PROFESSIONAL ELECTIVE COURSES

MEEL1	COMPUTER AIDED DESIGN	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES:

1. To provide adequate information about the product life cycle, concepts of CAD software and its applications.
2. Be able to comprehend how CAD technology can be leveraged in the designprocess.
3. Students will learn theory and practice related to Geometric modeling, and free form surface modeling.
4. Develop CAD models for downstream Engineering activities such as manufacturing and finite element analysis

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Interpret a part or assembly of parts using computer aided design software.
2. Implementation of parametric modeling techniques to reflect engineering requirements.
3. Generate a product by familiarizing with top-down design principles.
4. Specify the use of motion and interference checking to ensure that parts will not interfere throughout their complete range of motion

COURSE CONTENT:

UNIT-1	**CO1**	**12**
Fundamentals of Computer Graphics: Product cycle, sequential and concurrent engineering Fundamentals of CAD, Applications of computer for design, Benefits of CAD, CAD system architecture, Input devices. **CAD standards:** Graphical Kernel System (GKS), Data exchange standards- IGES, STEP, CALS etc., and Communication standards.		
UNIT-2	**CO2**	**12**
Geometric Transformations: Coordinate systems, Transformation Principles, Translation, Scaling, Rotation, Matrix Representations and Homogeneous Coordinates, Composite transformations, Viewing Transformation.		
UNIT-3	**CO3**	**12**
Geometric Modeling: Representation of curves, Hermite curves, Bezier curves, B-spline curves, Surface modeling and entities, surface patch, Coons and bi-cubic patches, Bezier and B-spline surfaces **Solid Modeling:** Solid entities, Solid representation, Sweep representation, Constructive solid geometry and Boundary representation, Solid modeling based applications.		
UNIT-4	**CO4**	**12**
Visual realism: Hidden line-surface-solid removal algorithms, shading, coloring, computer animation **Assembly of parts:** Assembly modelling, interferences of positions and orientation, tolerance analysis, interference checking		

LEARNING RESOURCES:

TEXT BOOK(s):

1. CAD/CAM by Mikel P.Groover and Emory W.Zimmers,Prentice Hall of India ,Delhi
2. CAD/CAM by P.N.Rao, Tata McGrawhill ,Delhi
3. CAD/CAM by Ibrahim Zeid, TataMcGrawhill,Delhi.
4. Principles of Interactive Computer Graphics by Newman and Sproull,McGrawhill.

MEEL2	FINITE ELEMENT METHODS	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES:

1. To furnish information on the basic concepts, background and methodology of FEM
2. To select suitable elements for Finite element modelling, deriving the necessary elemental matrices and for applying the principles to various mechanical systems
3. To learn the application of FEM to various structural problems by incorporating temperature and boundary conditions.
4. To derive the element mass matrices which help to predict dynamic behaviour of the structure.

COURSE OUTCOMES:

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

1. Solve 1-D problems using principle of minimum potential energy.
2. Formulate 2-D truss and beam problems using Finite Element Method.
3. Finite Element modeling of 2D and axisymmetric problems using CST element.
4. Analyze 1-D heat transfer in a straight uniform fin.
5. Formulate 2-D problems using quadrilateral elements.
6. Evaluate eigenvalues and eigenvectors of 1D bar.

COURSE CONTENT:

UNIT-1	**CO1**	**12**
Introduction: Objectives and Methods of Engineering Analysis, FDM Vs FEM, Rayleigh – Ritz Method, Weighted Residual Methods. Introduction to Finite Element Method, FEM Advantages, Disadvantages, FEM Applications, Stresses and Equilibrium. Strain Displacement relations. Stress - Strain relations for Plane stress and Plane Strain, FEM Procedure. **One Dimensional Elements:** Finite Element modelling, coordinates and shape functions, Potential Energy approach - Assembly of Global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Temperature Effects, Problems related to simple Axially loaded members.		
UNIT-2	**CO2**	**12**
Analysis of Trusses: Element stiffness matrix, Stress Calculations, Problems limited to truss with three members only. **Analysis of Beams:** Derivation of Element stiffness matrix for two node, two degrees of freedom per node Beam element and Simple Problems.		
UNIT-3	**CO3,CO4**	**12**

Two Dimensional Elements: Finite element modelling of two-dimensional stress analysis with constant strain triangles (CST) and treatment of boundary conditions. Finite element modelling of Axisymmetric solids subjected to Axisymmetric loading with triangular elements. **Heat transfer problems:** Formulation and solution procedure, 1D – Straight uniform fin analysis.		
UNIT-4	**CO5,CO6**	**12**
Concepts of Iso parametric, Super parametric and Sub parametric Elements, Stiffness and Force Matrices for Two dimensional four noded Quadrilateral element and numerical Integration by using Gaussian Quadrature. **Dynamic Analysis:** Formulation of finite element model, element matrices for one dimensional element, evaluation of Eigen values and Eigen vectors for a stepped bar by Characteristic Polynomial Technique.		

LEARNING RESOURCES:

TEXT BOOK(S):

1. Introduction to Finite Elements in Engineering, Chandraputla, Ashok and Belegundu, PHI, 3rd edition, 2003.
2. The Finite Element Methods in Engineering, SS Rao, Pergamon, 5th Edition,2011.

REFERENCE BOOK(S):

1. An Introduction to Finite Element Method, JN Reddy / Me Graw Hill, 2nd Edition,1993.
2. Finite Element Methods: Basic concepts and applications, Alavala, Chennakesava.R, PHI, 2009.

WEB REFERENCE:

1. Nptel.ac.in/courses/112104116
2. www.colorado.edu/MCEN/MCEN4173

MEEL3	MECHATRONIC SYSTEM DESIGN	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES:

1. Explain mechatronics and its relevance in engineeringdesign.
2. Study of means of measuring various physical variables and to understand the concepts of signalconditioning
3. Study of different types of actuators and to study pneumatics & hydraulic system and its components
4. To study PLC system and to design mechatronicsmodels.

COURSE OUTCOMES:

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

1. Explain key elements of mechatronics and interpreting them for engineering, science and mathematics.
2. Describe the concept of signal processing and its functions in interfacing systems involving ADC, DAC, digital I/O and also actuators using appropriate DAQ micro-controller.
3. Develop Time and Frequency domain analysis of system model used in engineering by drawing conclusions
4. Model PLC ladder programming and collate it with real life applications.

