Department of Mechanical Engineering

Programme: B.Tech. in Mechanical Engineering

Bridge Year [For Lateral Entrants (10+3 Diploma) to Degree Module]

BridgeYear : SemesterI

			L	T	P	C
HS	4301	Elements ofEconomics	3	0	0	3
PH	4301	ComprehensivePhysics	4	0	2	5
CY	4301	ComprehensiveChemistry	4	0	2	5
MA	4301	ComprehensiveMathematics-I	3	1	0	4
ME	4301	Strength of Materials &MachineTheory	3	1	0	4
ME	4302	Fluid Mechanics &Machines	3	1	0	4
			20	**3**	**4**	**25**

BridgeYear : SemesterII

			L	T	P	C
HS	4401	Comprehensive CommunicationSkill	2	0	2	3
MA	4401	ComprehensiveMathematics-II	3	1	0	4
ME	4401	Mechanical Component Design &drawing	3	1	2	5
ME	4402	ThermalEngineering	4	0	0	4
ME	4403	ProductionTechnology	4	0	2	5
ME	4451	Comprehensive MechanicalLab	0	0	4	2
ME	4477*	Computer Applications in MechanicalEngg.Engineering	1	0	4	3
*Audit Course			**16**	**2**	**10**	**23**

Programme: B.Tech. in Mechanical Engineering Department: Mechanical Engineering

For Lateral & Vertical Entrants

YearI:SemesterI			L	T	P	C
MA	5106	Engineering Mathematics IIIE	4	0	2	5
ME	5101	OperationsResearch	3	1	0	4
ME	5102	FluidMechanics	4	0	2	5
ME	5103	Mechanics ofSolids	4	0	0	4
ME	5104	Dynamics ofMachines	4	0	0	4
ME	5105	Heat and MassTransfer	4	0	0	4
			23	**1**	**4**	**26**

YearI:SemesterII

ME	5201	MachineDesign	4	0	2	5
ME	5202	ManufacturingScience	4	0	0	4
ME	5203	IndustrialEngineering	3	0	0	3
ME	5204	Refrigeration and AirConditioning	3	1	0	4
ME	5205	Instrumentation & ControlEngineering	3	0	0	3
ME	5206	Elements ofMechatronics	3	0	0	3
ME	5251	ExperimentalTechniques	0	0	4	2
ME	5289	Seminar	0	0	4	2
			20	**1**	**10**	**26**

YearII: SemesterI

**	60**	Open Elective	3	0	0	3
ME	6101	Energy Conversion Techniques	4	0	0	4
ME	6102	Numerical Control and CAM	3	0	0	3
ME	6103	Power Plant Engineering	4	0	0	4
ME	6104	Product Design	2	0	2	3
ME	60**	Elective-I	3	0	0	3
ME	60**	Elective -II	3	0	0	3
ME	6199	Project – Part I	0	0	4	2
ME	6179	IndustrialTraining*	-	-	-	2* **30 days** compulsory
			22	**0**	**6**	**25**

* Audit Course

YearII: SemesterII

HS	6201	Human Resource Management	3	0	2	4
ME	60**	Elective-III	3	0	0	3
ME	60**	Elective-IV	3	0	0	3
ME	6251	Advanced Laboratory Practice	0	0	6	3
ME	6299	Project – Part II	0	0	8	4
ME	6290	Comprehensive Viva	-	-	-	2
ED	6288	Extra curricular activities&discipline	-	-	-	2
			9	**0**	**16**	**19+2(ED)**

List of Electives

Group-1 (For Elective – I & Elective – II)

ME	6001	Combustion Engineering	ME 6015 Boundary Layer Theory
ME	6003	Aerodynamics	ME 6017 Air and Noise Pollution Control
ME	6005	Compressible Flow	ME 6019 Heat Exchanger Design
ME	6007	Fluid Power Control Systems	ME 6021 Design of Thermal Systems
ME	6009	Internal Combustion Engines	ME 6023 Value Engineering
ME	6011	Finite Element Methods	ME 6025 Mechanical Handling of Materials
ME	6013	Principles of Tribology	ME 6027 Tool Design
			ME 6029 Production Planning and Control

Group-II (For Elective – III & Elective – IV)

ME	6002	Computational Fluid Dynamics	ME 6016 Management of Production System
ME	6004	Prime mover design	ME 6018 Non-Conventional Machining
ME	6006	Two Phase Flow and Heat Transfer	ME 6020 Energy Management
ME	6008	Composite Materials	ME 6022 Design of RAC Systems
ME	6010	Turbo machines	ME 6024 Vibration Analysis
ME	6012	Non-Conventional Energy	ME 6026 Metal Casting Technology
ME	6014	Theory of Elasticity	ME 6028 Industrial Robotics

Courses Offered to other Branches only:

Course Code	Course Name	L- T- P- Cr	Offered to
ME 5121	Machine Theory	3 – 1 – 0 – 4	AE
ME 6121	Theory of Refrigeration and Air Conditioning	2 – 0 – 0 – 2	AE

COURSE CONTENTS:

ME 4301: Strength of Materials & Machine Theory		**4 Credits (4-0-0)**
Unit I	Introduction to strength of materials: Basic concepts and definition, elastic constants, concept of direct, induced stresses, thermal stresses, stress, strain relationship, equilibrium equation (2-D), strain, displacement relationship, biaxial tension and compression, compound stress and strain, principal stresses and strains, strain rosette; Mohr's circle for stresses.	10 lectures
Unit II	Torsion: Torsion of circular shaft, angle of twist, torque and power, springs (helical&leaf), stresses in beam: shear force and bending moment diagrams, point of inflections, point of contra flexure.	8 lectures
Unit III	Bending stresses in beam, various beam section, shear stresses in beam, its variation over different cross, section, introduction to deflection of beams, double integration method, moment area method, Castigliano's theorem.	8 lectures
Unit IV	Theories of failure: Maximum principle stresses, maximum shear stress theory, Mohr's diagram, maximum strain theory, total strain energy theory, Octahedral shearing stress theory.	10 lectures
Unit V	Theories of column and strut: Eccentric loading of a short strut, long column, Euler's column formula, Secant's formula, Empirical column formula.	6 lectures
Unit VI	Kinematics and kinetics, mechanism and structure, degree of freedom and its determination, lower and higher pairs, type of motions, links, joints, kinematic chains and their inversions, Grashoff'slaw, miscellaneous mechanism, graphical methods of velocity analysis and acceleration analysis.	8 lectures

Unit VII	Brake and dynamometers: different types of brakes and dynamometers, working principles, clutches: torque transmission through friction and centrifugal clutches.	6 lectures

Recommended Books :

1. Strength of Materials, W. Nash, Schaum Series, 6th Ed., 2014.
2. Strength of Materials, S.Timoshenko, CBS, 3rd Ed., 2004.
3. Mechanism & Machine Theory, G.S.Rao&R.V.Deukipat, New Angel International Publisher, 2008.
4. Theory of Machines, S.S.Rattan, Tata McGraw Hill, 3rd Ed.,2009.

ME 4302: Fluid Mechanics and Machines 4 Credits (3-1-0)

Unit I	Characteristics of fluids, continuum principle, Langrangian and Eulerian approach, Control volume and system, fluid properties; viscosity, compressibility, surface tension and vapour pressure, hydrostatic thrust on immersed plane and curved surfaces, centre of pressure, buoyancy, metacentre, stability of immersed and floating bodies.	6 lectures
Unit II	Kinematics of fluids: Velocity & acceleration, rotational &irrotational flow, circulation &vorticity, flow characteristic,stream line, steak line & path line: velocity potential & stream function, flow net, basic flows and the corresponding velocity potential & stream functions.	6 lectures
Unit III	Fluid dynamics: Fundamental & subsidiary governing equations, continuity equation, NavierStoke's equation (statement only): Euler's equation of motion, momentum equation & its application: force caused by a jet striking a surface, force caused by flow round a pipe bend, momentum theory of a propeller) steady flow energy equation, energy correction and momentum correction factors, Bernoulli's equation, application of Bernoulli's equation – pitot tube, venturi meter, orifice meter and nozzle.	8 lectures
Unit IV	Laminar &Turbulent flow in pipes, shear stress & velocity distribution, Major and minor losses in a piping system, Pipes in parallel and series. Power transmission through pipes, dimensional analysis, dimensional homogeneity, Buckingham-ð theorem, dimensionless parameters and their significance, model analysis.	8 lectures
Unit V	Reciprocating pumps and their characteristics, rotodynamic machines, Centrifugal pump,Pelton wheel, Francis and Kaplan turbines, characteristics of rotodynamic machines, cavitation.	14 lectures

Recommended Books:

1. Mechanics of fluids, V. Massey, Y. Nelson Thornes, Pearson, 2001.
2. Fluid Mechanics & Hydraulic Machines, R.K.Rajput, S.Chand Publishers, 1998.
3. Fluid Mechanics, J.F. Douglas, J.M. Gasiorek, J. A. Swaffield and L.B. Jack, Pearson Education, 2008.
4. Fluid Mechanics and Fluid Machines, S.K. Som and G. Biswas, 3rd Ed., McGraw Hill Education, 2012
5. Fluid Mechanics and Thermodynamics of Turbomachinery, S. L. Dixon, 5th Ed., Elsevier, 1998.
6. Fluid mechanics and hydraulics, J. Jagadishlal, 9th Ed., Metropolitan New Delhi, 1991.

ME 4401: Mechanical Component Design & Drawing 5 Credits (3-1-2)

Unit I	Design criteria for machine elements,design against deflection and stiffness, stress concentration under static load, stress concentration factor, mechanical properties of engineering materials (strength, hardness, ductility, impact properties and creep) and their variations with temperature, common engineering materials and their properties, use of design data books, theories of failure and factor of safety.	7 lectures
Unit II	Joints: Design of riveted, bolted and welded joints, bolt preloading, cotter and knuckle joint.	7 lectures
Unit III	Power screws: Mechanics of power screw, different type of power threads, self locking condition, design of power screws.	7 lectures
Unit IV	Keys and couplings: Design of different keys, design of rigid and flexible couplings.	7 lectures
Unit V	Shafts: Transmission of shafts, design under static loading, design for torsional rigidity, design under combined loading.	7 lectures
Unit VI	Mechanical springs: Stress analysis of helical and leaf springs.	7 lectures
Practice:	Drawing of different components designed in lecture hours.	28 hours

Recommended Books :

1. Design Data Book for Engineers, PSG College of Technology, Publisher KalaikathirAchchagam, Coimbatore, 2009.
2. Design of Machine Elements, M.F. Spotts, T.E. Shoup, L.E. Hornberger, S.R. Jayram, and C. V. Venkatesh, Person Education, 8th ed., 2006.
3. Design of Machine Elements, V. B. Bhandari, Tata Mcgraw Hill, 2nd Ed., 2007.
4. Fundamentals of Machine Component Design, R.C.Juvinall&K.M.Marshek, Wiley Student Edition, 3rd Ed., 2007.

