics	PEC

Unit -I

Steam Boiler: Boilers and their classification, comparison between fire tube and water tube boilers, essentials of a good boiler. Constructional and operational details of Locomotive, Babcock-Wilcox, and Lamont boilers, Boiler mountings and accessories. Natural draft from chimney, height of chimney, maximum draft and chimney efficiency, forced draft and induced draft, Boiler Heat Balance Sheet.

Unit -II

Compressible flow: Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas table for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, super-saturation- compressible flow in diffusers, efficiency of nozzle and diffuser. Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of inter-cooling, minimum work for multistage reciprocating compressors.

Unit -III

Steam Turbines: Classification, flow through impulse blades, velocity diagram, calculation of power output and efficiency, maximum blade efficiency of single stage impulse turbine, blade friction, compounding of impulse turbine. Flow through impulse reaction blades, degree of reaction, velocity diagram, calculations for power output, efficiency and blade height, comparison of impulse and impulse reaction turbines.

Unit -IV

Efficiency and Governing in Steam Turbines: Losses in steam turbines, stage efficiency overall efficiency and reheat factor. Governing of steam turbines, throttle governing, nozzle control governing and by pass governing. Steam for heating and process work, back pressure turbines and pass out turbines.

Unit -V

Steam Condensers: Elements of a condensing plant, types of condensers, comparison of jet and surface condensers. Condenser vacuum, air leakage and loss of vacuum, vacuum efficiency and condenser efficiency, Dalton's law and air vapour mixture, air pumps.

Pschyrometric chart: Properties of dry and wet air, use of schyrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.

Text and Reference books

1. Thermodynamics – An Engineering Approach, Cengel, Y.A., & Boles, M.A, McGraw – Hill Inc.
2. Thermal Engineering, Rajput, R.K., Laxmi Publications.
3. Engineering Thermodynamics by P.K.Nag, Tata McGraw Hill Pub
4. Thermodynamics and Heat Engines, Vol-II, R. Yadav, Central Publishing House.
5. A textbook of Thermal Engineering, R.S.Khurmi, S.Chand & Sons.
6. Thermal Engineering, Bellany, P.L., Khanna Publishers.
7. Applied Thermodynamics for Engineering Technologists, T.D. Eastop & A McConkey, Pearson Education.
8. Heat Engineering, V.P. Vasandani & D.S. Kumar, Metropolitan Book Co. Pvt. Ltd.

Professional Elective-I

Mechanical Engineering (B. Tech.), VI Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
04	3	1	0	PEC-ME-302	Tribology	PEC

Unit -I

Introduction to the concept of tribo design: Principles of tribodesign, tribological problems in machine design, Plain sliding bearings, Rolling contract bearings, piston rings and cylinder liners.

Unit-II

Elements of Contact mechanics: Introduction, Concentrated and distributed forces on plane surfaces, Contact between two elastic bodies in the form of spheres, Contact between cylinders and between bodies of general shape, Failures of contacting surfaces. Thermal effects in surface contact.

Unit -III

Friction, lubrication and wear in lower kinematic pairs: Introduction, The concept of friction angle, Friction in screws with a square thread, Friction in screws with a triangular thread, , Boundary lubricated sliding bearings.

Unit -IV

Sliding-element bearings : Derivation of the Reynolds equation, Hydrostatic bearings Squeeze-film lubrication bearings, Thrust bearings, Journal bearings, Journal bearings for specialized applications, Gas bearings, Dynamically loaded journal bearings Modern developments in journal bearing design, Selection and design of thrust bearings self-lubricating bearings.

Unit -V

Rolling contact bearings: Introduction, Analysis of friction in rolling-contact bearings, Deformations in rolling contact bearings, Kinematics of rolling-contact bearings, Lubrication of rolling-contact bearings, Acoustic emission in rolling-contact bearings.

Text and Reference books

1. Dudley D.Fulier" Theory and practice of Lubrication for Engineers", New YorkCompany.1998
2. Moore "Principles and applications of Tribology" Pergamon press, 1975
3. Oscar Pinkus, BenoSternlicht, “Theory of hydrodynamic lubrication”, McGraw-Hill, 1961
7. Tribology in Machine Design by T.A. Stolarski

Professional Elective-I

Mechanical Engineering (B. Tech.), VI Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
04	3	1	0	PEC-ME-303	Numerical Methods & Analysis	PEC

Unit-I

Basic concepts: round-off errors, floating point arithmetic, Convergence. Numerical solution of Nonlinear Equations a) Bisection method, fixed-point iteration, Newton's method, Error analysis for Iterative Methods, Computing roots of polynomials.

Unit-II

Interpolation and Polynomial Approximation: LaGrange Polynomial, Divided Differences, Hermite Interpolation

Unit-III

Numerical integration and differentiation: Trapezoidal rule, etc., Gaussian quadrature and Euler-Maclaurin formula. Applied Linear Algebra, Direct methods for solving linear systems, numerical factorizations, Eigenvalue problems.

Unit-IV

IVP problems for ODE:Euler's, Taylor, Runge-Kutta, and multistep methods, Stability,Numerical linear algebra,Direct methods,Iterative methods

Unit-V

Approximation theory :Least square approximation,Approximating Eigenvalues,Power method, Householder's method , BVP for ODE ,Shooting method

Text and Reference books

[1] J. Stoer and R. Bulirsch, Introduction to Numerical Analysis, Springer-Verlag, ISBN 0-387-90420-4

[2] L.N. Trefethen and D. Bau, Numerical Linear Algebra, Society of Industrial and Applied Mathematics

[3] C.T. Kelley, Iterative methods for linear and nonlinear equations, Society of Industrial and Applied Mathematics

OPEN ELECTIVE COURSE (OEC)

Open Elective-I

Mechanical Engineering (B. Tech.), VI Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	OEC301	Instrumentation &Control	OEC

Unit-I

Definition — Basic principles of measurement — Measurement systems, generalized configuration and functional descriptions of measuring instruments — examples. Dynamic performance characteristics — sources of error, Classification and elimination of error.

Measurement of Displacement: Theory and construction of various transducers to measure displacement — Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

Measurement of Temperature: Classification — Ranges — Various Principles of measurement — Expansion, Electrical Resistance — Thermistor — Thermocouple — Pyrometers — Temperature Indicators

Unit-II

Measurement of Pressure: Units — classification — different principles used. Manometers, Piston, Bourdon pressure gauges, Bellows — Diaphragm gauges. Low pressure measurement — Thermal conductivity gauges — ionization pressure gauges, Mcleod pressure gauge.

Measurement of Level: Direct method — Indirect methods — capacitative, ultrasonic, magnetic, cryogenic fuel level indicators — Bubbler level indicators.

Unit-III

Flow Measurement: Rota meter, magnetic, Ultrasonic, Turbine flow meter, Hot — wire anemometer, Laser Doppler Anemometer (LDA).

Measurement of Speed: Mechanical Tachometers — Electrical tachometers — Stroboscope, Non- contact type of tachometer.

Measurement of Acceleration and Vibration: Different simple instruments — Principles of Seismic instruments — Vibro meter and accelerator meter using this principle.

Unit-IV

Stress Strain Measurements: Various types of stress and strain measurements — electrical strain gauge — gauge factor — method of usage of resistance strain gauge for bending compressive and tensile strains — usage for measuring torque, Strain gauge Rosettes.

Measurement of Humidity: Moisture content of gases, sling psychrometer, Absorption psychrometer, Dew point meter.

Measurement Of Force, Torque And Power: Elastic force meters, load cells, Torsion meters, Dynamometers.

Unit-V

Elements of Control Systems: Introduction, Importance — Classification — Open and closed systems Servomechanisms — Examples with block diagrams — Temperature, speed and position control systems.

Text and Reference Books

1. Measurement Systems: Applications & Design I D.S Kumar/Anuradha Agencies.
2. Instrumentation, measurement & analysis IB.C.Nakra & K.K.Choudhary/ TMH.
3. Beckwith Thomas G., "Mechanical Measurements", Narosa Publishing House, New Delhi.
4. Doeblein E. O., "Measurement Systems", Application Design, Mc Graw Hill, 1990
5. Kumar K. J., "Engineering metrology", MacDonald and Co, 1963
6. Gupta I. C., "Engineering Metrology", Dhanpat Rai & Sons, New Delhi, 1994.

Open Elective-I

Mechanical Engineering (B. Tech.), VI Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	OEC-302	Total Quality Management	OEC

UNIT-I

Introduction: Evolution of Quality Management, Philosophy, Concepts of Product and Service Quality, Dimensions of Quality, Quality Guru's, Quality Awards, Quality Cost.

