COURSES OF STUDY

FOR

B. TECH.

MECHANICAL ENGINEERING

AT

N. I. T. SRINAGAR Hazratbal, Srinagar

J&K 190006

CONTENTS

Course wise Credit Scheme

3rd Semester Mechanical Engineering					
Course No.	***Course Name***	***Credits***	***L***	***T***	***P***
MEC 301	Fundamental Dynamics	3	2	1	0
MEC 302	Mechanics of Materials-I	4	3	1	0
MEC 303	Fluid Mechanics	3	2	1	0
MEC 304	Engineering Thermodynamics	3	2	1	0
MEC 305	Manufacturing Technology	3	2	1	0
MEC 306	Engineering Graphics & Computer Modelling	3	0	0	6
MTH 304	Mathematics	3	2	1	0
MEC 302P	Mechanics of Materials -I Lab.	1	0	0	2
MEC 303P	Fluid Mechanics Lab.	1	0	0	2
MEC 305P	Manufacturing Technology - I Lab.	1	0	0	2
	Total of Credits & LTP	**25**	**13**	**6**	**12**

4th Semester Mechanical Engineering					
Course No.	***Course Name***	***Credits***	***L***	***T***	***P***
MEC 401	Materials Science	3	2	1	0
MEC 402	Mechanics of Materials- II	4	3	1	0
MEC 403	Theory of Machines -I	4	3	1	0
MEC 404	Applied Thermodynamics-I	3	2	1	0
MEC 405	CAM & Industrial Automation	4	3	1	0
ELE 406	Electrical Engineering Technology	3	2	1	0
MEC 403P	Theory of Machines-I Lab.	1	0	0	2
MEC 404P	Applied Thermodynamics-I Lab.	1	0	0	2
MEC 405P	CAM & Industrial Automation Lab.	1	0	0	2
ELE 407P	Electrical Engineering Technology Lab.	1	0	0	2
	Total of Credits & LTP	**25**	**15**	**6**	**8**

5th Semester Mechanical Engineering					
Course No.	***Course Name***	***Credits***	***L***	***T***	***P***
MEC 501	Theory of Machines -II	4	3	1	0
MEC 502	Machine Design- I	4	3	1	0
MEC 503	Hydraulic Machinery	3	2	1	0
MEC 504	Heat Transfer	3	2	1	0
MEC 505	Industrial Engineering-I	4	3	1	0
ECE 508 / 507	Industrial Electronics	3	2	1	0
MEC 501P	Theory of Machines II-Lab.	1	0	0	2
MEC 504P	Heat Transfer Lab.	1	0	0	2
MEC 505P	Industrial Engineering -I Lab.	1	0	0	2
ECE 508P	Industrial Electronics Lab.	1	0	0	2
	Total of Credits & LTP	**25**	**15**	**6**	**10**

6th Semester Mechanical Engineering					
Course No.	***Course Name***	***Credits***	***L***	***T***	***P***
MEC 601	Automatic Control	4	3	1	0
MEC 602	Machine Design-II	4	3	1	0
MEC 603	Fundamentals of Tribology	4	3	1	0
MEC 604	Linear Optimization in Engineering	4	3	1	0
MEC 605	Introduction to Mechatronics	4	3	1	0
MEC 606	SEMINAR	3	0	0	6
MEC 603P	Fundamentals of Tribology Lab.	1	0	0	2
MEC 605P	Mechatronics-Lab.	1	0	0	2
	Total of Credits & LTP	**25**	**15**	**05**	**10**

7th Semester Mechanical Engineering					
Course No.	***Course Name***	***Credits***	***L***	***T***	***P***
MEC 701	Basic Fracture Mechanics	3	2	1	0
MEC 702	Measurement and Instrumentation	4	3	1	0
MEC 703	Industrial Engineering-II	4	3	1	0
MEC 704	Applied Thermodynamics- II	4	3	1	0
MEC 705	Computer Applications in Mech. Engg. (CAME)	3	2	1	0
MEC 703P	Industrial Engineering- II Lab.	1	0	0	2
MEC 705P	CAME Lab.	1	0	0	2
MEC 706	Final Year Project	3	0	0	6
MEC 707	Practical Training & Professional Viva	2	0	0	0
	Total of Credits & LTP	**25**	**13**	**05**	**10**

8th Semester Mechanical Engineering					
Course No.	***Course Name***	***Credits***	***L***	***T***	***P***
MEC 801	Production & Operations Management	4	3	1	0
MEC 802	Internal Combustion Engines	4	3	1	0
MEC 803	Departmental Elective- I	3	2	1	0
MEC 804	Departmental Elective - II	3	2	1	0
MEC 805	Final Year Project	10	0	0	20
MEC 802P	I.C. Engine Lab.	1	0	0	2
	Total of Credits & LTP	**25**	**10**	**04**	**22**

ELECTIVE-I	
Course No.	***Course Name***
MEC 80*	Value Engineering
MEC 80*	Theory of Elasticity (TOE)
MEC 80*	Introduction to Acoustics
ELECTIVE-II	
MEC 80#	Power Plant Engineering (PPE)
MEC 80#	CAD of Thermal systems
MEC 80#	Introduction to MEMS

Course No.: MEC 301 FUNDAMENTAL DYNAMICS C L T (3 2 1)

UNIT I

Kinematics of Particles: Introduction, Rectilinear Motion, Plane Curvilinear Motion , Rectangular coordinates (x-y), Normal and Tangential coordinates (n-t), Polar coordinates (r-θ), Space curvilinear Motion, Relative Motion, Constrained particle Motion. (Vectorial approach to be adopted)

UNIT II

Kinetics of Particles: Review of Force, Mass, Acceleration, Impulse, Momentum, Work and Energy, Linear impulse and linear momentum, Angular impulse and angular momentum, Impact, Central- Force and motion, and relative motion.

Kinetics of Systems of Particles: Introduction, Generalised Newton's second law, Work-Energy, Impulse-Momentum, Conservation of Energy and Momentum, Steady Mass Flow, Variable mass

UNIT III

Plane Kinematics of Rigid Bodies: Introduction, Rotation, Absolute Motion, Relative velocity, Instantaneous center of zero velocity, Relative acceleration, Motion relative to rotating axes.

Plane Kinetics of Rigid bodies: Introduction, General equation of Motion, Translation, Fixed axis rotation, General plane motion, Work energy relations, acceleration from work-energy; virtual work, Impulse-Momentum equation.

Text Book:

1. Meriam, J.L., Kraige, L.G., "Engineering Mechanics: Vol.2, Dynamics". S.I., Version, *John Wiley & Sons Inc.,1996.*

Reference Book:

1.Hibbeler, R.C., "Dynamics", *Prentice Hall, N.Jersy , USA, 2000.*

Course No.: MEC 302 **MECHANICS OF MATERIALS -I** **C L T (4 3 1)**

UNIT I

General concepts: Free body diagram, section forces in beams, general concepts of stress and strain, stresses on inclined plane in an axial member, strain displacement equation, compatibility conditions, statically indeterminate structures, thermal effects.

Analysis of stress and strain: Three dimensional states of stress, Mohr's circle, Cauchy's formula, principal stresses and principal planes, three dimensional state of strain, principal strains and principal axes, Generalized Hook's law, elastic constants and their relationships, measurement of strain, strain energy.

Pressure Vessels: Stresses and strains in thin cylindrical and spherical shells, thick cylinders, Lame's theory, radial deflection, compound cylinder, effective proportions, laminated cylinders.

UNIT II

Introduction to mechanical properties of solids: Stress – strain diagrams, resilience, hardness, impact strength. Symmetric beam bending: The elastic flexural formula and applications, built-up and composite beams. Integration method of solution, Macaulay's method of solution, Area moment method, Statically indeterminate beams, Conditions for indeterminacy, Energy methods for beams, strain energy and complementary strain energy.

UNIT III

Theories of Elastic Failures: Various theories of elastic failure, significance of the theories of failure, comparison and graphical representation.

Columns: Concept of elastic stability, Euler's theory of buckling of columns, eccentric loading, short columns.

Torsion: Torsion of circular shafts, comparison between hollow & solid shafts, tapered circular shafts, torsion of thin circular tubes, statically indeterminate shafts.

Text Books:

1. Popov, E.P., Balan, T.A, "Mechanics of Solids", *Prentice Hall of India, N.Delhi, 2007*.
2. Shames, I.H., Pitaresi, J.M., "Introduction to Solid Mechanics" *Prentice Hall of India. EEE,* 2006.
3. Kazmi, S.M.A, "Solid Mechanics", *Tata Mc-Graw Hill, 1998.*

Reference Books:

1. Fung, Y.C., "Foundations of Solid Mechanics", *Prentice Hall of India, 1968.*
2. Hearn, E.J., "Mechanics of Materials", Vol. I, *Pergamon press, 1989.*

Course No.: MEC 303 **FLUID MECHANICS** **C L T (3 2 1)**

UNIT I

Introductory definitions, fluids, types of fluids, Continuum approach to stress, Fluid properties, Fluid at rest, Pascal's law, Barometers, Manometers, Hydrostatic pressure thrusts, Buoyancy, Flotation, Stability, Scalar and velocity fields, Flow field and description of fluid motion

UNIT II

Continuity equation, Momentum equation, Energy equation, Euler's equation, Bernoulli equation, Ideal fluids, Navier-stokes equations, exact solutions, Laminar boundary layer, boundary layer equations, Blausius flow, momentum-integral equation of boundary layer

UNIT III

Turbulent flow, Laminar-Turbulent Transition, Fluctuations, Turbulent boundary layer equations, Shear stress models, Universal velocity distribution law, pipe flow, friction factor, fully developed pipe flow, pipe bends, pipe losses, Dimensional homogeneity, Raleigh methods, Buckingham's theorem, typical non dimensional parameters, Geometric, kinematics and dynamics similarity, model testing.

Text Book:

1. White , F.M., "Fluid Mechanics", *Mc-Graw Hill, 2001*.

Reference Books:

1. Munson, B.R., "Fundamental of Fluid Mechanics", *John Wiley, 2002.*

2. Cengal Y., "Fluid Mechanics", *McGraw Hill, 2001*.

Course No.: MEC 304 **ENGINEERING THERMODYNAMICS** **C L T (3 2 1)**

UNIT I

Introduction and historical development, Microscopic and macroscopic views of matter, Thermodynamic systems, properties, processes, cycles, thermal equilibrium, Zeroth law of thermodynamics, temperature, thermodynamic equilibrium, Energy and the first law, Mechanical concept of energy, internal energy, conservation of energy, energy transfer as work, various modes, energy transfer as heat, First law for closed system, The state postulate, pure substance, simple compressible substances, specific heat, isothermal, isobaric, isentropic compressibility.