ME 4402: Thermal Engineering : 4 Credits (4-0-0)

Unit I	Introduction, thermodynamic systems, surroundings, states, process and cycles, microscopic and macroscopic view, properties, thermodynamic equilibrium, quasi-static processes, continuum, Zeroth law of thermodynamics, heat and work, path function and point function, work done for quasi-static processes, p-v diagrams, First law of thermodynamics for closed system in a cycle, internal energy, non-flow processes and their analysis, enthalpy, steady flow energy equation and its application to different flow processes.	12 lectures
Unit II	Second law of thermodynamics, limitations of first law of thermodynamics, concept of heat engines and heat pump, classical statements of second law of thermodynamics and their equivalence, reversible and irreversible processes, factors affecting reversibility of a process, corollaries of second law of thermodynamics, reversible cycle and its efficiency, thermodynamic temperature scale, Clausius inequality, entropy change during processes, T -S diagrams, principle of entropy increase.	12 lectures
Unit III	Gas laws, ideal gases, equation of state, C_p and C_v definition and relation, property relations, p-v-t surface, properties of pure substance, use of properties table and charts of pure substance.	9 lectures
Unit IV	Air standard cycles, Otto cycle, Diesel cycle, dual cycle, Joule cycle**,** efficiency, mean effective pressure, steam power cycles, Rankine cycle, modified Rankine cycle, efficiency, combination of first and second laws: lost work, concept of availability and energy, properties of mixture of ideal gases, analysis of thermodynamic cycles.	14 lectures
Unit V	Thermodynamic relations, Maxwell's relation, coefficient of expansion and compressibility, energy relations for a simple systems, specific heat relations, Joule-Thomson coefficient, relations of enthalpy and entropy.	9 lectures

Recommended Books :

1. Thermodynamics, Y.A. Cengel and M. A Boles, McGraw Hill Education, 2011.
2. Fundamentals of Engineering Thermodynamics, M. J. Moran and H N Shapiro, 3rd Ed., John Wiley, 1995.
3. Fundamentals of Thermodynamics, R.E. Sonntag, C. Borgnakke and G. V. Van Wylen,6th Ed., Wiley, 2003.
4. Engineering Thermodynamics, P. K. Nag, Tata McGrawHill,2005.
5. Engineering Thermodynamics Work and Heat Transfer, G. F. C. Rogers and Y. R. Mayhew, 4th Ed., Pearson, 2001.

ME 4403:Production Technology : 5 Credits (4-0-2)

Unit I	Fundamentals of metal cutting, mechanism of chip formation, tool geometry, tool signature in ORS, parameters effect tool life, calculation of cutting force and tool life, eneral purpose machine tools and operation mechanisms lathe, milling, shaping, introduction to NC/CNC. 12lectures	12 lectures
Unit II	Introduction to pattern making; Pattern materials and allowance, moulding, moulding processes and core making, melting furnaces, fettling basic manufacturing processes and casting defects. 11lectures	11 lectures
Unit III	Plastic deformation of metals, deformation by slip and twinning, hot/warm forming, cold forming, rolling, forging, drawing, stamping, shearing, coining, punching and extrusion; Press work operations, coining, punch and dies. 11lectures	11 lectures
Unit IV	Welding processes and applications, arc welding, TIG welding, MIG welding, friction welding. 11lectures	11 lectures
Unit V	Newer and advanced machining processes: USM, ECM, EDM,WEDM, I\introduction to jig &fixtures, NC/ CNC lathe and part programing. 11lectures	11 lectures
Machine Shop: Turning and milling jobs.		14 hours
Welding shop: Design of weld model and fabrication of welding model		14 hours

Recommended Books :

1. Manufacturing Science – A.Ghosh and A.K. Mallik, East,West Press Pvt Limited, 2nd Ed., 1993
2. Fundamentals of Metal Machining and Machine tools ,G.Boothroyd, Scripta Book Co., 3rd Ed., 1988
3. Production Technology – HMTBangalore, Tata Mc,Graw Hills Publishing company limited New Delhi, 2008
4. Non-conventional Machining,P.K.Misra, Narosa Publishing House, 1997
5. Manufacturing Technology (Vol I & II), P.N. Rao,TataMc,Graw Hills Publishing company limited New Delhi, 2nd Ed., 2004.
6. Principles of Metal Casting, B.Ravi, Prentice Hall of India Private Limited, 2005.

ME 4451: Comprehensive Mechanical Lab : 2 Credits (0-0-4)	
Gas Dynamics Lab: Visualization of external & internal flows in a smoke tunnel, forced vortex, flow through venturimeter/nozzle, flow through pipes, performance of centrifugal pump, performance of hydraulic turbines (Pelton/Francis), cavitation test of pump.	10 hours
IC Engine Lab: Study of diesel and petrol engine.	8 hours
Heat & Mass Transfer Lab: Study of two stage reciprocating compressor, determination of thermal conductivity of liquids.	9 hours
Metrology lab: Inspection of jig plate, measurement of taper angle by sine bar	9 hours
Strength of Materials Lab: Tensile & compressive test of MS / aluminum rods, Charpy&Izod impact test for MS/aluminum.	10 hours
Kinematics & Dynamics lab: Determination of stiffness of helical springs, study of rotating mass balancing, study of internal / external gear trains, study of kinematics of mechanism trainer	10 hours

ME 4477* Computer Applications in Mechanical Engineering:	**3 Credits (1-0-4) [Audit Course]**	
Unit I	Orientation to various programming languages: Fortran, C++, Matlab, development of some programs using the above language.	5 lectures
Unit II	Programming structures, development of algorithm, debugging, compiling, program execution, interpretation and presentation of results.	5 lectures
Unit III	Use of common softwares in mechanical engineering: ANSYS, Creo, AutoCAD, Catia.	4 lectures
Computer Lab **(Practice)**	Solution of general problems through Matlab programming.	8 hours
	Solution of nonlinear engineering problems through Matlab programming.	12 hours
	Computer Aided Drafting of machine elements through AutoCAD/Creo.	20 hours
	Stress-strain determination of linear elastic problems through ANSYS, CAE softwares.	16 hours

Recommended Books:

1. Object Oriented Programming with C++, E. Balagurusamy, TMH 4th Ed.,2008.
2. Fortran 90/95 for Scientist and Engineers, S. J. Chapman, Tata McGraw Hill, 2013.
3. Getting Started with MATLAB, R. Pratap, Oxford University Press, 7th Ed., 2016
4. ANSYS Workbench Tutorial Release 13, K.Lawrence, SDC Publications, 2011

ME 5101: Operations Research : 4 credits (3-1-0)		
Unit I	Introduction to linear programming introduction, feasible solution, equality principle, formulation procedures,Simplex algorithm and its variants, sensitivity analysis	9 lectures
Unit II	Application of LP to transportation & assignment problems, dual simplex method	5 lectures
Unit III	Introduction to integer programming, cut plane method, game theory, various solution methods	6 lectures
Unit IV	Introduction to dynamic programming, goal programming, nonlinear programming, genetic algorithms and simulated annealing	8 lectures
Unit V	Queuing theory, Poisson's arrival, exponential service times, basic equation, single channel models, simulation, Monte Carlo techniques, use of random numbers, applications in maintenance problems, optimal size of repair crew and queuing	7 lectures
Unit VI	Inventory and product control problem, EOQ, production run, shortage, quantity discount, ABC analysis, replacement models , capital equipment, PV, ARP, IRP, Payoff period, MAPI method	7 lectures

Recommended Books :

1. Operations Research , P. SankaraIyer,Tata McGraw Hills, New Delhi, 2009.

2. Engineering Optimization ,S.S.Rao, NewAge International (P) Limited, Publishers. 3rdEd., 2004.
3. Operations Research, H.A.Taha, Pearson Education India, 2008.
4. Introduction to Operations Research A Computer Oriented Algorithmic Approach, B.Gillet, Tata McGraw Hills, New Delhi, 1983

ME 5102: Fluid Mechanics : 5 Credits (4-0-2)

Unit I	Relative equilibrium: Pressure distribution in a fluid mass under Steady linear acceleration and fluid mass under uniform rotation.	4 lectures
Unit II	Similitude & model testing:Dimensional analysis review, geometric, kinematic and dynamic similarity of fluid motion, model testing, distorted models.	6 lectures
Unit III	Theory of ideal flow, flow net and their construction, basic patterns of flow(review of rectilinear flow, source and sink, vortex flow). hydrodynamiccombination of basic flows and analysis (doublets, half body, Rankine oval, flow past circular cylinder with and without circulation), Kutta-Jukowskii'slaw, Magnus effect.	10 lectures
Unit IV	Theory of viscous flow, viscous effect, displacement thickness, momentum thickness and energy thickness, boundary layer theory, laminar and turbulent boundary layer analysis for viscous flow over smooth flat plate at zero pressure gradient, effect of pressure gradient, boundary layer separation and control, flow past immersed bodies, lift and drag.	12 lectures
Unit V	Theory of compressible flow, generalizedenergy equation, energy equation for compressible flow, stagnation & critical properties, isentropic flow through variable area duct, nozzle operation, normal shocks, solution of problems without tables and charts.	10 lectures
Unit VI	Introduction to computational fluid dynamics, Models of the flow, substantial derivative, physical meaning of the divergence of velocity, continuity equation, the momentum equation, energy equation, Navier-Stokes equations for viscous flow, Euler equations for inviscid flow, physical boundary conditions, forms of the governing equations suited for CFD, conservation form of the equations, discretization of PDEs, discretization principles, explicit and implicit approaches, uniform and unequally spaced grid points, principles and applications.	14 lectures

Recommended Books :

1. Mechanics of fluids, B.S. Massey, Thornes, 2001.
2. Introduction To Fluid Mechanics, R.W. Fox, A.T. McDonald and P.J. Pritchard, John Wiley, 6thEd., 2004.
3. Fluid Mechanics, F. M. White, Tata McGraw,Hill, 6thEd., 2008.
4. Fluid Mechanics, J.F. Douglas, J.M. Gasiorek, J. A. Swaffield and L.B. Jack, Pearson Education, 2008.
5. Fluid Mechanics, Fundamentals and Applications, Y. A. Cengel and J.M. Cimbala, Tata McGraw,Hill, 2006.
6. Computational Fluid Dynamics, J. D. Anderson Jr., Tata McGraw,Hill International Edition, 1995.

ME 5103: Mechanics of Solids : 4 credits (4-0-0)

Unit I	Analysis of stresses: 3D state of stress at a point, principal stresses, invariants, 3D Mohr's circle, octahedral stresses, hydrostatic and pure shear stresses, differential equations of equilibrium in rectangular and polar coordinates, boundary conditions.	12 lectures
Unit II	Analysis of strains: 3D strain components in rectangular and polar coordinates, state of strain at a point, principal strains, strain deviators and invariants, compatibility conditions in rectangular and polar coordinates, constitutive relations.	10 lectures
Unit III	2D problems in rectangular and polar coordinates and axisymmetric problems: Cantilever beam with end load, uniformly loaded beam, thick and thin wallcylinders, rotating discs and cylinders, plate with a circular hole and curved beams.	10 lectures
Unit IV	Stresses due to torsion of non- circular bars and thin wall bars.	8 lectures
Unit V	Unsymmetrical bending: Shear center and shear flow.Energy methods: Principle of virtual work, minimum potential energy.	8 lectures
Unit VI	Statically indeterminate systems, method of superposition, theorem of three moments. Yield and Fracture criteria: Failure theories, stress space and strain space, yield surfaces. Introduction to plasticity.	8 lectures

Recommended Books :

1. Advanced Mechanics of Solids, L. S. Srinath, Tata McGraw,Hill, 3rdEd., 2008.
2. Theory Of Elasticity, , S. P. Timoshenko and J. N. Goodier, McGraw Hill International ,3rdEd., 1984.
3. Elasticity: Theory, Applications and Numerics, M. H. Sadd, Elsevier, 2ndEd., 2009.
4. Strength of Materials, S. P. Timoshenko, Vols. 1 and 2, CBS Publishers, 1986.
5. Introduction to Solid Mechanics, H. Shames and J. M. Pitarresi, Pearson, 3rd Ed., 1999.
6. An Introduction to The Mechanics of Solids, S. H. Crandall, N. C. Dahl and T. J. Lardner, Tata McGraw Hill, 2nd Ed., 2008.

