Course Syllabi
Department of Mechanical Engineering

MEL101 ENGINEERING DRAWING (3-0-2-4)
Pre-requisite: NIL
Contents:
Scales-concept of representative fraction, importance of scales, Orhographic projections, Projections of points, Projections of Straight lines and practical applications, Projections of planes, Projections of solids(right and regular prisms, pyramids ,cones and cylinders), Auxiliary Views of Planes and Solids, Sections of solids, Development of surfaces of solids, Isometric projections.
Practical: Practicals as per course contents.
Text Book:
1. Bhatt, N.D, Engineering Drawing: Plane and Solid Geometry, 51st ed., Charotar Publishing House Pvt. Ltd., 2012.
Additional Books:
1. Luzadder, W. J. and Duff, J. M., Fundamentals of Engineering Drawing: With an Introduction to Interactive Computer Graphics for Design and Production, 11th ed., Prentice Hall of India, 2012.
2. Narayana, K.L. and Kannaiah, P., Text Book on Engineering Drawing: Engineering Graphics, 2nd ed., SciTech Publications, 2010.
3. Gill, P.S., A Text Book of Engineering Drawing: Geometrical Drawing, 11th ed., S.K. Kataria & Sons, 2009.
4. Agrawal, B. and Agrawal, C.M., Engineering Drawing, 7th ed., Tawala McGraw Hill Education, 2011.
5. 5. Shah, M.B. and Rana, B.C., Engineering Drawing, 2nd ed., Pearson Education, 2012.
6. Jolhe, D.A., Engineering Drawing: With an Introduction to AutoCAD, Tata McGraw Hill Education, 2011.

MEL201 MECHANICAL BEHAVIOUR OF MATERIALS (3-0-0-3)
Pre-requisite: NIL
Contents:
Structures of materials – crystal structure, substructure, microstructure, etc. Phase diagram and phase transformation. Diffusion phenomenon.Mechanical behavior – strength, hardness, deformation creep, fatigue, etc.Mechanisms of strengthening and toughening of materials. Metallic alloys, Ceramics, Polymeric and Composite materials. Non-destructive testing.Standard numbering system including BIS designations of materials.
Text Book:
1. Raghavan, V, Materials Science and Engineering: A First Course, 5th ed., Prentice Hall of India, 2012.
Additional Books:
1. Avner, S.H., Introduction to Physical Metallurgy, 2nd ed., Tata McGraw Hill Education, 2012
2. Dieter, G.E. and Bacon, D., Mechanical Metallurgy, Tata McGraw Hill, 2001.
3. Lakhtin, Y.M., Engineering Physical Metallurgy and Heat-treatment, 6th ed., CBS Publishers, 1998
4. Rollason E.C., Metallurgy for Engineers, 4th e.d., Edward ArnoldPublications, 1982

MEL202 ENGINEERING THERMODYNAMICS (3-2-0-4)
Pre-requisite: NIL
Contents:
Introduction to Basic concept of thermodynamics; Types of systems, State of system and Thermodynamic equilibrium. Properties of system and Forms of Energy. Heat and thermodynamic work. Properties of Ideal gas, equation of state, Difference between gas and vapour, internal energy and specific heats of gases, Universal Gas constant. Zeroth law of thermodynamics. First Law of thermodynamics, as applied to a cycle, flow and nonflow system, change in internal energy, heat transferred and work transferred during various thermodynamic processes, P-V diagrams. The applications of steady flow processes like Nozzles / Diffuser, Turbines / Compressor, Throttle valve. Unsteady flow processes like Charging& Discharging of tank. Second law of Thermodynamics.Kelvin-Plank & Clausius Statement. Heat engine, Refrigerator and Heat pump, Reversible and Irreversible processes. Carnot cycle, Thermodynamic temperature scale. Entropy, Clausius inequality, Entropy Principle, Change in entropy for Closed and steady flow open systems. Availability, Reversible work and Irreversibility. Properties of pure system and use of Steam Tables for unsaturated steam, superheated steam, Mollier charts. Critical state, Sensible heat, Latent heat, Super Heat, Wet Steam, Dryness fraction, Internal energy of steam External work done during evaporation, P-V, T-S diagram and H-S diagram. Determination of dryness fraction using various calorimeters.Work and heat transfer during various thermodynamic processes with steam as working fluid. Air standard cycles such as Otto, Diesel, Stirling ,

Text Book:
1. Cengel, Y.A. and Boles M.A., Thermodynamics: An Engineering Approach, 7th ed., McGraw Hill, 2013.
Additional Books:
1. Moran M.J. and Shapiro H.N., Fundamentals of Engineering Thermodynamics, 6thed, Wiley-India, 2012.
2. Eastop, T.D. and McConkey, A., Applied Thermodynamics: For Engineering Technologists, 5th ed., Pearson Education, 2013.
3. Nag, P.K., Engineering Thermodynamics, 4th ed., Tata McGraw Hill Education, 2012.
4. 4. Holman, J.P., Thermodynamics, 4th ed., Mc-Graw Hill, 1988.
5. 5. Joel, R., Basic Engineering Thermodynamics, 5th ed., Pearson Education, 2014.
6. Arora, C.P., Thermodynamics, Tata McGraw Hill Education,2011.
7. Wylen, G.J.V., Fundamentals of Classical Thermodynamics, 4th ed.,Wiley, 1994.
8. Borgnakke, C. and Sonntag, R.E., Fundamentals of Thermodynamics, 7thed., Wiley India, 2011.

MEL203 FLUID MECHANICS (3-0-2-4)
Pre-requisite: NIL
Contents:
Introduction, fluid properties, classification, fluid statics, rigid body motions, kinematics of fluid motions, Reynolds transport theorem, mass, momentum and energy laws with applications, governing equations for Newtonian fluids, exact solutions, laminar and turbulent pipe flow.Introduction to boundary layer theory, Dimensional analysis and modeling, open channel flow.
Practical: Practicals as per course contents.
Text Books:
1. White, F.M., Fluid Mechanics, 7th ed., Tata McGraw Hill Education, 2013.
2. Cengel, Y.A. and Cimbala, J.M., Fluid Mechanics: Fundamentals and Applications, 2nd ed., Tata McGraw Hill Education, 2013.
Additional Books:
1. Streeter, V.L., Wylie E.B. and Bedford, K.W., Fluid Mechanics, 9th ed., Tata McGraw Hill Education, 2011.
2. Som, S.K., Biswas, G. and Chakraborty, S., Introduction to Fluid Mechanicsand Fluid Machines, 3rd ed., Tata McGraw Hill Education, 2011.
3. Kundu, P.K., Cohen, I.M. and Dowling, D.R., Fluid Mechanics, 5th ed., Elsevier, 2012.
4. Muralidhar, K. and Biswas, G., Advanced Engineering Fluid Mechanics, 2nd ed., Narosa Publishing House, 2006.
5. Gupta, V. and Gupta, S.K., Fluid Mechanics and its Applications, 2nd ed., New Age International Limited Publishers, 2011.
6. Bansal, R.K., A Textbook of Fluid Mechanics and Hydraulic Machines, 9th ed., Laxmi Publication, 2014.
7. Fox, R.W., Pritchard, P.J. and Mcdonald, A.T., Introduction to FluidMechanics, 7th ed., Wiley India, 2012.
8. Munson, B.R. and et. al., Fundamentals of Fluid Mechanics, 6th ed., Wiley India, 2012.

MEL204 SOLID MECHANICS (3-0-2-4)
Pre-requisite: NIL
Contents:
Introduction, Definition of stress, Equations of equilibrium, Principal stress, Maximum shear stress, Plane stress, Concept of strain, Strain displacement relations, Principal strains, Plane strain, Constitutive relations, Uniaxial tension test, Idealized stress-strain diagram, Isotropic linear elastic, viscoelastic and plastic materials, Uniaxial deformations, Thermal stresses, Torsion of shafts, Bending and shear of beams, Energy methods, Fracture, Deflection, Stability.
Mechanical Engineering Design vis-à-vis Solid Mechanics, factor of safety, standards and design equations.Selection of materials and processes.Application of theories of failure to design. Design procedure and its application to static strength.
Design of thin and thick pressure vessels and pipes. Design of shrink fit.
Practical: Practicals as per course contents.
Text Books:
1. Gere, J.M. and Timoshenko, S.P., Mechanics of Materials, 3rd ed., CBS Publishers, 2012
2. Beer, F.P. and Others, Mechanics of Materials, 6th ed., Tata McGraw Hill Education, 2013
Additional Books:
1. Shames, I.H. and Pitarresi, J.M., Introduction to Solid Mechanics, 3rd ed., Prentice Hall India, 2013
2. Popov, E.P., Engineering Mechanics of Solids, 2nd ed., Prentice Hall India, 2012.

3. Budynas, R.G. and Nisbett, J.K.,Shigley's Mechanical Engineering Design, 9th ed., Tata McGraw Hill Education, 2011

MEL205 KINEMATICS OF MACHINES (3-2-0-4)

Pre-requisite: NIL

Contents:

Basic concept of mechanisms, links, kinematic pairs, kinematic chain, mechanisms, machine, Types of mechanisms, Degree of freedom of link and planer mechanism, Classification of four-bar chain (Class I and Class II) Inversion of four bar chain, Slider crank chain and double slider crank chain. Velocity, acceleration analysis of planer mechanism by graphical method using relative velocity/ acceleration.Concept of velocity and acceleration image, Coriollis component of acceleration, Instantaneous centre of velocity method.Synthesis of four-bar/ slider crank mechanism for gross motion. Input/ Output coordination and quick return ratio. Transmission angle.Types of cams, follower and applications.Synthesis of cam for different types of follower motion like constant velocity, parabolic SHM, cycloidal etc.Construction of eccentric cam, tangent cam and circular arc cam.Analysis of follower motion for cams with specified contours like eccentric cam, tangent cam and circular arc cam.Belt Drive: Ratio of belt tension, initial tension for flat and V belts. Power Screw: Theory of Friction, Efficiency and torque required to raise and lower load Brakes: Types of brakes and braking torque relations Clutches: Types of clutches and relations for torque transmitted Types of gears, Gear tooth terminologies. Concept of conjugate action, law of conjugate action, kinematics of involute gear tooth pairs during the contact, number of pairs of teeth in contact, path of approach and path of recess Interference, undercutting for involute profile teeth.Introduction to cycloidal profile.Types of gear trains. Kinematic analysis of gear trains including simple epicyclic and double epicyclic gear trains. Static force analysis: free body diagram, condition of equilibrium. Analysis of all links of given linkages, cams, gears mechanism and their combinations without friction. Force analysis of four bar chain with friction, Force analysis of gear trains. Concept of inertial load.Dynamic force analysis of four link mechanisms.Dynamic force analysis of cam follower mechanism.

