

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 design process.
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. Design a part or assembly of parts using computer aided design software.
2. Implement parametric modelling techniques to reflect engineering requirements.
3. Familiarize with top-down design principles to model a product.
4. Gain knowledge in 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 McGraw hill ,Delhi
3. CAD/CAM by Ibrahim Zeid, Tata McGraw hill, Delhi.
4. Principles of Interactive Computer Graphics by Newman and Sproull, McGraw hill.

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. Understand the concept of FEM & formulate and solve 1D axially loaded members.
2. Derive elements stiffness matrices for truss and beam elements, formulate and solve problems related to trusses and beams.
3. 2D structural problems using CST element, analyse the axi-symmetric problems with triangular elements, formulate and solve 1D heat transfer problems.
4. Apply numerical integration to solve 1D, 2D stiffness integrations and evaluate the Eigenvalues & Eigenvectors for stepped 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	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

CO4

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, Chandruputla, 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 engineering design.
2. Study of means of measuring various physical variables and to understand the concepts of signal conditioning
3. Study of different types of actuators and to study pneumatics & hydraulic system and its components
4. To study PLC system and to design mechatronics models.

COURSE OUTCOMES:

1. After successful completion of the course, the students are able to be able to model and analyse electrical and mechanical systems
2. Have complete understanding of data acquisition and PLC programming.
3. Understand different types of sensors and actuators and their implementation.
4. Understanding the concepts of design of Mechatronics system through case studies

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 these systems. 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 programming- 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. Devdas shetty, 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, New Delhi, 1998
2. A Textbook of Mechatronics, R.K. Rajput, S. Chand & Company Private Limited
3. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall

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 hydraulic systems
3. To know the variety of industrial circuits
4. To understand the common methods of designing logic circuits

COURSE OUTCOMES:

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

1. To recognize various elements of hydraulic systems. To have good knowledge on working principles of various pumps and actuators
2. To use various control elements of hydraulic systems.
3. To design various logic circuits
4. To adapt 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 synchronizing circuits-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 Esposito, "Fluid power with Applications", Prentice Hall, 1980
2. Dudley 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/mmrzzaque/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 in industry.
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 on robot the 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 by robot.

COURSE OUTCOMES:

1. Students will be familiarized in basic components of robotics, classification of robots and their applications.
2. They will have knowledge on types of robot grippers, their usage and design considerations.
3. They attain knowledge on various types of sensory devices their working and applications.
4. Students will apply basic transformations related to the movement of manipulator and able to 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 Comparison of 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	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, and C.S. G. Lee, Tata McGraw-Hill, NY, 2008.
3. Introduction to Robotics: Analysis, Systems, Applications, Saeed B. Niku, Prentice Hall, NJ, 2010.

WEB REFERENCE:

1. <http://nptel.iitm.ac.in/courses.php?branch=Mechanical>
2. <http://academicearth.org/courses/introduction-to-robotics> Video 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 IC engines
2. To know the fuel supply systems and combustion processes understand combustion and various parameters and variables affecting it in various types of IC engines.
3. To make the student about the working of Reciprocating and Rotary Compressors
4. To make the student about various types of Gas turbines their working principles and basic principles of Jet and Rocket propulsion systems.

COURSE OUTCOMES:

1. The students are expected to understand the various components, principle of operation, working of different types of I.C engines.
2. Able to know the variables affecting the performance of IC engines and methods to improve the performance.
3. Able to understand the Working of different types of compressors.
4. Able to know the working principles of Gas turbines and methods to improve the performance of the plant and also various jet propulsion systems.

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 stroke engines. 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-stage compressor. 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, Centrifugal compressor 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 and regeneration.

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, 3rd Edition
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 Delhi 2010.
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/>
- SAE journals.

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 vapor compression
2. Refrigeration cycle, analysis and methods for improving performance.
3. To know the operation of vapor absorption system.
4. To know the various components of refrigeration system and their working principles.
5. To design air conditioning systems by cooling load calculations. To know the various applications of refrigeration and air conditioning systems.

COURSE OUTCOMES:

1. The students will get the knowledge about the principle of refrigeration, different Methods of refrigeration.
2. Able to know the various components of refrigeration system and their working Principles.
3. Able to understand what is meant by air conditioning and various psychrometric Properties and processes and know the usage of Psychrometric chart.
4. Know how to provide required environment to suit various needs of day to day Requirements like comfort air conditioning, water cooling, and storage of perishable Food etc., and enable them to do simple design calculations and analysis of these Systems.

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 NH ₃ - water system, Li - Br- H ₂ O system, principle of operation of three fluid absorption system and salient features. 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 RSHP, GSHP, ERSHP & 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 Supply Systems.
2. The student acquires sufficient knowledge to Cooling Methods, Lubrication Methods, Ignition Systems, Starting systems, Generating Systems.
3. Acquisition of sufficient knowledge to Clutch, Power train Systems and working of Suspension and braking methods.
4. The students acquires sufficient knowledge about emissions and its control and also Latest trends in IC engines

COURSE OUTCOMES:

1. Identify the components of an automobile and analyze the working of each of the components.
2. Able to understand the Cooling Methods, Lubrication Methods, Ignition systems.
3. Able to understand the components of a transmission systems and braking methods.
4. The students are expected to understand the emissions and its control and also the Latest trends in IC engines.

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 methods 3-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 modification needed.

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:

1. Able to describe functions of various external and internal components of an airplane.
2. Able to classify the various forces and moments acting on an airfoil.
3. Able to describe the working principles of various aircraft engines systems
4. Able to describe the stability and control aspect of air planes and describe the basic aspects of space flight.