ME 5104: Dynamics of Machines : 4 Credits (4-0-0)

Unit I	Static force equilibrium/analysis of forces and torques, dynamic force analysis, concept of dynamically equivalent link, force analysis of single slider crank mechanism.	10 lectures
Unit II	Balancing: Balancing of rotating masses, single plane and two plane balancing, unbalanced forces and couples, static and dynamic balancing, balancing of rotors by analytical method and graphical method, balancing of reciprocating masses.	8 lectures
Unit III	Gyroscope: Principle of gyroscope and its applications, roll, yaw and pitch motions, practical problems and flywheels.	10 lectures
Unit IV	Governors: Flywheels versus governors, types of governors, concept of control force and its diagram, definition and concept of stability, isochronism, sensitivity, hunting and energy of governor.	8 lectures
Unit V	Vibrations: Vibrations of SDOF systems, free and force vibrations, damped and undamped vibration, vibration isolation, transverse and torsional vibrations of two and three rotor systems, critical speeds.	12 lectures
Unit VI	Cam dynamics: Analysis of cam and follower, jump phenomenon. 8 lectures	8 lectures

Recommended Books :

1 Theory of Machines, S. S. Rattan, Tata McGraw Hill, 3rdEd., 2009.
2 Mechanism and Machine Theory, J. S. Rao and R. V. Dukkipat, New Age, 2nd Ed., 2008.
3 Theory of Machines, T. Bevan, CBS Publishers and Distributors, 1984.
4 Design of Machinery–An introduction to Synthesis and Analysis of Mechanisms and Machines, R.L. Norton, McGraw Hill International Editions, New York, 2ndEd., 2000.
5 Theory of Vibration with Applications, W. T. Thomson and M.D. Dahleh, Pearson Education, 5thEd., 1999.

ME5105: Heat and Mass Transfer : 4 Credits (4-0-0)

Unit I	Introduction: Modes of heat transfer, conduction, convection and radiation, thermal resistance, general heat conduction equations for rectangular, cylindrical and spherical co-ordinates system, overall heat transfer coefficient, thermal contact resistance, and critical thickness of insulation, resistance networks, effect of variable thermal conductivity for plane rectangular slab, hollow cylinder, steady heat conduction with uniform heat generation for plane slab and solid cylinder.	9 lectures
Unit II	Fin equation: Cases, infinitely long fin, finite length, convection. fin heat conduction with finite length for specified temperature at its end, efficiency, effectiveness, Fourier series solution, transient heat conduction, lumped system analysis, criteria for lumped system analysis, response time of a thermocouple, lumped system analysis for a slab, Heisler chart.	9 lectures
Unit III	Radiation: Absorption, reflection, transmission, emissive power, radiosity and irradiation, black-body, Intensity of radiation, Lambert's cosine law, Planck's distribution law, Wien's formula, Rayleigh-Jean's formula, Wien's displacement law, radiation from non-black surfaces, Kirchoff's law, shape factor, Hottel's Cross string method, reradiating black surfaces, heat exchange between non-black bodies, radiation exchange between small Gray bodies, radiation shields.	10 lectures
Unit IV	Continuity Equation, momentum equation and energy equation in two-dimension, velocity boundary layer, thermal boundary layer, boundary layer equation, Couette flow, heat transfer in Poiseuille flow, turbulent flow, forced convection and free convection, diffusion of mass transfer: concentration, velocity, mass fluxes, molar fluxes, Fick's law of diffusion, species conservation equation.	18 lectures

Unit V	Types of heat exchangers, overall heat transfer coefficient, LMTD method of heat exchanger analysis for parallel flow, Condenser and Evaporators, Effectiveness-NTU method of heat exchanger analysis. Effectiveness for parallel flow heat exchanger and counter flow heat exchangers. Nucleate pool boiling, Flow boiling, Condensation of flat vertical surfaces.	10 lectures

Recommended Books :

1. Heat Transfer, J.P. Holman, Tata McGraw,Hill, 2011.
2. Fundamentals of Heat and Mass Transfer, F.P. Incropera and D. P. Dewitt, 5th Ed. John Wiley and Sons, 2009.
3. Heat Transfer, S.P.Sukhatme, University Press, 2005.
4. Heat Transfer – A Basic Approach, M.N. Ozisik, TataMcGraw Hill, 1985.
5. Convective Heat Transfer, A. Bejan John Wiley and Sons, 3rd Ed., 2004.
6. Heat Transfer – A Practical Approach, Y.A.Cengel, Tata McGraw Hill, 2nd Ed., 2007.

ME 5201: Machine Design : 5 Credits (4-0-2)

Unit I	Attributes of design, design philosophy and design process, design evaluation methods, linear weighting scale method, AHP model, and failure theories.	5 lectures
Unit II	Design under fatigue loading: Stress concentration, reduction of stress concentration effects, fluctuating stresses, fatigue failures, endurance limit, notch sensitivity, SN diagrams, reverse unit stress design in fatigue, Soderberg and Goodman diagram, fatigue design under combined loading.	10 lectures
Unit III	Design of spur, helical, bevel, rack & pinion and worm gears. Standard system of gears, Lewis equation, design of gear tooth based on strength and wear.	15 lectures
Unit IV	Sliding contact bearing and lubrication: Basic module of lubrication, Petroff's law, stable lubrication, thick film lubrication, hydrodynamic lubrication theory, design consideration of hydrostatic and hydrodynamic bearings.	10 lectures
Unit V	Rolling element bearings: Bearing life, bearing load, selection of ball, straight roller and taper roller bearings, lubrication.	8 lectures
Unit VI	Systems approach to design: decision making/simulation of mechanical systems using CAD tools, sensitivity analysis of design parameters, overview of design optimization.	8 lectures
Any seven (07) design drawings based on theoretical design.		28 hours

Recommended Books :

1. Mechanical Engineering Design, J. E. Sheigley, McGraw Hill, 5th Ed., 1988.
2. Design of Machine Elements, V. B. Bhandari, Tata Mcgraw Hill, 2nd Ed. 2007.
3. Design of Machine Elements, M.F. Spotts, T.E Shoup, L.E. Hornberger, S.R. Jayram and C. V. Venkatesh, Person Education , 8th Ed., 2006.
4. Fundamentals of Machine Component Design, R. C. Juvinall and K. M Marshek, Wiley Student Edition, 5th Ed., 2007.
5. Design Data Book of Engineers, PSG College of Technology, Publisher K. Achchagam, Coimbataore, 2009.

ME 5202: Manufacturing Science : 4 Credits (4-0-0)

Unit I	Metal cutting, mechanism of chip formation, type of chips, determination of shear angle, shear strain, velocity triangle, force analysis, Merchant's circle diagram, economics of machining.	12 lectures
Unit II	Heat generation and cutting tool temperature, cutting fluids, mechanism of tool wear, effects of parameters on tool life/tool wear, machinability index.	8 lectures
Unit III	Forming processes, plastic deformation and yield criteria, relation between tensile and shear yield stress, force analysis in rolling, extrusion and drawing.	8 lectures
Unit IV	Mechanics of forging process, analysis of strip forging and disc forging, die design, compound and combination die design, press work operation such as punching, blanking, cupping.	8 lectures
Unit V	Metal transfer in arc welding, electron beam welding, LASER welding, Friction stir welding.	8 lectures
Unit VI	Elements of gating and riseringdesign, charge calculations in melting, special casting processes.	12 lectures

Recommended Books :

1. Manufacturing Engineering & Technology, S. Kalpakjian and S.R. Schmid, Pearson, 7th Ed., 2014.
2. Manufacturing Science, A.Ghosh and A.K. Mallik, East-West Press Pvt Limited, 2nd Ed., 2010.
3. Manufacturing Technology (Vol. I)– P.N. Rao,TataMc-Graw Hills Publishing company limited New Delhi, 2nd Ed., 2004.
4. Metal Cutting Theory and Practice ,A. Bhattacharya, New Canal Book Agency (P) Ltd. 2011.
5. Production Engineering –S. K. Singh, Made Easy Publication, 2013.

ME 5203: Industrial Engineering : 3 Credits (3-0-0)

Unit I	History and development of work study, use and application, techniques, human factors in method study, objectives, basic procedure in various chart, use of photographic techniques, simo charts, principles of motion economy.	7 lectures
Unit II	Work measurement:Purpose and basic procedure; various charts of management, time study, work sampling and predetermined time studies, analytical estimation.	7 lectures
Unit III	Production planning and control: Function, plant layout methods, forecasting techniques, time series, Causal models.	7 lectures
Unit IV	Introduction: Aggregate planning & disaggregation, routing, dispatching machine loading, scheduling, sequencing &process control.	7 lectures
Unit V	Material handling systems, modes of material handling; supply chain management.	7 lectures
Unit VI	MRP and MRP-II, MPS, Introduction to ERP, productivity principles and techniques.	7 lectures

Recommended Books :

1. Industrial Engineering and Production Management, M. Mahajan, DhanpatRai& Co, 2005.
2. Problems and Solutions in Production and Operations Management, S.N. Chary, Tata McGraw Hills, 2012.
3. Industrial Engineering. & Management Science, T.R. Banga, N.K. Aggrawal and S.C. Sharma, Khanna Publishers, 1995.
4. Production and Operation Management- Joseph S. Martinich, Wiley India, 2008.
5. Motion and Time Study Design and Measurement of Work- Ralph M.Barnes, Wiley, 2009.

ME 5204: Refrigeration and Air Conditioning : 4 Credits (3-1-0)

Unit I	Introduction, concept of heat engine, heat pump and refrigeration, efficiency and COP, Ideal refrigeration cycle, Reverse Carnot cycle, unit of refrigeration, refrigeration effect, different types of refrigeration systems, air refrigeration system, Bell Coleman cycle, Reverse Brayton cycle, ideal and actual cycle analysis, air cycles for aircraft, simple system, bootstrap system. regenerative system, reduced ambient system, concept of dry aerated temperature.	8 lectures
Unit II	Vapor compression refrigeration system, limitation of reversed Carnot cycle with vapor as a refrigerant, P-V,T-S, P-h diagram, actual vapour compression cycle and deviation from ideal conditions and their effects on cycle performance, use of tables and charts for solving problems, production of low temperature - compound vapor compression and cascade systems.	8 lectures
Unit III	Vapour absorption refrigeration systems, principles, different refrigerants absorbent combination, ideal and actual systems, ideal COP of absorption refrigeration systems, solar refrigeration.	7 lectures
Unit IV	Refrigerant types: Designation of refrigerants, their properties, desirable properties of an ideal refrigerants, selection of refrigerants, impact of refrigerants on global warming and ozone depletion, global warming potential and ozone depletion potential, environmentally friendly refrigerants, secondary refrigerants and its applications.	6 lectures
Unit V	Air Conditioning: Working substance in air conditioning, psychometric properties, wet bulb temperature, dry bulb temperature, thermodynamic wet temperature, relative humidity and humid specific heat, use of Psychometric chart, air conditioning processes, sensible and latent heating, humidification and dehumidification, SHF, BF, mixing of air streams, summer and winter air-conditioning, industrial air-conditioning.	7 lectures
Unit VI	Introduction to steam jet refrigeration, thermoelectric refrigeration, vortex tube refrigeration and pulse tube refrigeration, Aircraft refrigeration, Introduction to solar refrigeration.	6 lectures

Recommended Books :

1. Refrigeration and Air Conditioning, C.P. Arora, Tata McGraw-Hill, 3rd Ed., 2008.

2. Refrigeration and Air Conditioning, W.F. Stoecker and J W Jones, Tata McGraw Hill International Editions, 2nd Ed., 1982.
3. Principles of Refrigeration, Roy, J. Pearson, 4th Ed., 2010.
4. Refrigeration and Air Conditioning, R.C. Arora, PHI, 2010.

ME 5205: Instrumentation and Control Engineering : 3 Credits (3-0-0)

Unit I	Basics of measuring instruments, study of transducers, display and recording instruments, static and dynamics characteristics of instruments.	6 lectures
Unit II	Introduction to control systems, Laplace/inverse Laplace transformation	8 lectures
Unit III	Modelling of feedback systems, mathematical modelling of physical systems, block diagrams, signal flow graphs, state-space models,	8 lectures
Unit IV	Time domain analysis, performance specifications, steady state error, transient response of first and second order systems.	8 lectures
Unit V	Stability analysis of Routh-Hurwitz stability criterion, relative stability, control action of proportional integral, PI, PD, and PID controllers, lead, lag, and lag-lead compensators, root-locus method, analysis, design, state-space methods of analysis and design.	6 lectures
Unit VI	Frequency response method, bode diagrams, Nyquist stability criterion, performance specifications and design. Physical realizations of controller, hydraulic, pneumatic, and electronic controllers	6 lectures

Recommended Books :

1. Modern Control Engineering, K. Ogata, Pearson Education Asia, 4th Ed. 2002.
2. Automatic Control Systems, B. C. Kuo and F. Golnaraghi, John Wiley, 8th Ed. 2002.
3. Modern Control Systems, R. C. Dorf and R. H. Bishop, Addison Wesley, 8th Ed.1998.
4. Modern Control System Theory, M. Gopal,New Age International, 2nd Ed., 1993.