Text Book:

1. Norton, R.L., Kinematics and Dynamics of Machinery, 1st ed., Tata McGraw Hill Education, 2013

Additional Books:

1. Uicker, J.J., Pennock, G.R. and Shigley, J.E., Theory of Machines and Mechanisms, 3rd ed., Oxford University Press, 2013.
2. Bevan, T., The Theory of Machines, 3rd ed., Pearson Education, 2012.
3. Rao, J.S. and Dukkipati, R.V., Mechanism and Machine Theory, 2nd ed., New Age International, New Delhi, 2012.
4. Ghosh, A. and Mallik, A.K., Theory of Mechanisms and Machines, 3rd ed., New Delhi Affiliated East-West Press, 2011.
5. Rattan, S. S., Theory of Machines, 3rd ed., Tata McGraw Hill Education, 2012.
6. Waldron, K.J. and Kinzel, G.L., Kinematics, Dynamics and Design of Machinery, 2nd ed., John Wiley & Sons, 2004.
7. Ambedkar, A.G., Mechanism and Machine Theory, 3rd ed., Prentice Hall of India, 2011.

MEL206 MACHINE DRAWING (3-2-0-4)

Pre-requisite: NIL

Contents:

Drawing Standards for following Drawing Sheets, Name Blocks, Lines, Sections, Dimensioning, Dimensioning of Tolerances Standard Components, Standard Features, Machining Symbols, Welding Symbols, Surface Finish Symbols, Heat Treatment, Manufacturing Instructions, Allowances, Materials. Orthographic Projections of Elements Orthographic Projections, Sectional Views, Multiple Views, Missing Views, Profiles, Cross sections, References, Alignments, Dimensioning. Study, qualitative selection of type / size (excluding design calculations) and standard practices for the following elements Threads, Bolts, Nuts, Washers, Rivets, Welds, Keys& Keyways, Splines, Couplings.Assembly and Dismantling Techniques, Principles of Assembly Fits and Tolerances (Standard, types, application and selection) Tolerance Charting Surface Finish requirement for assembly, Manufacturing Method, Geometrics suitable for assembly, Assembly/Dismantling Tools, Bearing Assemblies, Assemblies by fastening. Assembly Drawings (Principles, techniques and standards of drawing of following) Component, Subassembly, Full assembly, Exploded Views, Various frames / brackets / housings / casings, Study of some standard assemblies. Name Plates, Part List, Revisions, etc., Essential Parts/Formats required for production drawing, Process Sheet.

Text Book:

1. Naryana, K.L., Kannaiah, P. and Reddy, K.V. Machine Drawing, 4th ed., New Age International, 2013.

Additional Books:

1. Bureau of Indian Standards, Engineering Drawing Practice for Schools and Colleges, 1st ed., 1998
2. Bhatt, N.D. and Panchal, V.M., Machine Drawing, 47th ed., CharotarPublishing House, 2012.

3. PSG College of Technology, Design Data, 1st ed., DPV Printers, Coimbatore, 2002.
4. Junnarkar, N.D., Machine Drawing, Pearson Education, 2011.

MEL207 CASTING, WELDING AND FORMING (3-0-2-4)

Pre-requisite: NIL

Contents:

Study of metal casting processes; Study of welding and other joining processes; Study of metal forming processes; Processing of plastics; Process planning and process analysis casting, Economic and quality issues in casting; Welding and forming processes.

Practical: Practicals as per course contents.

Text Book:

1. Kalpakjian, S. and Schmid, S.R., Manufacturing Engineering and Technology, 4th ed., Pearson Education, 2013

Additional Books:

1. Groover, M.P., Fundamentals of Modern Manufacturing : Material Processes And Systems, 3rd ed., Wiley India, 2011
2. Rao, P.N., Manufacturing Technology (Vol.1), 2nd ed., Tata McGraw Hill Education, 2012
3. Ghosh, A. and Malik, A.K., Manufacturing Science, 2nd ed., Affiliated East-West Press Private Limited, 2010.
4. Choudhuri, S.K.H., Choudhuri, A.K.H. and Roy, N., Elements of Workshop Technology, 15th ed., Media Promoters and Publishers, 2013
5. Bawa H. S., Workshop Technology, Tata McGraw Hill, 2001.

MEL208 MACHINING AND MACHINE TOOLS (3-0-2-4)

Pre-requisite: NIL

Contents:

Introduction to machine tools and machining operations.Mechanics of metal machining. Cutting forces, friction, cutting fluids and surface finish, lubrication, temperatures and heat transfer and its measurement, tool life and tool wear aspects. Theoretical models of shear angle solution, Basic concepts of cost and economics of metal cutting operations, Tool nomenclature, chip control and design for machining. Electrical discharge Machining, Electrochemical Machining, Ultrasonic machining, Abrasive Jet Machining, Laser Beam Machining, Water Jet and Electron Beam machining.

Practical: Practicals as per course contents.

Text Book:

1. Kalpakjian, S. and Schmid, S.R., Manufacturing Engineering and Technology, 4th ed., Pearson Education, 2013.

Additional Books:

1. Groover, M.P., Fundamentals of Modern Manufacturing : Material Processes And Systems, 3rd ed., Wiley India, 2011
2. Rao, P.N., Manufacturing Technology (Vol.1), 2nd ed., Tata McGraw Hill Education, 2012
3. Ghosh, A. and Malik, A.K., Manufacturing Science, 2nd ed., Affiliated East-West Press Private Limited, 2010.
4. Boothroyd, G. and Knight, W.A., Fundamentals of Machining and Machine Tools, 3rd ed., CRC Taylor and Francis, 2013
5. Shaw M.C., Metal Cutting Principles, CBS Publishers, 2012.

MEL301 APPLIED THERMODYNAMICS (3-0-2-4)

Pre-requisite: NIL

Contents:

Only fundamentals and elementary treatment is expected to be covered in this course. Introduction to I.C. Engines: Two/Four stroke engine. SI and CI engines carburation and fuel injection.Indicated/brake power.Air standard, mechanical, thermal efficiencies. Introduction to Reciprocating Compressors: Ideal Cycles, multi stage compression, intercooling, condition for minimum work. Volumetric efficiency and power required. Introduction to Gas Turbines and Jet propulsion: Ideal cycles (open and close cycles), and working of turbojet, turboprop, ramjet & pulsejet, performance. Components of Steam power plant, their functions and processes involved there in. Such as,Boilers: Classification based on type of fuel, fire tube/water tube, and very high pressure boilers like La Mont Boiler, Benson Boiler, Schmidt Hartman Boiler, Loeffler Boiler, and Velox Boiler. Steam Turbines: Classification base on impulse/Reaction. Velocity diagrams for single rotor system involving friction on blade. Blade/Diagram efficiency.Condensers: Jet condenser/ Surface condenser. Calculations of cooling water requirement. Law of Partial pressure, Air leakage in condenser. Calculations of Condenser efficiency and vaccum efficiency. Calculation of pump size.Introduction to Refrigeration and air conditioning: Vapor compression and vapor absorption system. Ideal Cycles, effect of Sub cooling and Superheating on C.O.P. and performance calculation. Psychometric chart and processes such as heating cooling, humidification and dehumidification.

Practical: Practicals as per course contents.

Text Books:

1. Eastop, T.D. and McConkey, A., Applied Thermodynamics: For Engineering Technologists, 5th ed., Pearson Education, 2013.
2. Nag, P.K., Engineering Thermodynamics, 4th ed., Tata McGraw Hill Education, 2012.

Additional Books:
1. Rogers, G.F.C. and Mayhew, Y.R., Thermodynamics and Transport Properties of Fluids, 5th ed., Blackwell Publishers, 2013
2. Ganesan, V., Internal Combustion Engines, 4th ed., Tata Mc Graw Hill Education, 2013
3. Dixon, S.L. and Hall, C.A., Fluid Mechanics and Thermodynamics of Turbomachinery, 6th ed., Elsevier, 2010
4. Arora, C.P., Refrigeration and air conditioning, 3rd ed., Tata McGraw Hill Education, 2013
5. Yadav, R., Steam and Gas Turbines and Power Plant Engineering, 7th ed., Central Publishing House, 2012
6. Joel, R., Basic Engineering Thermodynamics, 5th ed., Pearson Education, 2014
7. Ballaney, P.L., Thermal Engineering, 5th ed., Khanna Publishers, 2012
8. Heywood, J.B., Internal Combustion Engine Fundamentals, 1st ed., Tata McGraw Hill Education, 2012.