COURSE CONTENT:

UNIT-1	CO1	12
Introduction: Integrated Design issues in Mechatronics, Mechatronics Design process, Mechatronics Key Elements, Applications in Mechatronics. Sensors & transducers: Introduction, performance terminology, sensor for motion and position measurement, force, torque and tactile sensors, sensor for flow measurement, temperature sensing devices.		
UNIT-2	**CO2**	**12**
Signal Conditioning and Real Time Interfacing: Signal conditioning process, Elements of a Data Acquisition, transducers and signal conditioning, Data Conversion Process: Analog to Digital Conversion and Digital to Analog conversion types. Actuation Systems: Pneumatic and hydraulic actuation systems, stepper motors.		
UNIT-3	**CO3**	**12**
System Models: Modelling of one and two degrees of freedom mechanical, electrical, fluid and thermal systems. Block diagram representations for thesesystems. Closed Loop Controllers: Continuous and discrete processes control modes, two step, proportional, and derivative, integral, and PID controllers.		
UNIT-4	**CO4**	**12**
PLC: Programmable Logic Controllers, Architecture, Ladder programing- Ladder diagram -Timers, Internal Relays and Counters. CASE STUDIES: Pick and place robot, Car park barriers, car engine management		

LEARNING RESOURCES:

TEXT BOOK(S):

1. Devdasshetty, Richard A.Kolk, “Mechatronics System Design”, PWS Publishing

Company, 1997.
2. "Mems & Microsystems Design & Manufacture", Tai –Ran Hsu, Tata Mc Graw-Hill publications, 2002

REFERENCE BOOK(S):

1. HMT, "Mechatronics", Tata Mcgraw,Hill Publishing Company,Newdelhi,1998
2. A Textbook of Mechatronics ,R.K.Rajput, S. Chand & Company PrivateLimited
3. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, PrenticeHall

WEB REFERENCE:
http://nptel.ac.in/syllabus/syllabus.php?subjectid=112103174

MEEL4	FLUIDICS AND CONTROL SYSTEMS	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES:

1. To identify the elements of hydraulic systems. To Explain the working of various pumps and actuators
2. To understand various control elements of hydraulicsystems
3. To know the variety of industrialcircuits
4. To understand the common methods of designing logiccircuits

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Recognize various elements of hydraulic systems. To have good knowledge on working principles of various pumps and actuators.
2. Explain various control elements of hydraulic systems.
3. Design various logic circuits
4. Determine proper industrial circuits for given application

COURSE CONTENT:

UNIT-1	CO1	12
Hydraulic Pumps & Pressure Regulation: Pressure regulation, pump types: Gear Pump, Vane Pump, Piston Pump, and Combination Pumps. Selection and specification of pumps pump characteristics. **Hydraulic & Pneumatic Actuators:** Linear and Rotary Actuators-Selection, Specification and Characteristics, Hydraulic and pneumatic accessories		
UNIT-2	**CO2**	**12**
Control and Regulation elements: Pressure-direction and flow control valves, relief valves, non-return valves and safety valves. Actuation systems. Application circuits.		
UNIT-3	**CO3**	**12**
Hydraulic Circuits: Reciprocation, quick return, sequencing synchronizingcircuits-accumulator circuits, industrial circuits-press circuits.		
UNIT-4	**CO4**	**12**
Pneumatic Systems and Circuits: Pneumatic fundamentals, Control elements, Sequential circuits, Cascade methods, Mapping Methods, Step counter method, Compound circuit design, Combination circuit design.		

LEARNING RESOURCES:

TEXT BOOK:

Andrew Parr, "Hydraulics and Pneumatics", (HB), Jaico Publishing House, 1999.

REFERENCE BOOK(s):

1. Antony Espossito, "Fluid power with Applications", Prentice Hall,1980
2. Dudleyt A.Pease and John J.Pippenger, "Basic Fluid Power", Prentice Hall,1987.

WEB RESOURCES:

1. http://nptel.ac.in/courses/112105046/m7L27.pdf
2. http://teacher.buet.ac.bd/mmrazzaque/Fluidics/Fluidic%20control.pdf

MEEL5	INDUSTRIAL ROBOTICS	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES:

1. To provide an introduction to Robotics and Automation including robot classification, design and selection, analysis and applications inindustry.
2. To provide information on various types of end effectors, their design, interfacing and selection.
3. To provide the details of operations for a variety of sensory devices that are used onrobotthe meaning of sensing, classification of sensor, that measure position, velocity & acceleration of robot joint.
4. The goal of the course is to familiarize the students with the basic concepts of transformations performed byrobot.

COURSE OUTCOMES:

At the end of the course the students should be able to:

1. Differentiate the various types of Industrial Robots and their architecture based on application.
2. Describe about the different types of gripper mechanisms and actuators.
3. Describe the use of sensory devices in robot applications.
4. Solve basic transformations related to the movement of manipulator.
5. Design a robot mechanism to meet kinematics requirements.

COURSE CONTENT:

UNIT-1	CO1	12
Introduction to Robotics, major component of a robot, robotic like devices, classification of robots - Classification by coordinate system and by control method, Specifications of robots, fixed versus flexible automation,economic analysis and overview of robot application in industry		
UNIT-2	**CO2**	**12**
Robot End Effectors: Introduction, end effectors, interfacing, types of end effectors, grippers and tools, considerations in the selection and design of remote centered devices, Requirements of End effectors. **Robot Actuators:** Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparisonof all these Drives		
UNIT-3	**CO3**	**12**
Robotic Sensory Devices: Objective, Non-optical position sensors - potentiometers, synchros, inductosyn, optical position sensors – opto interrupters, optical encoders (absolute & incremental) Proximity Sensors: Contact type, non-contact type – inductive, capacitive proximity sensor, fibre optic proximity sensor, laser scanning proximity sensor, and reflected light sensor. **Touch & Slip Sensors:** Touch sensors - proximity rod & photo detector sensors, slip sensors - Forced oscillation slip sensor, interrupted type slip sensors.		
UNIT-4	**CO4, CO5**	**12**
Transformations and Kinematics: Objectives, homogenous coordinates, basic transformation operations, homogeneous transformation, **Forward solution –** Denavit Hartenberg procedure. Problems involving 2 and 3 DOF manipulators and SCARA manipulator. **Inverse or backward solution -** Closed form solution, problems involved articulated manipulators and SCARA manipulator		

LEARNING RESOURCES:

TEXT BOOK(S):

1. Robotic Engineering by Richard D.Klafter, Prentice-Hall of India Pvt Ltd,2010.
2. Industrial Robotics by Mikell P. Groover, Tata McGraw-Hill Int. Edition 2,2012.
3. Robotics and Control, R.K. Mittal and I.J.Nagarath, TMH, 2005

REFERENCEBOOK(S):

1. Introduction To Robotics: Mechanics And Control, John J. Craig 3rd edition,pearson,2008
2. Robotics: Control, Sensing, Vision, and Intelligence, K. S. Fu, R. C. Gonzales, andC.S. G. Lee, Tata McGraw-Hill, NY, 2008.
3. Introduction to Robotics: Analysis, Systems, Applications, Saeed B. Niku, PrenticeHall, NJ, 2010.

WEB REFERENCE:

1. http://nptel.iitm.ac.in/courses.php?branch=Mechanical
2. http://academicearth.org/courses/introduction-to-roboticsVideo references:
3. http://nptel.iitm.ac.in/video.php?courseId=1052

MEEL6	I.C.ENGINES & GAS TURBINES	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES:

1. To familiarize with the basic components and working principles of different IC engines and also the various testing methods to estimate the performance of ICengines
2. To know the fuel supply systems and combustion processes understand combustion and various parameters and variables affecting it in various types of ICengines.
3. To make the student about the working of Reciprocating and RotaryCompressors
4. To make the student about various types of Gas turbines their working principles and basic principles of Jet and Rocket propulsionsystems.

COURSE OUTCOMES:

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

1. Determine the various performance parameters of I.C. Engines
2. Describe the fuel supply systems and combustion processes in I.C. Engines
3. Compute the power requirements and performance parameters of reciprocating and rotary compressors
4. Determine the performance of Gas turbines and various jet propulsion – aircraft and rockets.