ME 5206: Elements of Mechatronics : 3 Credits (3-0-0)

Unit I	Introduction to mechanics: Types, open and closed loop system, microprocessor based control, application of mechatronics system, CNC, Automatic camera, engine management system, FMS.	8 lectures
Unit II	Digital logic fundamentals, Logic gates, AND, OR, NOT, NOR, XOR, NAND gates, combination gates, boolean representation, sequential logic, decoder, flip-flops and registers.	8 lectures
Unit III	Sensors and transducers, LVDT, encoder, velocity, acceleration sensors, proximity sensors, photo-electric sensors, sensors in robotics.	8 lectures
Unit IV	Actuators, electrical actuators, solenoids, relays, speed controls, stepper motor control, mechanical actuators, hydraulic and pneumatic actuation systems, valves and its control, mechanical elements, cam, gear & ratchet drive, re-circulated ball screw drives.	8 lectures
Unit V	Application of microprocessor in mechanical engineering, programmable Logic controller (PLC), system block diagrams, ladder diagram, basic components and their symbols, switch controlling a solenoid, temperature control, cylinder sequencing, timers, delays, counters, PLC programming.	10 lectures

Recommended Books :

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering – William Bolton, Pearson Education, 2015.
2. Mechatronics - M.D. Singh, and J.G. Joshi, Prentice Hall of India Private Limited, 2006.
3. Mechatronics An integrated approach - Clarence. W. De Silva, CRC Press, 2004.
4. Programmable Logic Controller – FESTO Pneumatics, Bangalore (Report), 1991.

ME 5251: Experimental Techniques : 2 Credits (0-0-4)	
Gas Dynamics Lab: Study of boundary layer development, study of flow past circular cylinder (pressure distribution & drag components), flow characteristics over an aerofoil section, flow through convergent, parallel/convergent, divergent nozzle, demonstration of Schlieren apparatus/3 components electronic balance.	14 lectures
Heat & Mass Transfer Lab: Study of convective heat transfer, study of radiation heat transfer, fluidized bed combustion, study of RAC systems, study of boiling heat transfer.	14 lectures
Computer Lab: Programming, compilation & running the program and analysis of results of simplex algorithm/ network problems/simulation methods, comparison of results above with the standard software available in the lab.	14 lectures
Kinematics & Dynamics lab: Study of Gyroscope, Study of reciprocating mass balancing, Study of cam profile, Vibration study on universal vibration apparatus.	14 lectures

ME 5289: Seminar : 2 Credits (0-0-4)

Self introduction-students will introduce themselves in 3-4 minutes time each without any aid such as blackboard, powerpoint presentation etc.
Students will prepare a report on any non technical/non scientific topic and present the same within 6-7 minutes each
Student will prepare and present a complete technical report on any interdisciplinary topic in 8-10 minutes time each.
Students will prepare a complete review report and present any topic related to Mechanical engineering in 12-15 minutes time each.
Group discussions, debates and brainstorming sessions, discourse on topics like entrepreneurship/ motivation/latest world developments.

ME 6101: Energy Conversion Techniques : 4 Credits (4-0-0)

Unit I	Steam power systems, steam generator, introduction (review) draught -natural draught, induced draught, forced draught and balance draught, calculation of chimney height, and chimney diameter, condition for maximum discharge through the chimney, steam jet draught, chimney efficiency, evaporation rate, performance, boiler efficiency, factor affecting boiler efficiency, boiler trial, heat balance.	9 lectures
Unit II	Introduction and classification of steam nozzles, isentropic flow in nozzle, velocity of steam leaving the nozzle, p-V, h-s and T-S diagram, classification of steam turbine, impulse turbine& reaction turbine, pressure compounded impulse turbine, velocity compounded impulse turbine, impulse-reaction turbine, velocity diagrams.	12 lectures
Unit III	Performance of steam turbine, diagram efficiency, energy converted to heat by friction, stage efficiency, velocity diagram for parsons' reaction turbine, degree of reaction of turbines.	9 lectures
Unit IV	Regenerative cycles, reheat factor, governing of steam turbine, methods of governing, back pressure and pass out turbines.	9 lectures
Unit V	Steam condenser, classification of steam condenser, jet and surface condenser, types of surface condenser, comparison of jet and surface condenser, mass of circulating water required in condenser, air removal methods, vacuum efficiency.	7 lectures
Unit VI	Introduction to the non-conventional energy sources, energy conversion principles, new energy conversion methods, biomass, wind, solar, photovoltaic, biogas, biodiesel, fuel cells and MHD.	10 lectures

Recommended Books :

1. Principles of Energy Conversion, A. W. Culp, McGraw-Hill, 1991.
2. Energy Conversion (Vol. II &III), V. Kadambi and M. Prasad, New Age, 2011.
3. Power Plant Engineering, P.K. Nag, Tata McGraw-Hill, 2002.
4. Theory and Practice of Steam Turbines, W.J. Kearton, CBS Publishers & Distributers, 2004.
5. Power Plant Technology, M.M. Wakil, Tata McGraw-Hill,1985.

ME 6102: Numerical Control and CAM : 3 Credits (3-0-0)

Unit I	Introduction to NC; Advantages and application; NC Classifications: PTP, Straight cut, Contouring; Structure of NC machine tools; Punched tape formats.	7 lectures

Unit II	Introduction to Computer Numerical Control (CNC); Open and closed loop control; Designation of axes, drives & actuation systems, feedback devices, CNC tooling, automatic tool changers & work holding devices. DNC; Communication systems; PLC; LAN in manufacturing.	10 lectures
Unit III	CNC Programming: Manual part programming: PTP drilling, Milling and Turning; APT Programming, Geometric and motion commands, Post processor commands; Programming of components; Computer aided part programming.	12 lectures
Unit IV	Introduction to group technology (GT); Part classification & coding: OPTIZ system; GT cell formation; Introduction to Computer Aided Process Planning (CAPP); Variant and Generative approaches, advantages of CAPP; CAD/CAM and CIM.	7 lectures
Unit V	Introduction to FMS, AGVS, Automated material handling and storage systems; Induction to robotics; shop floor control,	6 lectures

Recommended Books :

1. Computer Control of Manufacturing System - Y. Koren, Tata Mc-Graw Hills, New Delhi, 2006.
2. Introduction to Computer Numerical Control - James V. Valentino and Joseph Goldenberg, Prentice Hall, Englewood Cliff, New Jersey, 5th Ed., 2012.
3. Introduction to Computer numerical control - Barry Leatham, PitamPublishers, 1986.
4. Numerical Control and Computer aided manufacturing - T.K. Kundra, P.N. Rao and N.K. Tiwari, Tata Mc-Graw Hills Publishing company limited New Delhi, 2001.
5. Automation, Production system & Computer Integrated Manufacturing System -M.P.Groover, Pearson Eucation Asia, 2008.

ME 6103: Power Plant Engineering : 4 Credits (4-0-0)

Unit I	Steam power plant, major component of power plants, fuels, their storage, preparation, handling, feeding, combustion and combustion control, ash handling and dust collection, cooling towers, feed water treatment plants, insulation and power plant heat balance.	10 lectures
Unit II	Nuclear power plants, principle of power generation by nuclear reaction, fuels for nuclear power plants, preparation and care, components of nuclear reactor, types of nuclear reactor, nuclear plants of India, recent advances in power plant .	8 lectures
Unit III	Diesel and gas turbine power plants, applications, air supply and cleaning system, fuel storage and supply systems, cooling system, lubrication and starting systems, comparative study of diesel and gas turbine plants.	12 lectures
Unit IV	Hydro-electric power plant, rain fall and run off measurements and plotting of various curves for estimating power available with or without storage, different types;hydel power plants.	8 lectures
Unit V	Non-conventional power plant, design aspects of geothermal power plants, tidal power plants, wind power plants, solar thermal and solar photovoltaic power plants, biomass power plants.	10 lectures
Unit VI	Site selection and economics of power plants, criterion of site selection of different types of power plants, cost consideration of different types of power plants, cost consideration for selection of different equipment, comparison of total cost of different types of power plants, tariff of power, load production methods to meet variable loads.	8 lectures

Recommended Books :

1. Power Plant Technology, M.M. Wakil, Tata McGraw-Hill, 1985.
2. Power Plant Engineering, P. K. Nag, Tata McGraw-Hill, 2002.
3. Power Plant Engineering, R.K. Rajput, Laxmi Publishers, 4th Ed., 2007.
4. Power Plant Engineering, V. Black and B. Veatch, CBS Publishers & Distributers Pvt. Ltd., 1st Ed., 2005.
5. Power Plant Engineering, F.T. Morse, East-West Press, New Delhi, 1953.

ME 6104: Product Design : 3 Credits (2-0-2)

Unit I	Design background, design theory, design materials, human factors in design, ergonomics, product development processes & organizations, customerneed, identification, compliance to standards.	8 lectures

Unit II	Product design methods, creative & rational, objective trees method, function analysis method,QFD method, generating alternatives, morphological chart method, evaluating alternatives, weighted objectives method, AHP analysis, improvement, value analysis and design strategies.	12 lectures
Unit III	Design for manufacture, design for assembly & disassembly, preparation of manufacturing drawing and processed places.	8 lectures
Practice	An engineering product is to be conceptualized, modeled, designed, fabricated, demonstrated and presented in small groups of four to five students in practice sessions.	28 hours

Recommended Books :

1. Product Development, A.K. Chitale and R.C. Gupta, Tata McGraw Hills, New Delhi, 1979.
2. Engineering by Design, G.Voland, Pearson, 2003.

ME 6199: Project– Part I : 2 Credits (0-0-4)
Students should undertake following activities
1. Literatuire survey in the area of interest.
2. Identification of the problem and its objectives.
Mid semester seminar presentation.
3. Preliminary design/identification and procurement of materials/ learning of program code or related software.
4. Experimental set up/mathematical formulation of the problem/significant progress of the work.
Report submission and end semester seminar presentation
Further work will be continued in the next semester

ME 6179: Industrial Training : 2 Credits
On completion of the Industrial training during summer, students will prepare a concise report and submit the same alongwith the training diary and a copy of the certificate to the departmental coordinator of T & P. The same is to be presented as notified by T & P Counselor.

ME 6001: Combustion Engineering : 3 Credits (3-0-0)

Unit I	Energy sources, energy scenario, review of general fuel properties & their resources in Indian context, solid, liquid & gaseous fuels.	5 lectures
Unit II	Various refining methods of fossil fuels and nuclear fuels, synthetic and other fuels, hydro-carbon fuel testing, bio fuels, fuel cells, fuel preparation for combustion.	8 lectures
Unit III	Theories of combustion, burners & combustors for solid, liquid & gaseous fuels, fuel chemistry, thermodynamics of combustion, calculation of temperature and equilibrium flame gas composition for constant pressure and constant volume combustion.	10 lectures
Unit IV	Premixed flames, theories of flame propagation, factors affecting propagation velocity, effects of turbulence, diffusion flames.	6 lectures
Unit V	Burning rates of solid and liquid fuels, combustion of liquid, droplet and fuel sprays, combustion of coal and pulverized particles in air, combustion in engines.	7 lectures
Unit VI	Gas turbine combustion system, stoichiometric & combustion reactions, flue gas analysis.	6 lectures

Recommended Books:

1. Fuels and combustion, S.P. Sharma and Chander Mohan, Tata McGraw Hill, 1987.
2. Introduction to Combustion phenomena, A. Murthy Kanury, Gordon & Beach Science Pub, 1977.
3. Fuels and Fuel Technology (Vol. I & II), W. Francis, Pergamon Press, 1982.
4. Fuels-Solid, Liquid & Gaseous, J.S.S. Brame and J.G. King, Edward Arnold, 1956.
5. Understanding Combustion, H.S. Mukunda, Macmillan, 1992.
6. Principles of Combustion, K. K. Kuo, Wiley, 2nd Ed., 2005.
7. An Introduction to Combustion, S. R. Turns Tata McGraw Hill, 2nd Ed., 2000.