UNIT II

First law for open systems , enthalpy, first law for cyclic processes, applications, Second law of Thermodynamics, Entropy and second law, Thermodynamic reservoirs, various statements and their equivalence, reversible cycle, Carnot cycle, efficiencies of reversible cycle, Carnot's theorem, Thermodynamic temperature scale, Clasius's theorem, entropy concept, inequality of Clasius's principle's of increase of entropy and its applications, Second law for closed system , Second law for open system.

UNIT III

Energy, Gibb's function, Helmholtz function, Relationship between specific heats, Clapeyron equations, thermodynamic relations for ideal gases (computation of entropy and internal energy from measurable quantities, Process with ideal gases and vapours, Calculations involving heat transfer, work transfer and change in thermodynamic properties with various processes, Ideal gas mixture, various definitions, Dalton's law, Gibb's – Dalton's law, Amagat - Leduc law, internal energy, enthalpy, specific heat and entropy of an ideal gas mixture, air water vapour mixture**,** Complete and incomplete combustion analysis, heating value of fuels, analysis of products of combustion, Orsat apparatus.

Text Books:

1. Moran, M.J., Shapiro, "Fundamentals of Engineering Thermodynamics", *John Wiley, 2005.*
2. Wark, K., "Thermodynamics", *Mc-Graw Hill, 2001*.

Reference Books:

1. Cengal, Y., Boles, "Thermodynamics", *Mc-Graw Hill, 2001.*
2. Van-Wylen, G.J., "Fundamentals of Classical Thermodynamics", *John Wiley, 2001*.

Course No.: MEC 305 **MANUFACTURING TECHNOLOGY** **C L T (3 2 1)**

UNIT I

Introduction to basic manufacturing processes and engineering materials, Casting terminologies, solidification, expendable mould casting processes, patterns and risers, investment casting and plaster mould castings, die casting , centrifugal casting. Introduction to metal cutting, machining processes and machine tools. Orthogonal machining, Cutting forces, shear plane angle, Ernst Merchant theory, mechanics of metal cutting. Tool life equation. Lathe parts and turning operations, Cutting tool nomenclature, tool materials, tool wear. Various machine tools and operations.

UNIT II

Metal Forming : fundamentals of metal forming , independent and dependent variables, hot working and cold working , warm forming, rolling. Forging and various types of forging, extrusion and various types of extrusion. Introduction to various press work operations, press working dies, shearing load and press selection, spinning, High energy rate forming, explosive forming, Electromagnetic forming and its applications, Fabrication of composites.

UNIT III

Welding: Introduction to welding, types of welding. Welding machines, Shielded Metal Arc Welding (SMAW) process, Gas Metal Arc Welding(GMAW) process, Gas Tungsten Arc Welding (GTAW) process, Shielded Arc welding (SAW) process, Resistance welding, Seam, Spot and Flash butt welding, Ultrasonic welding, Laser beam welding, Automation in welding and various defects.

Text Book:

1. Degarmo, E.P., Black, J.T. and Kohser, R.A., "Materials and Processes in Manufacturing", *Prentice Hall of India, 2005.*

Reference Books:

1. Serop, K., Steven, R.S., "Manufacturing Processes for Engineering Materials", *Prentice Hall of India,1998.*

Course No.: MEC 306 ENGINEERING GRAPHICS & COMPUTER MODELLING

C L P (3 0 6)

UNIT I

Introduction to CAD, Theory of general engineering design, conceptual design, embodiment design involving layout and form designing to standard, geometrical modelling: basic sketching, lines and arcs, extrude and revolve features.

UNIT II

Extrude cut and fillets, solid modelling of Oldham's coupling components, surface modelling, merging of surfaces, assembly modelling, assembly modelling of Oldham's coupling, machine elements.

UNIT III

Tailstock components and assembly of tailstock components, components of globe valve, assembly of globe valve components of butterfly valve, assembly of butterfly valve, Introduction to animation, Mini Project.

Text Books:

1. Bhat, N.D., "Machine Drawing", *Charotar Publishing House Pvt. Ltd*., 2008.
2. Gill, P.S., "Machine Drawing", *Kataria and Sons, New Delhi, 2008.*

Reference Book:

Zeid I., "CAD/CAM Theory & Practice", *Tata Mc-Graw Hill, New Delhi, 2008.*

Course No.: MTH 304 **MATHEMATICS** **C L T (3 2 1)**

UNIT 1

Laplace transform, shifting theorem, Laplace transforms of derivatives and integrals, Heaviside's unit function. Dirac Delta function and its Laplace transforms. Laplace transforms of periodic functions, Heaviside's expansion theorem, Inverse Laplace transforms, initial and final value theorems.

UNIT II

Convolution theorem and its applications, use of Laplace transforms in the solution of linear differential equations.

Complex variables, analytic functions, Cauchy Riemann equations, Complex integration, Cauchy's fundamental theorem, Cauchy's integral formula, Cauchy's inequality and Liouville's theorem on integral function.

UNIT III

Taylor's & Laurent's expansions, Zeros & poles of analytic functions, Residues. Fourier series, Harmonic analysis, Definition of Fourier transform. Fourier sine and cosine transform. Fourier integral formula and its applications to solution of boundary value problems.

Reference Books:

1. Spiegel, "Laplace transform", *Schaum series*, Snedden, I.N., " The use of Integral Transform", *Tata McGraw Hill, New Delhi, Year*.
2. Loknath, Debnath, "Integral Transforms" *CR C Press, New York, USA*.

Text Books:

1. Churchill,R.V., "Complex Variables and Applications", *McGraw Hill.*
2. Titchmarsh, E.C., "Theory of functions", *Academic University Press.*

MEC 302P **MECHANICS OF MATERIALS –I LAB.** **C P(1 2)**

1. Tensile test of mild steel and aluminium bars.
2. Shear test on specimen of two different metals.
3. Bending tests on a steel bar/wood.
4. Impact tests on metals: a) Izod Test; b) Charpy Test
5. Torsion test on specimen of different metals for determining the angle of twist for a given torque.
6. Hardness tests on metal to determine Brinell and Rockwell hardness.
7. Buckling load for a column.
8. Compressive test of a specimen.

MEC 303P **FLUID MECHANICS LAB.** **C P(1 2)**

1. To determine the Viscosity of a fluid by falling sphere (ball) viscometer.
2. Critical Reynolds number in pipe flow.
3. Verification of the Bernoulli's theorem.
4. To find coefficient of discharge for Venturi meter.
5. Calibration of a Rotameter.
6. Measurement of velocity in the wind tunnel with pitot static tube.
7. Measurement of pressure with pressure sensors.
8. Flow visualisations past bluff and streamline bodies in a smoke tunnel.
9. Calculation of flow rate using an orifice meter.

MEC305P **MANUFACTURING TECHNOLOGY-I LAB.** **C P(1 2)**

1. Testing moulding sand for permeability, shear strength and compression strength.
2. Percentage of cross- sectional area reduction by rolling and wire drawing.
3. SMAW, welding parameters selection for MS strips.
4. Study of lathe machine.
5. Performing step turning and taper turning on lathe machine.
6. Performing drilling and boring operations on lathe machine.
7. Performing external thread cutting on lathe machine.
8. Study of bench type drilling machine.
9. Performing various operations like drilling, reaming, counter boring and countersinking on drilling machine.
10. Study of a surface grinding machine. Performing surface grinding on washers.
11. Study of dividing head and performing gear milling.

Course No.: MEC 401 **MATERIALS SCIENCE** **C L T (3 2 1)**

UNIT I

Introduction to material science and engineering, why study material science and engineering, classification of materials, modern and advanced materials, human needs and materials selection, and design considerations. Atomic structure and bonding, fundamentals of electron arrangements and modern periodic table, primary bonds and secondary bonds, energy related concepts. Structure of metals and ceramics, concept of unit cells and lattice arrangements.

UNIT II

Density computations for metals, ceramic crystal structure and density computations. Polymorphism and Allotropy, crystal systems, crystallographic directions and planes, Atomic densities (linear and planar), single crystals, polycrystalline materials anisotropy, x-ray diffraction and determination of crystal structures, Polymer structure, hydrocarbon molecules, polymer molecules and their chemistry, molecular weight and shape and structure, thermoplastic and thermosetting polymers, Imperfections in solids, point defects, line defects and volume defects

UNIT III

Impurities and their role in materials, grain size determination, Diffusion mechanism, steady state diffusion, nonsteady state diffusion, factors that influence diffusion, diffusion in ionic and polymeric materials. Deformation and strengthening mechanisms, plastic deformation of polycrystalline metals, Deformation by twining, strengthening by grain size reduction, Phase diagrams, solubility limit, phases, micro-structure and phase equilibria.

Text Book:

Callister,W.D, "Fundamentals of Materials Science and Engineering", *John Wiley & Sons, Inc. 2001*

Reference Books:

1. Cahn, R.W., Haasen P., " Physical Metallurgy", Vo I, II, III, *North-Holland, 1996.*
2. Ashby,M., Johonson,K., "Materials and Design" *Butterworth-Heinemann, 2002.*

Course No: MEC 402 **MECHANICS OF MATERIALS- II** **C L T (4 3 1)**

UNIT I

Strain energy due to normal and shear stresses, The total elastic strain of dilation and distortion, The energy elastic theorems, Theorems on virtual work, Castigliano's theorem, Complementary energy theorems, Strain energy due to axial bending and Torsional loads, Stresses due to suddenly applied loads, Use of energy theorems to determine deflection of beams and twists of shafts, Maxwell's theorem of reciprocal deflections and its corollaries, Unit couple and unit load methods of determining slopes, deflections.

Stresses in rotating disc of constant thickness, Stresses in hollow & solid discs, stresses in rotating solid and hollow cylinders, stresses in spooked rim.

