B.Tech. (Mechanical Engineering)
OVERALL CREDIT STRUCTURE

Undergraduate Core(UC)		Undergraduate Elective (UE)	
Category	*Credit*	*Category*	*Credit*
DC	67	**DE**	23 (minimum)
BS	19	**HM**	06 (minimum)
ES	22	**OC**	18 (Balance)
HM	05	**UN**	0 (03 Courses)
Total	113	**Total**	47
Grand Total (UC + UE)			**160**

Basic Science (BS)			
Course Code	**Course**	**L-T-P**	**Credit**
SCL152	Applied Mathematics-I	3-2-0	04
SCL153	Applied Mathematics-II	3-2-0	04
SCL251	Applied Mathematics-III*	3-0-0	03
SCL154	Applied Physics	3-0-0	03
SCP154	Applied Physics Lab	0-0-2	01
SCL155	Applied Chemistry	3-0-0	03
SCP155	Applied Chemistry Lab	0-0-2	01
Total			**19**

Humanities and Management (Core) (HM)			
Course Code	**Course**	**L-T-P**	**Credit**
HMP152	Technical Communication	2-0-2	03
HML151	Social Science	2-0-0	02
Total			**05**

Engineering Arts and Science (ES)			
Course Code	**Course**	**L-T-P**	**Credit**
MEL152	Elementary Mechanical Engineering	3-0-0	03
EEL151	Elementary Electrical Engineering	3-0-0	03
EEP151	Elementary Electrical Engineering Lab	0-0-2	01
ECL151	Basic Electronics Engineering	3-0-0	03
ECP151	Basic Electronics Engineering Lab	0-0-2	01
MEL151	Engineering Drawing	3-0-0	03
MEP151	Engineering Drawing Lab	0-0-2	01
CSL151	Computer Programming and Problem Solving	3-0-0	03
CSP151	Computer Programming Lab	0-0-2	01
MEP152	Mechanical Workshop	0-0-2	01
CEL151	Environmental Science	2-0-0	02
Total			**22**

Non Credit Requirement (UN)			
Course Code	**Course**	**L-T-P**	**Credit**
NCN101	NCC#	-	0
NCN102	NSS#	-	0
NCN103	NSO#	-	0
SPB101	Sports-I#	0-0-4	0
SPB102	Sports-II#	0-0-4	0
HMD251	Community Project	-	0
MET251	Practical Training	-	0

#A student has to opt at least one from NCC, NSS, NSO and Sports (I & II both).

Departmental Core (DC)			
Course Code	**Course**	**L-T-P**	**Credit**
MEL251	Mechanical Behaviour of Materials	3-0-0	03
MEL252	Engineering Thermodynamics	3-0-0	03
MEL253	Fluid Mechanics	3-0-0	03
MEP253	Fluid Mechanics Lab	0-0-2	01
MEL254	Solid Mechanics	3-0-0	03
MEP254	Solid Mechanics Lab	0-0-2	01
MEL255	Kinematics of Machines	3-2-0	04
MEL256	Machine Drawing	1-0-0	01
MEP256	Machine Drawing Lab	0-0-4	02
MEL257	Casting Welding and Forming	3-0-0	03
MEP257	Casting Welding and Forming Lab	0-0-2	01
MEL258	Machining and Machine Tools	3-0-0	03
MEP258	Machining and Machine Tools Lab	0-0-2	01
MEL351	Energy Conversion Techniques	3-0-0	03
MEP351	Energy Conversion Techniques Lab	0-0-2	01
MEL352	Fluid Machines	3-0-0	03
MEP352	Fluid Machines Lab	0-0-2	01
MEL353	Heat and Mass Transfer	3-0-0	03
MEP353	Heat and Mass Transfer Lab	0-0-2	01
MEL354	Dynamics of Machines	3-0-0	03
MEP354	Dynamics of Machines Lab	0-0-2	01
MEL355	Measurement and Control	3-0-0	03
MEP355	Measurement and Control Lab	0-0-2	01
MEL356	Operations Management	3-0-0	03
MEL357	Design of Machine Elements	3-2-0	04
MEL451	Refrigeration & Air Conditioning	3-0-0	03
MEP451	Refrigeration & Air Conditioning Lab	0-0-2	01
MEL452	Mechanical Vibrations	3-0-0	03
MEP452	Mechanical Vibrations Lab	0-0-2	01
MED351	Minor Project	-	01
MED451	Major Project	-	02

Departmental Elective (DE)			
Course Code	**Course**	**L-T-P**	**Credit**
SCL453	Probability Theory and Statistics	3-0-0	03
MEL358	Metrology and SQC	3-0-0	03
MEP358	Metrology and SQC Lab	0-0-2	01
MEL453	Operation Research	3-2-0	04
MEL454	Industrial Engineering	3-0-0	03
MEL455	Fluid Dynamics	3-0-0	03
MEL456	Computer Aided Design	3-0-0	03
MEP456	Computer Aided Design Lab	0-0-2	01
MEL457	Computer Integrated Manufacturing	3-0-0	03
MEL458	Mechatronics	3-0-0	03
MEP458	Mechatronics Lab	0-0-2	01
MEL459	Gas Turbine and Compressor	3-0-0	03
MEL460	Quality Assurance	3-0-0	03
MEL461	Robotics	3-0-0	03
MEP461	Robotics Lab	0-0-2	01
MEL462	Automation in Production	3-0-0	03
MEL463	Power Plant Engineering	3-0-0	03
MEL464	Renewable Energy Sources	3-0-0	03
MEL465	Automobile Engineering	3-0-0	03
MEP465	Automobile Engineering Lab	0-0-2	01
MEL466	IC Engine	3-0-0	03
MEP466	IC Engine Lab	0-0-2	01
MEL467	Tool Design	3-2-0	04
MEL468	Machine Tool Design	3-2-0	04
MEL469	Material Resource Planning	3-0-0	03
MEL470	Computer Integrated Manufacturing	3-0-0	03
MEP471	Machine System Design Lab	0-0-4	02

Course Syllabi (Under Graduate)
Department of Mechanical Engineering

Course Code: MEL 151
Course Title: ENGINEERING DRAWING
Structure (L-T-P): 3-0-0
Prerequisite: 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. Introduction to AutoCAD.

Text Book:
1. Bhatt, N.D, Engineering Drawing: Plane and Solid Geometry, 51st ed., Charotar Publishing House Pvt. Ltd., 2012.

Reference 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, 2012.
2. Gill, P.S., A Text Book of Engineering Drawing: Geometrical Drawing, 11th ed., S.K. Kataria& Sons, 2009.
3. Agrawal, B. and Agrawal, C.M., Engineering Drawing, 7th ed., Tata McGraw Hill Education, 2011.
4. Shah, M.B. and Rana, B.C., Engineering Drawing, 2nd ed., Pearson Education, 2012.
5. Jolhe, D.A., Engineering Drawing: With an Introduction to AutoCAD, Tata McGraw Hill Education, 2011.