UNIT-II

Quality Assurance: Inspection, Quality control, Quality assurance, Concept and Advantage of quality assurance, Quality rating, Quality survey/audit, Vendor rating, Quality function deployment.

Process Quality Improvement: Introduction to Process Quality, Graphical and statistical techniques for Process Quality Improvement, Graphical tools for data representation, 7QC tools, Process capability analysis, Measurement system analysis.

UNIT-III

Acceptance Sampling: Concept of acceptance sampling, advantage and limitations of sampling inspection, Sampling methods, Operating characteristics curve, producer and consumer risk, Average outgoing quality limits, sampling plans, sampling plans for variables, Problems.

UNIT-IV

Control Charts: Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables - $\bar{x}$and R charts, attribute control charts - p, np, c and u-Construction and application, Problems.

UNIT-V

Contemporary Trends in Quality Engineering & Management: Introduction to Quality Management Standards – ISO : 9000, ISO:14000, Reliability, Quality circles, Concept of Six sigma, Basic steps involve in six sigma, National and International bodies for quality aspects, Introduction to Japanese's quality techniques such as 5S, Kaizen, SMED, TQM,TPM.

Text and References Books:

1. Lt. Gen. H.LaI, "Total Quality management", Wiley Eastern Limited, 1990. .
2. Greg Bounds. "Beyond Total Quality Management". McGraw Hill, 1994.
3. Menon, H.G, "TQM in New Product manufacturing", McGraw Hill 1992.

Open Elective-I

Mechanical Engineering (B. Tech.), VI Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	OEC-303	PRODUCT DESIGN AND DEVELOPMENT	OEC

Unit-I

Need for developing products – the importance of engineering design – types of design –the design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process – various phases of product development-planning for products –establishing markets- market segments- relevance of market research

Unit-II

Identifying customer needs –voice of customer –customer populations- hierarchy of human needsneed gathering methods – affinity diagrams – needs importance- establishing engineering characteristics-competitive benchmarking- quality function deployment- house of quality-product design specification-case studies

Unit-III

Creative thinking –creativity and problem solving- creative thinking methods- generating design concepts-systematic methods for designing –functional decomposition – physical decomposition – functional representation –morphological methods-TRIZ- axiomatic design

Unit-IV

Decision making –decision theory –utility theory –decision trees –concept evaluation methods – Pugh concept selection method- weighted decision matrix –analytic hierarchy process – introduction to embodiment design –product architecture – types of modular architecture –steps in developing product architecture

Unit-V

Industrial design – human factors design –user friendly design – design for serviceability – design for environment – prototyping and testing – cost evaluation –categories of cost –overhead costs – activity based costing –methods of developing cost estimates – manufacturing cost – value analysis in costing

References Books

1. George E.Dieter, Linda C.Schmidt, “Engineering Design”, McGraw-Hill International Edition, 4th Edition, 2009, ISBN 978-007-127189-9

2. Anita Goyal, Karl T Ulrich, Steven D Eppinger, “Product Design and Development “, 4th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9

3. Kevin Otto, Kristin Wood, “Product Design”, Indian Reprint 2004, Pearson Education,ISBN 9788177588217

4. Yousef Haik, T. M. M. Shahin, “Engineering Design Process”, 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141

Open Elective-II

Mechanical Engineering (B. Tech.), VI Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	OEC-304	Cyber Laws And Security	OEC

UNIT-I

History of Information Systems and its Importance, basics, Changing Nature of Information Systems, Need of Distributed Information Systems, Role of Internet and Web Services, Information System Threats and attacks, Classification of Threats and Assessing Damages Security in Mobile and Wireless Computing- Security Challenges in Mobile Devices, authentication Service Security, Security Implication for organizations, Laptops Security Basic Principles of Information Security, Confidentiality, Integrity Availability and other terms in Information Security, Information Classification and their Roles.

UNIT-II

Security Threats to E Commerce, Virtual Organization, Business Transactions on Web, E Governance and EDI, Concepts in Electronics payment systems, E Cash, Credit/Debit Cards. Physical Security- Needs, Disaster and Controls, Basic Tenets of Physical Security and Physical Entry Controls, Access Control- Biometrics, Factors in Biometrics Systems, Benefits, Criteria for selection of biometrics, Design Issues in Biometric Systems, Interoperability Issues, Economic and Social Aspects, Legal Challenges

UNIT-III

Model of Cryptographic Systems, Issues in Documents Security, System of Keys, Public Key Cryptography, Digital Signature, Requirement of Digital Signature System, Finger Prints, Firewalls

UNIT-IV

Design and Implementation Issues, Policies Network Security- Basic Concepts, Dimensions, Perimeter for Network Protection, Network Attacks, Need of Intrusion Monitoring and Detection, Intrusion Detection Virtual Private Networks- Need, Use of Tunneling with VPN, Authentication Mechanisms, Types of VPNs and their Usage, Security Concerns in VPN

UNIT-V

Security metrics- Classification and their benefits Information Security & Law, IPR, Patent Law, Copyright Law, Legal Issues in Data mining Security, Building Security into Software Life Cycle Ethics- Ethical Issues, Issues in Data and Software Privacy Cyber Crime Types & overview of Cyber Crimes

Text and References Books:

1. Godbole,“ Information Systems Security”, Willey

2. Merkov, Breithaupt, “ Information Security”, Pearson Education

Open Elective-II

Mechanical Engineering (B. Tech.), VI Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	OEC-305	Soft Computing	OEC

Unit-I

Neural Networks: History, overview of biological Neuro-system, Mathematical Models of Neurons, ANN architecture, Learning rules, Learning Paradigms- Supervised, Unsupervised and reinforcement Learning, ANN training Algorithm perceptions, Training rules, Delta, Back Propagation Algorithm, Multilayer Perception Model, Hopfield Networks, Associative Memories, Applications of Artificial Neural Networks.

Unit-II

Fuzzy Logic: Introduction to Fuzzy Logic, Classical and Fuzzy Sets: Overview of Classical Sets, Membership Function, Fuzzy rule generation.

Unit-III

Operations on Fuzzy Sets: Compliment, Intersections, Unions, Combinations of Operations, Aggregation Operations.

Unit-IV

Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations.

Unit-V

Fuzzy Logic: Classical Logic, Multivalued Logics, Fuzzy Propositions, Fuzzy Qualifiers, Linguistic Hedges. Uncertainty based Information: Information & Uncertainty, Nonspecificity of Fuzzy & Crisp Sets, Fuzziness of Fuzzy Sets. Genetic Algorithms, Scope & application areas, solution of 0-1Knapsack problem using GA

Text and Reference books:

1. "Fuzzy sets and Fuzzy Logic: Theory and applications",G.J. Klir,B.Yuan, PHI
2. "Introduction to Fuzzy sets and Fuzzy Logic", M.Ganesh , PHI
3. "An Introduction to Fuzzy Control", D Driankov, H Hellendoorn, M Reinfrank, Narosa Publishing Company
4. " Neural Networks: A classroom approach", Satish Kumar , Tata McGraw Hill
5. Haykin S., "Neural Networks-A Comprehensive Foundations", Prentice-Hall International, New Jersey, 1999.

Open Elective-II

Mechanical Engineering (B. Tech.), VI Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	OEC-306	Special Electrical Machines	OEC

UNIT 1

Different types of FHP motors and uses in domestic & industrial applications, Single phase Induction motor, Qualitative examination starting and running performance of I-Phase Induction Motors.

UNIT 2

Linear Induction Motors and Actuators and its principle of operation, Linear Levitated machine & applications, Permanent magnet motors, High performance energy efficient machines, Effect of E.M.F injected into secondary circuits, quantitative study, scharge motor.

UNIT 3

Special Induction generations, Special motors and generators associated with Wind, Solar, Tidal, Biogas and other unconventional energy forms and their applications.

UNIT 4

Synchronous motors, Series universal motors, Stepper motor, Servo motor, Typical applications in Computers, Electronics, Communications and Information Technologies.

UNIT 5

Permanent magnet D.C. motor, Permanent magnet AC motors, Switch reluctance motors. Shaded pole motor, brush less D.C motor, Typical applications in Computers, Electronics, Communications and Information Technologies.