COURSE CONTENT:

UNIT-1	CO1	12
I.C. Engines: Introduction, Engine nomenclature, Classification of I.C. Engines, Working principles of S.I. and C.I. Engines (both 4 stroke and 2-stroke)-Valve Timing and Port timing diagrams - Differences between S.I. & C. I. and 2 Stroke & 4 strokeengines. **Testing of I.C. Engines:** Indicator diagram, evaluation of Indicated Power, Brake power, Fuel consumption, SFC, Mechanical & Thermal efficiencies, Mean Effective Pressure, air-fuel ratio, Heat balance sheet, Morse test.		
UNIT-2	**CO2**	**12**
Fuel Supply Systems: ***S.I. Engines***- Chemically correct air-fuel ratio, Air fuel Mixture requirements, Carburetion, Simple float type carburettor, Fuel injection System for SI engines, MPFI. ***C.I. Engines***- Air- fuel requirements, fuel injection systems, Electronic injection system, CRDI. **Combustion Processes:** ***S.I. Engines***- Normal combustion and flame front propagation, abnormal combustion, variables affecting detonation, Knock rating and Octane number, types of combustion chambers for petrol engines. ***C.I. Engines***- Ignition delay, combustion knock in the C.I. engines, variables affecting ignition delay, Knock rating and Cetane number, types of combustion chambers for diesel engines. Engine performance curves, Variables affecting engine performance for both S.I. & C.I. Engines.		
UNIT-3	**CO3**	**12**
Reciprocating Air Compressors: Classification, Operation, Effect of clearance volume, pressure ratio, volumetric efficiency, power input, Single-stage and Multi-stage compressors, Effect of inter-cooling, optimum intermediate pressure in a two-stagecompressor. **Rotary Compressors:** Introduction, Types and their applications, principles of working, static and total head values, Centrifugal compressor velocity vector diagrams, pressure coefficient, pre whirl, Axial flow compressor - polytropic efficiency, Surging, Choking and Stalling, Centrifugalcompressor versus axial flow compressor.		
UNIT-4	**CO4**	**12**

Gas Turbines: Closed and Open cycle gas turbines, analysis of closed cycle gas turbine, efficiencies of Compressor and turbine, cycles with inter-cooling, reheat andregeneration.
Jet & Rocket Propulsion: Basic principles of Jet propulsion - specific thrust, propulsive efficiency and overall thermal efficiency of a jet engine, Principles of Rocket propulsion, Types of rocket propulsion.

LEARNING RESOURCES:

TEXT BOOK(S):

1. I.C. Engines - V.Ganesan - T.M.H., New Delhi, 3rdEdition
2. Treatise on Heat Engineering- V.P.Vasandani and D.S.Kumar, Metropolitan Book co, New Delhi, 4th Edition.
3. A Course in I.C. Engines - M.L.Mathur & R.P.Sharma - Dhanpat Rai & Sons- New Delhi,2010.

REFERENCE BOOK(S):

1. Thermal Science and Engineering- D.S.kumar, S.K.Kataria Publ, New Delhi2010.
2. Thermal Engineering -Rajput, Laxmi Publication, New Delhi,2012.

WEB REFERENCE:

- **http://autoclub.rso.siuc.edu/frange.html**
- **http://www.howstuffworks.com/engine1.htm**
- **http://inventors.about.com/library/inventors/blinternalcombustion.htm**
- **http://www.animatedengines.com/**
- **SAEjournals.**

MEEL7	REFRIGERATION & AIR- CONDITIONING	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES:

1. To know the various methods of refrigeration and to introduce vaporcompression
2. Refrigeration cycle, analysis and methods for improvingperformance.
3. To know the operation of vapor absorptionsystem.
4. To know the various components of refrigeration system and their workingprinciples.
5. To design air conditioning systems by cooling load calculations. To know the various applications of refrigeration and air conditioningsystems.

COURSE OUTCOMES:

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

1. Apply the concept of the refrigeration cycle to different aircraft refrigeration.
2. Determine the Performance of the Vapour compression refrigeration system with system components and different refrigerants knowledge.
3. Describe the steam jet, vapor absorption, thermoelectric, and vortex tube systems.
4. Estimation of cooling load and heating loads**.**

COURSE CONTENT:

UNIT-1	CO1	12
Introduction to Refrigeration: Necessity and applications, unit of refrigeration and C.O.P, Mechanical refrigeration-types, Reversed Carnot cycle of refrigeration. **Air Refrigeration:** Bell Coleman cycle, Open and Dense air systems, Actual refrigeration system, Necessity of aircraft refrigeration, Aircraft refrigeration systems- Types.		
UNIT-2	**CO2**	**12**
Vapour Compression Refrigeration: Working principle, essential components of plant, simple vapor compression refrigeration cycle, modifications, Use of P - h charts, Refrigerants- Classification, desirable properties, commonly used refrigerants, nomenclature and Alternate refrigerants. **System Components**: Compressors-types, Condensers - classification, working, Evaporators - classification, working, Expansion devices - types, working.		
UNIT-3	**CO3**	**12**
Vapour Absorption System: Calculation of max COP, description and working of NH3 - water system, Li - Br- H2 O system, principle of operation of three fluid absorption system and salientfeatures. **Steam Jet Refrigeration:** Principle of working, applications, merits and demerits. **Non-Conventional Refrigeration Methods:** Principle and operation of thermoelectric refrigerator and Vortex tube or Hilsch tube.		
UNIT-4	**CO4**	**12**

Psychrometry: Introduction, Psychrometric properties and relations, Psychrometric chart, Psychrometric processes, Sensible, Latent and Total heat, Sensible Heat Factor (SHF), Bypass factor.
Introduction to Air Conditioning: Need for ventilation, infiltration, concepts of RSHF, GSHF, ERSHF& ADP, concept of human comfort and effective temperature, comfort air conditioning, industrial air conditioning requirements, air conditioning load calculations.
Air Conditioning Systems: Introduction, components of Air conditioning system, Classification of Air conditioning systems, Central and Unitary, summer, winter and Year round systems.

LEARNING RESOURCES:

TEXT BOOK(S):

1. Refrigeration and air conditioning - C.P.Arora, TMH,2007.
2. Refrigeration and Air conditioning - Manohar Prasad, New Age India, NewDelhi,2006.
3. A course in refrigeration and air conditioning - S.C.Arora & Domkundwar, Dhanpat Rai & sons, New Delhi,2008.

REFERENCE BOOK(S):

1. Principles of Refrigeration - Dossat, John Wiley, 5th Edition,2001.
2. Refrigeration and air conditioning - Stoecker, 2nd Edition,1983.

WEB REFERENCE:

1. IIT Video Lectures (NPTEL)

MEEL8	AUTOMOBILE ENGINEERING	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES:

1. The students acquire sufficient knowledge to classify Engines, Chassis, Fuel SupplySystems.
2. The student acquires sufficient knowledge to Cooling Methods, Lubrication Methods, Ignition Systems, Starting systems, GeneratingSystems.
3. Acquisition of sufficient knowledge to Clutch, Power train Systems and working of Suspension and brakingmethods.
4. The students acquires sufficient knowledge about emissions and its control and also Latest trends in ICengines

COURSE OUTCOMES:

After completion of the course the students can be able to

1. Describe the working of IC engines and the various components of IC Engines.
2. Demonstrate the Cooling systems, Lubrication Systems, Ignition systems and Electrical Systems of an IC Engines.
3. Demonstrate the transmission systems, Gear Box, Axles, wheel alignment and vehicle control systems.
4. Describe Emissions control methods, Alternative energy sources and different Prime movers.

