Bachelor of Technology in Mechanical Engineering (With option of specialization)

Overview

- It is a traditional program leading to Bachelor's degree in Mechanical engineering. However, a student can also get B.Tech in Mechanical engineering with specialization in any of the below mentioned specializations:
  - Energy Systems & Environment
  - Product Design & Development
  - Smart Manufacturing and Industrial Management
  - Automobile Engineering
  - Robotics & Automation

Some of salient features of the program-

- Student enrolled for this program will get bachelors degree in Mechanical Engineering after the completion of the program, but he/she will also have an option to get the above degree along with certificate of specialization in any one of above streams as per his/her choice and preference.
- To get B.Tech Mechanical Engineering with specialization, the student will have to take six mandatory specialization electives PE1, PE-2, PE-3 and PE-4, PE-5 and PE-6 from the same stream of specialization, and he/she will have to do B.Tech. Major project in the same area. Student who fulfills these conditions will be issued a separate certificate of specialization along with the degree of B.Tech in Mechanical Engineering.
- If the student wants to pursue B.Tech in Mechanical Engineering (without specialization) then he/she is free to choose the Program electives given in the scheme from the list of program electives, and there will not be any constraint regarding area of B.Tech Major project.
- The Students can opt four Open electives of three credits each. The students have an option of choosing two open Elective courses of minimum forty five hours duration through MOOCs (Massive Open Online Courses) on platforms like SWAYAM, Coursera, edX etc.
- Student will have the option of opting for pre-placement training in the final semester. This training will be of 6 credits and the student who opts for it is not required to register for Major project II.
# Bachelor of Technology in Mechanical Engineering - (2020-21)

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Name</th>
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Total =112 (BS=21, ESTA=30, HMS=17, PC=44); ELECTIVE COURSES = 30 (OE=12, PE=18); SPT =18 ; VA = 3 ; GP = 7
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<td>Energy Systems &amp; Environment</td>
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<td>Machine Design II (2-1-0) 3</td>
<td>Introduction to FEM (2-1-0) 3</td>
<td>Mechanics of Solids II (2-1-0) 3</td>
<td>Mechatronics (2-0-2) 3</td>
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<td>Supply Chain Management (2-1-0) 3</td>
<td>Smart Manufacturing Processes (3-0-0) 3</td>
<td>Modern Manufacturing Processes (2-0-2) 3</td>
<td>Additive manufacturing Technologies (2-0-2) 3</td>
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<td>Robotics and Control (2-0-2) 3</td>
<td>Industrial Automation and Process Control (3-0-0) 3</td>
<td>Mechatronics System Design (2-0-2) 3</td>
<td>Advanced Robotics (2-1-0) 3</td>
<td>Signal Processing, AI &amp; NN Technique (2-0-2) 3</td>
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Syllabus

MEP 110 (1-0-4) 3 – Engineering Graphics and Drawing

Types and use of lines and lettering; dimensioning; first and third angle systems of orthographic projection; projection of points in different quadrants; projection of lines; projection of planes; projections of solids; development of surfaces; section of solids (section planes, sectional views, true shape of sections); isometric projections; intersection of solids.

Practice(P): Tutorial sheets to be completed during practical classes.

MEL 150 (2-0-2) 3 Basics of Mechanical and Civil Engineering


Tutorials: Numericals based on thermodynamics, stress-staring, applied mechanics, lifting machines, and Surveying.


MEL 160 (3-0-2) 4 Production Engineering

Practice(P): Practice in workshop (job making) based on above topics.

MEL203 (3-0-2) 4 - Mechanics of Solids – I

Concept of stress and strain, Hooke's law, elastic constants, Poisson's ratio, Principle of superposition, One and two-dimensional stress problems, Thermal stresses and strains, Complex stresses and strains, Principal stresses, 2D & 3D Mohr's circle of stress and strain. Shear force and bending moment diagrams for beams. Bending and shearing stresses in beams, Deflection of beams. Torsion of circular sections and thin walled tubes. Concept of strain energy, Strain energy due to axial loading, pure shear, bending, and twisting. Stresses due to gradually applied load, suddenly applied load, impact or shock load.