Course Code: MEL 152
Course Title: ELEMENTARY MECHANICAL ENGINEERING
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents: Mechanics Introduction: System of forces, coplanar concurrent force system, equilibrium of rigid bodies, free body diagram, Lami's theorem, varignon's theorem, Analysis of framed structure: Reaction in beam with different end conditions, determination of reactions in members of trusses. Centre of gravity and moment of inertia: Concept of C.G and centroid, position of centroid, theorem of parallel and perpendicular axes, moment of inertia of simple geometrical figures. Types of Friction, Introduction to stress and strain, Elastic constants.
Basics of Thermal and Fluid Science: Introduction, thermodynamics properties, forms of energy, thermodynamic systems and control volume, steady flow systems, types of work, thermodynamic processes, Zeroth, first and second law of thermodynamics, Reversible and Irreversible processes, steady-state energy equation and its applications, Heat engine, Heat pump and refrigerator, COP.
Introduction to IC Engine: two-stroke engine, four stroke engine, Otto Cycle, Diesel Cycle and dual cycle.Introduction to fluid mechanics, Properties of fluids, surface tension, compressibility, pressure measurement.

Text Book:
1. Beer and Johnston, Vector Mechanics for Engineers: Statics and Dynamics, 10th ed., Tata McGraw-Hill, 2013.
2. Cengel Y. A., Boles M., Thermodynamics: An Engineering Approach, 8th ed. McGraw- Hill, 2006.

Reference Book:
1. Shames, I.H., Engineering Mechanics: Statics and Dynamics, 4th ed., Pearson Education, 2011.
2. Nag P. K., Engineering Thermodynamics, 5th ed., Tata McGraw- Hill, 2005.
3. Cengel Y. A., Cimbala, J. M., Fluid Mechanics: Fundamentals and Applications, 3rd ed., Tata McGraw- Hill, 2010.

Course Code: MEL 251
Course Title: MECHANICAL BEHAVIOUR OF MATERIALS
Structure (L-T-P): 3-0-0
Prerequisite: 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, 5thed., Prentice Hall, 2012.

Reference Books:
1. Avner, S.H., Introduction to Physical Metallurgy, 2nded., Tata McGraw Hill, 2012.
2. Dieter, G.E. and Bacon, D., Mechanical Metallurgy, Tata McGraw Hill, 2001.
3. Lakhtin, Y.M., Engineering Physical Metallurgy and Heat treatment, 6thed., CBS Publishers, 1998.
4. Rollason E.C., Metallurgy for Engineers, 4th ed., EdwardArnoldPublications, 1982.

Course Code: MEL252
Course Title: ENGINEERING THERMODYNAMICS
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents: Introduction to basic concept of thermodynamics: Types of system, state and properties of system, thermodynamic equilibrium, heat and thermodynamic work. Laws of thermodynamics. First Law of thermodynamics: Flow and non-flow system, change in internal energy, heat transferred and work transferred during various thermodynamic processes, P-V diagrams. Applications of steady and unsteady flow processes. Second law of thermodynamics: Kelvin-Plank & Clausius Statement. Heat engine, refrigerator and heat pump, reversible and irreversible processes.Carnot cycle, thermodynamic temperature scale. Entropy: Clausiusinequality, entropy principle, change in entropy for closed and open systems. Availability: Reversible work and irreversibility. Properties of Ideal gas, equation of state, internal energy and specific heats of gases.Properties of pure system and use of steam tables, Mollier charts, P-V, T-S and H-S diagrams.Dryness fraction and its measurement. Work and heat transfer during various thermodynamic processes with steam as working fluid. Air standard cycles: Otto, Diesel, Stirling, Ericsson, Atkinson and Brayton. Vapour power cycles: Simple and Modified Rankine Cycle, combined cycle.

Text Book:
1. Cengel, Y.A. and Boles M.A., Thermodynamics: An Engineering Approach, 8th ed., McGraw Hill, 2015.
2. Nag, P.K., Engineering Thermodynamics, 6th ed., Tata McGraw Hill Education, 2017.

Reference 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, 5th ed., Tata McGraw Hill Education, 2013.
4. Holman, J.P., Thermodynamics, 4th ed., Mc-Graw Hill, 1988.
5. Joel, R., Basic Engineering Thermodynamics, 5th ed., Pearson Education, 2014.
6. Arora, C.P., Thermodynamics, Tata McGraw Hill Education, 2011.

7. Borgnakke, C. and Sonntag, R.E., Fundamentals of Thermodynamics, 7th ed., Wiley India, 2011.

Course Code: MEL253
Course Title: FLUID MECHANICS
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents: Introduction to Fluid Mechanics, fluid properties and classification. Fluid statics: Pressure variation in a static fluid, forces on submerged surfaces, stability of floating bodies, rigid body motion. Kinematics of fluid Flow, Ideal Fluid Flow.Inviscid flow: Euler equation, Bernoulli's equation and its applications, Reynolds transport theorem, mass, momentum and energy conservation laws with applications, governing equations for Newtonian fluids, exact solutionsofNavier-Stokes Equation,Internal flows: pipe flow, hydraulic diameter, laminar and turbulent flows, friction factor, Moody diagram, minor and major losses, pipe networks, flow measurement, Introduction to open channel flow.External flows: introduction to boundary layer theory, flow over flat and curved surfaces, boundary layer separation. Dimensional analysis and modeling, Buckingham Pi theorem,

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, 3rd ed., Tata McGraw Hill Education, 2015.

Reference 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 Mechanics and 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. Khan, M.K., Fluid Mechanics and Machinery, 1st ed. Oxford University Press India, 2015.
5. Bansal, R.K., A Textbook of Fluid Mechanics and Hydraulic Machines, 9th ed., Laxmi Publication, 2014.
6. Fox, R.W., Pritchard, P.J. and Mcdonald, A.T., Introduction to FluidMechanics, 7th ed., Wiley India, 2012.
7. Munson, B.R. and et al., Fundamentals of Fluid Mechanics, 6thed., Wiley India, 2012.

Course Code: MEL254
Course Title: SOLID MECHANICS
Structure (L-T-P): 3-0-0
Prerequisite: 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, Applicationof 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.

Text Books:
1. Gere, J.M. and Timoshenko, S.P., Mechanics of Materials, 3rded., CBS Publishers, 2012.
2. Beer, F.P. and Others, Mechanics of Materials, 6thed., Tata McGraw HillEducation, 2013

Reference Books:
1. Shames, I.H. and Pitarresi, J.M., Introduction to Solid Mechanics, 3rded., Prentice Hall India, 2013.
2. Popov, E.P., Engineering Mechanics of Solids, 2nded., Prentice Hall India,2012.

Course Code: MEL255
Course Title: KINEMATICS OF MACHINES
Structure (L-T-P): 3-2-0
Prerequisite: 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, Instantaneous centre of velocity method, Concept of velocity and acceleration image, Coriollis component of acceleration, 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.
Introduction to Belt drive, clutches and brakes, ratio of belt tension, initial tension for flat and V belts, types of clutches and relations for torque transmitted, types of brakes and braking torque relations.
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.