MEL302 FLUID MACHINES (3-0-2-4)
Pre-requisite: NIL
Contents:
Impact momentum principle, dynamic action of jet on fixed and moving flat plates and curved vanes, series of plates and vanes, water wheels, velocity triangles and their analysis, jet propulsion of ships. Principles and classification of hydraulic machines, element of hydroelectric power plant. Impulse turbines like Pelton wheel. Reaction turbines like Francis turbines, propeller turbine, Kaplan turbine and bulb turbine. Radial flow, axial flow, and mixed flow turbines. Principle of operation, construction, design, installation, characteristics, governing, accessories, selection, model testing, degree of reaction, velocity diagram and analysis, unit and specific quantities.Centrifugal pump, reciprocating pump and rotary pumps. Introduction to axial pump, mixed flow pump, self priming pump, gear pump, sliding vane pump, screw pump & hand pump. Principle of operation, classification, components installation, priming, velocity triangles and their analysis, slip factor, performance characteristics, multistaging of pumps, design, indicator diagram, cavitation, air vessels, model testing, NPSH, unit and specific quantities. Airlift pumps, hydraulic rams, bore hole pumps, submersible pumps, jet pumps, regenerative pumps. Industrial hydraulic components such as pumps, valves, accumulators, actuators. Hydraulic systems including hydraulic circuits for hydraulic presses, hydraulic cranes etc. Fluid couplings and torque converters.
Practical: Practicals as per course contents.
Text Book:
1. Bansal R.K., A Textbook of Fluid Mechanics and Hydraulic Machines, 9th ed., Laxmi Publication, 2014
Additional Books:
1. Yahya, S.M., Turbines, Fans and Compressors, 4th ed., Tata McGraw Hill, 2012.
2. Lal, J., Fluid Mechanics and Hydraulics, 9th ed., Metropolitan Book Corporation .Private Limited, 2012.
3. Kadambi, V. & Prasad, M., An Introduction to Energy Conversion Vol 3, 2nd ed., New Age International, 2011
4. Nag, P.K., Power Plant Engineering, 3rd ed., Tata Mc-Graw Hill Education, 2013.

MEL303 HEAT AND MASS TRANSFER (3-0-2-4)
Pre-requisite: NIL
Contents:
Modes of heat transfer in various applications. Conduction: Heat diffusion equation, 1-D steady state conduction in extended surfaces, infinite and semi-infinite walls, heat generation, lumped capacitance and simple transient models. Convection: Forced and free convection - mass, momentum and energy conservation equations, nondimensional numbers, hydrodynamic and thermal boundary layers, basics of heat transfer in external and internal laminar and turbulent flows, and use of co-relations. Boiling and condensation: physical phenomena and co-relations. Mass transfer – Fick's law, similarity with convection and correlations. Radiation: properties, Laws, 3- surface network for diffuse-gray surfaces. Heat exchanger fundamentals and design.
Practical: Practicals as per course contents.
Text Books:
1. Cengel, Y.A. and Ghajar A. J., Heat and Mass Transfer, 4th ed., Tata McGraw Hill Education, 2013
2. Incropera, F.P, and Others. Fundamentals of Heat and Mass Transfer, 6th ed., Wiley India, 2013.
Additional Books:
1. Holman, J. P.and Bhattacharyya, S., Heat Transfer, 10th ed., Tata McGraw Hill Education, 2012.

2. Sukhatme, S.P., A Textbook on Heat Transfer, 4th ed., Universities Press, 2013.

MEL304 DYNAMICS OF MACHINES (3-0-2-4)
Pre-requisite: NIL
Contents:
Concepts in machine element dynamics.D'Alembert principle and inertia forces. Unbalance forces and moments in rotor-disc assembly. Static and dynamic balancing by analytical as well as graphical method.Field balancing by vector diagram and by influence coefficient method.Dynamic force analysis of reciprocating mechanism by analytical method.Primary and secondary inertia forces.Balancing of inertia forces in reciprocating mechanism.T-diagram for single- cylinder and multi-cylinder engines and other reciprocating machines such as punching press.Selection of Flywheel inertia parameters.Balancing of inertia forces and couples in multi-cylinder engines.Selection of firing order and crank diagram.Radial engines and V-twin engines.Gyroscopic effect in machines such as ship, vehicles, grinding mills. Free body diagram, Rayleigh energy method and Langrange equation. Laplace transform and transfer function derivation. Free vibration of single DOF systems. Estimation of Damping. Forced vibration under harmonic excitation.mpulse and step response. Modeling of two DOF systems. Torsional vibrations of rotors. Whirling of shaft and critical speed. Modeling of multi-degree of freedom system mode orthogonality property. Natural frequency and mode shape calculation by matrix iteration method. Modal analysis.Free and forced vibration. Governors
Practical: Practicals as per course contents.
Text Book:
1. Uicker, J.J., Pennock, G.R. and Shigley, J.E., Theory of Machines and Mechanisms, 3rd ed., Oxford University Press, 2013
Additional Books:
1. Bevan, T., Theory of Machines, 3rd ed., Pearson Education, 2012.
2. Rao, J.S. and Dukkipati, R.V., Mechanism and Machine Theory, 2nd ed., New Age International, New Delhi, 2012.
3. Ghosh, A. and Malik, A.K., Theory of Mechanisms and Machines, 3rd ed., Affiliated East-West Press, 2011.
4. Rattan, S. S., Theory of Machines, 3rd ed., Tata McGraw Hill Education, 2012.
5. Norton, R.L., Kinematics and Dynamics of Machinery, 1st ed., Tata McGraw Hill Education, 2013
6. Rao, J.S. and Gupta, K., Theory and Practice of Mechanical Vibration, 2nd ed., New Age International, 2012.
7. Meirovitch L., Fundamentals of Vibrations, 2nd ed., Waveland Press, 2010.
8. Waldron, K.J. and Kinzel, G.L., Kinematics, Dynamics and Design of Machinery, 2nd ed., John Wiley & Sons, 2004.
9. Ambedkar, A.G., Mechanism and Machine Theory, 3rd ed., Prentice Hall of India, 2011.

MEL305 METROLOGY AND SQC (3-0-2-4)
Pre-requisite: NIL
Contents:
Definition, need, Precision & Accuracy, Standards of Measurements, linear and angular measurements, Comparators: Mechanical, Fluid displacement & Pneumatic, Electrical.
Screw thread measurement, Gear measurement.
Measurement of surface texture, straightness, flatness parallelism, circularity, Co-ordinate Measuring Machine (CMM), Automatic Gauging and Sorting machine, Interferometry: principle and types, optical flat Introduction, tolerances, interchangeability, selective assembly, limits & fits, types of fits, shaft basis system, hole basis system, allowances, IS specifications, Taylor principle, design of limit gauges. Limit gauges & its types, process planning sheet and tolerance chart preparation. Definition, function, objectives, concepts, characteristics, quality, quality of design & conformance, Statistical Quality Control, Process control charts & process capability, acceptance sampling techniques, sampling plans, inspection types and objectives Basics of ISO 9000 and ISO 14000, TQM concepts, quality assurance, quality circles.
Practical: Practicals as per course contents.
Text Book:
1. Jain, R.K., Engineering Metrology, 20th ed., Khanna Publishers, 2013.
Additional Books:
1. Logonthesis, Managing for Total Quality: from Deming to Taguchi and SPC, Prentice Hall, 1997
2. Gitlow, H., Quality Management, 3rd ed., Tata McGraw Hill, 2005.Grant, E.L. and Leavenworth, R.S., Statistical Quality Control, 7th ed., TataMcGraw Hill, 2000.
3. Feigenbaum, A.V., Total Quality Control, 4th ed., I.K International Publishing House, New Delhi, 2008.

MEL306 OPERATIONS MANAGEMENT (3-2-0-4)
Pre-requisite: NIL
Contents:

Production systems and performance measures.Life Cycle of a production system.Major managerial decisions in the life of a production system, Product design and process selection.Location and Layout of production systems, Product, Process and Cellular layouts, Demand Forecasting, Aggregate production planning, Inventory and MRP, Scheduling decisions and emerging trends.

Text Book:
1. Russell, R.S. and Taylor, B.W., Operations Management, 7th ed., Wiley India, 2013.

Additional Books:
1. Martinich, J.S., Production and Operations Management, Wiley India, 2009
2. Gaither, N. and Frazier, G., Operations Management, 9th ed., Cengage Learning, 2002.
3. Krajewski, L.J., Operations Management: Processes and Supply Chains with
4. MyOMLab, Pearson Education, 2013.
5. Boeuf, M.L., Essence of Time Management, Jaico Publishing House, 2001.
6. Gupta, A.K. and Sharma, J.K., Management of Systems, Macmillan India Limited, 2010.

MEL307 DESIGN OF MACHINE ELEMENTS (3-2-0-4)
Pre-requisite: NIL
Contents:
Design of elements subjected to simple loading: screws including power screws, axles, and couplings, clutches and brakes.
Introduction to design for fatigue strength.Endurance and modifying factors.Surface strength. Design procedure of fatigue failure with application to the design of bolted joints including eccentrically loaded joints,
Springs and shafts subjected to fatigue loading.
Design of spur, helical, bevel and worm gears, journal and rolling contact bearings, belts and chains.Selection of motors.

Text Books:
1. Norton, R.L., Machine Design : An Integrated Approach, 2nd ed., Pearson Education, 2013
2. Budynas, R.G. and Nisbett, J.K., Shigley's Mechanical Engineering Design, 9th ed., Tata McGraw Hill Education, 2013.

Additional Books:
1. Black, P.H. and Adams, O.E., Machine Design, 3rd ed., McGraw Hill, Kogakusha, 1981.
2. Maleev, V.L. and Hartman, J.B., Machine Design, CBS Publishers and Distributors, 1983.
3. Schmid, S.R., Hamrock, B.J. and Jacobson B.O., Fundamentals of MachineElements, 3rd ed., CRC Press, 2014.

MEL308 MECHANICAL MEASUREMENTS (3-0-2-4)
Pre-requisite: NIL
Contents:
Purpose, structure and elements of measuring system.Static characteristics of measurement system elements including systematic, statistical characteristic; generalized model of system element and calibration.Measurement error, error probability density function, error reduction, theory of experimentation.
Classification, Principle, Construction, Range and working of instruments for following measurements, Displacement, Speed, Force, Torque, Temperature, Flow, Level, Pressure, Sound, Light intensity
Practical: Practicals as per course contents.