Text and References books:

1. Generalized Electrical Machines by P. S. Bhimbra
2 Generations of Electrical Energy by A. E. Fitzgerald/Charles , Kingsley J. R.
3 The Performance &design of A.C Commutator Motor by O.E .Taylor
4 Performance & Design of A.C machines by M.G. Say

Credits	L	T	P	Course Code	Course Title	Category of Course
01	**0**	**0**	**2**	**PCC-ME-313**	**AUTOMOBILE ENGINEERING LAB**	**PCC**

LIST OF EXPERIMENTS

1. Study of cooling system of an automotive vehicle
2. Study of the ignition system, setting of contact breaker points and spark plug gap
3. Demonstration of steering system and measurement of steering geometry angles and their impact on vehicle performance.
4. Model Study of braking system with specific reference to master cylinder, brake shoes, overhauling of system and the adjusting of the system.
5. Model Study of transmission system elements as clutches, gear box assembly and differential.
6. Replacing of ring and studying the method of replacing piston after repair.
7. Model Study of fuel injection system, carburettor.

Credits	L	T	P	Course Code	Course Title	Category of Course
01	**0**	**0**	**2**	**PCC-ME-314**	**Mechanical Vibration Lab**	**PCC**

LIST OF EXPERIMENTS

1. To verify relation $T = 2\pi * (l/g)^{1/2}$ for a simple pendulum.
2. To determine radius of gyration of compound pendulum.
3. To determine the radius of gyration of given bar by using bifilar suspension.
4. To determine natural frequency of a spring mass system.
5. To study undammed free vibration of Equivalent spring mass system.
6. To determine natural frequency of free torsional vibrations of single rotor system.
    i. Horizontal rotor
    ii. Vertical rotor
7. To study the damped torsional oscillation and to determine the damping coefficient.
8. To verify the dunker ley's rule Viz.
9. Study the forced vibration of the beam for different damping.
10. Study of Vibration measuring instruments.
11. To study torsional vibration of single rotor system.
12. To study the free vibration of two rotor system and to determine the natural frequency of vibration theoretically and experimentally.

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	PCC-ME 401	COMPUTER AIDED DESIGN	PCC

Unit-I

Fundamentals of Computer Graphics- Product cycle, sequential and concurrent engineering, Computer Aided Design, CAD system architecture, computer graphics, Coordinate systems, 2D and 3D transformations, viewing transformation

Unit-II

Geometric Modeling- representation of curves, Hermit curves, Bezier curves, B-spline curves, rational curves, Techniques of surface modeling, surface patch, Coons and bicubic patches, Bezier and B-spline surfaces

Unit -III

Parametric representation of curves, Plane curves - line, circle, ellipse, parabola and hyperbola, , Solid modeling techniques, CSG and B-rep. Visual realism- hidden line-surface-solid removal algorithms, shading, colouring, computer animation

Unit -IV

Scan Conversion, Rendering, Rasterising polygons, Hidden surface removal, Antialiasing, Reflection, shading, generation of character

Computer Hardware: Introduction, Classification, fundamental of computer; Data communication, Design of workstation, Interactive display devices, Input devices, Output devices.

Unit -V

Assembly of parts- assembly modelling, interferences of positions and orientation, tolerance analysis, mass property calculations, mechanism simulation and interefence checking CAD standards- Graphical Kernel System (GKS), standards for vexchange images, Open Graphics Library (OpenGL), Data exchange standards- IGES, STEP, CALS etc.,

Communication standards

Text and References Books:

1. Mathematical elements for Computer Graphics, Rogers and Adams, Tata McGraw Hill
2. CAD/CAM: Theory and Practice, Zeid and Sivasubramanian., Tata McGraw Hill
3. Elements of Computer Aided Design and Manufacturing, Pao Y.C., John Wiley and Sons.

Credits	L	T	P	Course Code	Course Title	Category of Course
04	**3**	**1**	**0**	**PCC-ME 402**	**REFRIGERATION & AIR CONDITIONING**	**PCC**

Unit-I

Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect and C.O.P.,Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Boot strap refrigeration.

Unit-II

Vapour Compression System, Single stage system, Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P., Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P. of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirements, Inter cooling, Different configuration of multistage system, Cascade system.

Unit-III

Principle of vapour absorption refrigeration system, Comparison between absorption and compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature - concentration diagram and Enthalpy – concentration diagram, Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium- Bromide water vapour absorption system, Comparison. Refrigerants: Classification, nomenclature, properties, Types of refrigerants.

Unit-IV

Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside and outside design conditions, Heat transfer through walls & roofs, Infiltration and ventilation, Internal heat gain, Sensible heat factor, By pass factor, Grand Sensible heat factor, Apparatus dew point.

Unit-V

Refrigeration and air conditioning equipment's: Compressors, Condensers, Evaporators &Expansion devices, Air washers, Cooling towers and humidifying efficiency, Cold storage and food preservation, Freezers, Ice plant, Water coolers, Basic difference between comfort and industrial air conditioning.

Text and Reference Books:

1. R.S. Khurmi and J. K. Gupta, Refrigeration and Air conditioning, S Chand publication.
2. Arora, C.P., Refrigeration and Air conditioning, Tata McGraw Hill, 2nd Edition, 2000.
3. Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982.
4. Refrigeration and Air conditioning, Arora and Domkundwar.

Mechanical Engineering (B. Tech.), VII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	HSMC 401	Engineering Economics	HSMC

Unit -I

Basic Principles and Methodology of Economics. Demand/Supply – elasticity – Government Policies and Application. Theory of the Firm and Market Structure. Basic Macro-economic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes

Unit –II

Public Sector Economics –Welfare, Externalities, Labour Market. Components of Monetary and Financial System, Central Bank –Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets. Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve.

Unit -III

Elements of Business/Managerial Economics and forms of organizations. Cost &Cost Control – Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cashflows). Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method.

Unit -IV

Indian economy - Brief overview of post-independence period – plans. Post reform Growth, Structure of productive activity. Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization. Employment–Informal, Organized, Unorganized, Public, Private. Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors.

Unit -V

Estimation / Measurements for various items- Introduction to the process of Estimation; Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labour costs; rate analysis; Material survey-Thumb rules for computation of materials requirement for different materials for buildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials. Use of Computers in quantity surveying.

Text and Reference Books:

1. Mankiw Gregory N. (2002), Principles of Economics, Thompson Asia
2. V. Mote, S. Paul, G. Gupta(2004), Managerial Economics, Tata McGraw Hill
3. Misra, S.K. and Puri (2009), Indian Economy, Himalaya
4. Pareek Saroj (2003), Textbook of Business Economics, Sunrise Publishers
5. M Chakravarty, Estimating, Costing Specifications & Valuation

Professional Elective-II

Mechanical Engineering (B. Tech.), VII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	PEC-ME-401	Welding Technology	PEC

Unit-1

Electron beam welding, friction stir welding, plasma arc welding and ultrasonic welding, Laser beam welding, types of lasers, equipment, power calculation, applications, dual laser beam welding

Unit-II

Ultrasonic welding**,** propagation of ultrasonic waves in matter, mode of joint formation, joint types and design of product for ultrasonic welding, details of equipment

Unit-III

Investment casting, shell moulding, squeeze casting, vacuum casting, counter-gravity low - pressure casting, directional and mono-crystal solidification, semisolid metal casting and forging.

Unit-IV

Design of weldment, determination of distortion in weldments, modeling of temperature distribution. Design for casting, determination of hot spots, location of turbulence and other defects, modeling of flow in molds, modeling of heat transfer in castings.

Unit-V

NDT methods for welding, visual inspection, radio graphic, die penetrant, ultrasonic and magnetic particle **inspection** techniques.

Text and Reference Books:

1. Ravi B, Metal Casting- Computer Aided Design and Analysis, Prentice Hall, 2005.
2. Richard L Little, Welding and Welding Technology, Tata McGraw Hill, 2004.
3. John Campbell, Casting Practice, Elsevier Science Publishing Co., 2004.
4. Larry Jeffus, Welding: Principles and Applications, Delmar Publishers, 2004.
5. John Campbell, Casting, Butterworth Heinemann, 2003.
6. Klas Weman, Welding Processes Handbook, 2003.
7. Howard B Cary, Modern Welding Technology, Prentice Hall, 2002.
8. Larry Jeffus, Welding for Collision Repair, Delmar Publishers, 1999.

Professional Elective-II

Mechanical Engineering (B. Tech.), VII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	**3**	**0**	**0**	**PEC-ME-402**	**Advanced strength of material**	**PEC**

Unit-I

Introduction to Cartesian tensors, Strains: Concept of strain, derivation of small strain tensor and compatibility, Stress: Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions

Unit-II

Constitutive equations: Generalized Hooke's law, Linear elasticity, Material symmetry; Boundary Value Problems: concepts of uniqueness and superposition.

Unit-III

Plane stress and plane strain problems, introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems.

Unit-IV

Application to thick cylinders, rotating discs, torsion of non-circular cross-sections, stress concentration problems, thermo-elasticity, 2-d contact problems.