Text Book:
1. Norton, R.L., Kinematics and Dynamics of Machinery, 1st ed., Tata McGraw Hill Education, 2013
2. Rattan, S. S., Theory of Machines, 3rd ed., Tata McGraw Hill Education, 2012.

Reference 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., 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., East-West Press, 2011.
5. Waldron, K.J. and Kinzel, G.L., Kinematics, Dynamics and Design of Machinery, 2nd ed., John Wiley & Sons, 2004.
6. Ambedkar, A.G., Mechanism and Machine Theory, 3rd ed., Prentice Hall, 2011.

Course Code: MEL 256
Course Title: MACHINE DRAWING
Structure (L-T-P): 1-0-0
Prerequisite: MEL151
Contents: Introduction to the generation of drawings as a design process for machine assembly. Sectioning, dimensioning and version control in drawings.
Standardized representation of threads, fasteners, welds, bearings, springs and related components.
Introduction to limits fits, and tolerances, dimensional and geometric tolerances, surface finish symbols.
Generation of assembly drawings including sectioning and bill of materials.
Evolving details of components from assembly considerations.Solid modeling of components involving shafts, bearing, pulleys, gears, belts, brackets, gearbox, plumber block and tailstock for assembly.

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

Reference 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., Charotar Publishing House, 2012.
3. PSG College of Technology, Design Data, 1st ed., DPV Printers, Coimbatore, 2002.
4. Junnarkar, N.D., Machine Drawing, Pearson Education, 2011.

Course Code: MEL257
Course Title: CASTING WELDING AND FORMING
Structure (L-T-P): 3-0-0
Prerequisite: NIL

Contents: Casting: Casting Process and its classifications, Heating and Pouring, Fluidity, Porosity, Solidification and Cooling, Shrinkage, Riser and Gating Design, Sand Casting, Shell Moulding, Vacuum Casting, Investment Casting, Permanent Mould Casting - Die Casting, Squeeze Casting, Centrifugal Casting, Foundry Practices, Casting Quality, Product Design Considerations, Casting of Ferrous and Non-ferrous alloys, Economics of Casting, Shaping processes for plastics.

Welding: Classifications, Gas Welding and Cutting, Electric Arc Welding – Principle, Equipment and Electrodes, MMAW, Carbon Arc Welding, TIG, MIG, SAW, PAW, Resistance Welding – Spot, Seam, Upset, Flash, Welding Design, Welding Defects, Thermit Welding, Electroslag Welding, Electron Beam Welding, Laser Beam Welding, Forge Welding, Friction Welding, Diffusion Welding, Explosion Welding, Brazing and Soldering.

Metal Forming: Hot/Cold Working, Material Behaviour in MF, Strain Rate Sensitivity, Friction and Lubrication in MF, Rolling, Forging, Extrusion, Wire Drawing, Rod and Tube Drawing, Swaging, Sheet Metal Operations – Shearing, Drawing, Spinning, Bending, Embossing, Coining, Sheet Metal Die Design.

Text Book:

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

Reference 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. Bawa H. S., Workshop Technology, Tata McGraw Hill, 2001.

Course Code: MEL258
Course Title: MACHINING AND MACHINE TOOLS
Structure (L-T-P): 3-0-0
Prerequisite: NIL

Contents: Metal machining: Chip Formation, Shear Zone, Orthogonal Cutting, Shear Angle and its Relevance, Cutting-Tool Geometry, Dynamometers, Cutting-Tool Materials, Thermal Aspects, Tool Wear and Tool Life, Surface Finish, Cutting Fluids, Empirical and Analytical Determination of Cutting Forces, Economics.

Cutting- Tool Materials and Cutting Fluids

Machining processes: Turning, Hole making, Milling, Broaching, Sawing, Filing, Gear Manufacturing, Abrasive machining and finishing operations

Non-Traditional Machining - Electric-Discharge Machining, Electrochemical Machining, Ultrasonic Machining, Chemical Machining, Laser-Beam Machining, Abrasive Water-Jet Machining (AWJM), Electron-Beam Machining (EBM), Ion-Beam Machining (IBM), Plasma-Arc Machining (PAM)

Text Book:

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

Reference 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.

Course Code: MEL351
Course Title: ENERGY CONVERSION TECHNIQUES
Structure (L-T-P): 3-0-0
Prerequisite: MEL202

Contents: 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.Compressors: Classifications, working principle. Reciprocating compressor: 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. Steam Turbines: Classifications, Velocity diagrams, Blade/Diagram efficiency. Condensers: Classifications, cooling tower. Law of Partial pressure, air leakage in condenser.Calculations of Condenser efficiency and vacuum efficiency. 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.

Text Books:

1. Eastop, T.D. and McConkey, A., Applied Thermodynamics: For Engineering Technologists, 5th ed., Pearson Education, 2013.
2. Nag, P.K., Power Plant Engineering, 4th ed., Tata McGraw Hill, 2014.

Reference Books:

1. Rogers, G.F.C. and Mayhew, Y.R., Thermodynamics and Transport Properties of Fluids, 5thed., Blackwell Publishers, 2013.
2. Ganesan, V., Internal Combustion Engines, 4th ed., Tata McGraw Hill Education, 2013.
3. Dixon, S.L. and Hall, C.A., Fluid Mechanics and Thermodynamics of Turbomachinery, 6thed., Elsevier, 2010
4. Arora, C.P., Refrigeration and air conditioning, 3rded., 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, 5thed., Pearson Education, 2014.
7. Ballaney, P.L., Thermal Engineering, 5thed.,Khanna Publishers, 2012.
8. Heywood, J.B., Internal Combustion Engine Fundamentals, 1sted., Tata McGraw Hill Education, 2012.

Course Code: MEL352
Course Title: FLUID MACHINES
Structure (L-T-P): 3-0-0
Pre-requisite: MEL253

Contents: Introduction to Hydraulic Machines, Impulse 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. Hydraulic Turbine: impulse turbines i.e. Pelton wheel.

Reaction turbines i.e. Francis turbines, Propeller turbine, Kaplan turbine and bulb turbine.Principle of operation, construction, design, installation, characteristics, governing, accessories, selection, model testing, degree of reaction, velocity diagram and analysis, unit and specific quantities. Pump: centrifugal pump, reciprocating pump and rotary pumps. 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. Introduction to axial pump, mixed flow pump, self-priming pump, gear pump, sliding vane pump, screw pump & hand pump. Miscellaneous fluid machines: airlift pumps, hydraulic rams, hydraulic cranes, fluid couplings and torque converter.

Text Book:

1. Ojha C.S.P., Berndtsson R., Chandramouli P.N., Fluid Mechanics and Machinery, 1st ed., Oxford University Press 2010.
2. Cengel, Y.A. and Cimbala, J.M., Fluid Mechanics: Fundamentals and Applications, 3rded., Tata McGraw Hill Education, 2015.