COURSE CONTENT:

UNIT-1	CO1	12
Introduction: Classification of vehicles, arrangements of drive. Chassis: Introduction to Chassis, Types, Construction Details. Engine: Classifications based on number of strokes, cylinders, types of, valves, valve arrangements and operating Mechanisms, Piston types, Piston rings, Firing order, Crankshafts, Flywheel. **Assorted Equipment:** Fuel supply pumps-A.C. Mechanical and S.U.Electrical type diaphragm pumps, Air and Fuel Filters, super chargers and Turbo chargers,Mufflers.		
UNIT-2	**CO2**	**12**
Cooling Systems: Need for cooling system, Air and water cooling **Lubricating Systems:** Various lubricating systems for I.C. Engines **Ignition Systems:** Battery Ignition system, Ignition advance, ignition advance methods, Spark plugs, Magneto ignition system. **Electrical system:** Electronic Ignition, Alternator, Cut-out, Current and Voltage regulators, charging circuit, starting motors, lighting, instruments and accessories.		
UNIT-3	**CO3**	**12**
Transmission systems: Introduction to Clutches, Single-plate and Multi-plate clutches, Centrifugal clutches, wet and dry type, actuating mechanisms. **Gear Box** - Theory, Four Speed and Five Speed Sliding mesh, Constant mesh & Synchro-mesh type, selector mechanism, Automatic transmission, overdrive, propeller shaft, differential – principle of working. Suspension Systems: Need for suspension systems, springs, shock absorbers. **Axle and Wheel Alignment:** Axles front and rear, different methods of floating rear axle, front axle and wheel alignment. **Vehicle Control:** steering mechanisms and power steering, types of brakes and brake actuation mechanisms (air and hydraulic)		
UNIT-4	**CO4**	**12**

Exhaust emissions: pollutants and Emission norms, Pollutants from SI engine and its control methods3-way catalytic converter, Crankcase emission control, Evaporative emission control, EGR and Total emission control packages. Diesel engine emissions control-EGR, DPF, DOC and SCR.
Alternative energy sources: Natural gas, LPG, biodiesel and hydrogen in automobiles and modificationneeded.
Options of prime movers: Electric Vehicle, Hybrid vehicle, Fuel cell vehicle

LEARNING RESOURCES:

TEXT BOOK(S):

1. Automobile Engineering - G.B.S.Narang, Khanna Publishers,7th Reprint,2011.
2. Automobile Engineering -R.B.Gupta, SatyaPrakasan,2009
3. Automobile Engineering -Vol I & II - Kirpal Singh, Standard Publishers,2011.

REFERENCE BOOK(S):

1. Automotive Mechanics - Van Nostr and Company, Joseph Heitner,2007.
2. Automotive Mechanics - 10th Ed., Willia Crouse, Donald Anglin, Career Education,1993.

WEB REFERENCE:

1. IIT Video Lectures (NPTEL)

MEEL9	ELEMENTS OF AEROSPACE ENGINEERING	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES:

1. To learn the components of airplane and different types of flight vehicles, Function of structural components in flight vehicle.
2. To know the basic aspects of aerodynamics and airfoils forces and moments acting on an airfoil
3. To know the elements of propulsive systems and performance parameters of Airplanes
4. To Learn the generalized concepts of aircraft stability and control along with basic concepts of spaceflight

COURSE OUTCOMES:

After Completion of the course, the students are able to

1. Demonstrate the important basic concepts of Aerospace Engineering.
2. Describe the operational features of various aircraft elements.
3. Compute the stability and control aspect of air planes
4. Outline the knowledge of basic aspects of space flight for different space applications.

COURSE CONTENT:

UNIT-1	CO1	12
HISTORICAL EVOLUTION AND AIRCRAFT CONFIGURATIONS: History- Early Planes-Developments in aerodynamics- Multi-planes, biplanes and monoplanes-Components of an Airplane and Their functions, Types of Flight Vehicles, Classification-Standard Atmosphere, Altitude, Hydrostatic Equation, Geopotential and Geometric Altitudes **FLIGHT VEHICLE STRUCTURES**: Introduction, Fuselage-Monocoque, Semi-Monocoque Structures, Components of Wing-Spars, Ribs, Longerons, Stringers, Bulkheads, Aircraft Materials-Metallic and Non-Metallic Materials, Use of Aluminium Alloy, Titanium, Stainless Steel and Composite Materials.		
UNIT-2	**CO2**	**12**
BASIC AERODYNAMICS: Continuity equation, Incompressible and Compressible flow, Momentum equation, Energy equation, Speed of sound, Measurement of air speed, Compressible flow, Compressibility, Introduction to viscous flow, Laminar and Turbulent boundary layer, compressibility effect on Skin friction, Flow separation- Introduction-Airfoils - Airfoil Nomenclature,ClassificationsofNACAAirfoils,WingGeometry,AerodynamicForces,Lift, Drag and Moment Coefficients, Co-Efficient of Pressure, Centre of Pressure, Aerodynamics Centre, Pressure Distribution Over Aero foil, Types of Drag.		
UNIT-3	**CO3**	**12**

PROPULSION: Introduction, Propeller, Reciprocating Engine, Jet Propulsion-The Thrust Equation, Elements of Turbojet Engine-Turbofan Engine-Rocket Engine, Rocket Propellants-Liquid Propellants, Solid Propellants, Rocket Staging **ELEMENTS OF AIRPLANE PERFORMANCE:** Introduction: The Drag polar, Equations of Motion-Thrust required for Level, Un accelerated Flight, Thrust available and Maximum Velocity-Power required for Level, Un accelerated Flight, Power available and Maximum velocity- Altitude effects on Power required and Available, Rate of Climb, Gliding Flight, Absolute and Service Ceilings, Time of Climb, Range and Endurance-Propeller Driven Airplane , Jet Airplane		
UNIT-4	**CO4**	**12**
PRINCIPLES OF STABILITY AND CONTROL: Introduction, Definition of Stability and Control – Static stability, Dynamic stability, Control- Moments on the Airplane-Absolute angle of attack, Criteria for Longitudinal Static Stability Directional static stability –Lateral Static stabililty. **SPACE FLIGHT**: Introduction, Orbit Equation, Basic Aspects of Space Vehicle Trajectories, Kepler's Laws, Earth and Planetary Entry, Space Explorations- Space Vehicles and Its Types, Reusable Space Vehicles, Space Shuttle, Satellites, Types of Satellites and Their Functions.		

LEARNING RESOURCES:

TEXT BOOK(S):

Anderson. J. D, Introduction to Flight, Eighth Edition, McGraw-Hill Education,2017.