Text Books:
1. Doeblin, E.O. and Manik, D. N., Doeblin's Measurement Systems, 6th ed., McGraw Hill, 2012
2. Nakra, B.C and Chaudhry, K.K., Instrumentation Measurement and Analysis, 3rd ed., Tata McGraw Hill, 2013

Additional Books:
1. Bentley, J.P., Principles of Measurement Systems, 4th ed., Pearson Education, 2011.
2. Beckwith, T.G, Lienhard, V J.H., and Morangoni, R.D., Mechanical Measurements, 6th ed., Pearson Education, 2012.
3. Rangan, C.S., Sarma, G.R. and Mani, V.S.V., Instrumentation Devices and Systems, 2nd ed., McGraw Hill, 2011
4. Bewoor, A K. and Kulkarni, V.A., Metrology and Measurement, McGraw Hill, 2012
5. Dally, J.W., Riley, W. F. and Meconnell, K. G., Instrumentation for Engineering Measurements, 2nd ed., Wiley India, 2012

MEL401 OPERATIONS RESEARCH TECHNIQUES (3-2-0-4)
Pre-requisite: NIL
Contents:

Introduction to OR & basic OR models, definition, characteristics and limitations of OR, linear programming: solutions of LPP by graphical method and simplex method, formulation of dual of LPP. Assignment model, travelling salesman problem, transportation Problems, transhipment model. Dynamic programming, structure and characteristics of dynamic programming, application of dynamic programming to resource allocation, inventory control & linear programming.Project management: drawing of network, CPM & PERT, Probability of completion of project, cost analysis of project, allocation and updating of networks.
Replacement models: concept of equivalent, interest rate, present worth, economic evaluation of alternatives, group replacement models. Inventory control models, analysis of single product deterministic models. Waiting line situations, queuing theory and models (no derivations expected). Simulation concept and its application in waiting line situations, inventory and networks

Text Book:
1. Taha, H.A., Operations Research: An Introduction, 9th ed., Pearson Education, 2013.

Additional Books:
1. Sharma, J.K., Operations Research, 4th ed., Macmillan India Ltd., 2009.
2. Vohra, N.D, Quantitative Techniques in Management, 4th ed., Tata McGraw Hill, New Delhi, 2011.
3. Hillier, F.S. and Lieberman, G. J., Introduction to Operations Research, 10th ed., McGraw Hill, 2014.
4. Gupta, P.K. and Hira, D.S., Operations Research, S. Chand and Co. Ltd., 2012.

MEL402 AUTOMATIC CONTROL (3-0-0-3)
Pre-requisite: NIL
Contents:
Introduction to need for automation and automatic control.Use of Feedback, road spectrum of system application.
Mathematical modelling, Diff. Equations, transfer functions, block diagram, signal flow graphs, Application to elementary system simplications, Effect of feedback on parameter variation, disturbance signal servomechanisms and regulators.
Control system components, Electrical, Electromechanical, and other components. Their functional analysis and input output representation.
Time response of systems, First order and second order system, (standard inputs) concept of gain and time constants. Steady state error, type of control system, approximate methods for higher order system.
Root location and its effect on time response, Elementary idea of Root Locus, effect of adding pole and zero and proximity of imaginary axis.
Stability of control systems, conditions of stability characteristic equation, Routh Hurwitz criterion, special cases for determining relative stability.
Frequency response method of analyzing linear system, Nyquist and Bode plots, stability and accuracy analysis from frequency responses, open loop and close loop frequency response. Nyquist criterion, Effect of variation of gain and addition of pole and zero on response plot, stability margins in frequency response.

Text Books:
1. Nagrath, I.J. and Gopal, M., Control Systems Engineering, 5th ed., New Age International, 2012
2. Raven, F.H., Automatic Control Engineering, 5th ed., McGraw Hill, 2001.

Additional Books:
1. Ogata, K., Modern Control Engineering, 5thed, Pearson Education, 2012.
2. Kuo, B.C. and Golnaraghi F., Automatic Control Systems, 8th ed., Wiley India, 2011.
3. Nise, N.S., Control Systems Engineering, 6th ed., Wiley, 2013.
4. D'Azzo J. J., Houpis, C.H. and Sheldon, S.N., Linear Control SystemAnalysis and Design with MATLAB, 6th ed., CRC Press, 2014.

MEL403 FLUID DYNAMICS (3-0-0-3)
Pre-requisite: NIL
Contents:
Concept of boundary layer, flow over a flat plate, Navier-Stokes's equations and it's use. Von-Karmann Momentum Equation.General properties of boundary layer. Exact solution of two-dimensional methods.Correlation coefficient.
Concept of compressible flow, one dimensional isentropic flow, normal shock, flow with frictional heat transfer,

Text Book:
1. Yahya S.M., Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion, 4th Ed., New Age International, 2012

Additional Books:
1. Som, S.K., Biswas, G. and Chakraborty, S., Introduction to Fluid Mechanics and Fluid Machines, 3rd ed., Tata McGraw Hill Education, 2012.
2. Kundu, P. K., Cohen I. M. and Dowling, D.R., Fluid Mechanics, 5th ed, Elsevier, 2013
3. Bansal, R.K., A Textbook of Fluid Mechanics and Hydraulic Machines, 9th ed., Laxmi Publications, New Delhi, 2014

MEL405 COMPUTER AIDED DESIGN (3-2-0-4)

Pre-requisite: NIL

Contents:

Introduction , Product Life Cycle, Design Process, Application of Computers for Design, Benefits of CAD, Computer Configuration for CAD Application, Grover's Model of Product life Cycle for Selection of CAD-CAM.

Configuration of graphics workstations, Fundamentals of 2D graphics, Menu design and Graphical User Interface (GUI), Parametric Programming.Vector representation of geometric entities, Homogeneous coordinate systems, Geometric transformations.

Planner and Space Curve design -Analytical and Synthetic approaches, parametric equations, Modeling of biparametric Surfaces, Surfaces - Coons, Bezier, B-spline and NURBS patches, Surface manipulation techniques, Geometric modeling techniques- Wireframes, B-Rep, CSG and Hybrid modelers, Feature based, Parametric and Variation modelling

Text Book:

1. Rogers, D. F. and Adams, J.A., Mathematical Elements for Computer Graphics, 2nd ed., McGraw Hill, 2013.

Additional Books:

1. Faux, I.D. and Pratt, M.J., Computational Geometry for Design and Manufacture, Ellis Horwood, 1987.
2. Mortenson, M.E., Geometric Modeling, 3rd ed., John Wiley, 2006.
3. Choi, B.K., Surface Modeling for CAD/CAM, Elsevier, 1991.

MEL406 FINITE ELEMENT METHODS (3-2-0-4)

Pre-requisite: NIL

Contents:

Structural analysis, objectives, static, Dynamic and kinematics analyses, Skeletal and continuum structures, modeling of infinite DOF.system into finite DOF system, Basic steps in finite element problems formulation, general applicability of the method.

Discretization of the domain, Basic element shapes, Aspect ratio, shape function, generalized co-ordinates and nodal shape functions, 2d rectangular and triangular elements, Axisymmetric elements.

Concept of element assembly, Global and local coordinate system, band width and its effects, Banded and skyline assembly, Boundary conditions, solution of simultaneous equations, Guassian elimination methods, one and 2D applications Higher order and isoparametric elements One dimensional quadratic and cubic element, Use of natural co-ordination system, area co-ordinate system continuity and convergence requirements, 2D rectangular and triangular requirement Analyses of trusses and frames, analyses of machine subassemblies, advantages and limitations Hmilton's principle, derivation of equilibrium, consistent and lumpe mass matrices, Determination of natural frequencies and mode shapes, Bending of beams and plates, Applications in heat transfer and fluid mechanics, Numerical considerations: numerical integration, error analysis, mesh refinement, Eigen value and time dependent problems, Introduction to shell structures. use of commercial software packages.

Text Book:

1. Reddy J. N., An Introduction to Finite Element Method, 3rd ed., McGraw Hill, 2013.

Additional Books:

1. Chandrupatla, T.R. and Belegundu, A.D., Introduction to Finite Elements in Engineering, 4th ed., Pearson Education, 2012.
2. Bathe, K.-J., Finite Element Procedures, PHI Learning, New Delhi, 2010.
3. Seshu, P., Textbook of Finite Element Analysis, Prentice Hall of India, New Delhi, 2012.
4. Rao, S.S., The Finite Element Method in Engineering, 5th ed., Elsevier Butterworth Heinemann, 2011.
5. Segerlind, L.J., Applied Finite Element Analysis, 2nd ed., Wiley, 1987.
6. Krishnamoorthy C.S., Finite Element Analysis: Theory and Programming, Tata McGraw-Hill Education, 1995.
7. Hughes T.J.T., The Finite Element Method, Prentice-Hall, 1986.

MEL407 LUBRICATION (3-0-0-3)

Pre-requisite: NIL

Contents:

Importance of lubrication, mechanisms and regimes of lubrication.Viscosity and its measurement. Bearing varieties and selection.Hydrodynamic lubrication-Journal and Thrust Bearings.Lubricants.Bearing materials. Rolling Bearings

Text Book:

1. Khonsari, M.M. and Booser, E.R., Applied Tribology: Bearing Design and Lubrication, 3rd ed., John Wiley and Sons, 2014

Additional Books:

1. Hamrock, B.J., Schmid, S.R. and Jacobson, B.O., Fundamentals of Fluid Film Lubrication, 2nd ed., Marcel Dekker, 2004
2. Wilcock, D.F. and Booser, E.R., Bearing Design and Application, 1st ed., McGraw Hill, 1957

3. Neale, M. J., The Tribology Handbook, 2nd ed., Butterworth-Heinemann, 2001.

MEL408 MECHATRONICS (3-0-2-4)

Pre-requisite: NIL

Contents:

System Integration, Scope of Mechatronics, Measurement system, open and closed loop system, architecture of mechatronic system, approach towards mechatronic design. Basic electrical terminologies, basic electrical elements, semiconductor electronics, junction diode, Bipolar junction transistor, Field effect transistor. Function of Sensors, Performance terminology. Displacement / Position Sensors, Proximity sensors, Velocity / Motion sensors, Force Sensors, Temperature sensors, Fluid pressure sensor, Light sensors. Factors for selection of sensors.Purpose of signal conditioning.Interfacing with a microprocessor, Signal conditioning processes, protection circuits.A/D converters, D/A converter, Multiplexer, Data Acquisition.Analog and Digital Indicators, Digital display, Alarm Indicators, Recorders, magnetic recording. Hydraulic/Pneumatic Actuation: Power supplies, Direction control valves, Pressure control valves, Cylinders, Process control valves, Rotary actuators. Mechanical Actuation: Types of motion, Kinematic chain, cams, gears, belt and chain drives, ratchet and pawl, Geneva mechanism. Electrical Actuation: Switching devices, solenoids, electrical motors i.e. A.C. motor and its types, D.C. motor and its types, stepper motor. Continuous and discrete processes, control modes.Proportional mode, derivative mode, integral mode, PID controllers, adaptive control.Digital controllers. Logic gates, Boolean algebra, application of logic gates, sequential logic, logic families, Fuzzy logic. Microcomputer Structure, Micro controller, Applications and Programming.Basic structure of PLC, Input/Output processing, PLC programming, mnemonics, selection of PLC.Digital communication and interfacing.