UNIT II

Overview of Ixx, Iyy, & Ixy. Stresses due to unsymmetrical bending, combined bending & axial loads, Shear centre for symmetrical and unsymmetrical sections. Alternative procedures for calculation of stresses. Deflection of straight beams subjected to unsymmetrical bending,

Bending of beams with large initial curvature. Circumferential stresses, location of the neutral axis, Application to beams with rectangular, circular and trapezoidal cross sections. Stresses in crane hook, Stresses in a ring, stresses in a chain link. Deflection of curved bars, Deflection of curved bars by Castigliano's theorem.

UNIT III

Close coiled helical spring, axial load, axial torque, strain energy in the spring, spring under impact load, springs in series and parallel, concentric springs, open coiled helical spring, axial load, axial torque, stresses in spring wire, combined action of axial load and moment, flat spiral springs, leaf springs, semi-elliptical spring, quarter elliptical leaf spring, graduated & full length leaves, equalized stress in spring leaves, conical springs.

Text Books:

1. Popov, E.P., Balan,T.A, "Mechanics of Solids", *Prentice Hall of India,New Delhi, 2007*.
2. Shames, I.H., Pitaresi, J.M., "Introduction to Solid Mechanics" *Prentice Hall of India, EEE, New Delhi, 2006.*

Reference Books:

1. Fung, Y.C., "Foundations of Solid Mechanics", *Prentice Hall of India, New Delhi,1968.*

Course No.: MEC 403 **THEORY OF MACHINES-II** **C L T (4 3 1)**

UNIT I

Introduction, Kinematics and dynamics, Lower pairs & higher pairs, Degree of freedom (DOF), Gruebler's eqn. and Kutzbach's criterion, Mechanisms and DOF, Inversions, Grashof's law and Quick return mechanism, Coupler curves, Velocity and acceleration analysis, Mechanical advantage, Transmission and deviation angle, Instantaneous centre.

Friction: Types, Laws, Friction of nut and screw, Screw jack, Torque required to lift and lower loads, efficiency, Pivot and collars & journal bearings, Friction clutches, Single and multi-disc plate clutch, Brakes, classification, Braking of vehicle.

Governors: Difference between flywheel and governor, Watt governor, Porter governor, analysis, effect of friction, Proell governor, Hartnell governor. Controlling force, sensitivity, stability, hunting, Isochronism, effort and power of a governor.

UNIT II

Gears: Rolling contact and positive drive, classification of gears, Nomenclature, Law of gearing, Conjugate teeth, involute and cycloidal profile system of gear teeth, Length of path of contact, arc of contact, contact ratio, Interference and undercutting, interchangeable gears, Helical and spiral gears. Gear trains: Classification, Types, simple gear train, speed ratios, Compound, reverted, Epicyclic gear train, tabulation and algebraic method, Compound epicyclic train.

UNIT III

Cams: Comparison with lower paired mechanisms, Classification of cams and followers, Terminology for cams, types of follower motions, pressure angle, considerations influencing choice of cam, construction of cam profiles, layout, Offset followers. Precessional motion and angular acceleration, Gyroscopic couple, reaction couple. Effects on an aeroplane, naval ship, gyroscopic ship stabilization, Stability analysis of a two-wheel vehicle, Stability of a four-wheel drive on a curved path. Acceleration in Cartesian and Spherical co-ordinates, Inertia forces and D'Alembert's principle.

Text Book:

1. Shigley J.E, "Theory of Machines and Mechanisms", *Mc Graw Hill, New York,1995*.

Reference Book:

1. Mabie H.H., Reinholtz C.F, "Mechanism and Dynamics of Machinery" Fourth edition, *John Wiley & Sons, 1987.*

2. Ambekar A., "Mechanisms and Machine Theory", *Prentice Hall, New Delhi, 2007.*

Course No.: MEC 404 **APPLIED THERMODYNAMICS-I** **C L T(3 2 1)**

UNIT I

Carnot cycle for steam, Rankine and modified Rankine cycle, deviation of actual cycles from ideal cycles, cycle efficiency, second law analysis of vapour power cycle, binary vapor power cycles, Types of nozzles, isentropic flow through nozzles, effect of friction, nozzle efficiency, critical pressure ratio for maximum discharge, throat and exit areas, supersaturated flow.

UNIT II

Classification of boilers (Water tube, Fire tube), boiler mountings and accessories, boiler draught, boiler rating, boiler performance, heat balance, Steam Turbines, Position of steam turbine in power industry, types and applications, impulse turbines, pressure and velocity compounding, velocity diagram, work output, blade, stage, internal and overall efficiency, reaction turbines, velocity diagram, degree of reaction, work out put, losses and efficiency, Reheat cycle, regenerative feed heating, Direct and indirect feed heating, efficiency and work out put calculations, governing of steam turbines

UNIT III

Single stage compressor, induction diagram and power requirement, effect of clearance volumetric efficiency, Multistage compressors, indicators diagram with and without clearance, effect of intercooling, power requirement, Air standard Cycles, Carnot, Otto, diesel and dual cycles, work output and efficiency, mean effective pressure, deviation of actual cycles from ideal cycles.

Text Books:

1. Eastop, T.D., "Applied Thermodynamics for Engineering Technologist", *Pearson education, 1990.*
2. Rogers G.F.C., Mayhews, "Engineering Thermodynamics", *Pearson Education, 1990.*

Reference Book:

1. Kearton, W.J., "Steam Turbines", *CBS Publishers, New Delhi, 1960*.

Course No.: MEC405 **CAM & INDUSTRIAL AUTOMATION** **C L T(4 3 1)**

UNIT 1

Brief history of NC and CNC machines, Open loop & closed loop CNC machines, classification of CNC machines, Advantages of CNC machines, setup time reduction, Introduction to CNC programming, Adaptive control, machining parameters selection, Introduction to robotics and Automated Guided vehicles(AGV's), Introduction to Flexible manufacturing systems (FMS), Elements of FMS and its advantages, Cellular manufacturing, Expert systems in manufacturing & simulation, maintenance automation.

UNIT II

Introduction to unconventional machining processes, Abrasive Jet Machining (AJM), Abrasive water jet machining (AWJM), advantages and applications, Ultra Sound machining(USM), process variables and advantages, Electro Discharge Machining (EDM), process variables. Metrology: Limits, fits and tolerances: hole basis and shaft basis system, unilateral and bilateral system, Taylor's principles of gauge design, Sine bars and gauge blocks manufacturing method and their applications, use of Dial indicators, Comparators and Coordinate measuring machine (CMM).

UNIT III

Introduction to industrial automation, and justification, pneumatics and electro-pneumatics, different valves, design of different pneumatic circuits for various industrial automation related applications, fluid logic control systems, Automated inspection, Introduction to PLC's (??) and its applications.

Text Books

1. Degarmo, E.P., Black, J.T. and Kohser, R.A, " Materials and Processes in Manufacturing", *Prentice Hall of India***,** New Delhi, 2006.
2. Anthony, E., "Fluid Power with applications", *Prentice Hall of India ,New Delhi, 2007.*
3. Zeid, I., "CAD/CAM Theory & Practice", *Tata Mc-Graw Hill, New Delhi, 2008*

Reference Book:

1. Serop K. Steven, "Manufacturing Processes for Engineering Materials", *Prentice Hall of India, New Delhi, 2004.*

Course No.: ELE406 ELECTRICAL ENGINEERING TECHNOLOGY C L T(3 2 1)

UNIT I

Network Analysis and theorems, Basic Circuit Theory (D.C and A.C), Resistance, Inductance and Capacitance, Ohm's law, KCL (??) ,KVL (??) , Power and energy relations, superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power transfer theorem, Sinusoidally – excited circuits; Basic definitions of A.C. circuits, phasor algebra and complex number representations, solutions of sinusoidally excited R. L.C circuits, Introduction to 3 – phase circuits.

UNIT II

Transformers; Construction, Principle of operation, e.m.f. equation, Phasor diagrams, No Load and on load, Equivalent circuit model, Voltage regulation and test, Introduction to 3- phase transformers, Applications.

D.C. Generators and motors; Basic construction, Principles of operation, Types of D.C. generators and motors, Applications.

UNIT III

Transducers; Definitions, Types of transducers and their applications for mechanical measurements, Ammeters and voltmeters: Meter range extension and their connections in their circuits, Bridge methods to measure; Resistance, inductance and capacitance; various types of bridges and their applications for measuring, R, L and C., Measurement of power and energy; watt meters, measurement of power using Watt meters, energy meters and measurement of electrical using energy meters, Digital Instruments; Introduction to digital meters for the measurement of various electrical quantities.

Text Book:

1. Nagrath, I.J., Kothari, D. P., "Electrical Machines," *Tatal Mc Graw Hill, New Delhi, 1985.*

Reference Books:

1.Del Toro, V., "Principles of Electrical Engineering," *Prentice Hall International, 1985.*

MEC 403P THEORY OF MACHINES-I LAB. C P(1 2)

1. Study of kinematic pairs & working of stroboscope.
2. Slider crank motion, reciprocating engine mechanism, Inversion of four bar chain, Oscillating cylinder mechanism and Whitworth quick return mechanism.
3. Various models of brakes, and Working of a clutch using clutch model.
4. Study the characteristics of a Watt Governor.
5. Study the characteristics of a Proell Governor
6. Study the characteristics of a Porter Governor
7. Study the characteristics of a Hartnell Governor
8. Generation of involute gear tooth profile.
9. Involute teeth in contact & interference and under cutting of gear and its significance.
10. Study of pairs of cams and follower
11. Determine the velocity of precession of a given motorized gyroscope.

MEC 404 P APPLIED THERMODYNAMICS-I LAB. C P (1 2)

1. Study of Nestler Boiler.
2. Calculation of dryness fraction of steam.
3. Calculation of heat balance sheet of a boiler
4. Determination of COP of a refrigeration system.
5. Study of cooling tower.

Add three more experiments or include number of classes for each experiment

MEC 405P CAM & INDUSTRIAL AUTOMATION LAB. C P (1 2)

A) Jobs on CNC lathe machine.

1. Safety precautions and Study of CNC lathe machine.
2. Performing step turning.
3. Performing taper turning.
4. Performing radius turning.
5. Performing multiple turning cycle.
6. Performing pattern repetition cycle operation.

B) Jobs on CNC Milling machine.