ME 6002: Computational Fluid Dynamics : 3 Credits (3-0-0)

Unit I	Introduction, CFD as a design and research tool, applications and impact of CFD, concepts of finite control volume & infinitesimal fluid elements, analysis with fixed and moving fluid elements, substantial derivative, divergence of velocity – its physical significance.	4 lectues
Unit II	Governing equations, derivation of continuity equations for different flow models, conversion from one form of continuity equation to other forms, differential form vs. integral form, momentum equation, energy equation, forms of equations for viscous and inviscid flows, boundary conditions, conservation and non-conservation forms, forms of equations suited for CFD, shock fitting and shock capturing methods.	7 lectures

Unit III	Partial differential equations and discretization, classification of PDEs, method of determining the type of PDEs, general behavior of PDEs, hyperbolic, parabolic and elliptic equations, well posed and ill posed problems, finite difference techniques, difference equation, explicit and implicit approaches, errors in difference equations, stability analysis.	7 lectures
Unit IV	Introduction to grid generation, transformations of equations, metrics and Jacobians, transformation of governing equations, stretched grid and boundary fitted coordinate system.	6 lectures
Unit V	Simple CFD techniques, Crank-nicolson scheme, dufort-frankel scheme, lax-wendroff and Maccormack techniques, viscous flows, conservation form and space marching, relaxation technique, artificial viscosity, application in inviscid flows, vorticity transport method, ADI (Alternating Direction Implicit) technique, pressure correction technique, simple algorithm, programming in FORTRAN/ C/ C++.	10 lectures
Unit VI	Applications, finite difference method to solve wave equation, heat equation, poisson&laplace equations, burger equation, numerical methods applied to nozzle flow, couette flow, prandtl-meyer flow and supersonic flow over flat plates, programming in FORTRAN/ C/ C++, CFD softwares.	8 lectures

Recommended Books

1. Computational Fluid Dynamics, J. D. Anderson Jr., Tata McGraw-Hill International, 1995.
2. Computational Fluid Mechanics & Heat Transfer, D.A. Anderson, J.C. Tannehill and R.H. Pletcher, Taylor & Francis, 2nd Ed., 1997.
3. Introduction to Computational Fluid Dynamics, Anil W. Date, Cambridge University Press, 2005
4. Computational Techniques for Fluid Dynamics Vol. 1 and 2, C. A. J. Fletcher, Springer, 1991.
5. Computational Fluid Dynamics, T. J. Chung Cambridge University Press, 2010.
6. Computational Methods for Fluid Dynamics, J. H. Fergiger and M. Peric Springer, 2002.
7. Numerical Heat Transfer and Fluid Flow Hemisphere, S.V. Patankar, Taylor & Francis, 1980.

ME 6003:Aerodynamics : 3 Credits (3-0-0)

Unit I	Introduction, governing equations, potential flows, Kutta-Joukowski'stheorem, flow over arbitrary bodies, incompressible flow over aerofoils, aerofoil nomenclature and characteristics, thin aerofoil theorem- Kuttacondition, Kelvin's circulation theorem.	7 lectures
Unit II	Vortex panel model, effect of camber and thickness, estimation of aerodynamic forces and moments from pressure distribution.	7 lectures
Unit III	Incompressible flow over finite wings, down wash and induced drag, Biot-Savart law and Helmholtz's vortex theorem.	7 lectures
Unit IV	Prandtle's classical lifting line model, lifting surface theory.	7 lectures
Unit V	Numerical vortex lattice method, compressible flow over aerofoils, wave patterns- oblique shock, expansion waves.	7 lectures
Unit VI	Trailing edge boundary condition prandtle-gluert's theory, supersonics aerofoils, Ackert's theorem, wave drag, area rule, conical flow, axisymmetric flow, introduction to stability control of aircraft.	7 lectures

Recommended Books:

1. Fundamentals of Aerodynamics, J.D.Anderson, Tata McGraw Hill, 2010.
2. Aerodynamics for Engineers - J.J.Bertin and M.L.Smith,Tata McGraw Hill, 2003.
3. Introduction to Flight - J.D.Anderson, Tata McGraw Hill, 2010.
4. Aerodynamics Theory - W.F.Durrand, PHI, 2000.

ME 6004: Prime mover Design : 3 Credits (3-0-0)

Unit I	Thermodynamic design of Steam and Gas Turbines, Selection of type, number of stages and heat drops, design of blade geometry, design of nozzles and diaphragm.	10 lectures
Unit II	Design of casings, Design of packing and seals, Shaft design.	8 lectures
Unit III	Selection of bearing, governing system, cooling system and lubrication system,	7 lectures
Unit IV	Specific speed and selection of hydraulic turbines, velocity triangles and blade geometry, volute casing design, governing system, draft tubes.	9 lectures
Unit V	IC engine design aspects, design of cylinder,valvesand ports, Fuel injection system, engine governing system.	8 lectures

Recommended Books:

1. Theory and practice of Steam turbines, W.J. Kearton, CBS Publishers &Distributers, 2004.
2. Gas Turbine Theory, Cohen, Rogers and Saravanmutto, Pearson, 5th Ed., 2008.
3. Aerothermodynamics of Gas Turbine and Rocket Propulsion, G.C.Oates, AIAA Education Series, 3rd Ed., 1997.
4. I C Engine Fundamentals, J.B. Heywood, Tata McGraw Hill, 1988.

ME 6005: Compressible Flow : 3 Credits (3-0-0)

Unit I	Review of fluid dynamics and thermodynamics principles and concepts, generalised energy equation, energy equation for compressible flow, compressibility correction factor, stagnation and critical state parameters.	6 lectures
Unit II	Isentropic flow with variable area, subsonic, supersonic nozzle &diffuser. Nozzle operation, nozzle choking, overexpansion & under expansion.	7 lectures
Unit III	Normal shock analysis, hugoniot equation, oblique shock-tangential velocity superposition on normal shock, oblique shock analysis, shock strength, weak & strong shocks, attached & detached shocks, pressure and entropy changes across a mach wave.	10 lectures
Unit IV	Isentropic turn of supersonic flow, Prandtlmeyer flow, expansion fans and compression waves	7 lectures
Unit V	Effects of friction on compressible flow (Fanno flow), effect of heat transfer (Rayleigh flow), flow choking. combined effect of friction and heat transfer, compressible flow measurement, supersonic wind tunnels.	8 lectures
Unit VI	Flight speed measurement, optical techniques–schlieren technique and interferometer, computational methods in compressible flow.	4 lectures

Recommended Books:

1. Fundamentals of Gas Dynamics, R.D. Zucker, John & Wiley, 2002.
2. Gas Dynamics, E.Rathakrishnan, PHI, 2012.
3. The Dynamics and Thermodynamics of Compressible Flow, A. Shapiro, The Ronald Press Co., 1954.
4. Gas dynamics (Vol. I & II), J. Zuckrow and J. Hoffman, Wiley International, 1976.
5. Modern Compressible Flow, J. D. Anderson, Tata McGraw Hill, 1989.

ME 6006: Two Phase Flow and Heat Transfer : 3 Credits (3-0-0)

Unit I	Definitions, properties of mixtures, review of one-dimension conservation equations in single phase flows, governing equations for homogeneous, separated and drift- flux models.	7 lectures
Unit II	Flow pattern maps for horizontal and vertical system, material handling, solid-liquid and solid-gas system, particle distribution, pressure variation.	7 lectures
Unit III	Simplified treatment of stratified, bubbly, slug and annular flows.	7 lectures
Unit IV	Thermodynamics of boiling, pool boiling –onset of nucleation, heat transfer coefficient, critical heat flux, effect of sub- cooling, flow boiling-onset of nucleation, heat transfer coefficients.	7 lectures
Unit V	Condensation-film and drop wise condensation.	7 lectures
Unit VI	Fluidized bed heat transfer.	7 lectures

Recommended Books

1. One-Dimensional Two-Phase Flow, G.B. Wallis, Tata McGraw-Hill, 1969.
2. Convective Boiling and Condensation, J.G. Collier and J.R. Thome, Oxford University Press, 3rd Ed., 1996.
3. Heat transfer, J.P. Holman, Tata McGraw-Hill, 2011.
4. Two-Phase Flow, Theory and Applications, C. Kleinstreuer, Taylor & Francis, 2003.
5. Boiling, Condensation and Gas-Liquid Flow, P B Whalley, Oxford University Press, 1987.
6. Boiling Heat Transfer and Two-Phase Flow, L.S. Tong and Y.S. Tang, Taylor and Francis, 2nd Ed., 1997.
7. Thermo-Fluid Dynamics of Two-Phase Flow, M. Ishii and T. Hibiki, Springer, 2006.

ME 6007: Fluid Power Control Systems : 3 Credits (3-0-0)

Unit I	Introduction to fluid Power, hydraulics vs. pneumatics, properties of fluid, energy and power in hydraulic systems, distribution system, source of hydraulic power, positive displacement pumps, types, classifications, construction and operation of gear, vane (constant, variable delivery and pressure compensated and piston pumps (in-line and radial type), efficiency calculation, pump selection, pump performance.	8 lectures

Unit II	Fluid power actuators: Linear, single acting, double acting and telescopic, cylinder force, velocity and power, cylinder cushioning devices, cylinder mountings. Rotary or hydraulic motors, types – gear, vane and piston types, torque, power, flow rate and efficiencies, hydrostatic transmissions.	6 lectures
Unit III	Control components in hydraulic system, flow control valves, needle, pressure and temperature compensated valves, pressure control valves, relief – direct, compound & pilot operated, pressure - reducing, sequence valve, direction control valve, 3/2,4/2,4/3.5/ 2 check valve, center flow path configuration of 3 position d.c. valves, open centre, close centre, tandem centre, cartridge valves, manually operated - solenoid operated valves, servo valves, proportional control valves.	7 lectures
Unit IV	Symbols for hydraulic and pneumatic circuits, hydraulic circuit design and analysis, speed control circuits such as meter-in, meter-out, bleed-off, and regenerative circuits, unloading circuit, counter balance circuit, cylinder synchronization, accumulator circuits, and fail safe circuits, trouble shooting of hydraulic circuits.	7 lectures
Unit V	Pneumatic– air preparation and components, Basic pneumatic circuits – single & double acting, air pilot control, two step speed, two hand safety circuits, Cascade design of pneumatic circuits.	7 lectures
Unit VI	Electric control of fluid power circuits, electrical components, electrical ladder diagram. Application of pneumatics in low cost automation, dual cylinder circuits, regenerative circuit, box-sorting system, programmable logic controllers (PLCs), PLC control of hydraulic/ pneumatic cylinder and its ladder diagram, fluid power maintenance and safety, experiments on hydraulic and pneumatic circuits.	7 lectures

Recommended Books:

1. Fluid Power with Applications, A. Esposito, Pearson Education, 5th Ed., 2003.
2. Industrial Hydraulics, J.J. Pipenger, Tata McGraw Hill, 2000.
3. Oil Hydraulics (Principles and Maintenance, S.R.Majumdhar, Tata McGraw Hill, 2002.
4. Hydraulic and Pneumatic Power & Control, Y. Frankline, Tata McGraw Hill, 1966.
5. Pneumatic system, Principles and Maintenance, S.R.Majumdar, Tata McGraw Hill, 1996.
6. Fluid power system, A.B. Goodwin, Palgrave Macmillan, 1976.
7. Manual on Pneumatic Principle and its applications. Festo's, (Report), 2005.