Practical: Practicals as per course contents.

Text Book:

1. Bolton, W., Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 4th ed., Pearson Education, 2013

Reference Book:

1. Alciatore, D.G. and Histand, M.B., Introduction to Mechatronics and Measurement Systems, 4th ed., McGraw Hill, 2012.

MEL409 THEORY OF ELASTICITY (3-0-2-4)

Pre-requisite: NIL

Contents:

Elasticity, Stress, Strain, Hooke's, Plane stress & strain, Surface stress, Compatibility equations, Stress function, Two dimensional problems in rectangular coordinates, Two dimensional problems in polar coordinates, Photoelastic and Moire experimental methods, Analysis of stress and strain in three dimensions, Elementary problems of elasticity in three dimensions, Torsion, Bending of bars.

Practical: Practicals as per course contents.

Text Book:

1. Srinath L.S., Advanced mechanics of solids. Tata McGraw-Hill, 2003.

Additional Books:

1. Dally, J. W. and Riley, W. F., Experimental Stress Analysis, 4th ed., McGraw Hill, 2005.
2. Muskhelishvili, N. I, Some Basic Problems of the Mathematical Theory of Elasticity, Springer Verlag, 2010.
3. Dove, R.C. and Adams, P.H., Experimental Stress Analysis and Motion Measurement: Theory, Instruments and Circuits, Techniques, Prentice Hall, New Delhi, 1965.
4. Sokolnikoff I.S., Mathematical Theory of Elasticity, McGraw-Hill International, 2nd Edition, 1957.
5. Fung Y.C., Foundation of Solid Mechanics, Prentice Hall Inc., 1965.
6. Zhilun Xu, Applied Elasticity, Willey Eastern Ltd., 1992.

MEL410 MECHANICAL VIBRATIONS (3-0-2-4)

Pre-requisite: NIL

Contents:

Introduction to vibration in mechanical and structural systems.Discrete system modeling.Hamilton's principle and Lagrange's equation. Free and forced vibration response of single degree of freedom system with and without damping under harmonic excitation. Discussion on various types of damping; viscous, coulomb, hysteretic etc. Forced response under periodic excitation and transient response through Du-hamel's integral. Concept of response spectrum.

Rotor whirling and critical speed.Vibration isolation and transmissibility ratio.Vibration isolation in automobiles.Dynamic vibration absorber.Torsional vibration in rotors.Simulink of Matlab.

Modeling of multi degree of freedom systems.Determination of natural frequencies using matrix iteration and deflation technique. Concept of mode shapes and orthogonality principle. Rayleigh's quotient.Free and forced response through modal analysis.

Vibration of continuous systems.Longitudinal vibration of rods, transverse vibration of beams and torsional vibration of shafts.Determination of natural frequencies and mode shapes under various boundary conditions.Introduction to

FEM modeling of continuous systems. Free and forced response through modal analysis.

Introduction and distinguishing characteristics of nonlinear vibration. Phase plane, equilibrium points and limit cycles. Vibration measurement parameters and procedures. Vibration transducers and instruments. Source of vibration in Machineries. Role of vibration measurement and analysis in machine design and machine condition monitoring.

Practical: Practicals as per course contents.

Text Book:

1. Rao, J. S. and Gupta, K., Introductory Course on Theory and Practice of Mechanical Vibrations, 2ⁿᵈ ed., New Age International Publishers, 2012

Additional Books:

1. Rao, S.S., Mechanical Vibrations, 4ᵗʰ ed., Pearson Education, 2012.
2. Meirovitch L., Fundamentals of Vibrations, 2ⁿᵈ ed., Waveland Press, 2010.
3. Timoshenko, S., Vibration Problems in Engineering, 2ⁿᵈ ed., Oxford City Press, 2011
4. Thomson, W.T. and Dahleh, M.D., Theory of Vibration with Applications, 5ᵗʰ ed., Pearson, 2014

MEL411 ROBOTICS (3-0-2-4)

Pre-requisite: NIL

Contents:

Configuration, Introduction to Kinematics & Dynamics, drives, control, sensors and grippers. Application of robotics in handling, welding, painting, assembly, machining and other areas. Selection of robots.

Practical: Practicals as per course contents.

Text Book:

1. Groover M. P. and et. al., Industrial Robotics: Technology, Programming and Applications, 2ⁿᵈ ed, Tata McGraw Hill, 2013

Additional Books:

1. Deb, S. and Deb, S., Robotics Technology and Flexible Automation, 2ⁿᵈ ed., Tata McGraw Hill, 2010
2. Groover M.P., Automation, Production Systems and Computer Integrated Manufacturing, 3ʳᵈ· ed., Pearson Education, 2014
3. Koren, Y., Computer Control of Manufacturing Systems, 3ʳᵈ ed., Tata McGraw Hill, 2005
4. Viswanadham, N. and Narahari, Y., Performance Modeling of Automated Manufacturing Systems, Prentice Hall, 1994
5. Radhakrishnan, P., Subramanyan, S. and Raju, V., CAD/CAM/CIM, 3ʳᵈ ed., New Age International Publishers, 2011
6. Koren, Y., Robotics for Engineers, McGraw Hill, Singapore, 1987.

MEL412 AUTOMATION IN PRODUCTION (3-0-0-3)

Pre-requisite: NIL

Contents:

Modern developments in automation in manufacturing and its effect on global competitiveness, Need and implications of automation in Manufacturing, Different types of production systems and automation, hard/fixed automation including process automation, Rapid prototyping and tooling. Hydraulic and pneumatic actuators, their design and control devices, sequence operation of hydraulic/pneumatic actuators, designing of complete systems with hydraulic, electro-hydrolic and digital control devices, applications in manufacturing, material handling systems, feeders, orienting and escapement devices, their analysis and design, Automatic assembly machines, designing for automatic assembly.

Text Book:

1. Groover M.P., Automation, Production Systems and Computer Integrated Manufacturing, 3ʳᵈ· ed., Pearson Education, 2014.

Additional Books:

1. Grover, M.P. and Zimmers, E.W., CAD/CAM: Computer-Aided Design and Manufacturing, Pearson Education, 2008
2. Kundra, T.K., Rao, P.N. and Tewari, N.K., Computer Aided Manufacturing, Tata McGraw Hill, 2010
3. Koren, Y., Computer Control of Manufacturing Systems, 3ʳᵈ ed., Tata McGraw Hill, 2005

MEL413 ADVANCED MANUFACTURING TECHNIQUES (3-0-0-3)

Pre-requisite: NIL

Contents:

Introduction to CIM, Types of Manufacturing, CIM hardware and software, Elements of CIM, Product development through CIM Introduction, Database requirements of CIM, Database, Database management, Database Models, Product Data Management (PDM), Advantage of PDM. Manufacturing cell, Group Technology, Cellular Manufacturing. Introduction to FMS, Manufacturing integration model, flexible manufacturing strategy, Components of Flexible Manufacturing‑Pallets and fixtures, machining centers, inspection equipment, material handling stations, storage system, In-process storage, manually operated

stations, allied operation centers integration of the industrial robot into CIM system, product design of automatic manufacture of robots, computer aided inspection using robots. Principles of networking, Network Techniques, Local area network (LAN), networking standards, Design Activities in a networked environment, networking in a manufacturing company, hardware elements of networking, Collaboration Engineering.

Text Book:

1. Groover M.P., Automation, Production Systems and Computer Integrated Manufacturing, 3ʳᵈ· ed., Pearson Education, 2014

Additional Books:

1. Ranky, P.G., The Design and Operation of FMS: Flexible Manufacturing Systems, IFS, 1983.
2. Harrington, J., Computer Integrated Manufacturing, Krieger Publication, 1985.
3. Shover, R.N., An Analysis of CAD/CAM Application with Introduction to CIM, Prentice Hall.
4. Bedworth, D.D. and et.al., Computer Integrated Design and Manufacturing, McGraw Hill, 1991
5. Scholz-Reiter, B., CIM Interfaces, Chapman and Hall, 1992.
6. Goetsch, D.L., Fundamentals of CIM Technology: Automation in Design, Drafting and Manufacturing, Delmar Publication, 1988.

MEL414 POWER PLANT ENGINEERING (3-0-0-3)

Pre-requisite: NIL

Contents:

Introduction to power systems and technologies. Demand variation and fore casting. Grid features. Siting and costing. Diesel generators: systems, equipment and layout. Fossil-fuelled steam power plants: Boiler and accessories. Turbine and accessories, feed cycle equipment, generator. Combined cycle power plants: gas turbine, heat recovery boiler. Nuclear power: nuclear reactions, fuel, moderator and coolant, Neutron life cycle. Light water, Heavy water, Gas-cooled and fast reactors. Hydroelectric plants: Features and siting, Pelton, Francis, Kaplan and propeller turbines construction, mini- and micro-turbines. Renewable energy: solar, geothermal, wind, biomass, ocean, fuel cells, unique features of decentralized systems. Co-generation systems. Environmental issues, sustainability and future scenarios.