1. Study of CNC Milling machine.
2. Performing linear cuts and circular cuts
3. Performing linear and circular cuts using subroutines
4. Performing pocket milling

C) Metrology

1. Use of sine bars and slips gauges for angle measurement.
2. Use of bevel protector and dial gauges

ELE-407 P **ELECTRICAL ENGG. TECH. LAB.** **C P (1 2)**

1. To study the overall safety procedures to be employed, while working with electric circuits.
2. To study the series and parallel operations of resistors, inductors and capacitors.
3. To verify
    - KVL and KCL in DC circuits.
    - Superposition theorem.
    - Thevenin's Theorem
4. To measure electric power in a single phase AC circuit with resistive load, R – L and RLC load.
5. To study the overall construction of electric machines.
6. Measurement of Electric Energy by
    - KWH Meter
    - Watt meter
7. Measurement of Power factory by
    - Power Factor Meter
    - Voltmeter, ammeter and watt meter method

Course No.: MEC 501 **THEORY OF MACHINES -II** **C L T (4 3 1)**

UNIT I

Harmonic motion, periodic motion, vibration terminology, complex method of representing harmonic vibration, Fourier series and harmonic analysis,

Mathematical modelling for vibrations springs in series and parallel, differential equation of motion, solution of differential equation, torsional vibrations.

Various types of damping: dry friction and coulomb damping, structural damping. Free vibration with and without viscous damping. Logarithmic decrement. Energy methods

UNIT II

Forced harmonic vibration, rotating unbalance, support motion, vibration isolation, energy dissipated by damping, equivalent viscous damping, structural damping, vibration measuring instruments, impulse excitation, arbitrary excitation, Laplace transform formulation, pulse excitation and rise time, shock response spectrum, shock isolation.

UNIT III

Normal mode analysis, initial conditions, coordinate coupling, forced harmonic vibration, vibration absorbers and vibration dampers, Generalized coordinates, natural frequencies and mode shapes (Eigen values and Eigen vectors), Modal analysis, continuous systems.

Critical speed of a light shaft without damping, and with damping, critical speed of shaft having multiple discs, secondary critical speed, critical speed of a light cantilever shaft, Balancing of engines.

Text Book:

1. Grover, G. K. "Mechanical Vibrations, 7th edition, *Nem Chand and Bros, New Delhi, India 1996.*

Reference Books:

1. Meirovitch, "Elements of vibration analysis," 2nd edition, Mc *Graw Hill, 1998.*
2. Thomson, W. T., "Theory of Vibrations with applications" 5th edition, *Pearson Education, 2004.*

Course No.: MEC 502 **MACHINE DESIGN -I** **C L T (4 3 1)**

UNIT I

Introduction to design, design and designer, objective of design, design definitions, design process, System design verses component design, Introduction to behaviour of mechanical systems, transformation of costumer requirements into design artefacts, functional and structural hierarchies, functional and structural hierarchies of Gear, Engine, etc.

UNIT II

Various types of loading in mechanical systems, stress concentration, endurance limit, S N and SNP diagrams, stress concentration and its mitigation, manufacturing consideration in design, standardization, tolerances and fits, BIS code –IS-919, manufacturing processes , Introduction to single and multivariable optimization.

UNIT III

Materials, material selection at design stage, design for permanent fastening joints , Riveted joints, nomenclature of riveted joints , efficiency of joints, Lap joint analysis, Butt joint analysis, Boiler joint, Welded joints, design for fastener, joints, and fasteners, nut and bolt assembly, screw jack, efficiency of screw jack.

Text Books:

1. Ullman D.G., "The Mechanical Design process", *3rd edition, McGraw Hill, 2009.*

2. Mott, R.L, "Machine Elements in Mechanical Design", *4th edition, Prentice Hall, Singapore, 2005*.

3. Shigley, J.E., Mischke, C. Brown T., "Standard Hand book of Machine Design" *McGraw Hill.*

Reference Books:

1. Shigley, J.E., "Hand Book of Machine Design", *McGraw Hill, 2004.*

Course No.: MEC 503 **HYDRAULIC MACHINERY** **C L T (3 2 1)**

UNIT I

Force due to a jet on a curved plate, Velocity diagram for axial and radial flow turbine blades, Work output and efficiency, Pelton turbine, main components nozzle and jet diameters, mean diameter of Pelton runner, jet ratio, minimum number of buckets, work done, power developed and turbine efficiencies, Governing of impulse turbines.

UNIT II

Reaction turbine, Francis turbine, main components, design of spiral casing guide vanes, runner and number of runner blades, types of Francis runners, Kaplan turbine, velocity diagram power and efficiency calculations, draft tube, cavitation factor, Governing of reaction turbines. Principles of similarity: unit and specific quantities, performance characteristics, selection, of water turbines, hydro-electric power plants.

UNIT III

Roto dynamic pumps, classification, centrifugal pumps, specific speed, velocity diagrams, heads, power and efficiency, special features of propeller and mixed flow pumps, Positive displacement pumps, reciprocating pump, Indicator diagram, effect of friction and acceleration, Theory of air vessel, Hydraulic systems and power transmission, pumps and other devices used in hydraulic systems, Gear pump, vane pump, screw pump, pressure intensifier, Hydraulic coupling, torque converter and dynamometer. Hydraulic power transmission

Text Book:

1. Massey, B.S., "Mechanics of Fluid", 6th Edition, *Van Nostrand Reinhold co., 1968.*
2. Jagdish, L., "Hydraulic Machines including Fluidics", *Mertopolitan Books co. Pvt. Ltd., 1997*

Reference Books:

1. Guthrie, Brown, "Hydroelectric Engineering Practice, *CBS Publishers, New Delhi, 1993.*
2. Douglas, Gasiorek, Swaffield, "Fluid Mechanics", *Pearson Education, , 2007.*
3. Kumar, D.S., "Fluid Mechanics & Fluid Power Engineering", *S.K. Kataria & Sons., New Delhi, 2008.*

Course No.: MEC 504 **HEAT TRANSFER** **C L T (3 2 1)**

UNIT I

Introduction, Fourier's law of heat conduction, Thermal conductivity of solids, liquids and gases, combined heat transfer problems, One dimensional steady heat conduction, Thermal resistance, General three dimensional heat conduction equation in Cartesian, cylindrical and spherical coordinates, heat conduction with heat generation, Fins, Two dimensional steady state heat conduction through plane wall, Unsteady heat conduction with negligible internal temperature gradients, spheres, cylinders and cubes heat conduction when internal temperature gradients are not negligible, sphere, long cylinder and large slab, heat flow in semi infinite solids, with periodic change in surface temperature.

UNIT II

Free and forced convection, hydrodynamic and thermal boundary layer, Empirical relations for convection heat transfer, Heat transfer with change of face, film and drop wise condensation, empirical equations, fundamental of boiling heat transfer, pool boiling.

UNIT III

Thermal radiation, black and gray surfaces, Radiation laws, Heat transfer by radiation between black and gray surface shape factors, Heat transfer by radiation between two surfaces, heat transfer in presence of reradiating surfaces, radiation shields, Heat exchangers, Fouling factor, overall heat transfer coefficient, logarithmic mean temperature difference, effectiveness, NTU (??) methods, engineering applications of heat transfer, Introduction to Temperature measurements

Text Book:

1. Incropera, F.P., " Fundamentals of Heat and Mass Transfer ", *John Wiley, 2005*.
2. Kreith F., Bohn, "Principles of Heat Transfer", *Cengage publishers, 2006*.
3. Holman, J.P., " Heat Transfer", *McGraw Hill,2009*.

Reference Book:

1. Bejan, A., "Heat Transfer", *John Wiley, 1998*.

Course No.: MEC 505 **INDUSTRIAL ENGINEERING -I** **C L T (4 3 1)**

UNIT I

Concept of industrial productivity**:** Introduction and significance of Industrial engineering with brief explanation of its techniques, Functions of Industrial Engineering, Definitions and explanation of Productivity with significance in Industries, Productivity measurements, Factors affecting productivity, Basic work content and excess work content, Industrial applications to calculate total and partial productivities, Introduction to Work study and its basic procedures, definitions and concept of work study with examples, Human factor in the application of work study, Factors for selecting the work study, Ergonomics**:** scope and objectives of ergonomics, application of human factors in engineering work place design, etc.

UNIT II

Introduction to Method study and the selection of jobs, Record, Examine and Develop, Objectives and basic procedure of Method study, Recording techniques (Process Charts (PC), and Diagrams),Outline PC, Flow process charts, Two hand process charts, MAC (??), Simo chart, Flow diagram, String diagram, Cycle graph, Chronocycle graph, Travel chart, Define, Install and Maintain, the principles of motion economy,

UNIT III

Work measurement and its applications, Time study, Work Sampling, Rating and their methods, Breaking the jobs into Elements, types of Elements, Allowances and their calculations, Calculation of Standard time, Examples of Time study, PMT (??) systems, synthetic data, Various applications and examples.

Text Book:

1. Barnes, R.L., "Motion and Time Study, Design & Measurement of Work*" 7th edition, John Wiley & Sons, New York, 1980.*

Reference Books:

1. International Labor Office, Geneva, "Introduction to Work Study" 4th Edition, Geneva, *1985*.
2. Currie R.M, "Work study", ELBS *& Pitman, London, 1977.*
3. Mundel, M.E., "Motion and Time Study", 5th Edition, *Prentice Hall, Englewood Cliff, NewYork, 1978.*

Course No.: ECE507 /8 **INDUSTRIAL ELECTRONICS** **C L T (3 2 1)**

UNIT I

Introduction to Semi conductors; Intrinsic & extrinsic semiconductors, transport mechanism of charge carriers, electrical properties, P – N Junction Diode: Characteristic of Diode capacitances, application of Diode. Diode as a Switch. Different types of Diode and their applications.

UNIT II

BJT's: Types, Operations and characteristics, CE, CB, CC configurations, Transistor circuits, transistor as an amplifier, transistor as a switch, Operational amplifier basis, OP amp as uneverting and non uneverting amplifier and its applications.

UNIT III

Oscillators: Barkhausan's C and different types of oscillators, Modulation: Amplitude Modulation, frequency Modulation. Types of Modulators, Power Electronics circuits: SCR, Drac, Twac. Regulated Power Supplies, Electronic Welding.