Reference Books:

1. Yahya, S.M., Turbines, Fans and Compressors, 4thed., Tata McGraw Hill, 2012.
2. Lal, J., Fluid Mechanics and Hydraulics, 9th ed., Metropolitan Book Corporation .Private Limited, 2012.
3. Khan, M.K., Fluid Mechanics and Machinery, 1st ed. Oxford University Press India, 2015.
4. Nag, P.K., Power Plant Engineering, 3rded., Tata Mc-Graw Hill Education, 2013.
5. Bansal, R.K., A Textbook of Fluid Mechanics and Hydraulic Machines, 9thed., Laxmi Publication, 2014.

Course Code: MEL353
Course Title: HEAT AND MASS TRANSFER
Structure (L-T-P): 3-0-0
Pre-requisite: MEL252, MEL253

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, non-dimensional 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.

Text Books:

1. Cengel, Y.A. and Ghajar A. J., Heat and Mass Transfer, 5th ed., Tata McGraw Hill Education, 2015.
2. Incropera, F.P, and Others. Fundamentals of Heat and Mass Transfer,6th ed., Wiley India, 2013

Reference Books:

1. Holman, J. P.and Bhattacharyya, S., Heat Transfer, 10thed., Tata McGraw Hill Education, 2012.
2. Sukhatme, S.P., A Textbook on Heat Transfer, 4thed., Universities Press, 2013.
3. Ghoshdastidar, P.S., Heat Transfer, 2nded., 2012, Oxford University Press, 2012.
4. Nag, P.K., Heat and Mass Transfer, 3rded. Tata McGraw Hill Education, 2011.

Course Code: MEL354
Course Title: DYNAMICS OF MACHINES
Structure (L-T-P): 3-0-0
Prerequisite: MEL255

Contents: Dynamics: Concept of free body and its equilibrium, work-done-energy equation, general plane motion with translation and rotation, impulse-linear momentum, angular impulse-angular momentum, impact, generalized angular impulse-angular momentum, static force analysis, friction effects, D'Alembert's principle, dynamic force analysis, equivalent dynamical systems, simple gyroscopic motion.

Application: Gyroscopic effect and application, Flywheel and turning moment diagram, Dynamics of slider-crank mechanism, concept of offsets, governors and its types, brakes and dynamometer, Balancing of engines, analysis of friction devices (belt drives, pivots and collars, plate and cone clutches, band and block brakes), applications of Cam and follower.

Vibrations: Free vibration of single-degree-of-freedom undamped and damped systems, resonance, natural frequency, damping, forced vibration of single-degree-of-freedom systems, base excitation, vibration isolation, vibration transmission.

Text Books:

1. Uicker, J.J., Pennock, G.R. and Shigley, J.E., Theory of Machines and Mechanisms, 3rd ed., Oxford University Press, 2013.

Reference 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, 2011.

Course Code: MEL355
Course Title: MEASUREMENT AND CONTROL
Structure (L-T-P): 3-0-0
Prerequisite: 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.

Text Book:

1. Venkateshan, S.P., Meachincal Measurements, 2nd Ed., John Wiley and Sons Ltd., 2015.
2. Montgomery, D. C., Statistical Quality Control, 6th Ed., John Wiley and Sons Inc., 2009.

Reference 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.

3. Grant, E.L. and Leavenworth, R.S., Statistical Quality Control, 7th ed., TataMcGraw Hill, 2000.
4. Feigenbaum, A.V., Total Quality Control, 4th ed., I.K International Publishing House, New Delhi, 2008.
5. Jain, R.K., Engineering Metrology, 20th ed., Khanna Publishers, 2013.

Course Code: MEL356
Course Title: OPERATIONS MANAGEMENT
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents: Production systems and performance measures.Life Cycle of a production system, Major managerial decisions in the life of a production system, Just in Time (JIT), Theory of Constraints (TOC), 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.

Reference 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 withMyOMLab, Pearson Education, 2013.
4. Boeuf, M.L., Essence of Time Management, Jaico Publishing House, 2001.
5. Gupta, A.K. and Sharma, J.K., Management of Systems, Macmillan India Limited, 2010.

Course Code: MEL357
Course Title: DESIGN OF MACHINE ELEMENTS
Structure (L-T-P): 3-2-0
Prerequisite: MEL254, MEL255
Contents: Introduction to Design of Machine Elements, Review of Failure theories, Introduction to design for fatigue strength, Endurance limit and modifying factors, surface strength, Design procedure for fatigue failure, Design of elements subjected to simple and fatigue loading, Design of Shafts and Couplings, Power Screws, Springs, Belts, Chain, Brakes, Bearing, Gears and Mechanical Joints.

Text Books:

1. Norton, R.L., Machine Design : An Integrated Approach, 2nd ed., Pearson Education, 2013
2. Bhandari, V. B., Design of Machine Elements, 4th ed., McGraw Hill, 2016.

Reference Books:

1. Spotts, M. F., Design of Machine Elements, 8th ed., Pearson Education India, 2006.
2. Black, P.H. and Adams, O.E., Machine Design, 3rd ed., McGraw Hill, Kogakusha, 1981.
3. Maleev, V.L. and Hartman, J.B., Machine Design, CBS Publishers and Distributors, 1983.
4. Schmid, S.R., Hamrock, B.J. and Jacobson B.O., Fundamentals of Machine Elements, 3rded., CRC Press, 2014.
5. Budynas, R.G. and Nisbett, J.K., Shigley's Mechanical Engineering Design, 9th ed., Tata McGraw Hill Education, 2013.
6. Juvinall, R. C. and Marshek, K. M., Machine Component Design, 5th ed., Wiley India, 2012.

Course Code: MEL358
Course Title: METROLOGY AND SQC
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents: Mechanical Measurements: Purpose, structure and elements of measuring system, Static performance characteristics, Generalized model of system element and calibration, linearity, static sensitivity, accuracy, precision, repeatability, hysteresis, threshold, resolution and readability. Measurement error: Sources of errors, error analysis, propagation of uncertainties, theory of experimentation. Dynamic Performance characteristics, Input types, instrument types, zero, first, and second order instruments. Measurements and methods applications: Classification, Principle, Construction, Range and working of instruments for following measurements, Displacement, Speed, Force, Torque, Temperature, Flow, Level, Pressure, Sound, Light intensity. Classical Control: Laplace Transformation, Block diagram and its reduction, Time response, Root Locus Analysis, Routh Stability, Frequency response, Bode, Polar, Nyquist, Nichols charts, Nyquist stability, Compensation: Lead, Lag, Lead-Lag, PID controller. Modern Control: State space method, Signal Flow Graph (SFG), State Transition Matrix, Stability, Steady state error. Advanced Control: Digital control, z-transformation, Digital transformation, Stability, Performance plot, Root Locus, Compensation, PID controller, Robust control, Concept of system sensitivity, Sensitivity function, Perturbation: additive, multiplicative, Robust stability, Uncertain system and its stability, Robust PID controller

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

Reference 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.
6. Ogata K., Modern Control Engineering, 5th ed., Pearson Education,2015.
7. Dorf, R. C., & Bishop, R. H., Modem control systems., 6th ed., Addison-Wesely Publishing, Reading, MA, 1995.
8. Nagrath, I. J., Control systems engineering. New Age International, 2006.