Unit-V

Solutions using potentials. Energy methods. Introduction to plasticity.

Text and Reference books

[1] G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press, 2004.

[2] Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International, 1965.

[3] Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international, 1969.

Professional Elective-II

Mechanical Engineering (B. Tech.), VII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	PEC-ME-403	Production planning &control	PEC

Unit-I

Introduction to Production Systems: Production Systems: Classification & Characterization, Overview of Production Planning and Control issues, Review of EOQ & inventory control systems.

Unit-II

Just in Time Production Systems: Just-in-Time System: Evolution, Characteristics of JIT Systems, Continuous Improvement, The Kanban System, Strategic Implications of JIT System.

Unit-III

Material Requirement Planning: Dependent Demand & Material Requirement Planning, Structure of MRP system, MRP Calculations, Planning Issues, Implementation Issues.

Unit-IV

Factory Physics: Basic factory dynamics, Variability basics, Push and pull production systems, Lean manufacturing.

Aggregate Planning: Aggregate Planning: Purpose & Methods, Reactive and Aggressive Alternatives, Planning Strategies, Master Production Scheduling.

Unit-V

Issues in PPC: New developments in Planning & Control of Product-focused Systems and Process-focused Systems, Theory of Constraints.

Text and Reference Books:

1. Production & Operations Management – Chary, TMH, New Delhi.

2. Modern Production Management – S.S. Buffa, Pub.John Wiley.

3. Krajewski L.J. and Ritzmen L.P., Operations Management: Strategy and Analysis, 9th Edition, Pearson Education, 2010.

4. Chase, R.B., Jacobs, F.R. and Aquilano, N.J., Operations Management for Competitive Advantage, 11th Edition, Tata McGraw Hill Book Company, New Delhi, 2010.

OPEN ELECTIVE-III

Mechanical Engineering (B. Tech.), VII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	OEC-401	NON CONVENTIOANL ENERGY SOURCES	OEC

Unit-I

Global and National scenarios, Form and characteristics of renewable energy sources.

Solar Energy: Solar radiation, its measurements and prediction, Solar thermal collectors, flat plate collectors, concentrating collectors, Basic theory of flat plate collectors, solar heating of buildings, solar still, solar water heaters, solar driers, conversion of heat energy in to mechanical energy, solar thermal power generation systems.

Solar Photovoltaic: Principle of photovoltaic conversion of solar energy, types of solar cells and fabrication, **Photovoltaic applications:** battery charger, domestic lighting, street lighting, water pumping, power generation schemes.

Unit -II

Wind Energy: Atmospheric circulations, classification, factors influencing wind, wind shear, turbulence, wind speed monitoring, Betz limit, WECS- classification, characteristics and applications.

Unit -III

Ocean Energy: Ocean energy resources, ocean energy routes, Principles of ocean thermal energy conversion systems, ocean thermal power plants, Principles of ocean wave energy conversion and tidal energy conversion.

Unit-IV

Other Sources: Nuclear fission and fusion, Geothermal energy- Origin, types of geothermal energy sites, site selection, geothermal power plants, Magneto-hydro-dynamic (MHD) energy conversion, Formation of biomass, photosynthesis, Biomass resources and their classification, Chemical constituents and physicochemical characteristics of biomass, Biomass conversion processes.

Unit-V

Fuel Cells: Thermodynamics and electrochemical principles, Basic design, types, applications. **Hydrogen Energy:** Economics of hydrogen, Production methods.

Text and References Books:

1. Power Generation through Renewable Source of Energy, Rai and Ram Prasad, Tata McGraw-Hill,
2. Ashok V. Desai,"Nonconventional Energy", New Age Internantional Publishers Ltd.
3. Bansal Keemann, Meliss," Renewable energy soucesa and conversion technology", Tata Mc Graw Hill
4. Rai G.D,"Non-Conventional energy Sources", Khanna Publishers.

OPEN ELECTIVE-III

Mechanical Engineering (B. Tech.), VII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	OEC402	Management information system	OEC

Unit-I

Organisation & Types, Decision Making, Data & information, Characteristics & Classification of information, Cost & value of information, Various channels of information & MIS.

Unit-II

Foundation of Information System: Introduction to Information System in Business Fundamentals of Information System, Solving Business Problems with Information System, Concept of Balanced MIS, Effectiveness & Efficiency Criteria. Tool and Techniques of MIS-dataflow diagram, flow chart etc.

Unit-III

Business application of information technology, electronic commerce, Internet, Intranet, Extranet & Enterprise Solutions, Information System for Business Operations, Information system for managerial Decision Support, Information System for Strategic Advantage.

Unit-IV

Managing Information Technology, Enterprise & Global Management, Security & Ethical Challenges, Planning & Implementing Change. Reports: Various types of MIS reports, GUI & Other Presentation tools.

Unit-V

Advanced concepts in information system: Enterprise Resource Planning: introduction, various modules like Human Resources, Finance, Accounting, And Production & Logistics. Supply Chain Management, CRM, and Procurement Management System Object Oriented modelling case studies.

Text and References Books:

1. O.Brian, “Introduction to Information System”, Mc-Graw Hill.
2. O.Brian, “Management Information System”, TMH. Alter,
3. “Information Systems : A Management Perspective”, Addison Wesley.
4. Arora & Bhatia, “Information Systems for Managers”,
5. Excel Bansal, “Information System Analysis & Design”, TMH. Jawadegar,

OPEN ELECTIVE-III

Mechanical Engineering (B. Tech.), VII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3		0	OEC403	Soft Skills for Engineers	OEC

UNIT- I

SELF ANALYSIS: SWOT Analysis, Who am I, Attributes, Importance of Self Confidence, Self Esteem.

CREATIVITY: Out of box thinking, Lateral Thinking**.**

UNIT- II

ATTITUDE: Factors influencing Attitude, Challenges and lessons from Attitude, Etiquette.

UNIT- III

MOTIVATION: Factors of motivation, Self talk, Intrinsic & Extrinsic Motivators.

UNIT-IV

GOAL SETTING : Wish List, SMART Goals, Blue print for success, Short Term, Long Term, Life Time Goals.

TIME MANAGEMENT: Value of time, Diagnosing Time Management, Weekly Planner To do list, Prioritizing work

UNIT- V

LEADERSHIP: Skills for a good Leader, Assessment of Leadership Skills,Conflicts in Human Relations – Reasons Case Studies, Approaches to conflict resolution.

DECISION MAKING: Importance and necessity of Decision Making, Process and practical way of Decision Making,Weighing Positives & Negatives.

Text and Reference Books

1. Covey Sean, Seven Habit of Highly Effective Teens, New York, Fireside Publishers, 1998.

2. Carnegie Dale, How to win Friends and Influence People, New York: Simon & Schuster, 1998.

3. Thomas A Harris, I am ok, You are ok , New York-Harper and Row, 1972

4. Daniel Coleman, Emotional Intelligence, Bantam Book, 2006

Credits	L	T	P	Course Code	Course Title	Category of Course
01	**0**	**0**	**2**	**PCC-ME 403**	**REFRIGERATION AND AIR CONDITIONING LAB**	**PCC**

LIST OF EXPERIMENTS

1. Study & Performance test rig and to study vapour compression Refrigeration Cycle
2. To find COP of water cooler.
3. To study and perform experiment on vapour absorption apparatus.
4. To find the performance parameter of experimental water colling tower.
5. To study various components in room air conditioner.
6. To study different control devices of a refrigeration system.
7. To study various compressors.
8. To find the performance parameters of Ice Plant.
9. To perform the experiment & calculate various Performance parameters on a blower apparatus.
10. To study vapour compression water cooler test rig.

Mechanical Engineering (B. Tech.), VII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
02	0	0	2	PROJ-ME 401	Industrial Training-II/ Seminar	PROJ

Objective of Industrial Training: This two credit course is meant to give students practice the objective of undertaking industrial training is to provide work experience so that students engineering knowledge is enhanced and employment prospects are improved. The student should take this course as a window to the real World and should try to learn as much as possible from real life experiences by involving and interacting with industry staff. Industrial training also provides an opportunity to students to select an engineering problem and possibly an industry guide for their Major Project in final semester.

Scheme of Studies: This two credit course is meant to give students of Duration 4 weeks in summer break after VI semester, assessment to be done in VII semester During training students will prepare a first draft of training report in consultation with section in charge. After training they will prepare final draft with the help of Faculty of the concern Department Then they will present a seminar on their training and present it in the institute in front of the committee headed by the HOD/Faculty Member.