Text Book:

1. Millman, J., Halkias, Ch.C., "Basic Electronics", *Tata McGraw Hill, New Delhi, 1998.*

MEC 501P THEORY OF MACHINES –II LAB. C P (1 2)

1. Determine the time period of a simple pendulum. Verify that the time period is independent of the mass of the bob.

2. Determine the radius of gyration of a compound pendulum.

3. Determine the radius of gyration of a given bar by using a Bifilar suspension.

4. Study the undamped free vibration of an equivalent spring mass system.

5. Study the forced vibration of an equivalent spring mass system.

6. Study the torsional vibration of a single rotor shaft system.

7. Determine the frequency response function of an equivalent spring- mass- dashpot system.

8. Pressure profile measurement on Journal bearing

MEC 504P HEAT TRANSFER LAB. C P (1 2)

1. Determination of Fin efficiency and effectiveness of a pin fin in forced convection and natural convection
2. Determination of thermal conductivity of a plate by two slab guarded hot plate method
3. Determination of thermal conductivity of pipe insulation and insulation powder
4. Determination of thermal conductivity of a liquid by the guarded hot plate method
5. Determination of thermal conductivity of a good conductor of heat (metal rod)
6. Determination of overall resistance of a composite wall
7. Determination of heat transfer coefficient in forced convection through a horizontal tube
8. Determination of heat transfer coefficient for heat vertical cylinder in natural convection
9. Determination of LMTD and NTU in parallel flow and counter flow heat exchanger
10. Determination of Stefan Boltzmann's constant
11. Determination of Emissivity.

MEC505 INDUSTRIAL ENGINEERING-I LAB. C P (1 2)

1. Ergonomic design study (Present/proposed/new) of a product, equipment or work environment (human-machine interface) – (This involves about four to five laboratory classes / sessions)
2. To assembly a product (electrical holder, etc.), record the cycle time and draw learning curve of the operator performing the assembly.
3. Draw Out line process chart and two hand flow process charts for the assembly performed in experiment no. 2, and analyse the present method and also suggest improved method/s.
4. Study and draw of flow process charts (some suitable assembly operation)
5. Study and draw multi activity chart of a suitable method and propose better method/s.(Man and machine)
6. Study suitable movements/travel of man, material or equipment, and draw string diagram, travel chart and flow diagrams.
7. To calculate the standard time of a suitable job, using predetermined time standard techniques.

ECE 508P **INDUSTRIAL ELECTRONICS LAB.** **C P (1 2)**

1. Study of CRO Measurement of Voltage, frequency and Phase of a given waveform.
2. To obtain diode characteristics.
3. a) To assemble a half wave and a full wave rectifier and to study their performance.

   b) To suppress the ripple using RC filter.
4. To obtain Zener diode characteristics and to use Zener diode as a voltage regulator.
5. To assemble and observe the performance of clipping and clamping circuits.
6. To obtain transistor characteristics in the following configurations:

   i.) Common base. ii.) Common emitter
7. To assemble a CE amplifier and observe the performance.
8. To assemble a differential amplifier and obtain in CMRR circuits (??) .
9. To study different application of OP AMPS.
   - OP – AMP as an inverting amplifier.
   - OP – AMP as a Non inverting amplifier.
   - OP – AMP as an integrator
   - OPAMP as a differentiator.
10. To study the performance of a voltage regulator IC Chip.

Course No.: MEC 601 **AUTOMATIC CONTROL** **C L T(4 3 1)**

UNIT I

Introduction: Concept of automatic control, open loop and closed loop systems, servo mechanism, block diagram, transfer function.

Representation of control components and systems: Translation and rotational mechanical components, electrical components -series and parallel combinations, comparators for rotational and linear motions, integrating devices, hydraulic servomotor temperature control systems ,speed control systems.

UNIT II

System response: First and second order systems, response to step, pulse, ramp and sinusoidal inputs, systems with distance velocity lag.

Modes of controls: Proportional control, Proportional pulse reset control, proportional pulse rate control, proportional reset rate control, two position control.

Controller Mechanism: Pneumatic, hydraulic and electric controllers, general principles and circuits for generating various control actions.

UNIT III

Control system analysis: Transient response of simple control systems, stability of control systems, Mouths criterion. Frequency response analysis, polar rectangular and logarithmic plots, experimental determination of frequency response, Bode and Inquest stability criteria, gain and phase margins. Root locus plots of simple transfer function, transient response from root locus.

Electronic Analogue computers: Elements of analogue computers, solution of simple differential equations.

Text Book:

1. Ogata,K., " Modern Control engineering", *Prentice Hall of India, 3rd edition, New Delhi, 1997.*

Reference Book:

1. Raven, F., "Automatic Control" *McGraw Hill Int., 1999.*

Course No.: MEC 602 **MACHINE DESIGN- II** **C L T(4 3 1)**

UNIT I

Design of friction elements, various types of brakes, design equations for various types of brakes, design analysis of all types of brakes, e.g., band brake, long shoe brake, etc. design analysis of all types of clutches, design of couplings and keys for shafts, etc, design and analysis of flat and V-belt, equations for power, slip, etc, design of chain drive.

UNIT II

Introduction to gear design, design of spur gear, equation for σ_b and σ_c for spur gear, design analysis for bending, force analysis for Helical gear, design analysis for helical gear, design of bevel gear, determination of bearing forces, horizontal and vertical shafts, design analysis for bevel gear , design analysis for worm gear.

UNIT III

Introduction to Plain bearings, Bearing surface at Micro level, Derivation of Energy equation and PV factor , PV graph, Values of PV , Derivation of Wear coefficient equation, Step-by-step procedure for Plain bearing design, Self lubricating bearings and use of clearance for life of bearing, Design of Hydrodynamic bearings, Derivation of Reynolds equation for three dimensional case, Journal bearing geometry,Variation of viscosity with pressure and temperature, Viscosity index, Sommerfeld number, Analysis of ho, h_{min}, Q_{in}, Q_{loss}, T_{in} , T_{out}, Introduction to Rolling element bearings, Design of AFB (??) , Equations for L_{10} life, Static loading and dynamic loading ,Use of AFB catalogue, Determination of Load based on radial and thrust load for ball bearings, Derivation of Load equation for Tapered AF (??) bearings, Design analysis on the basis of loads and selection of AFB from a catalogue.

Text Books:

1. Mot, R.L., "Machine Elements in Mechanical Design", *Maxwell Macmillan Intl. edition N.York , USA, 1992.*
2. Shigley, J.E., "Machine Engineering Design", *McGraw Hill, higher education,2004.*

Reference Books:

Shigley, J.E., Mischke, C. Brown T., "Standard Hand book of Machine Design" *McGraw Hill.*

Course No.: MEC 603 **FUNDAMENTALS OF TRIBOLOGY** **CL T (4 3 1)**

UNIT I

Introduction to tribology, tribology in Industry, energy saving through tribology engineering, Surfaces and interaction between surface, production of engineering surface, surface roughness, RMS value, average value and ten point average of surface roughness. Development of engineering surface and measurement of surface roughness, Tribology in Industry, Losses of due to friction and wear in industry, Tribo-elements and a systems concept in tribology, Introduction to friction static and dynamic friction analysis, Da Vinci concept of friction, Amonton's laws of friction, Coulomb's laws of friction, Bowden and Tabor concept of friction.

UNIT II

Wear and Types of wear, adhesive wear and its mathematical model, Two body abrasive wear, Three body abrasive wear, abrasive wear and its mathematical model, corrosive wear model, erosive wear model, cavitation wear, scuffing wear, delimination wear, pitting wear, wear coefficient and wear measurement, wear measurement through Pin- on- Disc machine, Pin-on-ring, Profilometer, wear coefficient of various materials,

UNIT III

Lubricants, types of lubricants, physical adsorption, Chemisorption, Self lubrication properties of materials, Solid lubrication, Lubrication in space, Food industry, etc, High temperature lubrication, Hydrodynamic lubrication, Various components of Reynolds equation, Sommerfeld number and its use in hydrodynamic lubrication, Materials for tribological applications.

Text Books :

1. Czichos, H., "A system approach to science and Technology of Friction, Lubrication and Wear" Volume I, Tribology series, *Elsevier Publications, , 1978.*
2. Glaeser, J " Marerials for Tribology",Tribology series Vol. 20, *Elsevier Publications, , 1992.*

Reference Books:

1. Peterson M.B.,Winner W.O, "Wear control Handbook" *sponsored by The Research Committee on Lubrication, Publsher, , 1980.*
2. Cameron A., "The principles of Lubrication", *Longman, London, 2000.*

Course No.: MEC 604 **LINEAR OPTIMIZATION IN ENGINEERING** **C L T (4 3 1)**

UNIT I

Overview of Operations Research (OR), OR Methodology and techniques, Introduction to Linear Programming (LP), Application of LP techniques in Production management, graphical solutions, the simplex method, Duality and Sensitivity analysis, transportation model problems and their variants, assignment model problems.

UNIT II

Project planning and scheduling, CPM & PERT, Project crashing and recourse allocation problems, decision theory, steps in decision making, decision making under uncertainty and under risk, marginal analysis, decision trees.

UNIT III

Flow shop scheduling, Job shop scheduling, Queuing theory and their applications, Waiting line models and their applications, introduction and basic concepts of Simulation.

Text Book:

1. Taha, H.A., "Operation Research- an Introduction", 6th edition, Prentice Hall of India, New Delhi, 2000.

Reference Books:

1. Joseph Ecker, Michael K, "Introduction to Operations Research" *John Wiley & Son, , 1998.*
2. Hillier &Lieberman, "Introduction to Operations Research", *McGrawHill, Singapore, 2001.*
3. Gupta M.P, Khanna R.B., "Quantitative Techniques for Decision Making", *Prentice Hall of India, New Delhi, 2008.*

Course No.: MEC 605 INTRODUCTION TO MECHATRONICS C L T (4 3 1)

UNIT I

Introduction to mechatronics, mechatronic design approach, system interfacing, instrumentation and control systems microprocessor-based controllers and microelectronics, mechatronics; a new directions in nano-, micro-, and mini-scale, electromechanical systems design, physical system modelling, electromechanical systems structures and materials, modelling of mechanical systems for mechatronics applications,

UNIT II

Sensors and actuators, fundamentals of time and frequency, sensor and actuator characteristics, linear and rotational sensors, acceleration sensors, force measurement, torque and power measurement, flow measurement, temperature measurements, distance measuring and proximity sensors, light detection; image, and vision systems, integrated micro-sensors, actuators; electro-mechanical actuators, electrical machines, piezoelectric actuators; hydraulic and pneumatic actuation systems.