ME 6008: Composite Materials : 3 Credits (3-0-0)

Unit I	Introduction, materials, fiber reinforcement, matrix materials.	7 lectures
Unit II	Manufacturing processes, hand lay-up, prepeglay-up, bag molding, autoclave processing, compression molding, resin transfer molding, pultrusion, filamentwinding.	7 lectures
Unit III	Micro-mechanics: Strength of materials approach, continuum approach, Ply mechanics, co-ordinate systems, off-axis stiffness.	7 lectures
Unit IV	Macro-mechanics: Description of laminates, laminate moduli, computation of stresses in laminates.	7 lectures
Unit V	Types of joints, Mechanics of joints, Damages in joints.	7 lectures
Unit VI	Failure criteria, Strength of materials approaches, Fracture mechanics approach.	7 lectures

Recommended Books

1. Mechanics of Composite Materials, R. M. Jones, Taylor and Francis, 1999.
2. Mechanics of Composite Materials, S. W. Tsai and H.T. Hahn, Technomic Publishing Company, 1980.
3. Mechanics of Composite Materials, A.K. Kaw, CRC Press, 2006.
4. Introduction of Composites Materials and Fibres, K. Zyong, CRC press, 2000.

ME 6009: Internal Combustion Engines : 3 Credits (3-0-0)

Unit I	Review of basics of IC Engines, basic components and nomenclature, classification of IC engines, SI and CI engine, 2- stroke and 4-stroke engine, Engine performance parameters such as various efficiencies, average piston speed, specific fuel consumptions.	4 lectures
Unit II	Fuel-air cycle and their analysis, significance of cycle, comparison with air standard cycle, basis of cycle analysis, variable specific heat, Actual cycles and their analysis, time loss factor, heat loss factor, exhaust blow down, Fuels, classification, properties, characteristics and rating, Alternate fuels.	9 lectures
Unit III	Air and fuel induction, Carburetion – factors affecting carburetion, air-fuel mixture and requirements at different load and speeds, principle of carburetion, and essential parts of	8 lectures

	carburetor, calculation of air-fuel ratio, compensating devices, types of carburetor. Injection systems – functional requirement, classification, components of injection system, electronic injection systems.	
Unit IV	Fluid motions in combustion chamber, turbulence, swirl, tumble, squish, cerevic flow, blow,combustion in SI Engine, stages of combustion, factors influencing flame speed, rate of pressure rise, abnormal combustion pre ignition, detonation, factors causing abnormal combustion, combustion chamber for SI Engines Combustion in CI Engine, stages of combustion, factors influencing delay period, knocking in CI engine, factors causing abnormal combustion, combustion chamber for CI Engines, comparison of knock in SI and CI engine.	9 lectures
Unit V	Engine heat transfer, variation of gas temperature, piston and cylinder temperature distribution, heat transfer, parameters affecting engine heat transfer, need for cooling systems, types of cooling system, fundamentals of engine friction and lubrication.	6 lectures
Unit VI	Engine operating characteristics, heat balance, supercharged and turbo charged engine, Engine emission and their control.	6 lectures

Recommended Books:

1. Internal combustion Engines, P.W. Gill and J. H. Smith and E.J. Ziurys, Oxford & IBH, 1959.
2. Internal Combustion Engines, V. Ganesan, Tata McGraw Hill, 2007.
3. Internal Combustion Engines, C. R. Fergusan and A. T. Kirkpatrick, John Wiley & Sons, 2001.
4. I.C. Engine Fundamentals, J.B. Heywood, Tata McGraw Hill, 1988.
5. Engineering Fundamentals of the Internal Combustion Engine, W. W. Pulkrabek, PHI, 2002.

ME 6010: Turbo Machines : 3 Credits (3-0-0)

Unit I	Introduction, dimensional analysis & similitude as applied to turbo machines, performance laws, incompressible flow analysis, performance characteristics, variable geometry turbo machines (axial, radial & mixed flow machines), specific speed & cavitation, compressible gas flow relations and compressible fluid analysis, inherent unsteadiness of flow within turbo machines.	6 lectures
Unit II	Two dimensional cascades, cascade nomenclature & geometry, analysis of cascade forces, energy losses, lift & drag, circulation and lift, efficiency of compressor cascades, performance of two-dimensional cascades, cascade wind tunnel & instrumentation, cascade test results, compress or cascade correlations, turbine cascade correlation, comparison of profile loss in a cascade and in a turbine stage, optimum space-chord ratio.	6 lectures
Unit III	Axial flow turbines, two dimensional theories, velocity diagrams, stage losses and efficiency, stage reaction, diffusion within blade rows, design point efficiency, maximum total to static efficiency of a reversible turbine stage.	8 lectures
Unit IV	Axial flow compressors and fans, 2-D analysis, velocity diagram & thermodynamics of compressor stage, stage losses &efficiency, reaction ratio & stage loading, off-design performance, stage pressure rise, pressure ratio in a multistage compressor, estimation of compressor stage efficiency, Axial flow ducted fans, Blade element theory.	8 lectures
Unit V	Radial Turbines, Steam turbines, Losses & efficiencies, work & power calculations, velocity triangles & thermal design, Radial flow Gas turbines, Types of inward flow radial turbines, thermodynamics of IFR turbines, rotor design, nominal design point efficiency, loss coefficients, incidence losses, clearance &windage losses, significance & application of specific speed	7 lectures
Unit VI	Centrifugal pumps, fans & compressors, theoretical analysis, inlet casing and impeller, conservation of enthalpy, diffuser, limitation of inlet velocity, optimum design of pump & compressor inlet, slip factor, performance characteristics, choking in a compressor stage.	7 lectures

Recommended Books :

1. Fluid Mechanics and Thermodynamics of Turbo machines, S.L. Dixon, Butterworth-Heinemann, 5th Ed., 2005.
2. Pumps, Fans and Compressors, V. Cherkassky, Mir Publishers, 1990.
3. Turbines, Fans and Compressors, S.M. Yahya, Tata McGraw Hill, 1987.
4. Theory and Practice of Steam turbines, W.J. Kearton, CBS Publishers & Distributers Pvt. Ltd., 2004.
5. Steam and Gas turbines and Power Plant Engineering, R. Yadav, Central Publishing House, 7th Ed., 2011.
6. Gas Turbines, V. Ganesan, Tata McGraw Hill, New Delhi, 3rd Ed., 2010.
7. Gas turbine theory, G. Cohen, R. Rogers and S. Saravanmutto, Pearson, 5th Ed., 2008.

ME 6011: Finite Element Methods : 3 Credits (3-0-0)

Unit I	Introduction: historical background, basic concept of the finite element method, comparison with finite difference method, direct FEM formulations. variational methods: calculus of variation, the Rayleigh-Ritz and Galerkin methods. 10 lectures	10 lectures
Unit II	Finite element analysis of 1-D problems: formulation by different approaches (direct, potential energy and Galerkin), derivation of elemental equations and their assembly, solution and its post-processing.	8 lectures
Unit III	FEM application: Heat transfer and solid mechanics problems (rod, beam, truss and frame), eigen value and time dependent problems, discussion about preprocessors, postprocessors and finite element packages.	8 lectures
Unit IV	Finite element analysis of 2-D problems: finite element modeling of single variable problems, triangular and rectangular elements, applications in heat transfer, and solid mechanics 6 lectures	6 lectures
Unit V	Numerical considerations: numerical integration, error analysis, mesh refinement. plane stress, plane strain problems and bending of plates.	10 lectures

Recommended Books

1. Finite Element Methods for Engineers, U. S. Dixit, Cengage Learning India Pvt Ltd, 1st Ed., 2009.
2. An introduction to the Finite Element Method, J. N. Reddy, McGraw-Hill, New York, 3rd Ed., 2005.
3. Concepts and Applications of Finite Element Analysis, R. D. Cook, D. S. Malkus and M. E. Plesha, John Wiley, New York, 3rd Ed., 1989.
4. Finite Element Procedures in Engineering Analysis, K. J. Bathe, Prentice-Hall, Englewood Cliffs, NJ, 1st Ed., 1996.
5. The Finite Element Method, O. C. Zienkiewicz and R L Taylor, McGraw-Hill, 3rd Ed., 1989.

ME 6012: Non-Conventional Energy : 3 Credits(3-0-0)

Unit I	Energy sources, classification, importance of non-conventional energy sources, advantages and disadvantages of non-conventional energy sources, environmental aspect of energy, energy storage, necessity of energy storage, energy storage methods.	7 lectures
Unit II	Solar radiation: extraterrestrial radiations and terrestrial radiations, solar radiation geometry, solar time, solar day length, solar radiation measurement on horizontal and inclined surfaces, solar thermal systems, solar collectors, classification, performance indices. Liquid flat plate collector &their components, efficiency, solar thermal system applications, photovoltaic devices.	7 lectures
Unit III	Wind energy: Origin of wind, factor affecting the distribution of wind on the surface of earth, nature of wind, wind turbines, components of wind turbine, wind energy conversion systems, types of wind machines: horizontal and vertical axis wind rotors performance.	7 lectures
Unit IV	Design and evaluation of wind mills, Wind regime analysis.es	7 lectures
Unit V	Bio-mass: Introduction, photosynthesis process, bio fuels, biomass resources, recycling of agricultural wastes, Biomass conversion technologies, types, digester, urban waste to energy conversion, biomass gasification.	7 lectures
Unit VI	MHD, thermoelectric, thermionic, thermo nuclear fusion technology, hydroelectric (mini and macro hydropower).	7 lectures

Reommended Books :

1. Power Plant Engineering, Black and Veatch, CBS Publishers & Distributers Pvt. Ltd., 1st Ed., 2005.
2. Non- conventional energy source, G.D. Rai, Khanna Publishers, 2011.
3. Energy models: 2000 and Beyond, J. Parikh, Tata McGraw Hill, 1997.
4. Towards clean energy, B. Ghosh, S.K. Saha and S. Basu, Tata McGraw Hill, 1998.
5. Principles of solar engineering, Kreith and Kreider, Hemisphere, 1978.

ME 6013: Principles of Tribology : 3 Credits (3-0-0)

Unit I	Modes of friction, dry friction.	7 lectures
Unit II	Boundary lubrication, hydrodynamics and hydrostatic lubrication, elastic hydrodynamics, lubrication, design characteristics of slider bearings.	7 lectures
Unit III	Operating characteristics of slider bearings.	7 lectures
Unit IV	Wears types and characteristics.	7 lectures
Unit V	Selection of rolling element bearing and their operating parameters.	7 lectures
Unit VI	Industrial lubricants: oils, grease, solids and special lubricants, bearing failures, bearing maintenance, diagnostic,maintenance of tribology,components.	7 lectures

Recomended Books :

1. Intoduction to Tribology, B.C. Majumdar, Wheeler Publishing, 2000.
2. Introduction of Tribology for Bearing, B. C.Majumder, S. Chand & Company, 2nd Ed., 2008.
3. Introduction to Tribology, Cameron., Longman, London, 1970

ME 6014: Theory of Elasticity : 3 Credits (3-0-0)

Unit I	Surface and body forces, stress tensor and transformation laws, Lagrangian and Eulerian description, strain tensor, equations of elasticity (equilibrium, constitutive law and compatibility, boundary conditions), uniqueness and St. Venant's principle, strain energy functions.	8 lectures
Unit II	Two-dimensional problems in rectangular coordinates (polynomial solution, bending of beam, Fourier series solution).	6 lectures
Unit III	Two-dimensional problems in polar coordinates: axi symmetric problems – rotating discs, wall cylinders, plate with a hole, infinite plate with point load, curved beams.	6 lectures
Unit IV	Two-dimensional problems in curvilinear coordinates: stress functions in terms of harmonic and complex functions, complex potential function, elliptic coordinates, and plate with elliptic holes.	6 lectures
Unit V	Three-dimensional problems (extension of bar under its body weight, pure bending of bars and plates, twist of circular shafts).	6 lectures
Unit VI	Torsion (circular and non-circular cross section, membrane analogy, thin wall members, hydrodynamic analogy).	4 lectures
Unit VII	Bending of bars with circular, elliptic and rectangular cross section and shear center.	6 lectures

Recommended Books:

1. Theory of Elasticity, S.P. Timoshenko and J.N.Goodier, McGraw-Hill, 3rd Ed., 1970.
2. Mathematical Theory of Elasticity, S. Sokolnikoff, McGraw-Hill, 2nd Ed., 1957.
3. Foundation of Solid Mechanics, Y. C. Fung, Prentice Hall, 1965.
4. Applied Elasticity, X. Zhilun, Willey Eastern Ltd., 1992.