Practice(P):

- Tensile Test, Compression Test, Bending Test, Shear Test, Torsion Test, Impact Test, Hardness test, Cupping Test and numerical practice on related topics.
- Virtual tests from Virtual Labs (http://vlab.co.in/)
- Case study on Stress analysis of simple structural elements using FEM software
MEL 290 (3-1-0) 4 – Thermodynamics


Tutorial (T): Numericals based on above topics.

MEL205 (3-1-0) 4-Engineering Mechanics


Tutorial (T): Numerical Problems on force system, equilibrium, kinematics and kinetics; Case studies on identification of force system, kinematics of rigid body; Presentations on given topics and mini projects (if possible).

MEP 207 (0-0-4) 2 – Machine Drawing
Sectional views: full and half section views, standard practices; Tolerance: coordinate tolerancing, geometric tolerancing, gauging and measuring principles, material conditions, tolerance symbols; Assembly drawing: types of assembly drawing, sectioning, dimensioning, and hidden lines in assembled views, standard parts in assembled views; Computerized 2-D drawing using AutoCAD: draw toolbar; modify toolbar; dimensioning toolbar; properties toolbar; ortho and OSnap; layers.

**Practice(P):** Exercises on the above topics should be done with common machine components such as: threaded joints (threaded fasteners, locking arrangements); keys, cotter and knuckle joints; couplings (flange, muff, and Oldham's couplings). Minimum 4 manual drawing sheets and 4 CAD sheets must be made by the students during the course. AutoCAD drawing should be taught from the beginning of the course.

**MEL 314 (2-0-2) 3- Energy Conversion**

Energy Sources, Fuels and Combustion: Types of fuels, Combustion equations, Stoichiometric air fuel ratio, orsat analyser, Determination of calorific value of fuels; Fundamentals of Steam power: Rankine cycle, Reheat & Regeneration, Binary Vapour cycles, steam turbines and nozzles; Thermal power plant: Boilers, Low pressure and High pressure, boilers mountings and accessories, Compounding of Turbine, Cooling Towers; Gas power cycles: Air standard Otto Cycle, Diesel Cycle, Dual Cycle, Brayton cycle, Stirling cycle and Ericsson cycle; Gas Turbines: Gas turbine cycles, operation and materials; Condensers; Gas compressors; Refrigeration and air conditioning: Refrigeration cycles, refrigerants, psychometry.

**Practice(P):** Numerical on energy conversion and power point presentation by students. Experiments in the energy conversion lab.

**MEL206 (3-1-2) 5- Theory of Machines**

Tutorial: Numerical on velocity analysis, acceleration analysis, static and dynamic force analysis, balancing of rotating and reciprocating masses, balancing of different configuration of engines, Projects to design mechanisms.

Practical: Experiments on linkages & mechanisms, Governors, balancing and Gyroscope.

MEL208 (3-1-0) 4-: Fluid Mechanics

Fluid Properties - Concept of fluid-flow, ideal and real fluids, properties of fluids, Newtonian and non-Newtonian fluids; Fluid Statics - Pascal's law, hydrostatic forces on bodies, stability of floating and submerged bodies; Fluid Kinematics - Eulerian and Lagrangian description of fluid flow; fluid acceleration, stream, streak and path lines, types of flows, continuity equation, rotation, vorticity and circulation, stream and potential functions; Fluid Dynamics - Concept of system and control volume, Euler's equation, Bernoulli's equation, correction factors, Impulse momentum relationship and its applications; Laminar Flow - Flow regimes and Reynolds number, analysis of uni-directional flow between parallel plates; Flow through Pipes - Losses in pipes, Hagen-Poiseuilli law, hydraulic gradient and total energy lines, series and parallel connection of pipes, hydraulically smooth and rough pipes, velocity distribution in pipes, friction coefficients for smooth and rough pipes. Boundary Layer Flow (External Flows)- Concept, displacement, momentum and energy thickness, Von-Karman momentum integral equation, laminar and turbulent boundary layer flows, boundary layer separation and control, concept of drag and lift.