UNIT III

Microtransducers analysis, design and fabrication, role of controls in mechatronics, role of modeling in mechatronics design, response of dynamic systems, introduction to computer and logic systems, logic concepts and design system interfaces, communication and computer networks, fault analysis in mechatronic systems, logic system design, programmable logic controllers, software and data acquisition.

Text Book:

1. Shetty D., Richard A.K., "Mechatronics system design", *Cengage learning, , 2011.*

Reference Books:

1. Dan S.N., "Mechatronics" *Prentice Hall, , 2002.*
2. "Micromechatronics - Modeling, Analysis, and Design with Matlab", *CRC Press, London, 2004.*

MEC 603 P FUNDAMENTALS OF TRIBOLOGY LAB C P (1 2)

1. Preparation of samples for friction and wear tests.
    - Polishing
    - Cleaning.
2. Microhardness Measurement; Knoop and Vicker for metals, polymers and ceramics
    - HV V/s Load plots.
    - HK V/s Load Plots.
    - Influence of indentation time.
    - HV V/s Indentation time
    - HK V/s Indentation time
3. Measurement of Friction
4. Measurement of Wear through weight loss, etc.
5. Plot of friction coefficient V/s Load , and Plot of wear volume V/s Load
6. Calculation of wear coefficient for a metallic material.
7. Calculation of Wear coefficient for ceramics.
8. Measurement of friction in presence of lubricant at room temperature.
9. Measurement of wear under lubricated conditions for metallic materials.
10. Influence of additives on friction and wear of metals.

MEC 605P **MECHATRONICS LAB.** **C P (1 2)**

1. Sensor/Actuator - Interfacing, calibration, frequency domain characterization, MATLAB serial interface, and serial LCD display
2. Design of electropneumatic circuits for L (??) and square cyles using PLC's.
3. Sorting of components on an intelligent a conveyor system.
4. Modelling of DC Motor System.
5. DC Motor position tracking.
6. DC Motor position set-point control via PID controller, using relay automatic tuning technique
7. Disection of an existing system.
8. Demonstration of recent projects on Mechatronics.

Mini Project on Independent modeling, analysis, and design of a mechatronic control system (Select one “mechatronic plant” from the Quanser, rotary family).

Course No.: MEC 701 **BASIC FRACTURE MECHANICS** **C L T(3 2 1)**

UNIT I

Summary of basic problems and concepts in fracture, a crack in a structure, crack tip stresses, The Griffith criterion, crack opening displacement criterion, crack propagation.

Mechanisms of fracture and crack growth, cleavage fracture, ductile fracture, fatigue cracking, Environmental assisted cracking, service failure analysis.

UNIT II

The elastic crack-tip stress field, Airy stress function, complex stress function, solution to crack problems, the effect of finite size, Some special cases, elliptic cracks The energy principles, The concept of energy release rate, The criterion for crack growth, The crack resistance, The concept of J-integral.

UNIT III

Crack-tip plastic zone, Irwin's plastic zone correction, The Dugdale approach, Plane stress versus plane strain, plastic constraint factor, The thickness effect, application of von Mises and Tresca yield criteria to obtain plasticity effected regions, Dynamics and crack arrest, Crack speed and kinetic energy, the dynamic stress intensity and elastic energy release rate, principles of crack arrest.

Text Book:

1. Anderson T.L., "Fracture Mechanics Fundamentals and applications",*CRC, Taylor & Francis, 2005.*

Reference Book:

1. Janssen,M.J., Zuidema, J., Wanhill R.J.H., " Fracture Mechanics", *Spon Press, , 2004.*

Course No.: MEC702 MEASUREMENT AND INSTRUMENTATION C L T (4 3 1)

UNIT I

Measurement and Instrumentation; definitions, significance, Fundamental methods, generalized measurement system, Functional elements, Types of input quantities, standards, calibration, uncertainty, Errors, Classification of instruments, Input-output configuration, Interfering and modifying inputs, methods of correction, Generalized performance characteristics, static characteristics, static calibration, Dynamic characteristics, zero and first order instruments, time constant, Second-order instruments, transient response characteristics. Relative and absolute motion devices, relative displacement, Resistive potentiometers, bridge circuit, LVDT, Variable inductance and variable capacitance pick-ups, Piezoelectric transducers, fibre optic displacement transducer, Resistance strain gage, Relative velocity-translational and rotational, Mechanical revolution counters and timers, stroboscopic method, Moving coil and moving magnet pickups, DC and AC tachometers, Eddy current drag-cup tachometer, acceleration measurement.

UNIT II

Hydraulic and pneumatic load cells, flapper nozzle principle, Force transducers with elastic members, Proving ring transducer, cantilever beam transducer, electromagnetic balance, Dynamometers – Absorption, driving and transmission type, reaction forces in shaft bearings, prony brake, eddy current brake dynamometer, Instruments for high, mid and low pressure measurement, dead weight and null type, Elastic element gages, Differential pressure cell, high pressure measurement, Low pressure measurement –, Pirani gages & McLeod pressure gauge.

UNIT III

Orifice meters, Venturimeter, Pitot tube, Flow nozzle, Variable area meters, rotameter, design and accuracy, Positive displacement flow meter, turbine flow meter, Electromagnetic flow meter, ultrasonic flow meters, Temperature sensing techniques, liquid-in-glass and bimetallic thermometers, Pressure thermometers, electrical resistance thermometers, Thermistors, Thermocouples, thermopiles, Radiation pyrometers, Optical pyrometer.

Text Book:

1. Beckwith, B., "Mechanical Measurements", 6th edition, *Pearson Education Int. ,2008.*

Reference Book:

1. Nakra B.C. "Instrumentation, Measurements & Analysis", 2nd edition, *Tata McGrawHill, N.Delhi, 2008.*
2. Doeblin, E.O., "Measurement systems",5th edition, *McGraw Hill, New Delhi, 2004.*

Course No.: MEC 703 **INDUSTRIAL ENGINEERING - II** **C L T(4 3 1)**

UNIT I

Factory organization**:** Introduction to Plant organization, Principles of Organizational structure, Organization charts, Types of Organizations, Developing an organization structure, Results of good organization,, Informal organization, advantages and disadvantages.

Location and Layout analysis: Introduction to Facility location problems, Factors affecting the plant location. Break even analyses and their application, Subjective, qualitative and semi-Quantitative techniques of facility location, Single facility Location problem, Minimax Location problem, Gravity problem and their applications. Line balancing, Introduction to facility layout and their objectives, Classification of Layouts, with advantages and disadvantages of each, Layout design procedures(CRAFT,CORELAP,ALDEP), Material handling systems, Make or Buy decisions, Planning and control of Batch Production,. Characteristics of Batch Production, Determination of Batch size, Minimum Cost batch Size, Maximum Profit Batch size, Sequencing and scheduling for Batch Production, Line of Balance technique.

UNIT II

Inspection and quality control**:** Concept and Definition of Quality, Concepts of Inspection and quality control, Objectives of inspection, Function of Inspection and their types, Concept of statictical quality control (SQC), Process variation, Sampling inspection. Concepts and types of Control charts, Acceptance sampling, application of control charts and sampling plans.

UNIT III

Materials management and inventory control**:** Integrated materials management and their components, Functions and objectives of material management, Introduction and concepts of Inventory management, Purchase model with instantaneous replenishment and without shortage, Manufacturing model without shortages, Purchase model with shortages, Manufacturing model with shortages, Probabilistic inventory concepts with lead time., Selective inventory management-ABC , FSN, VED analyses.

Text Book:

1. Everett, E.A., Ronald J.E, "Production and Operations Management" *Prentice Hall of India, 5th edition, New Delhi, 2001.*

Reference Books:

1. Claude, S.G., "Management for Business & Industry" *Prentice Hall of India*, New Delhi, 2000.
2. Everett, E.A., Ronald J.E, "Production and Operations Management", *Prentice Hall of India, 5th Edition, New Delhi, 2001.*
3. Grant, E.L; Leavenworth R.S, "Statistical Quality Control", *Tata Mcgraw Hill, 7th Edition*, New Delhi, 1996.
4. Apple, J.M, "Plant Layout & Material Handling", *JohnWiley & Sons, New York.*
5. Maynard, Industrial Engineering Hand Book, *McGraw Hill, New York.*

Course No.: MEC 704 APPLIED THERMODYNAMICS- II C L T (4 3 1)

UNIT I

Gas dynamics, Definitions and basic relations, Energy equation, rate equations for a control volume, Isoentropic flow with variable area, wave motion, Flow with normal shock waves, Flow in Constant area ducts with friction, Flow in constant area ducts with heat transfer, Centrifugal compressor, Energy transfer in compressors and turbines, Euler's equation. Principles parts and description of centrifugal compressor, impeller diameter, number of blades, velocity diagram, sprewhirl (??) slip, factor work input, factor pressure coefficient, compressor efficiency.

UNIT II

Axial flow compressor, Stage velocity diagram, stage pressure ratio and number of stages, degree of reaction blade and stage efficiency, poly tropic and isentropic efficiency surging, Gas Turbines, Ideal gas turbine cycle, condition for maximum output, actual gas turbine cycles, reheating and regeneration velocity diagram for a stage, stage pressure ratio and number of staged polytropic efficiency, isoentropic efficiency, Jet propulsion, Turbojet cycle, net thrust, specific thrust, thermal efficiency of turbojet engine, propulsive efficiency, effect of forward speed.

UNIT III

Applications of Refrigeration and Air-conditioning, Thermal Principles for Refrigeration, Vapor Compression System, Reversed Carnot Cycle, Survey of Refrigerants, Designation of Refrigerants, Selection of Refrigerants, Thermodynamic Requirements, Multistage compression, multi-evaporator system, cascade systems, systems practices for multistage systems, Reciprocating Compressors, Rotary screw compressors, Vane compressors, Centrifugal compressors, Condensers, Heat Transfer in Condensers, Evaporators, Heat Transfer in Evaporators, Extended surface Evaporator, Cooling and Dehumidifying coils, Automatic or constant-pressure expansion valve, Psychometric properties, Wet bulb temperature, Psychometric chart, mixing process.