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, Classification of NACA Airfoils, Wing Geometry, Aerodynamic Forces, 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 stability.

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, Pearson Education,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 power plants.
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 per kW.

COURSE OUTCOMES:

1. Identify elements and their functions of steam, hydro, diesel, nuclear, wind and solar power plants.
2. Able to Analyse and improve the efficiency of Advanced Gas-Turbine Plant.
3. Analyze economics of power plants and list factors affecting the power plants. Determine performance of power plants based on load variations.
4. Upon completion of this course, the students can able to understand different types of power plant, and its functions and their flow lines and issues related to them.

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 ash handling, 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 auditing energy.
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 Conservation measures.
4. Able to understand the conservation of energy in major utilities and Energy Economics.

COURSE OUTCOMES:

1. Students can able to assess the national energy scenario and environmental aspects associated with energy utilization
2. Students can able to analyse the conservation methods in power transmission and utilization.
3. Students can able to analyse the thermal systems efficiency computation and energy conservation measures.
4. Students can able to analyse 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, Pergamon Press, 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 based manufacturing
2. To get the knowledge of various elements of manufacturing automation
3. To understand the basics of CAPP and FMS and the role of manufacturing automation
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 shop floor.
6. To educate students by covering different Integrated production management system.

COURSE OUTCOMES:

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

1. Get a comprehensive picture of computer based automation of manufacturing operations. Able to understand the function of robots in industrial ppplication
2. Understand the working of NC,CNC and adaptive control machining
3. To write manual and computer assisted part programmes.
4. Understand 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, 1st edition

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 composites.
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. Know various types of composite materials and their practical importance.
2. gain knowledge on different fabrication processes of polymer composites
3. Familiarize on different reinforcements and their mixing processes in metal matrix composites.
4. Understand various types of CMC's and their fabrication procedures and 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 in casting.
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 cost estimation.

COURSE OUTCOMES:

1. Recommend remedies for the defects in castings.
2. Model components for castings using CAD tools.
3. Design gating system for metal casting processes
4. Perform economic and castability analysis using Auto-CAST software.

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, optimization and validation.		
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, optimization and validation		
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. Kalpak jian. 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 and codes
2. To study various mechanical machines and their safety importance
3. To understand the principles of machine guarding and operation of protective devices.
4. To know the working principle of mechanical engineering processes such as metal forming and joining process and their safety risks.
5. Developing the knowledge related to health and welfare measures in engineering industry.

COURSE OUTCOMES:

1. Knowledge in safety rules, standards and codes in various mechanical engineering processes
2. Able to design 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. Knowledge in testing and inspection as per rules in boilers, heat treatment operations etc., and can take 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, resistance 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 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 of India.
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 maintenance activities.
2. To explain the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.
3. To illustrate some of the simple instruments used for condition monitoring in industry.

COURSE OUTCOMES:

1. To implement the maintenance function and different practices in industries.
2. To identify different maintenance categories and schedules.
3. To gain knowledge on condition monitoring, methods and instrument
4. To 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, repair cycle - 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 fault location. REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT: Repair methods for Material 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 “Maintance 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. Understand product data, information, structures and PLM concepts.
2. Apply PLM systems in organization verticals including production, after sales, sales and marketing, and sub contracting.
3. Relate optimization theories for the design of products.
4. Apply PLM concepts for service industry and E-Business.

COURSE CONTENT:

UNIT-1	CO1	12
Fundamentals of PLM: Product data or Product information, Product lifecycle management concept, Information models and product structures-Information model, The product information (data) model, The product model, Reasons for the deployment of PLM systems. Product Structures: Standardized product data and materials data model, Product structure of a ship, Product structure of a customizable product, Product structure of a configurable service product.		
UNIT-2	CO2	12
Enterprise solution with PLM: Use of product lifecycle management systems in different organization verticals, Product development and engineering, Impact of Manufacturing with PLM Challenges of product management in the engineering and manufacturing industry, Life cycle thinking, value added services and after sales, Case 1: Electronics manufacturer, Case 2: An engineering product. PLM service information model: Categorizing services , Rational for building service products, How to make a service more like a tangible product?, Making items out of product functions, PLM challenges in service business, An IT-service provider and a customer-specifically variable product.		
UNIT-3	CO3	12
Knowledge And Optimization Of Design Products: Know how, best practices, parameterization of design, Applied problems and Solution on optimization of products using power copy, publication, parameters, formula, rule, check, design table, configuration, reaction.		
UNIT-4	CO4	12
PLM for e-manufacturing: electronic business and PLM, Preconditions for electric business from the view point of the individual company, Significance of product management, collaboration and electronic business for the manufacturing industry. PLM applications in process and product industries examples: Case 1: Electronics manufacturer, Case 2: An engineering product, Case 3: Capital goods manufacturer and customer-specifically variable product, Case 4: An IT-service provider and a customer-specifically variable product.		

LEARNING RESOURCES:**TEXT BOOK(S):**

1. Jaya Krishna S, Product Lifecycle Management: Concepts and cases, ICFAI Publications 2011.
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 (3rd Edition).
2. International Journal of Product Lifecycle Management, Inder science Publishers
3. Ivica Crnkovic, Ulf Askund 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 OF THINGS

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. State the purpose of planning and understand the complexities associated with management of human resources in the organizations.
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:

1. Apply the principles of quality control.
2. Realize the importance of significance of quality.
3. Manage quality improvement teams
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 – PDCA 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.Besterfield, 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.