REFERENCE BOOK(S):

1. Houghton. E. L., Carpenter P.W., Aerodynamics for Engineering Students, Seventh Edition,Butterworth-Heinemann,2017.
2. Kermode. A. C, Mechanics of Flight, Eleventh Edition, PearsonEducation,2007.
3. Kermode, A.C., "Flight without Formulae", McGraw Hill,1987.
4. Clancy, L.J., "Aerodynamics", Pitman,1986

WEB REFERENCE:

1. https://nptel.ac.in/courses/101/101/101101079/
2. https://nptel.ac.in/courses/101/101/101101001/
3. https://www.youtube.com/watch?v=v7jbCROl7o8
4. https://www.youtube.com/watch?v=Ub2E6-pr3r4
5. https://nptel.ac.in/courses/101/104/101104061/
6. https://nptel.ac.in/courses/101/104/101104061/
7. https://nptel.ac.in/courses/101/104/101104062/

https://www.youtube.com/watch?v=Pym_O50SUts

MEEL10	POWER PLANT ENGINEERING	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES:

1. To provide an overview of Coal based thermal power plants and the associated energy conversion systems
2. To provide an overview of Brayton and combined cycles powerplants.
3. List the principal components and types of nuclear reactors.
4. Explain the major types of hydro-power and define terms and factors associated with power plant economics and estimate the cost of producing power perkW.

COURSE OUTCOMES:

After Completion of the course, the students are able to

1. Describe the working and layout of coal based steam power plant with different systems
2. Describe the methods to improve the efficiency of Gas-Turbine Plant.
3. Describe the elements and their functions of nuclear power plants.
4. Describe the elements and their functions of steam, hydro, diesel, wind and solar power geothermal, biogas power plants and analyze economics of power plants.

COURSE CONTENT:

UNIT-1	CO1	12
Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, cooling towers and cooling ponds, fuel and ashhandling, draught system, binary cycles and cogeneration systems.		
UNIT-2	**CO2**	**12**
Gas turbine and combined cycle power plants, Brayton cycle analysis, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle(IGCC)systems.		
UNIT-3	**CO3**	**12**
Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, Nuclear Waste and its disposal.		
UNIT-4	**CO4**	**12**
Hydroelectric power plants, classification, typical layout and components, principles of wind, OTEC, solar PV and solar thermal, geothermal, biogas and fuel cell, MHD power systems. Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve,capital and operating cost of different power plants.		

LEARNING RESOURCES:

TEXT BOOK(S):

1. Er. R.K. Rajput, A Textbook of Power Plant Engineering, 5th Ed., Laxmi Publications (P) Ltd,2016.
2. Nag P.K., Power Plant Engineering, 4th ed., Tata McGraw Hill,2014.
3. Manoj Kumar Gupta, Power Plant Engineering, Phi Learning Pvt. Ltd.,2012.

REFERENCE BOOK(S):

1. El Wakil M.M., Power Plant Technology, Tata McGraw Hill,2010.
2. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.
3. R.K.Hegde, Power Plant Engineering, Pearson India Education Services Pvt. Ltd,2015.

WEB REFERENCE:

https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-me10/

MEEL11	ENERGY CONSERVATION AND MANAGEMENT	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES:

1. Able to understand the methods of managing auditingenergy.
2. Able to understand the methods of supply of electrical energy and methods of conservation of energy.
3. Able to understand the working principle of Thermal Systems and Thermal Energy Conservationmeasures.
4. Able to understand the conservation of energy in major utilities and EnergyEconomics.

COURSE OUTCOMES:

After completion of the course the students can be able to

1. Demonstrate the national energy scenario, environmental aspects associated with energy utilization and Energy auditing methods.
2. Describe the conservation methods in power transmission and utilization.
3. Compute thermal systems efficiency and energy conservation measures.
4. Demonstrate the conservation of energy in major utilities.

COURSE CONTENT:

UNIT-1	**CO1**	**12**
Introduction to energy & power scenario of world, National Energy consumption data, and environmental aspects associated with energy utilization; Energy Auditing- need, types, methodology and barriers, role of energy managers, instruments of energy auditing.		
UNIT-2	**CO2**	**12**
Components of EB billing, HT and LT supply, transformers, cable sizing; Concept of capacitors, power factor improvement, harmonics; Electric motors- motor efficiency computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting.		
UNIT-3	**CO3**	**12**
Thermal systems, Boilers, Furnaces and Thermic Fluid heaters- efficiency computation and energy conservation measures; Steam distribution and usage, steam traps, condensate recovery, flash steam utilization; Insulation & Refractories.		
UNIT-4	**CO4**	**12**
Energy conservation in major utilities; pumps, fans, blowers, compressed air systems, Refrigeration& Air Conditioning systems, Cooling Towers, DG sets.Energy Economics-discount period, payback period, internal rate of return, net present value; Life Cycle costing-ESCO concept.		

LEARNING RESOURCES:

TEXT BOOK(S):

1. Witte L.C. , Schmidt P.S. and Brown D.R., Industrial Energy

Management and Utilization, Hemisphere Publ., Washington,1988..
2. Murphy W.R. and McKay G., Energy Management, Butterworths, London,1987.

REFERENCE BOOK(S):

1. Callaghn P.W., Design and Management for Energy Conservation, PergamonPress, Oxford, 1981.
2. Energy Manager Training Manual , Bureau of Energy Efficiency (BEE) under Ministry of Power, GOI, 2004 (available at www.energymanagertraining.com).

WEB REFERENCE:

1. IIT Video Lectures (NPTEL)

MEEL12	AUTOMATION IN MANUFACTURING	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES

1. To understand the importance of automation in the of field machine tool basedmanufacturing
2. To get the knowledge of various elements of manufacturingautomation
3. To understand the basics of CAPP and FMS and the role of manufacturingautomation
4. To educate students to understand different advances in manufacturing system like: GT, CAPP and FMS
5. To educate students by covering robotics and different material handling system required in manufacturing shopfloor.
6. To educate students by covering different Integrated production managementsystem.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Identify the types, need, and implementation of Automation in Production systems
2. Identify various components and applications of Robot
3. Illustrate the features, interpolation schemes and functioning of CNC machines.
4. Develop manual and computer Assisted part.
5. Describe the concepts of GT CAPP and FMS

COURSE CONTENT:

UNIT-1	**CO1**	**12**
Automation : Automation in production systems – automated manufacturing systems, computerized manufacturing support systems, reasons for automating, merits and demerits, automation principles and strategies, manufacturing industries and products, manufacturing operations – processing and assembly operations, other factory operations. **Industrial Robotics :** Introduction, robot anatomy, joints and links, common robot and configurations,joint drive systems, robot control systems, end effectors, sensors in robotics, applications of robots – material handling, processing, assembly and inspection		
UNIT-2	**CO2**	**12**
Numerical Control: Introduction, basic components of an NC system, classifications of NC systems, nomenclature of NC machine axes, interpolation methods, features of CNC, the machine control unit for CNC, CNC software. direct numerical control, distributed numerical control, applications of NC,advantages and disadvantages of NC, adaptive control machining**.**		
UNIT-3	**CO3**	**12**
NC Part Programming: NC coding systems, manual part programming, simple examples on drilling,milling and turning operations computer assisted part programming, part programming with APT language, simple examples in drilling and milling operations.		
UNIT-4	**CO4**	**12**
Group Technology & Cellular Manufacturing : Introduction, part families, parts classification and coding, features of parts classification of coding system, OPITZ , MICLASS, Product Flow Analysis, composite part concept, machine cell design, applications **Computer Aided Process Planning:** Introduction, retrieval CAPP system, generative CAPP systems, benefits of CAPP. **Flexible Manufacturing Systems:** Introduction, types of FMS, components, FMS layout		

configurations, computer control system, human resources, applications and benefits. Introduction to Computer Integrated Manufacturing.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Automation, Production systems and Computer Integrated Manufacturing by M.P.Groover, Pearson Education /PHI.
2. Serope Kalpakjian and Steven R. Schmid, Manufacturing – Engineering and Technology,7th edition, Pearson
3. Yoram Koren, Computer control of manufacturing system, 1stedition