Text Book:

1. Cohen H, Rogers G.F.C.,"Gas turbine Theory", *Pearson Education, , 2001*.
2. Yahya, S.M., "Fundamentals of Compressible flow", *New Age India, Place,* 2002.
3. Arora C.P., "Refrigeration and Airconditioning", *McGraw Hill, New Delhi, 1990.*

Reference Books:

1. Stoeker,W.F., " Refrigeration and Air conditioning", *McGraw Hill, , 1990.*
2. Shapiro A.H., "The Dynamics and Thermodynamics of Compressible Fluid Flow", *Ronald Press, 1953*.

Course No.: MEC 705 COMPUTER APPLICATIONS IN MECH. ENGG. (CAME) CL P(3 2 1)

UNIT I

Overview of C++, Flow charts. Computer languages. Constants and variables. Arithmetic expressions. Input/ output, control and the Do and for statements. Introduction to programming.

Types of errors. Computational algorithms and computer arithmetic. Iterative methods. Solution of equations: Bisection method, Regula-falsi method, Newton Raphson method. Solution of linear system of equations: Gauss elimination, Gauss-Jordan, Gauss- Siedel method, LU decomposition.

UNIT II

Interpolation and approximation of functions, Newtons forward formula (equal and unequal intervals) Curve fitting (straight line, nonlinear, exponential) differentiation, integration (Simpson's rule, Weddle's) and program.

UNIT III

Numerical solution of ordinary different equations. Runge- Kutta methods, Types of PDEs, boundary value problems, solution of parabolic PDEs using finite differences and program.

- Examples to be taken from Mechanical engineering applications.

Text Book:

1. Sastry,S. " Numerical Methods", *Printice Hall of India, New Delhi*.

Reference Books:

1. Lafore , G, "C++ Programming", *Galgotia publishers,New Delhi, 2001*.
2. Veerarajan, " Numerical Methods", *Tata Mc-GrawHill, New Delhi, 2000.*

MEC 703 P INDUSTRIAL ENGINEERING-II LAB. C P(1 2)

1. To study the layout of a shop in an organization and draw existing and proposed layouts.
2. To measure the variable characteristics (diameter of pins, with micrometer) and prepare a frequency histogram. Calculate values of X bar and sigma.
3. Verify that when random samples are taken from a lot with a certain percentage of defective, same %age lands to appear in random sampling by using Shewart's kit.
4. Simulate an inspection situation with the help of a Schewhart's bowl and plot X bar, and R charts using computed data.
5. To conduct Process capability study of a machine tool and to specify the tolerances for a job.
6. To verify the theorem "the standard deviation of the sum of any number of independent variables is the square root of the sum of the squares of the S.Ds of the independent variable. Determine statistically, the permissible tolerance of mating components, when the tolerance of the assembly is given.
7. To draw control chart for percent defectives after inspecting a sample and sorting out the defective units.

MEC 705P **CAME LAB** **C P (1 2)**

Develop programme and algorithm for:

1. Bisection method
2. Regula - Falsi method
3. Newton Raphson method
4. Gauss Elimination method
5. Gauss Jordon method
6. Gauss Seidel method
7. Integration by trapezoidal method
8. Integration by Simphson rule (1/3 and 3/8)
9. Solution of ordinary differential equations and Partial differential equations by

   a) R.K methods
   b) Solution of Parabolic partial differential equation.

Course No.: MEC 801 PRODUCTION & OPERATIONS MANAGEMENT C L T(4 3 1)

UNIT I

Managing and Planning Operations:

Introduction to operations management (OM), historical perspective and growth, operations strategies for competitive advantage. Forecasting (FC), nature and use of FC, sources of data, demand pattern, FC models. designing products, services and processes, new product design, product development, product life cycle, product development process, product reliability, process technology life cycle, flexible manufacturing systems,

UNIT II

Scheduling Systems and Aggregate Planning for Products and Services

Operations planning and scheduling systems, the aggregate planning process, strategies for developing aggregate planning, master schedule and rough cut capacity planning, implementing aggreate plans and master schedules, material requirement planning (MRP)

UNIT III

Managing for World class Competition

Japanese contribution for World Class Manufacturing(WCM), JIT manufacturing, basic concepts of TQM, ISO, PokaYoke and Kaizen. Business process re-engineering, lean manufacturing, concepts of supply chain management,

Text Books:

1. Panneerselvam R, " Production and Operations Management", 2nd Edition, New Delhi, 2005

Reference Book:

1. Roberta S. Russell, Taylor B.W, "Operations Management", *Pearson Prentice Hall, 4th edition, 2001.*

2. Everett, E.A., Ronald J.E, "Production and Operations Management" *Prentice Hall of India, 5th edition, New Delhi, 2001*
3. Evans J.R., Collier D.A., "Operations Management, An Integrated Goods and Services Approach", *Cengage Learning India, New Delhi, 2007.*

Course No: MEC 802 **INTERNAL COMBUSTION ENGINES** **C L T(4 3 1)**

UNIT I

Thermodynamics of actual working fluids: Working fluid before combustion, valve and port timing diagrams. Thermodynamic properties of fuel-air mixture before combustion. Use of combustion charts for unburned mixture. Use of combustion charts for burned mixture Appropriate treatment of fuel air mixtures. Fuel air cycles: Definition, constants, volume fuel air cycle, limited pressure cycle, characteristics of fuel-air cycles, comparison of real and fuel cycles. Air capacity of four stroke engines: Ideal air capacity , Volumetric efficiency , ideal induction process , actual induction process, Effect of operating conditions on volumetric efficiency, Effect of design on volumetric efficiency , estimating air capacity.

UNIT II

Two stroke engines: Scavenging process, ideal scavenging process, relationship of scavenging ratio and scavenging efficiency, power to scavenger, supercharged two stroke engines. Combustion and detonation: chemistry of combustion, normal combustion in S.I engines , pre-ignition and auto-ignition comparison, detonation in S.I engines, combustion in C.I engines, detonation in C.I engines, Methods of reducing detonation , preliminary detonation, preliminary facts about fuel and dopes, octane and cetane numbers, effect of design on detonation. Mixture requirements: Steady running, mixture requirements, transient mixture requirements, mixtures requirements for fuel injection engines, mixture requirements for S.I engines.

Performance of supercharged engines: engine performance measures, commercial engine ratings, basic performance equations for un-supercharged engines, effect of atmospheric conditions, altitude and compression ratio on performance characteristics, performance curves.

Supercharged engines: definitions, reasons for supercharging, supercharging of S.I engines, supercharging of diesel engines.

UNIT III

Heat losses and cooling: Area of heat flow engines, temperature profile, Engine cooling system, Numericals on heat transfer in IC engines, Engine design: selection of type, engine speed and principles of similitude. Numerical on alternative fuels, Numerical on diesel fuel injection system, Numericals on engine specification and verification, Numerical on two stroke engines. General design of petrol and diesel engine. Numericals on engine design, determination of main dimensions, Comparative Numerical on two stroke engines and four stroke engines

Text Book:

1. Heywood, J.B., " Internal Combustion Engine fundamentals", *Mc-Graw Hill Book Co., USA, 1989.*

Reference Books:

1. Domkundvar V.M., "A course in internal combustion engines", *Dhanpat Rai and company, New Delhi, 1999.*

MEC 802P **I.C. ENGINES LAB.** **C P (1 2)**

1. Study of two stroke spark ignition engine model
2. Study of four stroke spark ignition engine model
3. Study of four stroke diesel engine model.
4. Study of rotary wankel engine.
5. Study of models of gas turbine engines.
6. Study of single cylinder four stroke direct injection diesel engine. (cut section)
7. Study of multi-cylinder optical spark ignition engine.
8. Experimental study of characteristic performance curves of spark ignition engine using gasoline as fuel.
9. Experimental study of characteristic performance curves of compression ignition engine using diesel as fuel.
10. Experimental study of characteristic performance curves of compression ignition engine using biodiesel blends, with diesel as fuel.
11. Study of engine components. (like cylinder block , crank shaft etc).
12. Study of components of ignition system of S.I. Engines.

Course No.: MEC- 80* **VALUE ENGINEERING** **C L T(3 2 1)**

UNIT I:

Introduction to value engineering (VE) & value analysis (VA), Life Cycle of a product, Methodology of VE, Reasons for the existence of unnecessary costs. Quantitative definition of Value, use Value and Prestige value, Estimation of product Quality/Performance, Types of functions, Relationship between use functions and Esteem Functions in product design, Functional cost and functional worth, Effect of value improvement on profitability, Tests for poor value, Aims of VE systematic approach.

UNIT II

Elementary introduction to VE, Job plan functional approach to value improvement, Various phases and techniques of the job plan, Factors governing project selection, Types of projects, Life cycle costing for managing the total value, concepts in LCC, Present value concept, Annuity concept, net present value, Pay Back period, internal rate of return on investment (1RR), Examples and Illustrations. Creative thinking and creative judgement, positive or constructive discontent, Tangible and intangible costs of implementation, False material, Labour and overhead saving, VE/VA yardsticks, Relationship between savings and probability of success, Reliability Estimation, system Reliability, Reliability elements in series and parallel.

UNIT III

PHASES AND TECHNIQUES OF VE JOB PLAN:

General Phase, Information phase, Function phase, Creativity/Speculation Phase, Evaluation Phase, Investigation Phase and Recommendation Phase*:* Value improvement recommendation theory, determination of cut-off point (cop), road blocks in implementation. Decision Matrix/Evaluation Matrix, Quantitative comparison of Alternatives, Estimation of weights factors and efficiencies, Utility transformation functions, Bench marking, Perturbation of weight factors (sensitivity analysis), and Examples.

FAST Diagramming: Critical path of functions, HOW, WHY & WHEN Logic, Supporting and all time functions.

Reference Books:

1. Arthur E. Mudge, "Value Engineering- A Systematic Approach", *McGraw Hill Book Co.* , 1971.
2. Miles L.D., "Techniques of value Analysis and Engineering", *McGraw Hill Book Co., New York, 1970.*
3. ASTME-American society for Tool and Manufacturing Engineers," Value engineering in Manufacturing", *Prentice Hall Inc. USA, 1967.*

Course No.: MEC 80* **THEORY OF ELASTICITY (TOE)** **C L T (3 2 1)**

UNIT I

Introduction: Elasticity, stress components of stress and strain, Hooks law. Equations in polar coordinates, Plane stress and plane strain: Strain at a point, Mohr circle for strain rosette, differential equation of equilibrium, boundary conditions, compatibility equations, overview of Airys stress functions.