Tutorial (T): Numericals based on above topics.
MEL-209 (2-0-2) 3- Materials Science and Engineering

Introduction to Materials Science- Type of materials, Atomic Structure, Interatomic Bonding and Structure of Crystalline Solids, Crystal imperfections; Metallographic techniques of sample preparation; Mechanical Properties of metals- elastic and plastic deformations; Thermo-mechanical processing of metals and alloys; Phase diagrams; Heat treatment processes; Failure in materials-Ductile & Brittle Fracture and Fatigue, Creep and stress rupture, stress strain diagrams for engineering materials; Types of materials systems-Metallic alloys, Ceramics, Polymeric and Composite materials, magnetic and diamagnetic materials; Corrosion- electrochemistry, types of corrosion; Oxidation; Characterization of materials- x-ray diffraction and scanning electron microscopy.

Practice(P): Presenting demo model for crystal structures and imperfections in crystals, Metallographic techniques for sample preparation; microstructure observations of deformed and corroded samples under electron microscope; characterization and analysis of deformed specimens under both metallographic and electron microscopes. Impact Testing after Heat Treatment with different cooling media.

MEL 202 (3-0-2) 4- Heat & Mass transfer

Modes and Basic laws of Heat & Mass transfer; General conduction equations in Cartesian, Cylindrical and Spherical coordinates; Steady state one dimensional heat conduction with and without heat generation, Electrical analogy, Critical thickness of insulation, Fins; Unsteady heat conduction, lumped analysis, Heisler's charts; Governing equations for Convective heat transfer, Thermal boundary layer; Forced convection, Free convection; dimensionless parameters in free and forced convective heat transfer; Heat transfer correlations for flow over flat plates and through pipes, effect fo turbulence; Boiling and condensation; Heat exchangers, LMTD and NTU methods; Radiative heat transfer, Stefan-Bolzmann law, Wien’s displacement law, black and gray surfaces, view factor; Radiation network analysis; Radiation shields; Heat and mass transfer analogy; Mass diffusion equation.

Practice (P): Experiments will be carried out in lab on different test setups; Numerical on heat transfer problems.

MEL207 (3-1-0) 4 - Machine Design I
Factors to be considered in design projects; phases of a design project; mission and requirements documents; design engineer’s professional responsibilities; introduction to CAE; design for static and dynamic loading; factor of safety; theories of static failure (Tresca, von Mises, modified Mohr); stress concentration; basics of statistics (Frequency distribution; measures of central tendency and dispersion; normal distribution); fatigue failure (fatigue test, S-N curve, Goodman’s line); design of shafts and keys (design based on strength, design based on deformation, design of keys); rolling and sliding contact bearings (types of rolling contact bearings, selection of deep groove ball bearings, reliability and life of bearings); design of belt drive systems (types of belts, design of flat and V belt systems); design of welded joints (types of weld, weld symbols, Butt and fillet weld calculations, welded joints under torsion and bending, weld inspection); Design of riveted joints; Manufacturing considerations in design (casting, forging, machining, cold working, welding, DFMA)

**Tutorial (T):** Brain storming and class activities related to determination of design requirements; solving numericals related to the course content; presentations by students about their projects

**MEL303 (2-1-2) 4 Fluid Machines**

Impact of free jets: Impulse – momentum principle, jet impingement on various stationary and moving geometries, jet propulsion of ships. Hydraulic Turbines: Classification, Impulse & reaction principles, component parts, construction, operation, governing mechanism, design aspects, velocity diagrams and performance characteristics of a Pelton wheel, Francis and Kaplan turbine, slow, medium and fast runners, degree of reaction, unit quantities, specific speed and model relationships for turbines, scale effect, cavitations. Centrifugal Pumps: Classification, construction, operation, design aspects and performance characteristics, minimum starting speed, multi-stage pumps. Similarity relations, specific speed, net positive suction head, cavitation and maximum suction lift. Reciprocating Pumps: Construction and operational details, effect of acceleration and friction on indicator diagram (pressure – stroke length plot), separation, air vessels and their utility, rate of flow into or from the air vessel, maximum speed of the rotating crank, characteristic curves. Hydraulic systems: Function, construction and operation of Hydraulic accumulator, hydraulic intensifier, hydraulic crane, hydraulic lift and hydraulic press, Fluid coupling and torque converter, Hydraulic ram. Dimensional Analysis.
Tutorial (T) and Practical (P): Numerical solving and conduct of experiments.