ME 6015: Boundary Layer Theory : 3 Credits (3-0-0)

Unit I	Outline of fluid motion with friction, real and perfect fluids, viscosity and compressibility, similarity principles, comparison between theoretical experimental and numerical study of flow. concept of boundary layer, boundary layer separation and vortex formation.	4 lectures
Unit II	Navier-Stoke's equation, fundamental equation of motion and continuity applied to fluid flows, Stokes hypothesis and N-S equation.	8 lectures
Unit III	Simplification of N-S equation, normalisation of N-S equation, order of magnitude and simplification of N-S equation, Prandtl's boundary layer theory & boundary layer equation.	6 lectures
Unit IV	Laminar boundary layer, boundary layer equation for 2 –D incompressible flow, separation & control of boundary layer, momentum integral equation for boundary layer, some exact solutions, steady state boundary layer equation, flow past a wedge, flow in a convergent channel, flow past a cylinder.	9 lectures
Unit V	Approximate methods, approximate solution for flow over flat plate at zero incidence, flow past a circular cylinder, fundamentals of turbulent boundary layer, Reynolds equation, Prandtl's mixing length.	10 lectures
Unit VI	Introduction to thermal boundary layer, heat conduction equation from boundary layer equation, general properties of thermal boundary layers, forced and natural flows, adiabatic walls.	5 lectures

Recommended Books:

1. Viscous Fluid Flow, F.M. White, McGraw-Hill, 1991.
2. Mechanics of Fluid, W. J. Duncan, A. Thom and A. Young, Arnold Publications, 1970.
3. Mechanics of Fluids, B. Massey and J.W. Smith, Nelson Thornes Publications, 2001.
4. Boundary Layer Theory, H. Schlichting and K. Gersten , Springer-Verlag, 2000.

ME 6016: Management of Production System : 3 Credits (3-0-0)

Unit I	Job, Batch, Mass, cellular production systems, automation in production systems, MLT and its mathematical models, material handling.	7 lectures
Unit II	AGVS,TTW, productivity engineering, and methods of improvement, cost analysis, marketing and sales, inventory, production planning and control.	7 lectures
Unit III	Automated layout and flow analysis, systems concepts in production systems CAD, CAM &CIM.	7 lectures
Unit IV	Shopfloor management techniques, Job card design, work centers, work study, time study applications.	7 lectures
Unit V	Quality circles, productivity quality teams, work force planning.	7 lectures
Unit VI	TQM, ISO 9000, Future factories and MAP, group technology and FMS.	7 lectures

Recommended Books :

1. Production and Operations Management, S.N. Chary, Tata Mc-Graw Hills Publishing company limited New Delhi, 2012.
2. Modern Production and Management, E.S.Buffa, Wiley EasternLtd, 1989.
3. Production Planning and Control, S.K Mukhopadhyay, 2nd Ed., PHI, 2010.
4. Industrial Engineering and Production Management, Martin and Telseng, S Chand &Co, 2006.

ME 6017: Air and Noise Pollution Control : 3 Credits (3-0-0)

Unit I	Noise pollution and control: Basic information of noise, general noise criteria, noise emission standards, identification of noise impacts.	7 lectures
Unit II	Impact prediction, assessment of impact significance.	7 lectures
Unit III	Air pollution and control: Sources and classification of air pollutants.	7 lectures
Unit IV	Meteorology and air pollution, effect of air pollution.	7 lectures
Unit V	Air pollution & automobiles.	7 lectures
Unit VI	Control of air pollution by equipment. air quality emission standards, air pollution legislation and regulation.	7 lectures

Recommended Books:

1. Noise Pollution, D.P.Tripathy, APH Publishing, 2008.
2. Fundamentals of Air PollutionEngineering,R.C.Flagan, J.H.Seinfels, Courier Corporation, 2012.
3. Air Pollution Control Engineering, D.D.Nevers, Waveland Pr Inc., 2 Reissue Ed., 2010.
4. Air Pollution Control, a Design Approach, C.D.Cooper, F.C.Alley, Waveland Pr Inc., 4th Ed., 2010

ME 6018: Non Conventional Machining : 3 Credits (3-0-0)		
Unit I	Introduction of conventional and nontraditional machining (NTM), classification of NTM and need for NTM. EDM and ECM: working principle, material removal mechanism, process parameters, characteristics, modeling of material removal and application.	7 lectures
Unit II	AJM: Mechanism of material removal and working principle, process parameters, machining characteristics, effect of process parameters on material removal rate (MRR), applications and limitations.USM: mechanism of material removal, process parameters, machining characteristics, effect of process parameters on material removal rate (MRR), applications and limitations.	7 lectures
Unit III	LBM and EBM: Basic mechanism of material removal in EBM & LBM, process parameters, applications and limitations, and machining characteristics of EBM & LBM.	7 lectures
Unit IV	Water jet machining, elevated temperature machining and cold temperature machining: material removal mechanism, applications and limitations.	7 lectures
Unit V	Basic mechanism of material removal and applications of chemical milling, chemical blanking, chemical engraving, electroforming and metal spraying.	14 lectures

Recommended Books :

1. Advanced Machining Processes, V. K. Jain, Allied Publishers, 2009.
2. Modern Machining processes, P. C. Pandey, TataMcGraw,Hill Education, 2013.
3. A New Technology, A. Bhattacharya, The Institution of Engineers, India 1984.
4. Nonconventional Machining, P K Mishra, Narosa Publishing House, 1997

ME6019: Heat Exchanger Design : 3 Credits (3-0-0)

Unit I	Introduction to heat exchanger, types and constructional details, baffles design criteria, selection of material and type for typical application, use of hand book, and tables, charts.	7 lectures
Unit II	Design of various types of exchangers such as double pipe counter flow exchanger, double pipe series, parallel exchangers.	7 lectures
Unit III	Tubular exchangers, tubular gas after cooler, tubular gas inter cooler, atmospheric cooler, electric resistance heater.	7 lectures
Unit IV	Condenser; Horizontal and vertical, surface condenser.	7 lectures
Unit V	Evaporators: Raw water evaporators, power plant, make up evaporator, saltwater distiller, thermo compression cane sugar evaporator.	7 lectures
Unit VI	Vaporizing exchanger, kettle reboiler, thermo syphon reboiler, extended surfaces, fix heat exchanger, direct contact transfer equipment.	7 lectures

Recommended Books:

1. Process Heat Transfer, D.Q. Kern, McGraw Hill, 1950.
2. Extended Surface Heat Transfer, D.Q. Kern, McGraw Hill, 1972.
3. Fundamentals of Heat Exchanger Design, R. K. Shah and D P Sekulic, John Wiley & Sons, 2003.
4. Heat Transfer: A Practical Approach, Y.A. Cengel, McGraw Hill, 2002.
5. Process Heat Transfer, G. F. Hewitt, G L Shires and T R Bott, CRC Press, 1994.
6. Process Heat Transfer, Sarit K. Das, Narosa Publishing House, 2005.

ME 6020: Energy Management : 3 Credits (3-0-0)

Unit I	Energy conversion principles.	7 lectures
Unit II	Solar energy: Sources, reserves and technologies, photovoltaic devices, design of solar energy operated systems.	7 lectures
Unit III	Energy management and planning.	7 lectures
Unit IV	Energy audit.	7 lectures
Unit V	Production and consumption.	7 lectures
Unit VI	Conventional and non-conventional energy applications: case studies.	7 lectures

Recommended Books:

1. Energy Management, P. O'Callaghan, McGraw Hill Professional, 1993.
2. Industrial Energy Management, V. Kaiser, Technip Publications, 1993.
3. Principles of Energy Conversion, 2nd Edition, A. W. Culp, McGraw Hill, 2nd Ed., 1991.
4. Hand book of Industrial Energy Conservation, S. Davidttu, McGraw Hill, 1982.

ME 6021: Design of Thermal Systems : 3 Credits (3-0-0)

Unit I	Introduction to thermal systems, conceptofdesign,methodology, morphology, selection of equipment– heat exchanger, fan, blowers, pumps, heaters, specification and criteria, problems, creative input, low sheeting process.	9 lectures
Unit II	Economic, exergy analysis of the process.	6 lectures
Unit III	Process optimization tools.	6 lectures
Unit IV	Modeling thermal system, simulation, simulation techniques,case studies.	7 lectures
Unit V	Design of food freezing plant, design of cold storage, design of fluid andthermal systems.	7 lectures
Unit VI	Pumps,blowers, heat exchanger, simulation of a gas turbine system,simulation of desalination plant.	7 lectures

Recommended Books:

1. Design of Thermal Systems, W.F. Stoker, McGraw Hill, 1989.
2. Design Analysis of Thermal Systems, R.F. Boehm, John Wiley & Sons, 1987.

ME 6022: Design of Refrigeration and Air Conditioning Systems : 3 Credits (3-0-0)

Unit I	Review different types of refrigeration system: Air refrigeration system, vapourcompression refrigeration system and vapourabsorption refrigeration system, properties of refrigerants.	7 lectures
Unit II	Component Design: Compressor, condenser, evaporator, expansion valve.	7 lectures
Unit III	Regenerative refrigeration cycle, multi stage and cascade air liquefaction cycle, theory and method, chilling, freezing and dehydration.	7 lectures
Unit IV	Energy approach for efficient system, design aspects of refrigeration system. design of cold storage, analysis of direct contact systems.	7 lectures
Unit V	Psychrometry and applied psychrometry, concept of comfort and comfort conditioning, design of air conditioning systems.	7 lectures
Unit VI	Evaporative cooling in Indian climate, air distribution system, automatic controls.	7 lectures

Recommended Books:

1. Refrigeration and Air Conditioning, C.P. Arora, TataMcGraw,Hill, 3rd Ed., 2008.
2. Refrigeration and Air conditioning, M. Prasad, New Age International, 2011.
3. Principles of Refrigeration and Air conditioning, Jordan and Prister, Prentice Hall, 2nd Ed., 1956.
4. Refrigeration and Air Conditioning, W.F. Stoecker and J W Jones, McGrawHill International,2ndEd., 1982.
5. Refrigeration and Air Conditioning, R.C.Arora, PHI, 2010.

ME 6023:Value Engineering : 3 Credits (3-0-0)

Unit I	Value engineering (VE): Concept theory and practice, relevance to Indian scenario.	8 lectures
Unit II	Job plan and techniques, phases of VE, functional, creative, evaluation, investigation, implementation, kinds of value, value analysis.	8 lectures
Unit III	Fundamental analysis, family tree, logic question, numerical evaluation FAST diagram.	6 lectures
Unit IV	Function cost analysis, worth, project selection, team selection, VE case studies, production and productivity.	7 lectures
Unit V	Herringbone diagram, VE application in discards vendor assistance.	7 lectures
Unit VI	Expertise various check list and audit, quality quantity analysis.	6 lectures

Recommended Books:

1. Value Engineering, S.S.Iyer, New AgeInternational, 1999.
2. Managing Quality Concepts and Tasks ,N.S.Sreenivasan,Tata McGraw hill, 2008.
3. Aesthetics and Motivations in Arts and Science ,K.C.Gupta, Nova science, 2001.
4. Value Analysis: Universal Applicabilty, Limites Storage, Value World,G.Willingham, CVS, 1990.