REFERENCE BOOK(s):

1. CAD/CAM by M.P.Groover and E.W.Zimmers, Pearson Education /PHI.
2. CAD/CAM by P.N.Rao,TMH

WEB RESOURCES:

1. http//ocw.mit.ac.in//
2. http//nptel.iitm.ac.in//

MEEL13	COMPOSITE MATERIALS	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES:

1. To introduce different types of composites and their applications.
2. To discuss various types of fabrication methods of polymer rcomposites.
3. To know about MMC's and their fabrication procedures.
4. To study about various types of Ceramic composites and their processing techniques.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Classify composites according to their reinforcement and matrix used.
2. Explain various fabrication techniques utilized for the production of fiber-reinforced polymer matrix composite materials.
3. Describe types of metal matrix composites and their processing methods.
4. Select suitable manufacturing technique for ceramic composites based on their intended applications.

COURSE CONTENT:

UNIT-1	**CO1**	**12**
INTRODUCTION TO COMPOSITES: Fundamentals Of Composites – Need For Composites – Enhancement Of Properties – Classification Of Composites – Matrix-Polymer Matrix Composites (PMC), Metal Matrix Composites (MMC), Ceramic Matrix Composites (CMC) – Reinforcement – Particle Reinforced Composites, Fibre Reinforced Composites. Applications Of Various Types Of Composites. Fiber Production Techniques For Glass, Carbon And Ceramic Fibers		
UNIT-2	**CO2**	**12**
Polymer Resins – Thermosetting Resins, Thermoplastic Resins – Reinforcement Fibres – Rovings – Woven Fabrics – Non Woven Random Mats – Various Types Of Fibres. PMC Processes – Hand Lay Up Processes – Spray Up Processes – Compression Moulding – Reinforced Reaction Injection Moulding – Resin Transfer Moulding – Pultrusion – Filament Winding – Injection Moulding. Fibre Reinforced Plastics (FRP), Glass Fibre Reinforced Plastics (GFRP). Laminates- Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates.-Applications Of PMC In Aerospace, Automotive Industries		
UNIT-3	**CO3**	**12**
Metal Matrix Composites: Characteristics Of MMC, Various Types Of Metal Matrix Composites Alloy Vs. MMC, Advantages Of MMC, Limitations Of MMC, Reinforcements – Particles – Fibres. Effect Of Reinforcement – Volume Fraction – Rule Of Mixtures. Processing Of MMC – Powder Metallurgy Process – Diffusion Bonding – Stir Casting – Squeeze Casting, A Spray Process, Liquid Infiltration In-Situ Reactions-Interface-Measurement Of Interface Properties- Applications Of MMC In Aerospace, Automotive Industries		
UNIT-4	**CO4**	**12**
Ceramic Matrix Composites and Special Composites: Engineering Ceramic Materials – Properties – Advantages – Limitations – Monolithic Ceramics – Need For CMC – Ceramic Matrix – Various Types Of Ceramic Matrix Composites- Oxide Ceramics – Non Oxide Ceramics –		

Aluminium Oxide – Silicon Nitride – Reinforcements – Particles- Fibres- Whiskers. Sintering – Hot Pressing – Cold Isostatic Pressing (CIPing) – Hot Isostatic Pressing (HIPing). Applications Of CMC In Aerospace, Automotive Industries Carbon /Carbon Composites – Advantages Of Carbon Matrix – Limitations Of Carbon Matrix Carbon Fibre – Chemical Vapour Deposition Of Carbon On Carbon Fibre Perform. Sol-Gel Technique- Processing Of Ceramic Matrix Composites

LEARNING RESOURCES:

TEXT BOOK(s):

1. Mathews F. L. And Rawlings R. D., "Composite Materials: Engineering And Science", 1st Edition, Chapman And Hall, London, England,1994.
2. Chawla K. K., "Composite Materials", Second Edition, Springer – Verlag,1998.

REFERENCE BOOK(s):

1. Clyne, T. W. And Withers, P. J., "Introduction To Metal Matrix Composites", Cambridge University Press,1993.
2. Strong, A.B., "Fundamentals Of Composite Manufacturing", SME,1989.
3. Sharma, S.C., "Composite Materials", Narosa Publications,2000.
4. Broutman, L.J. And Krock,R.M., " Modern Composite Materials", Addison-Wesley,1967.
5. ASM Hand Book, " Composites", Vol.21, ASM International,2001

WEB RESOURCES:

2. http://emtoolbox.nist.gov
3. CambridgeViscosity.com/Viscometer
4. www.e.FlukeCal.com/Calibration
5. www.inscotemperature.com/

MEEL14	ADVANCED METAL CASTING	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES:

1. To enable the student to understand the concept Solid modeling of castings: casting features, modeling techniques,defects.
2. To enable the student to understand the design of various components incasting.
3. To enable the student to gain knowledge in gating design and analysis.
4. To enable students to obtain knowledge on casting process planning and costestimation.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Summarize various modeling of castings.
2. Design of casting components like Pattern, mould, core and feeder.
3. Design of Gating system and channel layout.
4. Implement of economic and castability analysis.

COURSE CONTENT:

UNIT-1	**CO1**	**12**
Metal casting-overview: Applications and production, historical perspective, casting processes. Solid modeling of castings: casting features, modeling techniques, graphical user interface, model representation model exchange formats, model verification.		
UNIT-2	**CO2**	**10**
Pattern, mould and core design: Orientation and parting, mould parting analysis, pattern design, cored features, core print design and analysis, mould cavity layout. **Feeder design and analysis:** Casting solidification, solidification time and rate, feeder location and shape, feeder and neck design, feed aid design, solidification analysis, vector element method.		
UNIT-3	**CO3**	**12**
Gating design and analysis: Mould filling, gating system and types, gating channel layout, optimal filling time, gating element design, mould filling analysis, numerical simulation.		
UNIT-4	**CO4**	**12**
Process planning and costing: Casting process selection, process steps and parameters, tooling cost estimation, material cost estimation, and conversion cost estimation. **Design for castability:** Product design for castability, process friendly design, and castability analysis		

LEARNING RESOURCES:

TEXT BOOK(S):

1. B.Ravi, "Metal casting: CAD and Analysis", PH Publication, 2014

REFERENCE BOOK(S):

1. P.L.Jain, "Principles of Foundry Technology",2012.
2. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2010.

MEEL15	SAFETY IN ENGINEERING INDUSTRY	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES:

1. To know the safety rules and regulations, standards andcodes
2. To study various mechanical machines and their safetyimportance
3. To understand the principles of machine guarding and operation of protectivedevices.
4. To know the working principle of mechanical engineering processes such as metal forming and joining process and their safetyrisks.
5. Developing the knowledge related to health and welfare measures in engineeringindustry**.**

COURSE OUTCOMES:

At the end of the course the students should be able to:

1. Acquire Knowledge in safety rules, standards and codes in various mechanical engineering processes
2. Describe machine guarding systems for various machines such as lathe, drilling, boring, milling etc.,
3. Implement the safety concepts in welding, gas cutting, storage and handling of gas cylinders etc.,
4. Acquire knowledge in testing and inspection as per rules in boilers, heat treatment operations etc.,
5. Use preventive measures in health and welfare of workers' aspects in engineering industry.