Text Book:

1. Nag, P.K., Power Plant Engineering, 3ʳᵈ ed., Tata McGraw Hill, 2013.

Additional Books:

1. El-Wakil, M.M., Power Plant Technology, 4ᵗʰ ed., Tata McGraw Hill, 2011.
2. British Electricity International, Modern Power Station Practice, 3ʳᵈ ed., Pergamon Press, 1992.
3. Babcock and Wilcox Company, Steam: Its Generation and Use, 36ᵗʰ ed., Kessinger Pub. Co., 2008.
4. O'Hayre, R.P. and et. al., Fuel Cell Fundamentals, 2ⁿᵈ ed., John Wiley and Sons, 2009.
5. Skrotzki, B.G.A. and Vopat, W.A., Power Station Engineering and Economy, Tata McGraw Hill, 2009
6. Arora, S.C. and Domkundwar, S., A Course in Power Plant Engineering, 3ʳᵈ ed., Dhanpat Rai and Sons, 1988.
7. Frederick, T.M., Power Plant Engineering, 3ʳᵈ ed., East-West Press, 1989.
8. Woodruff, E.B., Lammers, H.B. and Lammers, T.F., Steam Plant Operation, 9ᵗʰ ed., McGraw Hill, 2012

MEL415 RENEWABLE ENERGY SOURCES (3-0-0-3)

Pre-requisite: NIL

Contents:

Need for alternative sources of energy, various options available, principles of energy conversion using solar energy, wind energy, Ocean energy, Geothermal energy and MHD power generation. Introduction, Spectral distribution of solar radiation, beam and diffused radiations, measurement of solar radiation, pyranometer, pyrhelio meter, sunshine recorder. Solar radiation geometry, radiation on tilted surface, tilt factors. Liquid flat plate collector & their analysis, collector efficiency factor and heat removal factor, collector efficiency, Concept of selective surfaces, some novel designs of solar collectors, Solar air heaters and their analysis. Cylindrical parabolic collectors, compound parabolic collectors, parabolied collectors, their construction and principle of operation, advantages and drawbacks, tracking systems Solar energy storage. Water heating, space heating, drying, refrigeration, distillation, cooking, PV systems. Introduction to biogas generation, fixed dome & floating drum biogas plants, their constructional details, factors affecting generation of biogas, utilization of biogas. Introduction, methods of obtaining energy from biomass, inceneration, thermal gasification. Up draft and down draft gasifiers, their constructional details, Applications of producer gas. Power in wind, basic principles of wind energy conversion, basic components of WEC Systems, Savonius and Darrieus rotors, application of wind energy. Introduction, Ocean Thermal Electric Conversion (OTEC), open and closed cycle of OTEC, hybrid cycle, energy from tides, generation components of

tidal power plants, single and double basin design arrangement, estimation of tidal power and energy.

Text Book:
1. Sukhatme S.P. and Nayak J. K., Solar Energy: Principles of Thermal Collection and Storage, 3rd ed., Tata Mc Graw Hill, 2013.

Additional Books:
1. Beckman, W.A. and Duffie, J.A., Solar Engineering of Thermal Processes, John Wiley & Sons, 2013
2. Parulekar, B.B. and Rao, S., Energy Technology, 3rd ed.,Khanna Publishers, 1995.
3. Rai, G.D., Non-Conventional Sources of Energy, 4th ed., Khanna Publishers, 2009.
4. Garg, H.P. and Prakash J., Solar Energy: Fundamentals and Applications, 8th ed., Tata McGraw Hill, 2007.
5. Khandelwal, K.C. and Mahdi, S.S., Biogas Technology: A Practical Handbook, st ed., Tata McGraw Hill, 1988.

MEL416 REFRIGERATION AND AIR CONDITIONING (3-0-2-4)

Pre-requisite: NIL

Contents:

Revision of fundamentals.Applications.Environmental issues. Vapor compression system: Ideal and real cycle analyses, design and optimization. Refrigerants: designation, properties, environmental considerations. Advanced vapor compression cycles, part-load operation. Gas cycle refrigeration. Components: condensers, evaporators, compr essors and expansion devices – construction, operation and performance. Vapor absorption cycles: operation, system design, components. Psychrometry: definitions, heating, cooling, humidification and dehumidification processes, evaporative cooling systems. Environmental comfort specifications and standards.

Cooling load estimation and use of standards. Airconditioning systems and apparatus, air flow ducts, air quality. Control and optimization of HVAC systems

Practical: Practicals as per course contents.

Text Book:
1. Arora, C.P., Refrigeration and Air Conditioning, 3rd ed., Tata McGraw Hill Publication, 2013

Additional Books:
1. Arora, C.P., Refrigeration and Air Conditioning, 3rd ed., Tata McGraw Hill Publication, 2013
2. Prasad, M., Refrigeration and Air Conditioning, 2nd ed., New Age International Publishers, 2006.
3. Dossat, R.J., Principles of Refrigeration, 4th ed., Pearson Education, 2010.
4. Ballaney, P.L., Refrigeration and Air Conditioning, 7th ed., Khanna Publishers, 1992.
5. Khurmi, R.S. and Gupta, J.K., Textbook of Refrigeration and Air Conditioning, 5th ed., S. Chand Publication, 2011.
6. Arora, S.C. and Domkundwar, S., A Course in Refrigeration and Air Conditioning, 7th ed., Dhanpat Rai and Co., 1999.
7. Pita, E.G., Air Conditioning Principles and Systems: An Energy Approach,4th ed., PHI Learning Private Limited, 2008.
8. American Society of Heating, Refrigerating and Air-Conditioning Engineers, 2013 Ashrae Handbook: Fundamentals, Inch-Pound ed., ASHRAE, 2013.
9. CARRIER Handbook

MEL417 AUTOMOBILE ENGINEERING (3-0-2-4)

Pre-requisite: NIL

Contents:

Automobile history and development Present scenario of automobiles in India and Abroad.Chassis, articulated and rigid vehicles and vehicles layout.Prime movers. I. C. Engines, Gas turbines, Wankel engine, Engine construction - Structural components and materials Review of fuel, cooling and lubrication systems Filters, water pumps, radiators, Thermostats, and freezing Compounds. Steering systems, principle of steering, center point steering, Steering linkages, steering geometry and wheel alignment, power Steering, special steering systems. Tyres specifications, factors affecting tyre performance, Special tyres, wheel balancing, suspension system- Function of Spring and shock absorber, conventional and Independent suspension System, Telescopic shock absorber, linked suspension systems, Clutch - Necessity, requirements of a clutch system. Types of Clutches, size of clutch, centrifugal clutch, wet clutch, fluid Clutch. Transmission, Necessity of transmission, principle, types of transmission, Sliding mesh, constant mesh, synchromesh, Transfer gear box, Gear Selector mechanism, lubrication and control. Overdrive, Torque Converter, Automatic Transmission. Propeller shaft, Universal joint, constant velocity joint, Hotchkiss drive, and torque tube drive. Differential - Need and types Rear Axles and Front Axles. Need, types Mechanical, hydraulic, Pneumatic brakes, Electrical Brakes, Engine Exhaust brakes, Drum and Disc brakes, Comparison. Details of components, Brake adjustment.Construction. Operation and maintenance of Lead acid batteries, battery charging system, Principles and Operation of cut-out and regulators, Starter motor, Battery Ignition and magneto ignition systems ignition

timing. Lighting and electrical accessories Automobile air- conditioning, Panel board instruments. Maintenance, Trouble shooting and service, procedures, Overhauling, Engine tune up, Tools and equipment for repair and Overhaul. Testing equipments.Inspection, laboratory and road testing of automobiles. Safety Considerations in automobiles, Tractors, Trailers, Funmobiles, Hybrid vehicles racing cars. Recent Advances in automobiles such as ABS, Electronic Power Steering, Steer by wire, Traction control, Active suspension, Collision avoidance, Intelligent lighting, Navigational aids and Intelligent vehicle highway system.

Practical: Practicals as per course contents.

Text Book:
1. Singh K., Automobile Engineering (Vol. II), 12th ed., Standard Publishers and Distributors, 2011

Additional Books:
1. Ramalingum, K.K., Automobile Engineering, Scitech Publications, Chennai, 2011.
2. Srinivasan, S., Automotive Engines, Tata McGraw Hill, New Delhi, 2004.
3. Crouse, W.H. and Anglin, D.L., Automotive Mechanics, Tata McGraw Hill, 2002.

MEL418 I. C. ENGINES (3-0-2-4)

Pre-requisite: NIL

Contents:

Thermodynamics of fuel-air cycles, real cycles; Unburned and burned gas mixture charts; Ignition, normal and abnormal combustion in SI and CI engines; Conventional and alternative fuels for engines; Conventional and electronic fuel management systems for SI and CI engines; Design of combustion chamber for SI and CI engines; Engine emissions; Lubrication; Cooling; Supercharging and Turbocharging; Modern developments in IC engines.

Practical: Practicals as per course contents.

Text Book:
1. Ganesan, V., Internal Combustion Engines, 4th ed., Tata McGraw Hill, 2013.

Additional Books:
1. Heywood, J.B., Internal Combustion Engine Fundamentals, McGraw Hill, 2012.
2. Obert, E.F., Internal Combustion Engines and Air Pollution, Intext Educational Publishers, 1974.
3. Dankunwar, A.V., Course in Internal Combustion Engines, Dhanpat Rai and Sons, 2002.
4. Mathur, M.L. and Sharma, R.P., Course in Internal Combustion Engines, 8th ed., Dhanpat Rai and Sons, 2003.
5. Pulkrabek, W.W, Engineering Fundamentals of the Internal Combustion Engine, 2nd ed., Pearson Education, 2014.

MEL419 TOOL DESIGN (3-2-0-4)

Pre-requisite: NIL

Contents:

Tool design procedure, Tool making practices, Tooling materials and heat treatment, Cutting tools design, Locating and clamping methods, Design of drill jigs, Design of fixtures, Design of sheet-metal bending, forming and drawing dies, Design of sheet-metal blanking and piercing dies.

Text Book:
1. Donaldson, C. and et.al., Tool Design, 4th ed., Tata McGraw Hill, New Delhi, 2013.