Course Code: MEL451
Course Title: REFRIGERATION AND AIR CONDITIONING
Structure (L-T-P): 3-0-0
Pre-requisite: MEL253, MEL353
Contents: Fundamentals of refrigeration and air conditioning. Vapor compression system: Ideal and real cycle analyses, Refrigerants: designation, properties, and environmental considerations. Actual vapor compression cycles, Multi-stage compression. Air refrigeration cycle Components: condensers, evaporators, compressors 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. Air-conditioning systems and apparatus, air flow ducts, air quality. Control and optimization of HVAC systems.Applications and environmental issues.

Text Book:

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.

Reference Books:

1. Dossat, R.J., Principles of Refrigeration, 4th ed., Pearson Education, 2010.
2. Ballaney, P.L., Refrigeration and Air Conditioning, 7th ed., Khanna Publishers, 1992.
3. Khurmi, R.S. and Gupta, J.K., Textbook of Refrigeration and Air Conditioning, 5th ed., S. Chand Publication, 2011.
4. Arora, S.C. and Domkundwar, S., A Course in Refrigeration and Air Conditioning, 7th ed., DhanpatRai and Co., 1999.
5. Pita, E.G., Air Conditioning Principles and Systems: An Energy Approach, 4th ed., PHI Learning Private Limited, 2008.
6. American Society of Heating, Refrigerating and Air-Conditioning Engineers, 2013 Ashrae Handbook: Fundamentals, Inch-Pound ed., ASHRAE, 2013.

Course Code: MEL452
Course Title: MECHANICAL VIBRATIONS
Structure (L-T-P): 3-0-0
Prerequisite: MEL354

Contents: Fundamentals of Vibration: Basic concepts of vibration, classification, importance, vibration analysis procedure.

Single degree of freedom system: Free vibration analysis of undamped translational and torsional system, Rayleigh's energy method, Free vibration with various types of dampings (viscous, coulomb, hysteresis), Free vibration response under harmonic and other general forcing conditions, transient response through Du-hamel's integral.

Two degree of freedom systems: Free vibration analysis of damped and undamped translational and torsional system, Coordinate coupling and principle coordinates, Semi-defined system.

Multi degree of freedom systems: Modeling of continuous systems as multi degree of freedom system using Newton's second law, Influence coefficients, eigenvalue problem, forced vibration of undamped and damped systems using modal analysis.

Determination of natural frequencies and mode shapes: Dunkerley's formula, Rayleigh's method, Jacobi's method.

Vibration of Continuous systems: Longitudinal vibration of bar/rod, lateral vibration of beams and torsional vibration of shafts.

Vibration Control: Control of vibration, control of natural frequencies, vibration isolation and absorbers.

Vibration measurement and applications: Role of vibration measurement and analysis in machine design and machine condition monitoring.

Text Book:

1. Rao, S.S., Mechanical Vibrations, 4thed., Pearson Education, 2012.
2. Grover, G.K, Mechanical Vibrations, 8th ed., Nem Chand & Bros, 2009.

Reference Books:

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

Course Code: MEL453
Course Title: OPERATIONS RESEARCH
Structure (L-T-P): 3-2-0
Prerequisite: 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.

Reference 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.

Course Code: MEL454
Course Title: INDUSTRIAL ENGINEERING
Structure (L-T-P): 3-0-0
Prerequisite: NIL

Contents: Organization: Factory system, principles of organization, types of organization and their selection. Work study: Introduction, Scientific management – Productivity - Advantages of work study to Management. Method Study: Introduction - Process charts, Critical Examination, Identification of key activities on process charts, Diagrams and Templates, Therbligs, Micro motion analysis, Memo motion study. Ergonomics: Basics of Ergonomics and its industrial applications, Anthropometry. Principles of Motion Economy: Related to human body, work place, equipment. Work Measurement: Work measurement techniques – Rating - Measuring the job – Allowances - Standard time - Synthetic data - Analytical estimating – PMTS, Work factor, MTM, Activity sampling, Its applications. Job analysis, Job Evaluation, Techniques of job evaluation - Merit rating – Incentive plans, Value engineering and analysis. Industrial Relations: Labour welfare, wage and incentives, absenteeism and labour turnover. Quality and Quality Control: Types of inspections, statistical quality control; Control charts for variables and attributes: X bar, R, p and c charts; Sampling, concepts and scope of TQM and QFD.

Text Books:

1. Buffa, E.S., and Sarin, R.K., Modern Production / Operations Management, John Wiley & Sons, 1994.

Reference Books:

1. Kanawaty, G., Introduction to work study, International Labour Organization, 1992.
2. Barnes R.M., Motion and Time Study; Design and Measurement of Work, John Wiley, 1980.
3. Bridger, R., Introduction to ergonomics. Crc Press, 2008.

4. Jocobs, C.A., Production and Operations Management, Tata McGraw-Hill, 1999.
5. Maynard, H.B., Industrial Engineering Handbook, McGraw-Hill, 2001.

Course Code: MEL455
Course Title: FLUID DYNAMICS
Structure (L-T-P): 3-0-0
Pre-requisite: MEL253
Contents: Basic of fluid kinematics, Concept of boundary layer,General properties of boundary layer,flow over a flat plate, Reynolds Transport theorem, Navier-Stokes's equations and it's applications, Von-Karmann momentum equation, Exact solution using two dimensional method, Correlation coefficient, Concept of compressible flow, one dimensional isentropic flow, normal shock, Oblique 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.
2. Som, S. K., Biswas, G. and Chakraborty, S., Introduction to Fluid Mechanics and Fluid Machines, 3rd ed., Tata McGraw Hill Education, 2012.

Reference Books:

1. White, F.M., Fluid Mechanics, 7th ed., Tata McGraw Hill Education, 2013.
2. Kundu, P. K., Cohen I. M. and Dowling, D.R., Fluid Mechanics, 5thed, Elsevier, 2013
3. Streeter, V.L., Wylie E.B. and Bedford, K.W., Fluid Mechanics, 9thed., Tata McGraw Hill Education, 2011.

Course Code: MEL456
Course Title: COMPUTER AIDED DESIGN
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents: Introduction to computer aided design, brief history. Two and three-dimensional transformations: Introduction, representation of points, transformation of points and straight lines, rotation, reflection, scaling, combined transformations, translations and homogeneous coordinates and associated transformations; affine and perspective geometry, transformations for parallel and perspective projections.