COURSE CONTENT:

UNIT-1	CO1	15
Safety in Metal Working Machinery: General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines, **Safety in Wood Working Machines:** Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards		
UNIT-2	**CO2**	**10**
PRINCIPLES OF MACHINE GUARDING: Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing-guard construction- guard opening. **Selection and suitability:** lathe-drilling-boring-milling-grinding-shaping-sawing-shearing-presses-forge hammer-flywheels-shafts-couplings-gears-sprockets wheels and chains-pulleys and belts-authorized entry to hazardous installations-benefits of good guarding systems		
UNIT-3	**CO3**	**12**

SAFETY IN WELDING AND GAS CUTTING: Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases-colour coding – flashback arrestor –leak detection-pipe line safety- storage and handling of gas cylinders		
UNIT-4	**CO4, CO5**	**12**
SAFETY IN FINISHING, INSPECTION AND TESTING: Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation. Health and welfare measures in engineering industry-pollution control in engineering industry, industrial waste disposal.		

LEARNING RESOURCES:

TEXT BOOK(S):

1. "Safety in Industry" N.V. Krishnan Jaico Publishery House,1996.
2. "Safety Management by John V. Grimaldi and Rollin H. Simonds, All India Travelers Book seller, New Delhi, 1989.

REFERENCE BOOK(S):

1. "Accident Prevention Manual" – NSC, Chicago,1982.
2. "Occupational safety Manual" BHEL, Trichy,1988.
3. Indian Boiler acts and Regulations, Government ofIndia.
4. Safety in the use of wood working machines, HMSO, UK1992.
5. Health and Safety in welding and Allied processes, welding Institute, UK, High-tech. Publishing Ltd., London,1989.

MEEL16	MAINTENANCE ENGINEERING	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES:

1. To enable the student to understand the principles, functions and practices adapted in industry for the successful management of maintenanceactivities.
2. To explain the different maintenance categories like Preventive maintenance, condition monitoring and repair of machineelements.
3. To illustrate some of the simple instruments used for condition monitoring inindustry.

COURSE OUTCOMES:

At the end of the course the students should be able to:

1. Implement the maintenance function and different practices in industries.
2. Identify different maintenance categories and schedules.
3. Obtain knowledge on condition monitoring, methods and instrument
4. Implement repair methods of machine elements.

COURSE CONTENT:

UNIT-1	**CO1**	**15**
Principles and practices of maintenance planning: Introduction, definition, purpose, principle objectives and problems in maintenance. Basic principles of maintenance planning, objectives and principles of planned maintenance activity, Importance and benefits of sound Maintenance systems, Maintenance organization – objectives, design, basic types. Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability		
UNIT-2	**CO2**	**10**
MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE: Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repaircycle - Principles and methods of lubrication – TPM.		
UNIT-3	**CO3**	**12**
CONDITION MONITORING: Condition Monitoring – Cost comparison with and without CM– On-load testing and offload testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis.		
UNIT-4	**CO4**	**12**
REPAIR METHODS FOR BASIC MACHINE ELEMENTS: Repair methods for beds, slide ways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential faultlocation. **REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT:** Repair methods forMaterial handling equipment - Equipment records –Job order systems -Use of computers in maintenance.		

LEARNING RESOURCES:

1. R.C. Mishra, K. Pathak, Maintenance Engineering and Management, PHI Learning.
2. V.Venkataraman, Maintenance Engineering and Management, PHI Learning.

TEXT BOOK(S):

1. Srivastava S.K., “Industrial Maintenance Management”, S. Chand and Co.,1981
2. Venkataraman .K “Maintancence Engineering and Management”, PHI Learning, Pvt. Ltd.,

REFERENCE BOOK(S):

1. Bhattacharya S.N., “Installation, Servicing and Maintenance”, S. Chand and Co.,1995
2. White E.N., “Maintenance Planning”, I Documentation, Gower Press,1979.
3. Garg M.R., “Industrial Maintenance”, S. Chand & Co.,1986.
4. Higgins L.R., “Maintenance Engineering Hand book”, 5th Edition, McGraw Hill,1988.
5. Armstrong, “Condition Monitoring”, BSIRSA,1988.
6. Davies, “Handbook of Condition Monitoring”, Chapman & Hall,1996.
7. “Advances in Plant Engineering and Management”, Seminar Proceedings - IIPE,1996.

MEEL17	PRODUCT LIFE CYCLE MANAGEMENT	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES:

1. To know the fundamental concepts of PLM
2. To study the importance of Product Data Management and Tools of communication.
3. To gain the knowledge on optimization of design products
4. To create an awareness on digital manufacturing

COURSE OUTCOMES:

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

1. Explain the importance and need of various components/elements of PLM.
2. Demonstrate the benefits of PLM implementation/deployment.
3. Distinguish various task terminologies used in the domain of PLM.
4. Apply various strategies for process and product data management

COURSE CONTENT:

UNIT-1	CO1	12
Introduction: Overview, Need, Benefits, Concept of Product Life Cycle, Components /Elements of PLM, Emergence and Significance of PLM, PLM implementation cases in various Industry verticals.		
UNIT-2	**CO2**	**12**
PLM Strategy and Vision: Company's PLM vision, PLM Strategy, Principles for PLM Strategy, Preparing for the PLM strategy, Developing a PLM strategy, Strategy identification and selection, PLM business goals.		
UNIT-3	**CO3**	**12**
Information, Tools, Information systems and people involved in PLM. Product data and processes like New Product Development, Change Management, Concurrent Design & Process Management, product data linkages across the domain.		
UNIT-4	**CO4**	**12**
PLM Solutions: Different phases of product lifecycle and corresponding technologies,Enterprise information, knowledge and IP, Change Process, Product Structure & Configuration, Bill of Material, Requirement, Portfolio, Program & Project, Engineering Process, Supplier Relationship, Manufacturing Process, Maintenance Repair & Overhaul process and Simulation Process Management.		

LEARNING RESOURCES:

TEXT BOOK(S):

1. Jaya Krishna S, Product Lifecycle Management: Concepts and cases, ICFAI Publications2011.
2. SOA approach to Enterprise Integration for Product Lifecycle, IBM Red books,2011.

3. 3.Grieves, Michael. “Product Lifecycle Management”, McGraw-Hill,2006.