ME 6024: Vibration Analysis : 3 credits (3-0-0)		
Unit I	Generalised coordinates, constraints, virtual work, Hamilton's principle, Lagrange's equations, discrete and continuous system.	9 lectures
Unit II	Response of discrete systems, SDOF & MDOF: freevibration, periodic excitation and Fourier series, impulse and step response, convolution integral, vibration absorbersand vibration isolation.	9 lectures
Unit III	Modal analysis: undamped and damped nongyroscopic, undamped gyroscopic, and general dynamical systems, effect of damping.	8 lectures
Unit IV	Continuous systems: vibration of strings, beams, bars, free and forced vibrations.	10 lectures
Unit V	Vibration measurement techniques.	6 lectures

Recommended Books:

1. Theory of Vibration with Applications, W. T. Thomson, Prentice Hall, 4th Ed., 1993.
2. Principles & Techniques of Vibrations, L. Meirovitch, Prentice Hall International (PHI), 1997.
3. Mechanical Vibrations, F. S. Tse, I. E. Morse and R. T. Hinkle, CBS Publ., 1983.
4. Mechanical Vibration, R.V. Dukkipati, and J. Srinivas, PHI, 2nd Ed., 2012.
5. Theory and Practice of Mechanical Vibrations, J. S. Rao and K. Gupta, New Age Publication, 2nd Ed., 1995.

ME 6025: Mechanical Handling of Materials : 3 Credits(3-0-0)

Unit I	Definition of material handling, classification of materials, bulk load, unit load, their characteristics, classification of mechanical handling equipment, different types of elevators and lowers for handling materials in bulk and for unit loads and their working principles and estimation of handling capacity.	9 lectures
Unit II	Belt conveyor, picking belts, their construction, capacity and power requirements, other conveyors like apron, steel plate and slat conveyors, flight and screw conveyors, vibrating and oscillating trough conveyors, estimation of their handling capacity and power requirement.	9 lectures
Unit III	Automatic feeding devices for elevators and conveyors. Gravity chutes and gravity roller runways, humper, stacker and gadget, live rollers, pneumatic and hydraulic methods of conveying, endless rope and chain haulage, Aerial ropeways, monorails, telphers and blast furnace hoists.	9 lectures
Unit IV	Loading and unloading, operation of railway wagons, motor trucks and fork lift trucks.	5 lectures
Unit V	Wire ropes, pulley blocks, crab winch, grabs and lifting magnets, different types of cranes.	5 lectures
Unit VI	Definition and types of robots, basic concept, working principle and application of robotics, manipulators.	5 lectures

Recomended Books:

1. Material Handling Systems and Terminology, Edward Frazelle, LionheartPub, 1991.
2. Manufacturing Facilities Design and Material Handling, Meyers, Stephens, Prentice Hall, 1999.
3. Plant Layout and Material Handling, Fred E. Meyers, Prentice Hall, 2000.

ME 6026: Metal Casting Technology : 3 Credits (3-0-0)

Unit I	Foundry Industry in India, Asia and world, role of WFC, AFC and IFC.	7 lectures
Unit II	CAD/CAM in pattern design and manufacture.	7 lectures
Unit III	Near net shape casting processes, squeeze casting, centrifugal casting, die casting, fused diffusion methods, high pressure moulding processes, resin binders.	7 lectures
Unit IV	Foundry mechanization and automation, computer charging systems for cupola, arc and induction furnaces, automatic pouring systems.	7 lectures
Unit V	Solidification simulation, computer aided gating and riser design and methods, ISO 9000 / IS 14000 systems in foundry.	7 lectures
Unit VI	Energy conservation in foundry, manufacturability of castings, GT and FMS application in foundry, PLCs and loaded chains in foundry, productivity foundry, production economics, industrial robotics.	7 lectures

Recomended Books :

1. Metal Casting Principles and Practice,T.V.RamaRao,New Age International, 2007.
2. Foundry Engineering, ,H.F.Taylor, M.C.Fleemings, J.Walff, Wiley EasternLtd, 1993.
3. Principles of Metal Casting ,Heina, Loper, Rosenthal,TataMc,Graw Hills Publishing company limited, 1989.
4. Principles of Metal Casting, B.Ravi, Prentice Hall of India, 2005.

ME 6027: Tool Design : 3 Credits (3-0-0)

Unit I	Tools, their functions in the manufacturing process. General considerations in their design.	7 lectures
Unit II	Jigs and fixtures. Design of locating, clamping,guiding element and their integration.	7 lectures
Unit III	Sheet metal working tools, tools for blanking, bending and drawing operation.	7 lectures
Unit IV	Forging,casting die, design, dies for other processes.	7 lectures
Unit V	Gauges and inspection of fixtures.	7 lectures
Unit VI	Tool layout and cam design for automats; Introduction to Auto CAD, ProEngineer	7 lectures

Texts/ References:

1. Fundamentals of Tool Design, F.W.Wilson, and A. R. Konecny Literary Licensing, LLC, 2012.
2. Tool Design, C.B.Cole, Ameerican Technical Society, 1954.
3. Tool Design, C. Donaldson, G.H.Lecain and V.C.Goold, TataMcGawHill, , 4th Ed., 2012.

ME 6028: Industrial Robotics : 3 Credits (3-0-0)

Unit I	Introduction to robotics, classification of robots and manipulators, industrial application of robots.	7 lectures
Unit II	Design criteria for end effectors.	7 lectures
Unit III	Kinematics and dynamics of linkage with special emphasis to the open loop controls.	7 lectures
Unit IV	Actuators and drive elements, robot sensors and vision.	7 lectures
Unit V	Control of robots and manipulators, robot programming.	7 lectures
Unit VI	Problems related to design of grippers and robot models.	7 lectures

Recomended Books :

1. Robotics and Control, R. K. Mittal and I. J. Nagrath, McGrawHill, 2003.
2. Robotics: Control, Sensing, Vision and Intelligence, K. S. Fu, R. C. Gonzalez and C.S.G. Lee, McGrawHill, 2008.
3. Introduction to Robotics, J. J. Craig, Addision,Wesley, 2005.
4. Introduction to Robotics: Analysis, Control, Applications, S. B. Niku ,Wiley Publication,2nd Ed., 2010.
5. Robotics for Engineers, Y. Koren, McGraw Hill,1985.
6. Robot Vision, B. K. P. Horn, MIT Press, Cambridge,1986.

ME 6029 :Production Planning and Control : 3 Credits (3-0-0)

Unit I	Forecasting and methods of forecasting.	7 lectures
Unit II	Product design and development.	7 lectures
Unit III	Product planning and process planning.	7 lectures
Unit IV	Loading and scheduling of production systems.	7 lectures
Unit V	Dispatching and different types of dispatching for PPC.	7 lectures
Unit VI	Production control methods, systems concepts in PPC.	7 lectures

Recomended Books :

1. Elements of Production Planning and Control , Samuel Eilon, Universal BookCo, 1985.
2. Production Planning and Control ,J.R..King, PergamonPress, 1975.
3. Production and Inventory Control ,Plossi and Wight,Prentice Hall, 1967.
4. Production and Operations Management,K.C.Arora, Laxmi Publications, 2004.

ME 6299: Project– Part II J : 4 Credits (0-0-8)
In continuation of Project-Part I, students should undertake the following activities.
1. Fabrication of experimental set up/ conducting matching experiments/simulation of the problem.
2. Analysis of the experimental/simulated result.
Mid semester seminar presentation.
3. Validation of obtained result/ testing/etc
4. Thesis writing and submission of thesis
End semester seminar presentation

ME 6251: Advance Laboratory Practice : 3 Credits (0-0-6)	
Computer Lab (CFD): use of thermal and flow analysis softwares like Fluent, Gambit, development of learning material.	28 hours
Computer Lab (CAD,CAE): Use of solid modelling, design and analysis softwares like AutoCAD, Creo, ANSYS, Catia.	28 hours
CIM & Fluid Power Lab: exercise on hydraulic trainer, exercise on mechatronics trainer, job preparation in NC/CNC lathe/milling	28 hours

ME 6290: Comprehensive Viva Voce : 2 Credits (0-0-0)
The viva voce will be conducted by all the faculty members of the department on all subjects to check the insight of students on their knowledge on design, thermo-fluid, production and industrial engineering.

Syllabi of subjects offered to other branches:

ME 5121: Machine Theory : 4 Credits(3-1-0) [For AE Students]

Unit I	Introduction: purpose, kinematics and kinetics, machines, structures, mechanisms and their inversions, elements of kinematic chain, miscellaneous types of mechanism, kinematics fundamental, degree of freedom and its determination, lower pairs and higher pairs, types of motions, links, joints and kinematics chains, inversions, Grasshoff'slaw.	7 lectures
Unit II	Velocity analysis: definitions of velocity (rigid body mechanics), graphical velocity analysis, instantaneous centers of velocity, velocity analysis with instantaneous centres, slider crack of mechanism, withworth quick return mechanism and four bar mechanism.	7 lectures
Unit III	Acceleration analysis: definition of acceleration of mechanism, graphical acceleration analysis, analytical solution of acceleration analysis: four bar linkages, slider crank mechanism, Coriolis acceleration	7 lectures
Unit IV	Gear Trains: Introduction, rolling cylinder, fundamental law of gearing, involute tooth from pressure angle, simple gear train, compound gear train, epicyclic gear train, planetary gear trains, transmissions.	7 lectures
Unit V	Brakes and dynamometers: Different types of brakes and dynamometers, working principles, applications, governors and their types, governor applications.	7 lectures
Unit VI	Balancing of machineries, determination of balancing mass and moments, design of cams and followers with programmed motions.	7 lectures

Recomended Books :

1. Theory of Machines, S.S. Rattan, Tata McGraw Hill, 4th Ed., 2014.
2. Theory of Machines, T. Beven, CBS Publications,3rd Ed., 2005.
3. Design of Machinery, R.L.Nortan, Tata McGraw Hill, 4th Ed., 2008.
4. Theory of Machines & Mechanism, J.E. Shigley, McGraw Hill, 3rd Ed., 2009.

ME 6121: Theory of Refrigeration and Air Conditioning : 2 Credits (2-0-0) For AE Students]

Unit I	Introduction: concept of heat engine, heat pump and refrigeration, efficiency and COP, Ideal refrigeration cycle, Reversed Carnot cycle, Unit of refrigeration, refrigeration effect, different types of refrigeration systems.	2 lectures
Unit II	Vapor compression refrigeration system, limitation of reversed Carnot cycle with vapor as a refrigerant, p-V, T-S and p-h diagrams, actual vapor compression cycle and their performance, use of tables and charts for solving problems. vapour absorption refrigeration systems, principles and application. domestic and commercial refrigeration system.	10 lectures
Unit III Unit IV	Refrigerant types, designation of refrigerants and their properties, desirable properties of ideal refrigerants, selection of refrigerants, impact of refrigerants on global warming and ozone depletion, environment friendly refrigerants, secondary refrigerants and their applications. Air Conditioning: Working substance in air conditioning, psychometric properties, wet bulb temperature, dry bulb temperature, thermodynamic wet temperature, relative humidity,	6 lectures
	humid specific heat, psychometric chart, air conditioning processes, sensible and latent heating, humidification and dehumidification, industrial airconditioning, problems related to cold storage. Calculation of heat load and humidity in cold storage, refrigerator and freezing systems.	10 lectures

Recommended Books:

1. Refrigeration and Air Conditioning, C.P.Arora, TataMcGrawHill, 3rd Ed., 2008.
2. Principles of Refrigeration, Roy, J. Dossat, Pearson, 4th Ed., 2010.
3. Refrigeration and Air Conditioning, R.C.Arora, PHI, 2010.
4. Refrigeration and Air conditioning, M. Prasad, New Age International, 2011.