Design of curves: Introduction, wireframe models and curve representation.

Plane curves: non-parametric and parametric curves; Space curves: representation of space curves, cubic splines, normalized cubic splines, Bezier curves, B-spline curves, rational B-spline curves.

Design of surfaces: Introduction, surface models and surface representation, surface of revolution, sweep surfaces, quadric surface, bilinear surface, ruled and developable surface, brief introduction of the following surface patches: linear Coons surface, Coons bicubic surface, Bezier surface, B-spline surface, Rational B-spline surface.

Solid modeling: Introduction, solid models and solid representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG), half spaces and other representations.

Text Books:

1. Rogers, David F. and Adams, J. Alan, Mathematical Elements for Computer Graphics, McGraw-Hill, 2nded., 2005 .
2. Zeid, Ibrahim and Sivasubramanian, R., CAD/CAM: Theory and Practice, 2nded., McGraw Education, 2010.

Reference Books:

1. Faux, I.D. and Pratt, M.J., Computational Geometry for Design and Manufacture, Ellis Horwood Limited (a division of John Wiley & Sons), 1987.
2. Rooney, J. and Steadman P., Principles of Computer-aided Design, Affiliated East-West Press Pvt Ltd.
3. Mortenson, Michael E., Geometric Modeling, 3rd Ed., John Wiley & Sons, 2006
4. Foley, J.D., van Dam, A., Feiner, S.K. and Hughes, J.F., Computer Graphics: Principles and Practice, Pearson Education.
5. Hearn, Donald and Baker, M. Pauline, Computer Graphics, Prentice Hall of India.
6. Rao, P. N., CAD/CAM: Principles and Applications, 3rd Ed., McGraw Hill Education (India) Pvt Ltd, 2010.

Course Code: MEL457
Course Title: COMPUTER INTEGRATED MANUFACTURING
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents: Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system –Types of production – Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation.

Programmable control – Introduction, NC controller technology, computer numerical control combined with DNC/CNC systems, adaptive control machining systems.

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP).

Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method – Arranging Machines in a GT cell – Hollier Method.

Types of Flexibility – FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety

Text Book:

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

Reference 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.

Course Code: MEL458
Course Title: MECHATRONICS
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents: System Integration, Scope of Mechatronics, Measurement system, open and closed loop system, architecture of mechatronic system, approach towardsmechatronic 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.

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.

Course Code: **MEL459**
Course Title: **GAS TURBINE AND COMPRESSOR**
Structure (L-T-P): **3-0-0**
Prerequisite: **MEL351**
Contents: Introduction to gas turbines and compressor, its classification and application, Gas Turbine Cycles: Ideal and actual cycles, multi-stage compression, reheating, regeneration, combined and cogeneration. Energy transfer between fluid and rotor, axi-symmetric flow in compressors and gas turbines.Centrifugal Compressors: Principles of operation, compressor losses, adiabatic efficiency, slip factor, pressure coefficient, power unit and design consideration for impeller and diffuser systems, performance characteristics. Axial Flow Compressors: Elementary theory, vortex theory, degree of reaction, simple design, elementary air-foil theory, isolated airfoil and cascade theory, three dimensional flow, stages, stage efficiency and overall efficiency, performance characteristics. Turbines: Axial flow and radial flow turbines, impulse and reaction turbines, fundamental relations and velocity triangles, elementary vortex theory, limiting factors in turbine design, application of airfoil theory to the study of flow through turbine blades, aerodynamic and thermodynamic design considerations, blade materials, blade attachment and blade cooling.
Gas Turbine Power Plants: Fuel and fuel feed systems, combustion systems-design considerations and flame stabilization, regenerator types and design, gas turbine power plant performance and matching, application

Text Books:

1. Saravanamuttoo, H.I.H., Rogers, G.F.C., Cohen, H. andStraznicky, P.V., Gas Turbine Theory, 6th ed., Pearson Prentice Hall, 2008.
2. Ganesan, V. Gas Turbines, 3rd ed., Tata McGraw-Hill Education, 2010.

Reference Books:

1. Bathie, W. W., Fundamentals of Gas Turbines, 2nd ed., John Wiley & Sons, 1995.
2. Lefebvre, H. and Ballal, D. R., Gas Turbine Combustion, 3rd ed., CRC Press, 2010.

Course Code: MEL 460
Course Title: QUALITY ASSURANCE
Structure (L-T-P): 3-0-0
Prerequisite: 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.

Reference 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.

Course Code: MEL 461
Course Title: ROBOTICS
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:
Common Robot configurations, coordinate system, work envelop, Elements of robotic system, actuators, controller, teach pendant, sensors, Specification of robots, Applications.
Robot Kinematics: Forward and reverse Kinematics of 3 DOF Robot arms, Homogeneous transformations, Kinematics equation using homogeneous transformations.
Actuators: Hydraulic actuators, Pneumatic actuator, Electrical actuators, Directional control, Servo Control Flow control valves.
End Effectors: Classification of end effectors, Drive systems, Magnetic, Mechanical, Vacuum and Adhesive Grippers, force analysis in Grippers.
Sensors: Need for sensing systems, Sensory devices, Types of sensors, Robot vision system. Robot Programming: Types of Programming, Motions Programming, Robot Languages - VAL systems.

Text Book:

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

Reference Books:

1. Deb, S. R., Robotics Technology and Flexible Automation, 2nd ed., Tata McGraw Hill, 2010
2. Niku, S., Introduction to Robotics: Analysis, Control, Applications, 2nd ed., Wiley, 2011.
3. Radhakrishnan, P., Subramanyan, S. and Raju, V., CAD/CAM/CIM, 3rd ed., New Age International Publishers, 2011
4. Koren, Y., Robotics for Engineers, 2nd ed., McGraw Hill, 1987.

Course Code: MEL 462
Course Title: AUTOMATION IN PRODUCTION
Structure (L-T-P): 3-0-0
Prerequisite: 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.

Reference 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.

Course Code: MEL 463
Course Title: POWER PLANT ENGINEERING
Structure (L-T-P): 3-0-0
Pre-requisite: MEL351

Contents:

Introduction to power systems and technologies, Demand variation and forecasting, 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. Reactors: 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. Introduction to renewable energy sources, Co-generation systems, Environmental issues, sustainability and future scenarios.

Text Book:

1. Nag, P.K., Power Plant Engineering, 4th ed., Tata McGraw Hill, 2014.
2. El-Wakil, M.M., Power Plant Technology, 4th ed., Tata McGraw Hill, 2011.

Reference Books:

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

Course Code: MEL 464
Course Title: RENEWABLE ENERGY SOURCES
Structure (L-T-P): 3-0-0
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, Liquid flat plate collector & their analysis, collector efficiency factor and heat removal factor, Solar air heaters and their analysis. Solar tracking system and 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. Rai, G.D., Non-Conventional Sources of Energy, 4th ed., KhannaPublishers, 2009.
2. El-Wakil, M.M., Power Plant Technology, 4th ed., Tata McGraw Hill, 2011.