UNIT II

Two dimensional problems in rectangular coordinates: solution by polynomials, St Venants principles, determination of displacement, bending of beams, solution by Fourier series. Two dimensional problems in polar coordinates: Equations in polar coordinates, equation about 1-axis, and pure bending in curved bars.

UNIT III

Determination of strains and displacement, effect of circular hole on stress distribution in plate concentrated and vertical loading of a straight boundary, circular disc, general solution and its applications, Analysis of stress and strain in thee dimensions: stress at a point, principal stress, stress ellipsoid and stress director surface, homogenous deformation, strain at a point, principle strain rotation.

Text Books:

1. Timoshanko, S.P. and Goodier, J.N., "Theory of Elasticity," *Mc-Graw Hill Book Company, N.Y. , USA, 1970.*

Reference Books:

1. Love, A.E.H., "The Mathematical Theory of Elasticity," *Dover Publications, NewYork, USA, 1944.*

Course No.:MEC 80* **INTRODUCTION TO ACOUSTICS** **CL T (3 2 1)**

UNIT I

Fundamentals of Vibrations: Introduction, The simple oscillator, Complex exponential method of solution, Transient response of an oscillator, Power relations, Equivalent electrical circuits for oscillators, The Fourier Transform.

Transverse Motion: Vibrations of extended systems, Transverse waves on a string, The one-dimensional wave equation, General solution of the wave equation, The wave nature of the general solution, Initial values and boundary conditions, Reflection at a boundary, Forced vibration of an infinite string, Forced vibration of a string of finite length, Normal modes of the fixed string, Acoustic measurements.

UNIT II

The Two-Dimensional Wave Equation: Vibrations of a plane surface, The wave equation for a stretched membrane, Free vibrations of a rectangular membrane, Free vibrations of a circular membrane, Normal modes of membranes, The diaphragm of a condenser microphone, Vibration of thin plates.

The Acoustic Wave Equation and Simple Solutions: The equation of state, the equation of continuity, The Euler's equation, The linear wave equation, Speed of sound in fluids, Harmonic plane waves, Energy density, Acoustic intensity, Specific acoustic impedance, Spherical waves, The inhomogeneous wave equation, The point source.

UNIT III

Radiation and reception of acoustic waves: Radiation from a pulsating sphere, Acoustic reciprocity and the simple source, The continuous line source, Radiation from a plane circular piston, Radiation impedance, Fundamental properties of transducers (directional factor, beam pattern, beam width, source level, directivity).

Reflection and Transmission of Acoustic Waves: Transmission from one fluid to another: normal incidence, and oblique incidence, Normal specific acoustic impedance, Reflection from the surface of a solid: normal incidence, oblique incidence.

Text Book:

1. Kinsler, L.ER., Austin R. Frey, A. B., Coppens, J. V.,Sanders, "Fundamentals of Acoustics", *4th edition , John Wiley & Sons.*

Reference Book:

1**.** Philip M. Morse, Ingard,K.U., " Theoretical Acoustics", *Princeton University Press.*

Course No.: MEC 80[#] **POWER PLANT ENGINEERING (PPE)** **C L T (3 2 1)**

UNIT I

Introduction:- Energy source for generation of electric power. Principle types of power plants, their special features and applications, major power plants in India.

Steam Power Plants :- Selection of site, general layout of the power plant, special features of the modern steam boilers, circulation principle, steam separation and purification, economizers and air pre-heater types and estimation of performance, super-heater and superheat control, feed water heaters, cooling tower , temperature and pressure control. Introduction to hydro electric power plant, types of hydro-electric plant in combination with steam plant, Runoff river plant in combination with steam plant, storage plant in combination with steam or nuclear plant, Coordination of hydro-electric and gas turbine stations, coordination of different types of power plants.

UNIT II

Nuclear Power Plants :- Nuclear fuel, nuclear energy by fission, main components of nuclear reactors, pressurized water, boiling water, liquid metal and gas nuclear reactors.

Diesel Power Plants :- Plant layout , two and four stroke cycle diesel engines, fuel injection, lubrication and cooling systems, supercharging and starting systems. Gas and Steam Turbine combined Cycles:- Simple gas and steam combined cycle power generation.

UNIT III

Economic Analysis of Power Plants and Tariffs :- The cost of electrical energy , selection of types of generating equipment , performance and operating characteristics of power plant , load division among generators , Tariff methods of electrical energy .Combined operation of different power plants :- Advantages of combined working , Load division among power stations , Storage

Text Book:

1. Rajput R.K., "A text book of power plant engineering", *Laxmi Publication, Pvt. Ltd., New Delhi, 2007.*

Reference Books:

1. Domkundwar, S., "Power Plant Engineering", *S.C. Chand and company, New Delhi, 2000.*
2. Joel W, Roy E, "Modern Power Plant Engineering", *Prentice-Hall of India Ltd*., New Delhi, 1985.

Course No.: MEC 80# **CAD OF THERMAL SYSTEMS** **C L T(3 2 1)**

UNIT I

Introduction, Engineering Design, Design as Part of Engineering Enterprise, Thermal Systems, Formulation of the Design Problem, Conceptual Design, Steps in the Design Process, Types of Models, Mathematical Modelling, Physical Modelling and Dimensional Analysis.

UNIT II

Curve Fitting, Numerical Modelling, Solution Procedures, Numerical Model for a System, System Simulation, Methods for Numerical Simulation, Initial Design, Design Strategies, Design of Systems from Different Application areas, Additional Considerations for Large Practical systems, Economics.

UNIT III

Optimization, Basic Concepts, Mathematical formulation, Optimization Methods, Calculus Methods, Search Methods, Linear and Dynamic Programming, Geometric Programming, Introduction to Calculus Methods, Optimization of Unconstrained problems, Use of Gradient for Optimization, Optimization of Constrained problems, , Search Methods, Types of Approaches, Application to Thermal Systems, Single-Variable Problem, Uniform Exhaustive Search, Dichotomous Search, Fibonacci Search, Comparison of Different Elimination Methods, Unconstrained Search with Multiple Variables, Geometric, Linear and Dynamic Programming, Knowledge-based systems, Basic Components, Expert Knowledge, Design Methodology.

Text Book:

Janna, W.S., " Design of Fluid Thermal Systems", *PWS Publishing Company, Place, 1990.*

Reference Book:

Stoecker,W.F., "Design of Thermal Systems", *McGraw Hill, Place, 2001.*

Course No.: MEC 80# **INTRODUCTION TO MEMS** **C L T (3 2 1)**

UNIT I

Definition of MEMS, MEMS devices, Silicon as a MEMS material, mechanical properties of silicon, Fabrication technologies, Introduction to micro-fabrication, Silicon based MEMS processes, Surface Micromachining, Sacrificial Etching Process, Bulk Micromachining and Silicon Anisotropic Etching, Bulk versus surface micromachining, mechanical components in MEMS.

UNIT II

Review of essential electrical and mechanical concepts, Conductivity of Semiconductors, Review of solid mechanics for design of mechanical components, Crystal Planes and Orientation, Mechanical properties of Silicon and their related thin films.

UNIT III

Review of electrostatics and electrodynamics for electrical domain calculations, Electrostatic Sensing and actuation, analysis of comb drives, Dynamics of comb drives, Piezoelectric Sensing and actuation, Piezoresitive Sensing, Scaling laws, Instrumentation for MEMS testing and characterization.

Reference Books:

1. Senturia, S.D., "Microsystem Design", *Kluwer Academic Publisher,2000*.

2. Nadim M, "An Introduction to Micro Electromechanical Systems Engineering", *Artech house,1999*.

ANNEXURE I

Courses offered in First and Second Semesters

First Semester		
Subject	**Code**	**Credits**
Physics	**PHY101**	**3**
Physic Lab.	**101P**	**1**
Chemistry	**CHM102**	**3**
Chemistry Lab.	**102P**	**1**
Math	**MTH101**	**4**
Engineering Drawing	**CIV 102**	**4**
Humanities	**HSS101**	**4**
Computer Fundamentals	**IT101**	**3**
Workshops	**WSP1**	**2**
Second Semester		
Physics	**PHY201**	**3**
Physic Lab.	**201P**	**1**
Chemistry	**CHM201**	**3**
Chemistry Lab.	**201P**	**1**
Math	**MTH201**	**4**
Machine Drawing	**MEC201**	**4**
Humanities	**HSS201**	**4**
Computer Science	**CSC201**	**3**
Emech.	**CIV201**	**3**
Workshop II	**WSPII**	**2**

ANNEXURE II

Courses offered by MED to students of the other departments / disciplines

Semester	Branch	Course	Code
3rd	Chemical	Design of Machine Elements	MEC307
3rd	Metallurgy	Mechanics of Solids	MEC308
3rd	Metallurgy	MOS Lab.	MEC 308P
4th	Metallurgy	Machine Design & Instrumentation	MEC 406
4th	Metallurgy	MD&I Lab.	MEC 406P
4th	Metallurgy	Fluid flow & Heat transfer	MEC407
4th	Metallurgy	FF&HT Lab.	MEC407P
4th	Electrical	Mechanical Engg.	MEC408

Course No. MEC 201 MACHINE DRAWING (2nd semester) C L P

(4 1 6)

Principles of sectioning-Types of sections, standard sectioning practices

Principles of dimensioning: size and location of dimensions, incremental and absolute dimensioning, unidirectional aligned practices, tolerances, standard dimension practices

Screw and Screwed Fasteners (Temporary): representation of screws, threads and various types of screw threads, threaded fasteners, locking devices, foundation bolts

Permanent Fasteners: Rivet and riveted joints, welding symbols and welded joints

Pin and Cotter Joints (temporary fasteners): Spigot and socket type cotter joints, sleeve type cotter joint, knuckle joint, Gib and cotter joints.

Keys and shaft couplings (Temporary fasteners): Muff coupling (Pin type), Friction coupling.

Clutches: Oldham coupling and universal coupling.

Shaft Bearings: Types of bearings, Journal bearing, pivot bearing, thrust bearing, ball bearing, bearing bracket and hangers.

Drawing sheets to be prepared as practicals.

References:

1. Bhat, N.D., “Machine Drawing”

2. Gill, P.S., “Machine Drawing”

+ Indian Std., BIS, for drawing