Learning through Industrial: Training: During industrial training students must observe following to enrich their learning:

- Industrial environment and work culture.
- Organizational structure and inter personal communication.
- Machines/equipment/instrument-their working and specifications.
- Product development procedure and phases. Project Planning, monitoring and control.
- Quality control and assurance.
- Maintenance system Costing system Stores and purchase systems.
- Layout of Computer/EDP/MIS centers.
- Problems related to various areas of work etc. Students are supposed to acquire the knowledge on above byDirect Observations without disturbing personnel at work.
- Interaction with officials at the workplace in free/ tea time Study of Literature at the workplace (e.g. User Manual, standards, processes, schedules, etc.)
- Hands on" experience Undertaking/assisting project work. Solving problems at the work place. Presenting a seminar participating in group meeting/discussion.
- Consulting current technical journals and periodicals in the library.

Mechanical Engineering (B. Tech.), VII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
06	0	0	6	PROJ- ME 402	PROJECT-I	PROJ

The minor project work can be a design project, experimental fabrication project or software development project on any of the topics of mechanical engineering interest - it can be allotted as a group project with groups consisting of three or four students The assessment of all the minor projects should be done by a committee consisting of three or four faculty members specialized in the various fields of Mechanical Engineering - the students will present their project work and give a seminar on that topic for about thirty minutes - a committee consisting of at least three faculty members (preferably specialized in different fields of mechanical engineering) will assess the presentation of the seminars before the committee - the relative grading and group average marks for the various projects will be fixed by the committee - the guide will award the marks for the individual students in the project maintaining the group average - each group will prepare the project report and submit one copy of a write up of his minor project to the department through the guide - the Head of the Department will certify the copies and keep them in the departmental library

INSTRUCTIONS FOR PROJECT REPORT/ DISSERTATION WRITING

It is important that the procedures listed below be carefully followed by all the students of B.E. (Mechanical Engineering).

1. Prepare one spiral Bound Copies of your manuscript

2. Limit your Dissertation report to 50– 60 pages (preferably)

3. The footer must include the following: Institute Name, B.E. (Mechanical) Times New Roman 10 pt. and centrally aligned.

4. Page number as second line of footer, Times New Roman 10 Pt, centrally aligned.

5. Print the manuscript using

a. Letter quality computer printing.

b. The main part of manuscript should be Times New Roman 12 pt. with alignment - justified.

c. Use 1.5 line spacing.

d. Entire report shall be of 5- 7 chap

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	PCC-ME 404	POWER PLANT ENGINEERING	PCC

Unit -I

Introduction To Power Plants & Boilers: Layout of Steam, Hydel, Diesel, MHD, Nuclear and Gas Turbine Power Plants, Combined Power Cycles, Comparison and Selection, Load Duration Curves. Steam Boilers and Cycles, High Pressure and Super Critical Boilers, Fluidised Bed Boilers

Unit – II

Steam Power Plant: Fuel and Ash Handling, Combustion Equipment for burning coal, Mechanical Stokers, Pulveriser, Electrostatic Precipitator, Draught, different types, Surface Condenser Types, Cooling Towers

Unit –III

Nuclear And Hydel Power Plants: Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Nuclear Energy, Fission, Fusion Reaction, Types of Reactors, pressurized water reactor, Boiling Water Reactor, Waste Disposal and safety measures for nuclear power plants. Hydel Power Plant, Essential Elements, Selection of Turbines, Governing of Turbines, Micro Hydel developments.

Unit –IV

Diesel And Gas Turbine Power Plant: Types of Diesel Plants, Components, Selection of Engine Type, Applications Gas Turbine Power Plant, Fuels, Gas Turbine Material, Open and Closed Cycles, Reheating, Regeneration and Inter-cooling, Combined Cycle.

Unit –V

Other Power Plants: Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems. capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants, Energy Rates, Types of Tariffs, power tariffs and Economics of load sharing, comparison of economics of various power plants.

Text and Reference Books:

1. G. R. Nagpal, “Power Plant Engineering”, Hanna Publishers, 1998.
2. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
3. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010

Credits	L	T	P	Course Code	Course Title	Category of Course
03	**3**	**0**	**0**	**HMSC-402**	**Entrepreneurship development & Management**	**HMSC**

Unit I: Entrepreneurship

- Theories of Entrepreneurship
- Role and Importance of Entrepreneur in Economic Growth.

Unit II: Entrepreneurial Behaviours

- Entrepreneurial Motivation, Need for Achievement Theory
- Risk Taking Behavior
- Innovation and Entrepreneur

Unit III: Entrepreneurial Traints

- Definitions, Characteristics of Entrepreneurial Types
- Functions of Entrepreneur.

Unit IV: Entrepreneurial Development in India

- History, Objectives, Stages of Growth
- Target Group, Programmes
- Govt. Policy towards SSI's

Unit V: Project Feasibility Analysis

- Business Ideas – Sources, processing; Input requirements, Sources of Financing, Technical Assistance, Marketing Assistance
- Preparation of Feasibility Reports, Legal Formalities and Documentation.

Text and Reference books:

1. McClelland, D.C. & Winter, W.G. : Motivating Economic Achievement, Free Press.
2. Pareek, U & Venkateswara Rao, T : Developing Entrepreneurship – A Handbook on Learning Systems, Learning Systems, New Delhi.
3. Desai, A.N. : Entrepreneur and Environment, Ashish, New Delhi.
4. Druckar, Peter : Innovation and Entrepreneurship, Heinemann.
5. Chakraborty, Tridib : Introducing Entrepreneurship Development, Modern Book Agency

Mechanical Engineering (B. Tech.), VIII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
04	3	1	0	PCC-ME 405	CNC Machines & Automation	PCC

Unit-I

Automation Introduction to CAM, Automated Manufacturing system, Need of automation, Basic elements of automation, Levels of automation, Automation Strategies, Advantages & disadvantages of automation, Historical development and future trends. Features of NC MachinesFundamental of Numerical Control, elements of NC machine tools, classification of NC machine tools, Advantages, suitability and limitations of NC machine tools, Application of NC system, Methods for improving Accuracy considering the factors such as tool deflection and chatter and Productivity.

Unit-II

NC Part Programming & Common Problems in CNC Machines Part programming and basic concepts of part programming, NC words, part programming formats, simple programming for rotational components, part programming using canned cycles, subroutines and do loops, tool off sets, cutter radius compensation and wear compensation Manual (word address format) programming, Examples: Drilling, Turning and Milling, Canned cycles, Subroutine and Macro. APT programming, Geometry, Motion and Additional statements, Macro- statement. Common problems in mechanical, electrical, pneumatic, electronic and PC components of CNC machines, diagnostic study of common problems and Remedies , use of on-time fault finding diagnosis tools in CNC machines.

Unit-III

System Devices Introduction to DC motors, stepping motors, feedback devices such as encoder, counting devices, digital to analog converter and vice versa.

Interpolator's Digital differential Integrator-Principle of operation, exponential declaration, DDA Hardware Interpolator- Linear, Circular, DDA Software Interpolator

Control of NC Systems Open and closed loops, Control of point to point systems, Incremental open loop control, Incremental close loop, Absolute close loop, Control loop in contouring systems, Adaptive control.

Unit-IV

Computer Integrated Manufacturing system Group Technology, Flexible Manufacturing System, CIM, CAD/CAM, Computer aided process planning Retrieval and Generative, Concept of Mechatronics, Computer aided Inspection.

Unit-V

Robotics and Intelligent Manufacturing Types and generations of Robots, Structure and operation of Robot, Robot applications, Economics, Robot programming methods. Introduction to Artificial Intelligence for Intelligent manufacturing.

Text and Reference Books:

1. Numerical Control and Computer aided Manufacturing, By Kundra, Rao and Tewari.

2. Automation, Production Systems and Computer Integrated Manufacturing by Mikell P.Groover.

3. Computer Aided Manufacturing by Kundra and Rao.

4. Computer control of Manufacturing systems by Koren.

5. NC Machine Tools by S.J. Martin.

6. Computer Aided Design and Manufacture by Groover and Zimmer, PHI.

7. Technology of Computer aided Design and Manufacturing by Kumar and Jha, Dhanpat Rai and Sons

8. CNC Machines –Programming and Applications by M Adithan and BS Pabla, New Age International (P) Ltd., Delhi.

9. Computer Aided Manufacturing by Rao, Kundra and Tiwari; Tata McGraw Hill,New Delhi.

10. Numerical Control of Machines Tools by Yorem Korem and IB Uri, KhannaPublishers, New Delhi.

PROFESSIONAL ELECTIVE-III

Mechanical Engineering (B. Tech.), VIII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	PEC-ME 404	MECHATRONICS,	PEC

Unit-I

Introduction about Mechatronics: scope of Mechatronics, application, process control automation and N/cMachines.