Reference Books:

1. Beckman, W.A. and Duffie, J.A., Solar Engineering of Thermal Processes, John Wiley & Sons, 2013
2. Sukhatme S.P. and Nayak J. K., Solar Energy: Principles of Thermal Collection and Storage, 3rd ed., Tata McGraw Hill, 2013.
3. Parulekar, B.B. and Rao, S., Energy Technology, 3rded.,Khanna Publishers, 1995.
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, 1st ed., Tata McGraw Hill, 1988.

Course Code: MEL 465
Course Title: AUTOMOBILE ENGINEERING
Structure (L-T-P): 3-0-0
Pre-requisite: MEL301

Contents:

Brief history of automobile development, present scenario of automobiles in India and abroad.Chassis, articulated and rigid vehicles, vehicles layout. Engine construction: structural components and materials, Steering system: principle of steering, centre point steering, steering linkages, 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, Clutch: requirements of a clutch system, types of clutches. Transmission: necessity of transmission, principle, types of transmission, sliding mesh, constant mesh, synchromesh, transfer gear box, gear selector mechanism, propeller shaft, universal joint, constant velocity joint. Differential: need and types of rear axle and front axles. Brakes: mechanical brakes, hydraulic, pneumatic brakes, electrical brakes, engine exhaust brakes, drum and disc brakes, comparison.

Introduction to hybrid and electric vehicles: Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.Basic concept of electric traction, introduction to various electric drive-train.

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis,

Text Book:

1. Singh K., Automobile Engineering (Vol. I & II), 13thed., Standard Publishers and Distributors, 2012.
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.

Reference Books:

1. Ramalingum, K.K., Automobile Engineering, 2nd ed., Scitech Publications, Chennai, 2011.
2. Srinivasan, S., Automotive Engines, 2nd ed., Tata McGraw Hill, New Delhi, 2004.

3. Crouse, W.H. and Anglin, D.L., Automotive Mechanics, 10th ed., Tata McGraw Hill, 2007.

Course Code: MEL 466
Course Title: I. C. ENGINES
Structure (L-T-P): 3-0-0
Pre-requisite: MEL351
Contents:
Thermodynamics of fuel-air cycles, actual cycles.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.
Text Book:
1. Ganesan, V., Internal Combustion Engines, 4th ed., Tata McGraw Hill, 2013.
2. Heywood, J.B., Internal Combustion Engine Fundamentals, McGraw Hill, 2012.
Reference Books:
1. Obert, E.F., Internal Combustion Engines and Air Pollution, Intext Educational Publishers, 1974.
2. Dankundwar, A.V., Course in Internal Combustion Engines, DhanpatRai and Sons, 2002.
3. Mathur, M.L. and Sharma, R.P., Course in Internal Combustion Engines, 8th ed., Dhanpat Rai and Sons, 2003.
4. Pulkrabek, W.W, Engineering Fundamentals of the Internal Combustion Engine, 2nd ed., Pearson Education, 2014.

Course Code: MEL467
Course Title: TOOL DESIGN
Structure (L-T-P): 3-2-0
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.

Course Code: MEL468
Course Title: MACHINE TOOL DESIGN
Structure (L-T-P): 3-2-0
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
Reference Book:
1. Mehta, N.K., Machine Tool Design and Numerical Control, 3rd ed., Tata McGraw Hill, 2012.

Course Code: MEL469
Course Title: MATERIAL RESOURCE PLANNING
Structure (L-T-P): 3-0-0
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.
Reference 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.

Course Code: MEL 470
Course Title: COMPUTER INTEGRATED MANUFACTURING
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:
Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system – Types of production – Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation.
Programmable control – Introduction, NC controller technology, computer numerical control combined with DNC/CNC systems, adaptive control machining systems.
Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP).
Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method – Arranging Machines in a GT cell – Hollier Method.
Types of Flexibility – FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety

Text Book:
1. Groover M.P., Automation, Production Systems and Computer Integrated Manufacturing, 3rded., Pearson Education, 2014
Reference Books:
2. Ranky, P.G., The Design and Operation of FMS: Flexible Manufacturing Systems, IFS, 1983.
3. Harrington, J., Computer Integrated Manufacturing, Krieger Publication, 1985.
4. Shover, R.N., An Analysis of CAD/CAM Application with Introduction to CIM, Prentice Hall.

5. Bedworth, D.D. and et.al., Computer Integrated Design and Manufacturing, McGraw Hill, 1991
6. Scholz-Reiter, B., CIM Interfaces, Chapman and Hall, 1992.
7. Goetsch, D.L., Fundamentals of CIM Technology: Automation in Design, Drafting and Manufacturing, Delmar Publication, 1988.

Course Code: MEP 471
Course Title: MACHINE SYSTEM DESIGN LAB
Structure (L-T-P): 0-0-4
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 students. 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

Text Book:

1. PSG Design Data Book.

Course Syllabi (Under Graduate)
Department of Chemistry

Course Code: SCL155
Course Name: APPLIED CHEMISTRY
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:

Quantum Chemistry: Operators, Eigen functions & Eigen values, Schrodinger Equation & its applications, Particle in a box, wave function for hydrogen atom, Atomic orbital and molecular orbitals.

Kinetics: Rate of chemical reaction, Factors influencing rate of reactions, Order & molecularity of reactions, 1st, 2nd and Zero order reactions, Study of kinetics of reaction: Hydrolysis of EtOAc, Concept of activation energy, Significance, Arrhenius equation, Effect of catalyst and temperature on reaction rate, Theory of absolute reaction rates, Chain reaction, Enzyme Kinetics.

Electrochemistry: Introduction, Arrhenius ionic theory, Debye-Huckel theory of strong electrolytes, conductance, specific conductance and equivalent conductance, Ostwald's dilution law, Different concepts of acids & bases concept of pH & pOH, Buffer solution, Henderson-Hasselbalch equation, common ion effect. Conductometric titration.

Corrosion: Dry & wet corrosion, mechanism of wet corrosion, galvanic corrosion, concentration cell corrosion, pitting corrosion, waterline corrosion, Electrochemical Series, Factors influencing corrosion, Corrosion control.

Co-ordination Chemistry: Properties, coordination compounds, Terms used in Co-ordination Complex, Nomenclature of complex compounds, Valence bond theory, Explanation of formation of some complex, Crystal field theory, Crystal field splitting in octahedral and tetrahedral complex, Catalysis by metal salts: Wilkinson's catalyst, Role of metal ions in Biological systems: Structure of Hemoglobin.

Stereochemistry: Stereochemistry, geometrical isomerism, optical activity, Optical Isomerism, diastereomers, Optical activity without asymmetric carbons, *E*, *Z* & *R*, *S* System of nomenclature.

Nano Chemistry: Synthesis of nanoparticles, Nano molecules, applications.