MEL326 (3-0-2)4- Instrumentation and Control Engineering

Introduction of Instruments and their types, standards and their calibration, strain gauges and rosettes, static and dynamics characteristics of instruments, first and second order systems: transient and frequency response, error and uncertainties in performance parameters, transducers, digital logic number system, signal conditioners, Data acquisition system, introduction to control systems, types of control systems, transfer function of the systems, sequence control, stability check using Routh, root locus, Bode and Nyquist method, Fundamentals of vibration, free, damped and forced vibrations for single DOF system, vibration isolation, critical speeds of shafts.

Practice (P): Questions on classification of different types of instruments, numerical on static and dynamic characteristics based upon order of systems, descriptive questions on transducers and signal conditioners with numerical, questions on stability criterion, Practical measurement of displacement, load etc.; Data acquisition; Experimental study of 1st and 2nd order systems; Stability analysis using Matlab; experiments on different control systems, PID Controller.

MEL310 (3-1-0) 4- Industrial Engineering

Introduction to the need of IE and industrial safety, Productivity and productivity measurement; Work Study- Method Study and Work measurement, Job evaluation, wage incentives; Plant Location and Layout- Plant Location, Plant Layout; Material Handling and ergonomics, Production systems and their characteristics, systems analysis, Sequencing and scheduling; Inventory Management- Forecasting models, Inventory Control, Determinisic models and applications, safety stock inventory control systems; Aggregate production planning; Quality Management- Basic concepts in quality, cost reduction, 7 QC tools, Control charts and Process capability, Six Sigma and TPS; Materials requirement planning; Value
Engineering: Value engineering, waste management; Selected topics- Introduction to Lean Systems, Value Stream Mapping, SMED, Total Productive Maintenance, the big losses and OEE.

**Tutorial (T):** To carry out case study on productivity measurement, Method study, Time study, Plant Location, Plant Layout, select material handling system for particular product, Problems related to inventory management, Value engineering, Value stream mapping.

**MEL401 (2-1-0) 3- Operations Research**

Role of operations research in decision making, applications in industry; concepts in OR model building; Linear programming: Graphical method and Simplex methods, BIG-M and Two phase methods; computational problems; Allocation models: Transportation and Assignment problems; Advanced topics of linear programming: Duality, Primal-Dual relations, sensitivity analysis, dual simplex method; Simulation models, Monte Carlo technique and its applications, Queuing models and its applications; Software tools for Operations Research

**Tutorial (T):** Numericals Based on above topics. Case Studies

**MEL-482 (2-0-2) 3: Energy, ecology and environment**

Ecosystem, Environment pollution, Carbon Footprint, global warming and climate change, Ecology, Structure and functioning of natural ecosystems, Natural resources, Agricultural, industrial systems and environment, Energy technologies and environment, Sustainable consumption production.

**Tutorial (T):** Tutorial sheets based on above topics. Case Studies
MEL-611-TH (2-1-0) 3: Renewable Energy Systems

National and International energy scenario; Energy security and climate change; Various forms of renewable energy sources; concept of sustainability; their relative merits and demerits and barriers to their commercialization; Solar energy: solar heating and cooling, solar thermal and photovoltaic power generation systems, Wind energy-types of wind mills; hydro power plants; Biomass energy; biofuels and biomass, Digesters-fixed and floating digester biogas plants; Geothermal energy; Ocean thermal energy; Hydrogen as an alternative fuel and fuel cell, magneto hydrodynamic power generations.; Liveliest cost of energy and grid parity, case study on solar energy system, wind conversion system, biomass and geothermal energy system; Cost benefit analysis and environment concerns of conventional source of energy.

Tutorial (T): Numerical on sizing of renewable energy systems, case studies and presentations

MEL-483: (2-0-2) 3: Heating, Ventilation and Air Conditioning

Refrigerating machine; Reversed Carnot cycle; Air refrigeration; Simple vapour compression refrigeration; Actual vapour compression cycle; Multi pressure vapour compression systems; Low temperature refrigeration; Constructional study of commercial applications of Vapour compression Refrigeration: Refrigerants; Vapour absorption refrigeration; Steam jet refrigeration; Psychometry of Air-conditioning processes and comfort conditions; Air-conditioning systems; Estimation of cooling and heating loads.