Unit-II

Sensors and Transducers: Introduction, classification, specification, characteristics of transducers, type of transducers displacement, strain, vibration pressure, flow, temperature, force and torque, tactile.

Unit-III

Hydraulic Pneumatic and Electrical actuators: Pumps and Compressors, control valves and accessories, actuators, fluid power symbols, fluid power systems, switching devices, solenoids, motors.

Unit-IV

Data Acquisition and Control System: Introduction, Quantitating theory, Analog to Digital Conversion, Digital to Analog (D/A) conversation, transfer function, transient response and frequency response and frequency response, stability criteria

Unit-V

Design of Mechatronic systems: Introduction, Automatic front and book and cutting in steel rolling mill, lift control system, CNC lathe, temperature control of a heat treatment furnace, EOT crane control panel, Grey grain separators, electrode arm control in electric arc furnace.

Text and References Books

1. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Bolton, W., Pearson Education
2. Mechatronics: Principles, Concepts and applications, Mahalik N.P., Tata McGraw Hill.
3. Mechatronics, HMT Hand Book, Tata McGraw Hill.
4. Mechatronics, Singh and Joshi, Prentice Hall of India.

PROFESSIONAL ELECTIVE-III

Mechanical Engineering (B. Tech.), VIII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	0	0	0	PEC-ME 405	RAPID PROTOTYPING	PEC

Unit-I

Introduction: Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP

Unit-II

CAD Modelling and Data Processing for RP: CAD model preparation, Data Requirements, Data formats (STL, SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP), Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation

Unit-III

RP Systems: Photo polymerization Stereo lithography (SL), SL resin curing process, SL scan patterns, Microstereolithography, Applications of Photo polymerization Processes. Powder Bed Fusion: Selective laser Sintering (SLS), Powder fusion mechanism and powder handling, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Applications of Powder Bed

Unit-IV

Fusion Processes. Extrusion-Based RP Systems: Fused Deposition Modelling (FDM), Principles, Plotting and path control, Applications of Extrusion-Based Processes. 3D Printing : 3D printing (3DP), Research achievements in printing deposition, Technical challenges in printing, Printing process modelling, Applications of Printing Processes. Sheet Lamination : Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications. Beam Deposition: Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Processing-structure-properties, relationships, Benefits and drawbacks.

Unit-IV

Errors in RP Processes: Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS.

RP Applications: Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.

Text and Reference Books:

1. Chua C K, Leong K F, Chu S L, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific.
2. Gibson D W Rosen, Brent Stucker., Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer.

3. Chua C K, Leong K F, Chu S L, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific.

PROFESSIONAL ELECTIVE-III

Mechanical Engineering (B. Tech.), VIII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
04	4	0	0	PEC-ME 406	Foundry Technology	PEC

UNIT-I

Introduction and types of foundries: Basic steps in the process of metal casting; comparison of casting with metal joining. Pattern and Pattern Making: Patterns: Materials, types and design of Patterns, Pattern, Pattern allowances, Pattern colors

UNIT-II

Mould and Mould Making: Introduction, Moulding Sand – Types and Properties, Moulding Tools and Equipment- Moulding Machines and Hand Moulding tools, Function of Core, Types of Cores, Core Prints, Core Venting and Baking, Core Shifting and Chaplets, Moulding Processes- Bench Moulding, Floor Moulding, Pit Moulding, Stack Moulding, Green Sand Moulding, Dry Sand Moulding, Loam Moulding, Core Moulding, Machine Moulding.

UNIT-III

Foundry Furnaces: Types of Foundry Furnaces- Cupola Furnace, Electric Arc Furnace, Induction Furnace.

Gating Systems: Gating System- types of Gates and Risers, Gating Ratios and chills, Riser location & design in actual casting, Directional Solidification in Casting, Physical Behavior of Metals during Solidification.

Finishing & Heat Treatment Processes: Various Fettling, Finishing and Heat Treatment of Casting

UNIT-IV

Advance Casting Processes: Investment Casting, Centrifugal Casting, Shell Moulding, Gravity die/ permanent mold, casting, Continuous Casting, pressure die casting, Slush Casting, Non - metal Molding /Ceramic Molding.

UNIT-V

Inspection and Testing of Casting: Defects in Casting, its causes and remedies, Inspection and Nondestructive Testing of Casting

Modernization and Mechanization of Foundry: Material Handling, Pollution Control in Foundry, Application of Computers in Casting Processes

Text and Reference Books:

1. A Text Book of Foundry Technology by O.P. Khanna & M. Lal, Dhanpat Rai.

2. Manufacturing Technology Foundry Forming & Welding by P.N. Rao – TMH.

3. Foundry Technology by P.L. Jain.

4. Production Technology by P.C.Sharma – S Chand.

5. Process and Materials of Manufacture By Lindberg – PHI.

6. Casting Technology by Chakravarty – New Age.

7. Metal Casting by Ravi, PHI.

8. Metal Casting by Ramarao- New Age Publication.

9. Principles of Foundry Technology by R.K.Jain.

10. Principle of Metal Casting by Hein.

Professional Elective-IV

Mechanical Engineering (B. Tech.), VIII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	PEC-ME 407	Gas Turbine and Gas Power Plant	PEC

Unit-I

Review of Basic Principles and Fundamentals of Rotating Machines: Cycle arrangements-Open cycle and closed cycle arrangements, Basic requirement of the working medium, Properties of various working media, Applications of gas turbine, Comparison of gas turbines with reciprocating engines, Ideal cycles, Simple gas turbine cycle, Heat exchange cycle, Reheat cycle with heat exchange, Intercooled cycle, Intercooled cycle with heat exchanger and reheat, Comparison of various cycles.

Unit -II

Practical Cycles and their Analysis: Effect of variable specific heat, Mechanical losses, Loss due to incomplete combustion, polytrophic efficiency, Performance of actual cycles, Comparison of ideal versus actual cycles and Jet propulsion cycles.

Unit -III

Thermodynamic Cycles: Advantages, disadvantages and performance characteristics of Ram jet engine, pulse jet engine, turbo prop engine, turbo jet engine, turbo fan engine, Calculation of specific thrust and efficiency.

Unit -IV

Combustion Systems: Combustion theory applied to gas turbine combustor, Factors affecting combustion chamber design and performance, Combustion chamber geometry, Fuel injection and ignition, Use of cheap fuels, Impulse and reaction type gas turbines, Velocity triangles and calculation of work done, Efficiency etc.

Unit -V

Advantages of a gas turbine power plant, Comparison with steam, Diesel and hydro power plant, Performance of GT power plant-part load efficiency, Airflow rate, Thermal efficiency, Gas turbine blading and fuels, Gas turbine materials, Free piston engine plant.

Text and Reference Books:

1. Power Generation Handbook, Philip Kiameh, McGraw Hill**.**
2. Gas Turbine Engineering Handbook, Meherwan P. Boyce, Gulf Professional Publication.

Professional Elective-IV

Mechanical Engineering (B. Tech.), VIII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	PEC-ME 408	AERODYNAMICS & THEIR ANALYSIUS	PEC

Unit -I

Introduction: Lift, drag, moment and related coefficients; Vector operations (review); conservation equations (mass, momentum and energy); Streamlines, streaklines and path lines; Velocity potential and stream function

Unit -II

Inviscid, Incompressible flow: Bernoulli's equation, low-speed wind tunnel flows; Governing equations and boundary conditions; Elementary flows (uniform, sources, sinks and vortex); ideal lifting flow past a circular cylinder, Kutta-Joukowski theorem and lift generation; source panel method for non-lifting flows; d' Alembert's paradox.

Unit -III

Incompressible flow over airfoils: Introduction; Kutta Condition; Thin airfoil theory (symmetric, cambered); Aerodynamic center; vortex panel method for lifting flows; qualitative picture of viscous flow.

Unit -IV

Finite Wing Theory: Introduction; Downwash and induced drag; Biot-Savart Law and Helmholtz's Theorems; Prandtl's lifting line theory; Numerical lifting-line method; Some ractical aspects. Introduction to Compressible flows (Inviscid): Thermodynamics review; Governing equations; Compressibility.