MEL420 MACHINE TOOL DESIGN (3-2-0-4)

Pre-requisite: NIL

Contents:

Design requirements of machine tools. A design approach for machine tools. Identification and quantification of objectives and constraints in machine tool design. Estimation of power requirements and selection of motor for metal cutting machine tool spindles. Design of gearbox, spindle and guideways. Principles of design of structural components, namely, head stock, tail stock, carriage, table, knee, column and overarms to achieve desired static & fatigue strength, stiffness, dynamic characteristics and other requirements. Exercises on the design of machine tools using existing CAD software packages.Introduction to computer integrated manufacturing systems and CNC machine tools. Design/selection of linear motion systems, ball, screws, CNC feedback devices, controllers, feed drives and servomotors for CNC machine tools.Recent developments in CNC and other machine tools.

Text Book:
1. Basu, S.K., and Pal, D.K., Design of Machine Tools, 5th ed., Oxford and IBH Publishing House, 2011

Additional Book:
1. Mehta, N.K., Machine Tool Design and Numerical Control, 3rd ed., Tata McGraw Hill, 2012.

MEL421 MATERIAL RESOURCE PLANNING (3-0-0-3)

Pre-requisite: NIL

Contents:

Role of materials management techniques in material productivity improvement, cost reduction and value improvement. Purchase management, incoming material control. Acceptance sampling and inspection.Vendor rating system.Inventory management, various inventory control models.aterial requirement planning systems. Discrete lot sizing techniques.Wagner and whitin algorithm. Silver-Meal algorithm. Algorithms for multi-product lot sizing with constraints inventory management of perishable commodities. Design of inventory distribution systems. Inventory management in Kanban and Just-in-time.

Additional Books:
1. Gopalakrishnan, P., Purchasing and Materials Management, TMH, New Delhi, 2010.
2. Tersine, R.J., Material Management and Inventory Systems, North Holland, New York, 1979.

MEL 422 NON-METALLIC MATERIALS (3-0-0-3)
Pre-requisite: NIL
Contents:
Introduction to materials and structures, tensile behavior, effect of strain rate and temperature on tensile behavior. Creep: types and mechanisms of creep deformation, super plasticity, environmental effects. Fatigue: high and low cycle fatigue, process of fatigue fracture, effect of mean stress, cyclic stress/strain response of materials, establishment of cyclic stress/ strain curve, evaluation of parameters, characterizing resistance against high cycle and low cycle fatigue, thermochemical fatigue. Failure analysis: analyzing fractures, micro mechanisms of brittle and ductile fracture, fracture mechanism maps, fractography. Introduction to advanced materials: polymers, metals and ceramics matrix composites.

Text Book:
1. Ashby M.F., Engineering Materials, 4th Edition, Elsevier, 2005.

Additional Books:
1. Dieter G.E., Mechanical Metallurgy, 2nd Edition, McGraw Hill, 2005.
2. Ashby MF, Materials Selection in Mechanical Design, Butterworth Heinemann, 2005.
3. Callister W.D., Rethwisch D.G., Materials science and engineering: an introduction, 9th Edition, Wiley, 2014.

MEL423 DESIGN AND ANALYSIS OF EXPERIMENTS (3-0-0-3)
Pre-requisite: NIL
Contents:
Fundamentals of experimentation: role of experimentation in rapid scientific progress, historical perspective of experimental approaches, steps in experimentation, principles of experimentation; simple comparative experiments: basic concepts of probability and statistics, comparison of two means and two variances, comparison of multiple (more than two) means & ANOVA; experimental designs: factorial designs, fractional factorial designs, orthogonal arrays, standard orthogonal arrays & interaction tables, modifying the orthogonal arrays, selection of suitable orthogonal array design, analysis of experimental data; response surface methodology: concept, linear model, steepest ascent, second order model, regression; Taguchi's parameter design: concept of robustness, noise factors, objective function & S/N ratios, inner-array and outer-array design, data analysis.

Text Book:
1. Montgomery D.C., Design and Analysis of Experiments, 7th Edition, John Wiley & Sons, 2008.

Additional Books:
1. Ross P.J., Taguchi Techniques for Quality Engineering, McGraw-Hill Book Company, 2008.
2. Holman J.P., Gajda W.J., Experimental Method for Engineers, 7th Edition, McGraw-Hill, 2007.

MEL424 NON TRADITIONAL MANUFACTURING PROCESSES (3-0-0-3)
Pre-requisite: NIL
Contents:
Introduction, need for unconventional manufacturing processes, its classification and future possibilities, hybrid processes. Unconventional machining processes based on material removal by abrasion, abrasive jet machining and ultrasonic machining. Thermoelectric unconventional methods, plasma arc machining, laser beam machining, electron beam machining, Electric discharge machining, wire electric discharge machining. Electro-chemical machining processes, electro-chemical grinding, electro-chemical deburring, chemical machining. Electronic-device manufacturing, diffusion and photo- lithography process for electronic-device manufacturing, Rapid Prototyping- different techniques.

Text Book:
1. Kalpakjian S. and Schmid S.R., Manufacturing Engineering and Technology, 4th Edition, Pearson Education, 2013.

Additional Books:

1. Benedict G.F., Unconventional Machining Process, Marcel Dekker Publication, 1987.
2. Sharma P.C., A Text book of Production Engineering, New Delhi, 1995.
3. Mishra P.K., Nonconventional machining. Narosa publishing house, 2007.
4. Jain V.K., Advanced machining processes, Allied publishers, 2009.

MEL425 THEORY OF PLASTICITY AND METAL FORMING PROCESSES (3-0-0-3)
Pre-requisite: NIL
Contents:
Elements of theory of plasticity, formulation of plastic deformation problems and different methods of solution, stress-strain relations in elastic and plastic deformations, yield criteria for ductile metals, work hardening and anisotropy in yielding, flow curves, slip line field theory, effect of temperature and strain rate in metal working, friction and lubrication in cold and hot working, technology and analysis of important metal forming processes–forging, rolling, extrusion, wire drawing, sheet metal forming processes like deep drawing, stretch forming, bending.

Text Book:
1. Dixit U.S., Narayanan R.G., Metal forming: technology and process modelling, Tata McGraw-Hill Education, 2013.

Additional Books:
1. Avitzur B., Metal Forming: Processes and Analysis, McGraw-Hill Inc., 1968.
2. Chakrabarty J., Theory of plasticity, Butterworth-Heinemann, 2012.
3. Kumar S., Technology of metal forming processes. PHI Learning Pvt. Ltd, 2008.
4. Juneja B.L., Fundamentals of Metal Forming Processes, New Age International, 2007.

MEL426 ADVANCED JOINING PROCESSES (3-2-0-4)
Pre-requisite: NIL
Contents:
Introduction to joining technology, Physics of the welding arc and arc characteristics, Metal transfer & its importance in arc welding, Various forces acting on a molten droplet and melting rates, Welding consumables: fluxes, gases and filler materials, welding processes and its variants, Soldering, Brazing and diffusion bonding, Resistance welding, Thermit welding, Electro-slag and electro-gas welding, Solid-state and radiant energy welding processes. Heat flow in welds, Effect on HAZ, Development of phases, Microstructure etc, Weldability, Mechanical testing of weldments, Thermal stresses and distortion, NDT of welds, Joining metallurgy and microstructures, weld symbols, Weld joint designs for strength and quality, Welding of plastics, Automation in welding, Cost analysis.

Text Book:
1. Little R.M., Welding and Welding Technology, McGraw-Hill, 1973.

Additional Books:
1. Cary H.B., Modern Welding Technology, Prentice-Hall, 1979.
2. Parmar R.S., Welding Engineering and Technology, Khanna Publication, 2010.
3. Handbook W., Welding Processes, American Welding Society, 1991.

MEL427 QUALITY ASSURANCE (3-0-0-3)
Pre-requisite: NIL
Contents:
Introduction to quality assurance and quality control, Various elements in Quality Assurance program, On-line and Off-line quality control, Statistical concepts in quality, probability distributions, Central limit theorem, Chance and assignable causes of quality variation, Process control charts for variables, Control chart parameters, Target process setting/Centering, Control limits and specification limits. Process capability studies, Capability indices, Quality remedial/Corrective actions, Special purpose control charts, Reject limits, Variables inspection and attributes Inspection, Quality rating, Defects classification, Average run length. Economics of product inspection, Quality costs, ISO 9000 quality system, Product quality and reliability, Failure data analysis and life testing. Problems and illustrations in Quality Assurance. Automatic gauging, automatic measuring machines for inspecting multiple workpiece dimensions, measurement with coordinate measuring machines.

Text Book:
1. Mitra A., Fundamentals of quality control and improvement, John Wiley & Sons, 2016.

Additional Books:
1. Leavenworth R.S., Grant E.L., Statistical Quality Control, Tata McGraw-Hill Education, 2000.
2. Bestefield D.H., Quality Control, Prentice Hall, 2003.
3. Feigenbaum A.V., Total Quality Control, McGraw-Hill, 1983.

MEL428 PROCESS ENGINEERING (3-0-0-3)
Pre-requisite: NIL
Contents:

Process engineering functions, degrees of freedom and datum surfaces, errors in manufacturing, factors affecting manufacturing accuracy, preliminary analysis of processing alternatives, dimensional and tolerance analysis, dimensional and geometrical tolerances, detailed planning of process of manufacture, process-planning records, production techniques for typical components and tools jigs and fixture design and manufacture, group technology, CAPP, PFMEA, DFM.

Text Book:
1. Gadzala J.L., Dimensional Control in Precision Manufacturing, McGraw Hill, 2002.

Additional Books:
1. Wade O.R., Tolerance Control in Design and Manufacturing, Industrial Press, 1998.
2. Eary D.F. and Johnson G.E., Process Engineering for Manufacturing, Prentice Hall, 1962.