Tutorial/Practical: Numerical on refrigeration systems and experiments in lab

MEL 590N (2- 0-2) 3: Waste management


Tutorial (T): Case studies and presentations on above topics.
MEL 404 (2-1-0) 3 – Power Plant Engineering

Analysis of steam cycles: Rankine Cycle, Reheat and Regeneration; Thermal Power Plant – Components, operation, combustion mechanisms; Gas turbine and combined cycle power plants; Nuclear power plant - Nuclear reactors: types & their relative merits & limitation; Hydro-electric power plants – Construction, Operation of different components of hydraulic power plant; Environmental aspects of power generation – Emissions, Thermal, Nuclear and Hydro, Power plant Economics.

Tutorial (T): Numerical on economics and steam cycles, and case studies

MEL-484 (2-1-0): 3 Energy Management


Tutorial : Case Studies/Presentations based on the above topics

MEL- 470 (2-0-2) 3-: Production Design and Development

Practise(P): Tutorials based on above topics. Mini projects to be prepared in team.

**MEL 328 (2-2-0) 4- Machine Design II**

Selection of fits and tolerances (types of fits, fit symbols, fit selection guidelines, selective assembly); Design of bolted joints (types of bolts and screws, standards and terminology, failure modes, critical stresses, preloading effects, tightening torque, systems of bolts under torsion and bending); Design of springs (types and applications, spring materials, manufacturing process, design of helical springs, buckling and surge considerations); Design of gears (types and applications, spur gear tooth profile, gear manufacturing, stress analysis of spur gears, lubrication, design based on tooth bending strength, design based on surface durability); Design for corrosion control (chemistry of corrosion, electrode and electrolyte heterogeneity, techniques to control corrosion, corrosion plus static loads, corrosion plus cyclic loads); Design of brakes and clutches (types, torque transmitting capacity, brake and clutch materials, energy and thermal considerations)

**Tutorial(T):** Solving problems related to the syllabus; Presentations by students related to the their course mini projects.

**MEL 510 (2-1-0) 3 – Introduction to FEM**

Linear algebra: matrix operations, numerical solution of linear matrix equations; Elasticity theory: strain-displacement and stress-strain relations, temperature effects, St. Venant’s principle; Discretization (1-D and 2-D), Stiffness matrix, FEM equation for simple elements (bar, truss, beam, frame, and CST elements), assembling of elements, boundary conditions, nodal solutions; Coordinate systems, Shape functions, Consistant loads, Variational equation for deriving K; Heat
conduction equations, FEM formulation in 2-D conduction problems; Practical points in using FEM software (Types of analysis, Meshing, Post-processing, Non-linear analysis)

**Tutorial (T):** Numericals on various topics; Modeling and simulation of 1-D and 2-D problems using software: static structural analysis, and heat conduction; Presentations by students about their course mini-projects

**MEL315 (2-1-0) 3-: Mechanics of Solids-II**

Thin and thick cylindrical pressure vessels: Stress in thin cylindrical and spherical vessels, Lame’s theory for thick cylindrical shells, Compound cylindrical pressure vessels. Buckling in columns: Euler’s formula for columns, Energy methods, Rankine’s formula and Johnson’s parabolic formula, Eccentric loading in columns. Stresses in rotating ring, disc and cylinders. Unsymmetrical bending: Parallel axis theorem for product of inertia, Transformation laws, Principal axes, Stresses and deflection due to unsymmetrical bending, Shear center for symmetrical & unsymmetrical sections. Curved beams: Winkler–Bach theory, Value of h2 for various cross-sections, Stresses in various Curved Members like crane hook, ring etc.

**Tutorial (T):** Case study on Stress analysis for relevant machine or structural members using FEM software like Inventor, ANSYS. Real life problems on Thin and Thick Walled Pressure Vessels, Buckling of Columns & Struts, Unsymmetrical Bending, Stresses in curved beam and Stresses due to Rotation in various Rotating Elements etc.