Unit -V

Normal Shock, Oblique Shock and Expansion Waves: Basic relations; flow over wedges and cones; shock interactions; blunt body flow; Prandtl-Meyer expansion waves; qualitative pitcute of shock wave-boundary layer interaction; quasi-one-dimensional flow through nozzles and diffusers.Linearized Theory for Subsonic and Supersonic Flows: Introduction; Velocity potential equation and linearized form; Prandtl-Glauert correction; Improved corrections; Critical Mach number; Drag divergence; Supercritical airfoils and area rule.

Text and Reference Books:

1.Houghton and Carruthers,"Aerodynamics for engineering students",Edward Arnold (1982).

2. McCormick B.W,"Aerodynamics, aeronautics and flight mechanics", John Wiley (1995).

3. Anderson, Jr. J.D "Aircraft performance and design" McGraw Hill International edition (1999).

4. Eshelby , M.E."Aircraft performancetheory and practice" , Butterworth-Heinemann, Oxford,U.K.,(2001).

5. Pamadi,B.,"Performance, stability, dynamics and control of an airplane",AIAA (2004).

Mechanical Engineering (B. Tech.), VIII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	**3**	**3**	**0**	**PEC-ME 409**	**Advance Manufacturing Processes**	**PEC**

Unit-I

ADVANCE MECHANICAL MACHINING PROCESSES: Classification of AMPs-process selection; Ultrasonic machining; machining setup; mechanics of cutting; parameter analysis; process capability; application. Abrasive water jet machining.

Unit-II

ADVANCE CHEMICAL AND THERMAL MACHINING PROCESSES: Electrochemical machining; electrochemical grinding; electrochemical honing; chemical machining; electric discharge machining; wire cut EDM; electron beam machining; laser beam machining.

Unit-III

ADVANCE CASTING PROCESSES: Metal mold casting: low and high pressure; continuous casting; squeeze casting; vacuum mold casting; evaporative pattern casting; chemical shell casting.

Unit-IV

ADVANCE WELDING PROCESSES: Electron beam welding; laser beam welding; ultrasonic welding

Unit-V

ADVANCE METAL FORMING PROCESSES: High rate energy forming(HERF) processes; electromagnetic forming; explosive forming; electro-hydraulic forming; stretch forming; contour roll forming.

Text and References books:

1. Manufacturing Engineering & Technology, 7th Edition Serope Kalpakjian, Illinois Institute of Technology Steven Schmid, The University of Notre Dame ©2014 |Pearson
2. Nontraditional Manufacturing Processes Gary F. Benedict CRC Pres
3. Manufacturing Science by ghosh and mallik ; Prentice hall of India, 8th Edition
4. Shan & Pandey; Non traditional manufacturing

OPEN ELECTIVE-IV

Mechanical Engineering (B. Tech.), VIII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	OEC404	Utilization of electrical power &traction	OEC

Unit-1

Electric Heating: Different methods of electric heating. Principle of high frequency induction and di-electric heating. Construction, operation, performance and applications of arc furnace and induction furnace.

Electric Welding: Welding process, welding transformer, Classification of Electric Welding: arc welding, resistance welding, welding of various metals.

Unit-2

Illuminations: Definitions, laws of illuminations, polar curves, luminous efficiency, photometer, incandescent lamps: filament materials, halogen lamp. electric discharge lamps: sodium vapour lamp mercury vapour lamp and fluorescent lamp.

Light Calculations: commercial, industrial, street and flood lighting.

Unit-3

Electrolytic Process: Principles and applications of electrolysis, electro-deposition, manufactures of chemicals, anodizing, electro polishing electro-cleaning, electroextraction, electrorefinig, electro-stripping (parting) power supplies for electrolytic process.

Unit-4

Electric Traction & Means of Supplying Power: Systems of Electric Traction: DC & AC Systems, Power Supply for Electric Traction System: Comparison and application of different systems. Sub-station equipment and layout, conductor rail & pantograph.

Unit-5

Traction Methods: Types of services, speed time and speed distance curves, estimation of power and energy requirements, Mechanics of train movement. Co-efficient of adhesion, Adhesive weight, effective weight.

Traction Motor Controls: DC and AC traction motors, Series parallel starting. Methods of electric braking of traction motors.

Text and Reference Books

1. H. Partab,"Art and Science of Electrical Energy" Dhanpat Rai & Sons
2. H. Partab, "Modern Electric Traction" Dhanpat Rai & Sons.
3. C.L. Wadhwa – Utilization of Electric Traction Electric Power.
4. G.K.Dubey,"Fundamentals of Electric Drives" Narosa Publishing House
5. Vedam and Subrahmanyam – Concept & Application of Electric Drives (TMH)

OPEN ELECTIVE-IV

Mechanical Engineering (B. Tech.), VIII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	OEC405	Optimization techniques in Engineering	OEC

Unit-I

Unconstrained Optimization: Optimizing Single-Variable Functions, conditions for Local Minimum and Maximum, Optimizing Multi-Variable Functions.

Unit-II

Optimizing Multivariable Functions with Equality Constraint: Direct Search Method, Lagrange Multipliers Method, Constrained Multivariable Optimization with inequality constrained: Kuhn-Tucker Necessary conditions, Kuhn –Tucker Sufficient Conditions.

Unit-III

Quasi-Newton Methods and line search, least squares optimization, Gauss-Newton, Levenberg-Marquartd, Extensions of LP to Mixed Integer Linear Programming (MILP), Non-Linar Programming, The Newton Algorithm, Non-Linear Least Squares, Sequential Quadratics Programming (SQP), Constrained Optimization, SQP Implementation,

Unit-IV

Multi-Objective Optimization, Branch and Bound Approaches, Genetic Agorthms and Genetic Programming, Singular Based Optimization, On-Line RealTime Optimization, Optimization in Econometrics Approaches – Blue.

Unit-V

The Finite Difference Method for Poisson's Equation in two Dimensions and for the Transient Heat Equation, Eulers Method, The Modified Euler Mehtod and the Runge-Kutta Method for Ordinary Differential Equations, Jacobi's Iteration Method.

Text and Reference Books:

1. Winston W L: Operations Research: Applications and Algorithms
2. Rao S.S., Optimization: Theory and Applications.
3. Walsh G R: M methods of Optimization.
4. Williams H.P.: Model Building in Mathematics Programming.
5. Williams H.P.: Model Solving in Mathematics Programming

3. H.A. Taha,"Operations Research:An Introduction", 5th Edition, Macmillan, New York, 1992.
4. K. Deb,"Optimization for Engineering DesignAlgorithms and Examples",Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.

OPEN ELECTIVE-IV

Mechanical Engineering (B. Tech.), VIII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	OEC406	Microprocessor & microcontroller	OEC

Unit-I

Architecture of Microprocessors (6) General definitions of mini computers, microprocessors, micro controllers and digital signal processors. Overview of 8085 microprocessor. Overview of 8086 microprocessor. Signals and pins of 8086 microprocessor

Unit-II

Assembly language of 8086 (6) Description of Instructions. Assembly directives. Assembly software programs with algorithms

Unit-III

Interfacing with 8086 (8) Interfacing with RAMs, ROMs along with the explanation of timing diagrams. Interfacing with peripheral ICs like 8255, 8254, 8279, 8259, 8259 etc. Interfacing with key boards, LEDs, LCDs, ADCs, and DACs etc.

Unit-IV

Coprocessor 8087 (4) Architecture of 8087, interfacing with 8086. Data types, instructions and programming,Architecture of Micro controllers (4) Overview of the architecture of 8051 microcontroller. Overview of the architecture of 8096 16 bit microcontroller.

Unit-V

Assembly language of 8051 (4) Description of Instructions. Assembly directives. Assembly software programs with Algorithms.Interfacing with 8051 (5) Interfacing with keyboards, LEDs, 7 segment LEDs, LCDs, Interfacing with ADCs. Interfacing with DACs, etc. Module 8: High end processors (2) Introduction to 80386 and 80486

Text and Reference Books:

1. N.Senthilkumar, M.Saravanan, S,Jeevanathan, “Microprocessors and Microcontrollers”, Oxford University Press, 2011.
2. Kenneth J Ayala, “The 8086 Microprocessor: Programming and Interfacing the PC”, Cengage Learning, Reprint 2014.
3. 5. Kenneth J Ayala, “The 8051 Microcontroller”, 3rd edition, Cengage Learning, Reprint 2014.
4. 6. Muhammed Ali Mazidi, Janice GillispleMaidi, Rolin.D. McKinlay, “ The 8051 Microcontroller and Embedded Systems, Using Assembly and C”, Second edition, Pearson Prentice Hall, 2015.