REFERENCE BOOK(S):

1. Antti Saaksvuori and Anselmi Immonen, “Product Lifecycle Management”, Springer Publisher, 2008 (3rdEdition).
2. International Journal of Product Lifecycle Management, Inder science Publishers
3. Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist, “Implementing and Integrating Product Data Management and Software Configuration Management”, Artech House Publishers, 2003.
4. John Stark, “Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question”, Springer Publisher,2007.
5. John Stark, “Product Lifecycle Management: 21st Century Paradigm for Product Realisation”, Springer Publisher, 2011 (2nd Edition).
6. Michael Grieves, “Product Life Cycle Management”, Tata McGraw Hill, 2006. ED5075 DESIGN FOR INTERNET OFTHINGS

WEB REFERENCE:

I. http://nptel.ac.in/courses/110101005/downloads/Lecture%2039.pdf
II. http://www.product-lifecycle-management.info/what-is-plm/PLM-ROI.html
III. http://www.iped-uk.com/Product_Life_Cycle_Management.pdf
IV. http://www.sap.com/bin/sapcom/cs_cz/downloadasset.2011-07-jul-06-07.product-lifecyclemanagement-bringing-sustainable-products-to-market-faster-pdf.html

MEEL18	INDUSTRIAL MANAGEMENT	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES:

1. Outline the historical evolution of management theories.
2. Explain how decisions are made within an organization and how those decisions are communicated to the various stake holders.
3. Relate the basic concepts of planning: the importance of planning, strategic planning, and the types of objectives and plans developed by organizations.
4. Describe the directing and control process including: the importance of control, tools for measuring organizational performance, and managerial actions.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Demonstrate the roles, skills, and functions of management.
2. Describe the various forms of structure available to an organization.
3. Outline key terms, theories/concepts, and practices within the field of HRM
4. Differentiate the concepts of directing and controlling

COURSE CONTENT:

UNIT-1	**CO1**	**12**
Introduction to Management: Definition of management, science or art, manager vs entrepreneur; Types of managers, managerial roles and skills; Evolution of management-scientific, human relations, system and contingency approaches; Current trends and issues in management. Managing for competitive advantage - the Challenges of Management.		
UNIT-2	**CO2**	**12**
Organization: Nature and purpose of Organizing, formal and informal organization, Organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization. Types of Business Organizations: sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment.		
UNIT-3	**CO3**	**12**
Planning: Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps, job design, human resource management, HR planning, Recruitment, selection, Training, Development, Performance Management, Career planning and Management		
UNIT-4	**CO4**	**12**
Directing and Controlling: leadership, types, theories of leadership, Directing, individual and group behaviour, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, effective communication. Controlling- system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.		

LEARNING RESOURCES:

TEXT BOOK(S):

1. Robins S.P. and Coulter. M., Management, Prentice Hall India, 10th ed.,2009.
2. Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education,2004.
3. Tripathy P.C ; Reddy P.N, Principles of Management, Tata McGraw Hill,1999.

MEEL19	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES:

1. Gain knowledge in fundamental concepts of process planning.
2. Understand process planning activities.
3. To know the components in cost estimation.
4. Develop the skills to estimate the machining time and production costs.

COURSE OUTCOMES:

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

1. Describe process planning.
2. Interpret process planning activities.
3. Differentiate various elements of cost and solve basic problems.
4. Estimate the machining time and production costs.

COURSE CONTENT:

UNIT-1	**CO1**	**12**
Introduction of Process Planning- methods of process planning, drawing interpretation, material evaluation, steps in process selection, production equipment and tooling selection.		
UNIT-2	**CO2**	**12**
Process planning activities- process parameter calculation for various production processes, selection of jigs and fixtures, selection of quality assurance methods, documents for process planning, economics of process planning, case studies.		
UNIT-3	**CO3**	**12**
Introduction to cost estimation- importance of costing and estimation, methods of costing, elements of cost estimation, types of estimates, estimating procedure, estimation of labor cost, material cost, allocation of overhead charges, calculation of depreciation cost, break even analysis and related problems.		
UNIT-4	**CO4**	**12**
Machining time estimation- importance of machine time calculation, machining time for different lathe operations, drilling and boring time calculations, Machining time calculation for Milling, Shaping, Planing and Grinding Production costs- different production processes for different jobs, estimation of forging cost, estimation of welding cost, estimation of foundry cost, estimation of machining cost.		

LEARNING RESOURCES:

TEXT BOOK(S):

1. Peter Scalon, Process Planning, Design/ Manufacture Interface, Elsevier Sci.&Tech.2002.
2. Ostwaal P.F. and Munez J., Manufacturing Processes and Systems, 9th ed., John Wiley 1998.
3. Chitale A.V. and Gupta R.C., Product Design and Manufacturing, 2nd ed., PrenticeHall 2002

REFERENCE BOOK(S):

1. Russell R.S and Tailor B.W, “Operations Management”, 4th Edition, PHI,2003.
2. Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, 2nd Edition, PHI, 2002
3. Adithan.M.,”Process planning and Cost estimation”, New Age International (P)Ltd.,2007
4. T.R.Banga and S.C.Sharma, Estimations and Costing, KhannaPublishers,1988.
5. G.B.S.Narang and V.Kumar, Production and Costing, Khanna Publishers,1995.

WEB REFERENCE:

1.https://books.google.com/books?id=A9-ZXblNrPoC

MEEL20	TOTAL QUALITY MANAGEMENT	L	T	P	C	Int	Ext
		3	0	-	3	30	70
	PROFESSIONAL ELECTIVE						

COURSE OBJECTIVES:

1. To understand the concept of Quality
2. To understand the Implication of Quality on Business
3. To Implement Quality Improvement Programs
4. Exposure to challenges in Quality Improvement Programs

COURSE OUTCOMES:

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

1. Explain the significance of Total quality management
2. Summarize continuous process improvement in relation to customers
3. Describe various quality improvement tools
4. Identify requirements of quality improvement programs

COURSE CONTENT:

UNIT-1	**CO1**	**12**
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality. Basic concepts of TQM - Definition of TQM – TQM Framework -Contributions of Deming, Juran and Crosby – Barriers to TQM		
UNIT-2	**CO2**	**12**
TQM PRINCIPLES- Leadership – Strategic quality planning, Quality statements - Customer focus–Customer orientation, Customer satisfaction, Customer complaints, Customer retention -Employee involvement– Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal. Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering ,Supplier selection, Supplier Rating.		
UNIT-3	**CO3**	**12**
The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT. Bench marking– Reason to bench mark, Benchmarking process – FMEA – Stages, Types		
UNIT-4	**CO4**	**12**
Quality circles – Quality Function Deployment (QFD) – the voice of the customer, house of quality, QFD process. TPM Concepts, improvement needs – Cost of Quality – Taguchi quality loss function -Performance measures. Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS9000 – ISO 14000 – Concepts, Requirements and Benefits Case studies of TQM, Implementation in manufacturing and service sectors including IT		

LEARNING RESOURCES:

TEXT BOOK(S):

1. Dale H.Besterfiled, at., “Total Quality Management”, Pearson Education Asia, Third Edition, Indian Reprint(2006).

REFERENCE BOOK(S):

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, 6th Edition, South-Western (Thomson Learning),2005.
2. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, 3 rd Edition, 2003.
3. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd.,2006.
4. Janakiraman,B and Gopal, R.K, “Total Quality Management – Text and Cases”, Prentice Hall (India)Pvt.
5. Girish Pathak , ”Total Quality Management- Macmillan publishers IndiaLtd.