**MEL 627-MD (2-0-2) 3 – Mechatronics**

Introduction to mechatronic systems and their components, Integrated design issues in Mechatronics Design Process and its factors and its key elements, Conceptual design, Possible design solutions for Mechatronics systems, Traditional approach vs. Mechatronics approach, Choice of sensors and actuators for any Mechatronics application, Smart sensors, Field buses, Logic gates, Programmable Logic Controllers and its programming, Selection of PLC for any application.
**Practice (P):** Data acquisition, Transient response of first order and second order systems, PID Controller, PLC Controller.

**MEL 625-MD (2-0-2) 3 – Vibration and Noise Engineering**

Fundamentals of vibration; Vibration of single DOF systems: free vibrations, damped vibrations, forced vibration; Vibration of multi-DOF systems; Determination of natural frequencies and mode shapes: Dunkerley’s formula, Rayleigh’s method, Lagrange’s equation, Holzer’s method, Standard Eigen value problem, Continuous systems; Methods of vibration control: design of vibration isolators, auxiliary mass systems including tuned & untuned dampers for vibration control; Fundamentals of noise; Noise sources; Noise level measurement, instrumentation and test techniques; Machinery noise, air borne and structure born noise. Noise control strategies, Control measures using mufflers, barriers, enclosures.

**Practice (P):** Numerical problems based on different DOF vibration systems, Numericals on determination of natural frequencies and mode shapes, projects on vibration model of any practical system, and presentations on case studies of noise control. Find out different mode shapes of vibration of cantilever beam/shaft. Vibration measurement, find out natural frequency of cantilever beam/shaft.

**MEL 408 (2-1-0) 3 – Quality Assurance and Reliability Engineering (QARE)**

**Tutorial (T):** Quality related case studies, Quality problem practices, application of QC tools taught in the course to the Major project as a mini project / assignment with 10% weightage. An interactive teaching on key topics of Kaizen/ QC circles / Six sigma / introduction to DOE by industry expert and a group assignment on a special quality topics to be presented in the semester end with 15% weightage.

**MEL 412 (2-1-0) 3 – Supply Chain Management**

SCM – Need, Conceptual model, evolution, approach – traditional and modern, logistics, inbound and outbound, 3PL, 4PL, vendor relationships, elements of L&SCM, Global supply chain perspectives – Drivers, challenges, risk, Demand forecasting, methods, inventory management, bull whip effect, inventory costs, EOQ, VMI, Role of SCM in JIT, lean management, Agile, mass customization, aggregate planning, Warehousing – types, functions, strategy, Transportation – elements, importance, modes, multi modal, containerization, Fleet management – process, factors, Distribution strategies – Cross docking, milk run, direct shipping, hub and spoke model, Role of IT in SCM – need, Tools, application in SCM, Internet, data mining, use of IT in warehousing, customer service etc., RFID,GPS,GIS, supply chain collaboration, Decision support system in SCM, Performance measures – internal and external, activity based costing, benchmarking, balance score card. Basic concepts of Procurement (RFQ and its reply, basics of cost components, price negotiation etc.).

**Tutorial (T):** Case studies, Group Discussions and presentations related to applications in Industry. Industrial Exposure in the form of Expert Lecture. One research paper each student should be able to present in the topic allotted for presentation and should be able to write a brief review paper on the same.

**MEL-485 (2-0-2) 3: Smart Manufacturing**

Introduction to Automation: Automated Manufacturing system; Need of automation, Basic elements of automation, Levels of automation, Automation Strategies, Advantages & disadvantages of automation, Historical development and Introduction to Industry 4.0. Fundamental of Numerical Control, elements of NC machine tools, classification of NC

Practise (P): Tutorial sheets based on the topics, Case studies and presentations.

**MEL-318 (3-0-0) 3- Modern Manufacturing Process**

Need for unconventional machining method, characteristic feature of modern machining processes that distinguish them from conventional machining process, energy used and source of metal removal from modern manufacturing methods, basic principle of non-traditional machining methods, advantages and imitations of non-traditional machining processes, classification of new machining methods. Detailed concepts of various non-conventional machinery such as USM, ECM, AJM, EDM, LBM, EBM, PAM, ECG, Chemical Machining, covering six basic details (1) neat sketch (2) working and principles (3) construction (4) advantages and disadvantages (5) applications and (6) process parameters. Injection molding processes for plastics, engineering applications of plastics, Vacuum Sealed Molding Process, Electron Beam & Plasma Arc Welding, Super finishing Processes, Non Destructive Testing (NDT), Powder Metallurgy (PM).