OPEN ELECTIVE-IV

Mechanical Engineering (B. Tech.), VIII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
03	3	0	0	OEC-407	RELIABILITY AND MAINTINENCE ENGINEERING	OEC

Unit-I

Introduction: Maintenance Objectives and Functions, Maintenance Organisation and Administration of Maintenance Systems, Need of planned maintenance, Maintenance policies, Breakdown, time based maintenance, Block replacement, age replacement and periodic replacement policy, Corrective and preventive maintenance, Maintenance planning, Scheduled maintenance, Cost of maintenance versus Cost of equipment and production delays.
Inspection: Inspection intervals, Inspection reports, card history system.

Unit-II

Predictive Maintenance: Equipment wear records, standards, Equipment used in predictive maintenance. Computerized maintenance, Total Productive Maintenance, Methods of condition monitoring, Non-destructive testing, Liquid Penetrate, Magnetic particles, Ultrasonic testing, and Vibration analysis, Oil analysis, Radiographic testing.

Unit-III

Reliability: Definition, failure data analysis, Mean failure rate, mean time to failure (MTTF), mean time between failures (MTBF), hazard rate, Bathtub curve, Use of Weibull probability chart foe assessing characteristics life, guarantee period etc.

Unit-IV

System Reliability: Series, parallel and mixed configuration, Simple problems.

Reliability Improvement: Techniques, use of Pareto analysis-Design for reliability, redundancy unit and stand by redundancy, Optimization of reliability.

Unit-V

Spare Parts Management: Spare parts, features and categorization of spares, cost considerations, Techniques of cost reduction, Selective controls used in spare parts control, ABC analysis, FSN, XYZ, VED and other approaches, Inventory control of spares.

Text and Reference Books

1. Reliability Engineering, Srinath L.S., Affiliated East West Press.
2. Maintainability Principles and Practices, Blanchand, B.S., McGraw Hill
3. C.E. Ebeling, An Introduction to Reliability and Maintainability Engineering, McGrawHill,

Mechanical Engineering (B. Tech.), VIII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
01	0	0	2	PCC-ME 407	CNC Machines & Automation Lab	PCC

PART - A

CNC part programming using CAM packages. Simulation of Turning, Drilling, Milling operations. 3 typical simulations to be carried out using simulation packages like Master- CAM, or any equivalent software.

PART - B

(Only for Demo/Viva voce)

1. FMS (Flexible Manufacturing System): Programming of Automatic storage and Retrieval system (ASRS) and linear shuttle conveyor Interfacing CNC lathe, milling with loading unloading arm and ASRS to be carried out on simple components.

2. Robot programming: Using Teach Pendent & Offline programming to perform pick and place, stacking of objects, 2 programs.

PART - C

(Only for Demo/Viva voce)

Pneumatics and Hydraulics, Electro-Pneumatics: 3 typical experiments on Basics of these topics to be conducted.

Mechanical Engineering (B. Tech.), VIII Semester

Credits	L	T	P	Course Code	Course Title	Category of Course
06	0	0	6	PROJ- ME 403	Project-II	PROJ

The major project work can be a Modelling and Simulation, Case study, Design or Experiments in the field of Mechanical Engineering. It can be allotted as a group project with groups consisting of 3 to 4 students. The major project work started in the seventh semester (minor project) may be continued in this semester - the students should complete the project work in this semester and present it before the assessment committee The assessment committee will assess the various projects, fix the relative grading and group average marks - the guides will award the marks for the individual students in a project maintaining the group average - each group should submit three copies of a write up of his major project of the completed project report signed by the department (in the format prescribed by the department) through the guide - the Head of the Department-Dean of School of engineering and Technology will certify the copies and one copy return them to the students - other copy will be kept in the departmental and university library

INSTRUCTIONS FOR PROJECT REPORT/ DISSERTATION WRITING

It is important that the procedures listed below be carefully followed by all the students of B.E. (Mechanical Engineering).

1. Prepare Three Hard Bound Copies of your manuscript and if possible publish at least one international journal paper by each group for value addition of your project.

2. Limit your Dissertation report to 80 – 120 pages (preferably)

3. The footer must include the following: Institute Name, B.E. (Mechanical) Times New Roman 10 pt. and centrally aligned.

4. Page number as second line of footer, Times New Roman 10 Pt, centrally aligned.

5. Print the manuscript using

a. Letter quality computer printing.

b. The main part of manuscript should be Times New Roman 12 pt. with alignment - justified.

c. Use 1.5 line spacing.

d. Entire report shall be of 5- 7 chapters.

6. Use the paper size 8.5‘‘× 11‘‘or A4 (210 × 197 mm).

Margin Location Paper 8.5‘‘× 11‘‘ Paper A4 (210 × 197 mm)

Top	1‘‘	25.4 mm
Left	1.5‘‘	37 mm
Bottom	1.25‘‘	32 mm
Right	1‘‘	25.4 mm

7. All paragraphs will be 1.5 line spaced with a one blank line between each paragraph. Each paragraph will begin with without any indentation.
8. Section titles should be bold with 14 pt typed in all capital letters and should be left aligned.
9. Sub-Section headings should be aligning at the left with 12 pt, bold and Title Case (the first letter of each word is to be capitalized).

10. Illustrations (charts, drawings, photographs, figures) are to be in the text. Use only illustrations really pertinent to the text. Illustrations must be sharp, clear, black and white. Illustrations downloaded from internet are not acceptable.

a. Illustrations should not be more than two per page. One could be ideal
b. Figure No. and Title at bottom with 12 pt
c. Legends below the title in 10 pt
d. Leave proper margin in all sides
e. Illustrations as far as possible should not be photo copied.

11. Photographs if any should of glossy prints

12. Please use SI system of units only.

13. Please number the pages on the front side, centrally below the footer

14. References should be either in order as they appear in the thesis or in alphabetical order by last name of first author

15. Symbols and notations if any should be included in nomenclature section only

16. Following will be the order of report

i. Cover page and Front page as per the specimen on separate sheet
ii. Certificate from the Institute as per the specimen on separate sheet
iii. Acknowledgements
iv. List of Figures
v. List of Tables
vi. Nomenclature vii. Contents
vii. Abstract

(A brief abstract of the report not more than 150 words. The heading of abstract i.e. word ―Abstract‖ should be bold, Times New Roman, 12 pt and should be typed at the centre. The contents of abstract should be typed on new line without space between heading and contents. Try to include one or two sentences each on motive, method, key-results and conclusions in Abstract

1) Introduction (2-3 pages) (TNR – 14 Bold)
Problem statement (TNR – 12)
1.1 Objectives
1.2 Scope
1.3 Methodology
1.4 Organization of Dissertation
2) Literature Review (20-30 pages) Discuss the work done so far by researchers in the domain area and their significant conclusions. No derivations, figures, tables, graphs are expected.

3)This chapter shall be based on your own simulation work (Analytical/ Numerical/FEM/CFD) (15- 20 pages)
4) Experimental Validation - This chapter shall be based on your own experimental work (15-20 pages)
5) Concluding Remarks and Scope for the Future Work (2-3 pages) References ANNEXURE (if any) (Put all mathematical derivations, Simulation program as Annexure)
17.All section headings and subheadings should be numbered. For sections use numbers 1, 2, 3, …. and for subheadings 1.1, 1.2, …. etc and section subheadings 2.1.1, 2.1.2, …. etc.
18. References should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If figures and tables are taken from any reference then indicate source of it.

Please follow the following procedure for references / Reference Books/ Patent/ Internet

- Collier, G. J. and Thome, J. R., Convective boiling and condensation, 3rd ed., Oxford University Press, UK, 1996, pp. 110 – 112.
- 2. Papers from Journal or Transactions Jung, D. S. and Radermacher, R., Transport properties and surface tension of pure and mixed refrigerants, ASHRAE Trans, 1991, 97 (1), pp. 90 – 98.
- Bansal, P. K., Rupasinghe, A. S. and Jain, A. S., An empirical correction for sizing capillary tubes, Int. Journal of Refrigeration, 1996, 19 (8), pp.497 – 505.
- Papers from Conference Proceedings Colbourne, D. and Ritter, T. J., Quantitative assessment of flammable refrigerants in room air conditioners, Proc. of the Sixteenth International Compressor Engineering Conference and Ninth International Refrigeration and Air Conditioning Conference, Purdue University, West Lafayette, Indiana, USA, 2002, pp. 34 – 40.

Reports, Handbooks etc.

- United Nations Environmental Programme, Report of the Refrigeration, Air Conditioning and Heat Pumps, Technical Option Committee, 2002, Assessment - 2002ASHRAE Handbook: Refrigeration, 1994 (Chapter 44)

Patent

- Patent no., Country (in parenthesis), date of application, title, year.

Internet

- www.(Site) [Give full length URL