Green Chemistry: Introduction, Goal & signification, Basic Components, Alternative feedstock's, alternative regents, Alternative reaction conditions, atom economy, optimization of frameworks for greener synthetic pathways, Industrial applications of green chemistry.

Text books:

1. Kuriacose, J. C., Rajaram, J., *Chemistry in Engineering and Technology*; Vol. I & II, Mc.GrawHill
2. Jain & Jain, *Engineering Chemistry*, 15th ed. Dhanpat Rai Publishing Company (P) Ltd., 2012.

Reference Books:

1. Narula, A. K., Vermani O. P., *Industrial Chemistry*; Galgotia Publication.
2. Alanna, O. G., *Engineering Chemistry*; Mc Graw Hill.
3. Vairam, S., *Engineering Chemistry*; Wiley India.
4. Dara, S. S., *A Textbook of Engineering Chemistry*; S. Chand & Company Ltd. New Delhi.

Course Code: SCL464
Course Name: ENGINEERING CHEMISTRY
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:

Polymer Science: Nomenclature, Types of Polymerization, Classification of Polymers, bonding in polymers, Mechanism of Polymerization, stereochemistry of polymers, molecular weight of polymer, methods of polymerization-free radical, anionic, cationic and coordination polymerization, Characterization of polymers, thermoplastic (low and high density polythenes PMMA) and thermosetting resins (bakelite, epoxy), PVC (Polyvinyl chloride), PVA (polyvinyl acetate), rubbers (natural and synthetic) Inorganic polymers- preparation and uses of silicones.

Water Chemistry: Sources, hard & soft water, Temporary & Permanent hardness, Units of Hardness, Disadvantages of hard water, Scale & Sludge formation in boilers, estimation of hardness by EDTA method, softening of water, zeolite process & demineralization by ion exchangers, specifications for drinking water, treatment of water for domestic use, desalination - Reverse Osmosis & Electrodialysis, industrial waste water treatment.

Lubricants: Lubricants - Definition, theories of lubrication, characteristics of lubricants, viscosity, viscosity index, oiliness, pour point, cloud point, flash point, fire point, additives to lubricants, Solid lubricants.

Dyes: Introduction, Classification, Azo dyes, Triarylmethane dyes, Malachite Green, Rosaniline, Phenolphthalein, Alizarin, Methylene Blue, Other uses of Dyes.

Fuels: Fuels - Classification, examples, relative merits, types of coal, determination of calorific value of solid fuels, Bomb Calorimeter, theoretical oxygen requirement for combustion, Coal, Types of carbonization of coal, proximate & ultimate analysis of coal, manufacture of metallurgical coke, Petroleum, Cracking, Synthetic Petrol, Knocking, LPG, desulphurization of petrol.

Text Books:

1. Vermani, O.P. and A.K. Narula, *Applied Chemistry: Theory and Practice*. 2nd-Edition. New Age International Publishers, New Delhi, 2008.
2. Morrison, R.T. and R.N. Boyd, *Organic Chemistry.* 7th-Edition. Pearson Publisher, 2010.

Reference Books:

1. Jain and Jain, *Engineering Chemistry*. 15th-Edition. Dhanpat Rai & Sons, New Delhi, 2012.

2. Sharma, Deepa, *Textbook of Engineering Chemistry*. 1st-Edition. MedTech, Scientific International Pvt. Ltd., New Delhi, 2015.
3. Bahl, A. and B.S. Bahl, *Advanced Organic Chemistry*. Reprint. S. Chand & Company Ltd., New Delhi, 2012.

Course Code: SCL466
Course Name: QUANTUM CHEMISTRY
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:

Mathematical concepts: Vectors, Vector product, linearly dependant and independent vectors, linear vector space (introduction only) and basis set of LVS, Matrix, Types of Matrix (Symmetric, skew-symmetric, Hermitian, skew-Hermitian, unit, diagonal, unitary, etc) and their properties, Matrix equations, concept of eigen value and eigen vectors.

Quantum mechanics: Origin of Quantum mechanics, postulates of Quantum Mechanics, concepts of operators, Schrodinger equation, solution of the Schrodinger equation for simple systems viz. particle in a box, the harmonic oscillator, rigid rotor, the hydrogen atom, Born-Oppenheimer approximation. Variation theorem, linear variation principle. Perturbation theory (first order and non-degenerate).Application of perturbation theory to the Helium atom. Concept of Angular momentum. Eigen value of angular momentum operator, method of ladder operator, spin. Slater determinant wave functions. Term symbol (R-S and j-j coupling) and spectroscopic states. Molecular orbital theory, LCAO principle, formation of molecular orbitals from atomic orbital, construction of molecular orbitals of H_2^+ by LCAO principle, physical picture of bonding and anti-bonding molecular orbitals, VB and MO theory. Huckel theory of conjugated systems, application to ethylene, butadiene, cyclopropenyl system, cyclobutadiene, etc.

Text Books:
1. Levine, I.N., *Quantum Chemistry*, 7th-Edition. PHI Learning Pvt. Ltd.,2014.
2. Szabo, A., and Neil S. Ostlund, *Modern Quantum Chemistry: Introduction to the Advanced Electronic Structure Theory*, Revised Edition. Dover Publications, Inc., 1996.

Reference Books:
1. McQuarrie, D.A. *Quantum Chemistry*, University Science Books, 2011.

Course Code: SCL467
Course Name: REAGENT CHEMISTRY
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:
1. Organolithium reagents: Use of lithium in organic synthesis: Lithium diisopropyl amide (LDA)
2. Organocupper regents: Use of Cupper in organic synthesis: Gilman's reagent
3. Organopalladium Chemistry: Use of Palladium in organic synthesis
4. Organosilicon Chemistry: Use of Siliconin organic synthesis: trimethylsilyliodide
5. Organotitanium Chemistry: Use of Titanium in organic synthesis: Tebbe's reagent
6. Organotin Chemistry: Use of Tin in organic synthesis: tri-n-butyl tin hydride
7. Organomagnesium Reagent: Use of Grignard reagents in organic synthesis
8. Oxidation reaction: Use of DDQ, Selenium dioxide, Osmium tetroxide in organic synthesis
9. Reduction Reaction: Use of complex metal hydrides, Wilkinson's catalyst, Lithium aluminium hydride (LAH), Sodium Borohydride, Di iso butyl aluminium hydride (DIBAL-H) etc.
10. Use of Baker's Yeast, Phase transfer catalyst, DCC etc. in organic synthesis.

Text Books:
1. Carruthers, W. and I. Coldham, *Modern Methods in Organic Synthesis*, 4th-Edition, Cambridge University Press, 2015.
2. March, J., *Advanced Organic Chemistry*, 4th-Edition. Wiley, 2007.

Reference Books:
1. Smith, M.B. and J. March, *March's Advanced Organic Chemistry: Reactions, Mechanisms and Structures*, Wiley, 2007.
2. Morrison, R.T. & R. N. Boyd, *Organic Chemistry*, 7th-Edition. Pearson Publisher, 2010.