**MEL-473 (2-0-2) 3- Additive Manufacturing**

History and Advantages of Additive Manufacturing, Distinction Between Additive Manufacturing and CNC Machining,

Practise (P): Tutorial sheet based on the above topics, Case studies and Presentations.

MEL 613-IP (2-1-0) 3 - Project Management

Introduction to Project management: The growing importance/d relevance in the current environment. Project vs. Ongoing Operations, project characteristics, common terms used in project, growing importance, steps & check points, phases in the project cycle, Project Types: Pure Project, Functional Project and Cross-Functional or matrix structure. People aspect: Project leader, Roles, responsibilities, authority, accountability, team structure, stake holders. Project appraisal: Project Budgeting, Investment Planning, Pay back periods, ROI, IRR, NPV, project selection decisions. Project Risk Management: Risk identification, its assessment, Mitigation plan and case study. Project Network techniques: Work Breakdown Structure, Project Control Charts, GANTT charts, Network Planning Models; AOA & AON approach, Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), Floats, Network understanding, drawing and

**Tutorial (T):** This currently involves case studies, project selection & network problem practices and application of Primavera. An interaction with the industry expert on various real life practical aspects.

**MEL 319 (2-1-0) 3-Automobile System Engineering**


**Tutorial (T):** Students will study the construction and working of various automotive systems through demonstration rigs, models and actual vehicles.

**MEL 312 (3-0-2) 4- Internal Combustion Engines & Gas Turbine**

Engine types and their operation: CI and SI; Engine operating and performance parameters; Analysis of air standard, fuel-air cycle, and actual cycle; Comparison of Otto, Diesel and Dual cycle; Fuels for Internal Combustion Engines: Conventional and alternative fuels; Combustion in SI and CI Engines; Fuel Injection System for SI and CI Engines; Ignition system for SI engines; Turbo-charging and super-charging; Engine Cooling; Engine Lubrication; Emissions: Types
of emissions and their control; Gas Turbines: Brayton cycle, efficiency improvements, Types of Gas turbines engines: Turbojet, turbofan and turboprop gas turbine engines.

Practice (P): Experiments for determining the performance parameters of SI and CI engines; Numerical on Engine Performance

MEL 474 (2-1-0) 3 – Mass Transportation Technologies

The current state of transport. Challenges facing the transport sector. The changing nature of society and how transport is adapting. The cost of transportation – vehicle noise, emissions and the effects on public health. The cost of transportation – maintaining infrastructure, energy and climate change. Basic principles of electricity: voltage, current, power, resistance etc. - use of electrical clear notions about ac and dc simple electrical circuits.; Principles of ac and dc generators, transformers, rectifying devices – tap changers, lead acid and alkaline cells, relays, magnetic and pneumatic contactors. Study of power and control circuits of different types of locos -familiarization with the names, symbols and physical location of all equipment. Essential details of mechanical equipment of different types of locos. Wheel-slip and parting. Principles of driving, acceleration, speed control, use of gradient marks, procedure to be followed at neutral sections, correct use of electrical and mechanical brakes. Details of pneumatic and brake equipment. Introduction to mass transit options; Criteria in technology selection; Costs; Design and development factors; Performance; Impacts; The myths of BRT; Defining Bus Rapid Transit, History of BRT, Modern BRT systems, Conventional bus systems; Public transport in developing cities; Barriers to BRT; Benefits of BRT; Vehicle Technology; Intelligent Transportation system (ITS); Traction technology, SCADA, High Speed Technologies. Autonomous Cars, Hyperloop, Magnetic Levitation

Tutorial (T): Tutorial sheets based on the above topics, case studies and presentations.