MEL429 PROCESSING OF COMPOSITE MATERIALS (3-0-0-3)
Pre-requisite: NIL
Contents:
FRP Composites, fiber types, fiber forms and properties, matrices type and properties, lamina, laminate, composites–macro and micromechanical analysis & properties, failure theories, primary and secondary manufacturing - lay-up, filament winding, pultrusion, compression moulding, RTM, RIM, SRIM, machining - drilling, routing etc., application Metal Matrix Composites–powder metallurgy, sintering, squeeze casting, applications Ceramic Matrix Composites–clays, whiskers, fibers, mixing, mass processing techniques, applications.

Text Book:
1. Chawla K.K., Composite materials: science and engineering, 3rd Edition, Springer, 2013.

Additional Books:
1. Miracle D.B. and Steven L.D., ASM Handbook Composites Volume 21, ASM International, 2001.
2. Suresh G.A. and Sozer E.M., Process Modeling in Composites Manufacturing, 2nd Edition, CRC Press, 2009.
3. Schwartz M.M., Composite Materials: Processing, fabrication, and applications, Prentice Hall, 1997.
4. Kaw A.K., Mechanics of composite materials, CRC press, 2005.

MEL430 FRACTURE MECHANICS (3-0-0-3)
Pre-requisite: NIL
Contents:
Introduction, back ground history of fracture mechanics; conventional failure criteria, Griffith's work. Linear Elastic Fracture Mechanics (LEFM): Crack deformation modes and basic concepts, crack tip stresses and deformation, stress intensity factor (SIF) and its criticality in different modes, superposition of SIFs; Concept of energy release rate, equivalence of energy release rate and SIF. Anelastic Deformation at the Crack tip; Effective Crack length, Irwin model, Dugdales model. Fracture toughness: Fracture toughness; Effect of temperature and loading rate on fracture toughness; Fatigue and fatigue crack propagation laws, fatigue life calculations under constant and variable amplitude loading, Mixed mode-. Strain Energy Density Failure Criterion, volume strain energy density, basic hypothesis and application of energy density based failure criteria for two and three dimensional linear elastic crack problems. Elastic Plastic Fracture Mechanics: plastic zone corrections, crack opening displacement (COD), J-contour integral and crack growth resistance (R-curve) concepts.

Text Book:
1. Broek D., Elementary Engineering Fracture Mechanics, 3rd Edition, Springer, 1982.

Additional Books:
1. Kumar P., Elements of Fracture Mechanics, Tata McGraw-Hill Education, 2009.
2. Gdoutos E.E., Fracture Mechanics: An Introduction, 2nd Edition, Springer, 2005.
3. Kundu T., Fundamentals of Fracture Mechanics, CRC Press, 2008.

MEL431 DYNAMICS OF MECHANICAL SYSTEMS (3-0-0-3)
Pre-requisite: NIL
Contents:
Basic concepts: Inertial coordinate system, laws of motion, mechanics of system of particles, principles of linear and angular momentum, Lagrangian dynamics: Degrees of freedom, generalized coordinates, holonomic and non-holonomic constraints, Lagrange's equation from d'Alembert's principles, application of Lagrange's equation for conservative and non-conservative autonomous systems with holonomic and non-holonomic constraints, applications to systems with very small displacements; Hamilton principle from D'Alembert's principle, Lagrange equation from Hamilton's principle. Multi-body dynamics: Space and fixed body coordinate systems, coordinate transformation matrix, direction cosines, Euler angles, Euler parameters, finite and infinitesimal rotations, time derivatives of transformations matrices, angular velocity and acceleration vectors, equations of

motion of multi-body system, Newton-Euler equations, planar kinematic and dynamic analysis, kinematic revolute joints, joint reaction forces, simple applications of planar systems. Stability of motion: Fundamental concept in stability, autonomous systems and phase plane plots, Routh's criteria for stability.

Text Book:
1. Meirovitch L., Methods of Analytical Dynamics, McGraw Hill, 2010.

Additional Books:
1. Robert H.C., Dynamics of Physical Systems, McGraw Hill, 2003.
2. Robert L.W. and Kent L.L., Modeling and Simulation of Dynamic Systems, Prentice Hall, 2000.
3. Jordan D.W. and Smith P., Nonlinear ordinary differential equations: An Introduction to Dynamical Systems, Oxford University Press, 1999.
4. Greenwood D.T., Principles of Dynamics, Englewood Cliffs, Prentice-Hall, 1988.

MEL432 MECHANISM DESIGN (3-0-0-3)
Pre-requisite: NIL
Contents:
Introduction: Review of concepts of kinematic analysis of mechanisms, degrees of freedom, Grashof's and Gruebler's criteria, transmission angles. Kinematic Synthesis of Mechanisms: Type, number and dimensional synthesis, spacing of accuracy points, Chebyshev polynomials, graphical synthesis with two, three, and four prescribed positions and points. path motion and function generation, Analytical Synthesis Techniques: dyad and standard form equation, Freudenstein's equation for three point function generation, coupler curves, Robert's law. Path Curvature Theory: Fixed and moving centrode, inflection points and inflection circle, Euler-Savary equation. Dynamic Force Analysis: Introduction, inertia forces in linkages, kinetic-static analysis by superposition and matrix approaches and its applications, introduction to spatial mechanisms. Software usages: Modelling, analysis and synthesis of various mechanisms using software packages.

Text Book:
1. Robert L.N., Kinematics & Dynamics of Machinery, Tata McGraw Hill, 2003.

Additional Books:
1. Sacks E. and Joskowicz L., The Configuration Space Method for Kinematic Design of Mechanisms, MIT Press 2010.
2. Erdman A.G. and Sandor G.N., Mechanism Design: Analysis and Synthesis, 3rd Edition, Prentice Hall, 1994.
3. Sandor G.N. and Erdman A.G., Advanced Mechanism Design: Analysis and Synthesis, Prentice Hall, 1994.
4. Mallik A.K., Ghosh A. and Dittrich G., Kinematic analysis and synthesis of mechanisms. CRC Press, 1994.

MEL433 TRIBOLOGY IN DESIGN (3-0-0-3)
Pre-requisite: NIL
Contents:
Introduction, History and basic concept of friction wear and lubrication. Lubricants and Lubrication modes: Properties of lubricants, modes of lubrication: hydrodynamic, hydrostatic, Elasto-hydrodynamic lubrication, Reynolds' equation, Applications of hydrodynamic lubrication theory, Hydrodynamic lubrication of roughened surfaces. Bearings: Bearing characteristics, Selection of bearings, Squeeze-film lubrication bearings, Thrust bearings, Journal bearings, air lubricated bearing, bearing vibration measurements. Wear: Types of wear and their mechanisms: Adhesive wear, Abrasive wear, Wear due to surface fatigue, wear due to chemical reactions, wear of bearings, wear of metallic and non-metallic bearing materials, material combination for better tribological contacts.

Text Book:
1. Basu S.K., Sengupta S.N. and Ahuja B.B., Fundamentals of Tribology, PHI Learning Pvt. Ltd., 2005.

Additional Books:
1. Williams J.A., Engineering Tribology, Oxford Univ. Press, 2001.
2. Cameron A., Basic Lubrication Theory, Ellis Horwood Ltd., 2002.
3. Stachowaik G.W., Batchelor A.W., Engineering Tribology, 3rd Edition, Elsevier, 2010.

MEL434 MODELLING AND SIMULATION (3-0-0-3)
Pre-requisite: NIL
Contents:
Systems and models - Examples of models, models for systems and signals. Physical modelling - Principles of physical modelling, basic relationship. Mathematical modelling: Estimating response, spectra and frequency functions, parameter estimation in dynamic models, system identification as a tool for model building. Simulation and Simulation application: Numerical prototyping as modelling for design and synthesis using computational tools, Introduction to techniques for validation of models, Simulation of electromechanical, thermo-mechanical, hydraulic and pneumatic elements. Modelling and Simulation for Optimization: Introduction to the concept of optimization, the basic terminology and notations; modelling process; and illustration with modelling of engineering

problems Local and global optima; necessary and sufficient optimality conditions for unconstrained and constrained multivariate functions.

Text Book:

1. Bhonsle S.R. and Weinmann K.J., Mathematical Modelling for Design of Machine Components, Prentice Hall, 1999.

Additional Books:

1. Lennart L. and Torkel G., Modelling of Dynamic Systems, Prentice Hall, 1994.
2. Gordon G., System Simulation, Prentice Hall, 1978.
3. Mukherjee A. and Karmakar R., Modelling and simulation of engineering systems through bondgraphs, Alpha Science Int'l Ltd., 2000.

MEL435 DESIGN PRINCIPLES (3-0-0-3)

Pre-requisite: NIL

Contents:

Introduction: Considerations of a Good Design, Design Process, Concurrent and Computer aided engineering concepts, Design codes and Standards, Design Review and societal considerations. Need Identification and gathering information: Evaluating Customer requirements and Bench marking, Product Design Specification, Information sources, Copyright, Expert systems. Concept Generation and Evaluation: Creativity and Problem solving, Theory of Inventive Problem solving, Conceptual Decomposition and Axiomatic Design, Decision concept evaluation and decision making. Embodiment Design: Product Architecture, Configuration and Parametric Design Concepts, Industrial Design, Ergonomics and Design for Environment, Modeling and Simulation for engineering design process, Material selection and detailed design. Team Work and Ethics in engineering design: Team formation, functioning, discharge, team dynamics, Ethical issues considered during engineering design process.

Text Book:

1. George E.D., Engineering Design, McGraw Hill, 2001.

Additional Books:

1. Ken H., Engineering Design Principles, Elsevier, 1999.
2. Pahl G., Beitz W., Engineering Design: A Systematic Approach, Springer, 2013.

MEP401 MACHINE SYSTEM DESIGN (1-0-4-3)

Pre-requisite: NIL

Contents:

Design of a small Mechanical system consisting of shaft, bearing, gear/belt. Only output expected shall be provided. Complete concept shall be developed by tudents.

Final report shall consist of concept, Power and Force calculations, Component design report, Production Drawing of compounds, Assembly and sub assembly drawing of components.

This task can be done by a group of not more than 3 students.

Practical: Practicals as per course contents.

Text Book:

1. PSG Design Data Book.