MEL 418 (2-1-0) 3 – Vehicle Development & Testing

Introduction to vehicle development: Vehicle development cycle; Introduction to vehicle and regulations: Vehicles classification; International standards in automotive industry, Test facility: engine test cell, water conditioning, air conditioning and test rigs; Types of dynamometers and selection; Cardan shafts; Engine tests and procedures in automotive industry: durability testing, reliability testing; Combustion measurement: In cylinder pressure measurement
and other combustion parameters, components of in cylinder pressure measurement; Chassis dynamometer testing: types of chassis dynamometer testing; Emission Norms; Driving cycles: Indian and European; Emission tests and measurement: HC, CO and NOx

Tutorial (T): Numerical solving and Lab experiments

MEL-475 (2-0-2) 3-: E-Mobility

EVs: A clean mobility option; Motion and dynamic equations for vehicles, Propulsion requirements for vehicles. HEV architectures; EV architectures; Mechanical systems used in EVs and HEVs; Fundamentals of Regenerative Braking. Electrical machines for EVs and HEVs; DC-DC Converters; Boost and Buck-Boost Converters; Multi Quadrant DC-DC Converters; Voltage Control of DC-AC Inverters Using PWM. Control Systems for the HEV and EVs; The fuzzy logic based control system. Batteries for EVs; Battery Management System; Fuel cell and super capacitors. Electric vehicle charger; Electric vehicle charger technology; The EV charging station architecture; EV chargers and portfolio management; EV charging and the grid; Smart grid and EVs.

MEL-677-IP (2-0-2) 3-: Optimization Techniques

Introduction and Basic Concepts:- Historical Development; Engineering applications of Optimization; Art of Modeling, Objective function; Constraints and Constraint surface; Formulation of design problems as mathematical programming problems; Classification of optimization problems; Optimization techniques; Functions of single and two variables; Global Optimum; Convexity and concavity of functions of one and two variables; Optimization of function of one variable and multiple variables; Gradient vectors; Optimization of function of multiple variables subject to equality constraints; Lagrangian function; Optimization of function of multiple variables subject to equality constraints; Hessian matrix formulation; Eigenvalues; Standard form of linear programming (LP) problem; Canonical form of LP problem; Assumptions in LP Models; Elementary operations; Graphical method for two variable optimization problem; Examples;
Motivation of simplex method, Simplex algorithm and construction of simplex tableau; Simplex criterion; Minimization versus maximization problems; Revised simplex method; Duality in LP; Primal dual relations; Dual Simplex; Use of software for solving linear optimization problems using graphical and simplex methods; Examples for transportation, structural and other optimization problems; Sequential optimization; Representation of multistage decision process; Types of multistage decision problems; Concept of sub optimization and the principle of optimality; Problem formulation and application in Design of continuous beam and Optimal geometric layout of a truss; Water allocation as a sequential process; Capacity expansion and Reservoir operation; Integer linear programming; Concept of cutting plane method; Mixed integer programming; Solution algorithms; Examples; Piecewise linear approximation of a nonlinear function; Multi objective optimization – Weighted and constrained methods; Multi level optimization; Direct and indirect search methods; Evolutionary algorithms for optimization and search; Applications in Robotics

List of experiments: 1 Matrix operations in Matlab 2 Differentiation of a vector and matrix in Matlab 3 Integration of a vector and matrix in Matlab 4 Simplex algorithm in Matlab 5 Implementation of Newton’s method in Matlab 6 Implementation of Secant method in Matlab 7 Implementation of Lagrange multiplier method in Matlab 8 Implementation of KKT theorem in Matlab 9 Implementation of BFGS method in Matlab

MEL-478 (2-1-0) 3-: Robotics and Control

MEL-479 (3-0-0) 3-: Industrial Automation and Process Control

Production systems Categories of manufacturing systems, manufacturing support systems, automation in production systems, automated manufacturing systems, opportunities for automation and computerization, types of automation, computerized manufacturing support systems, reasons for automating, automation principles and strategies, the USA principle, ten strategies for automation, automation migration strategy, Automation and control technologies in production system Basic elements of an automated system, advanced automation functions, levels of automation, continuous and discrete control systems, computer process control, common measuring devices used in automation, desirable features for selection of measuring devices, Material handling system Material handling equipment, design considerations for material handling system, material transport equipment, analysis of material transport systems, storage systems and their performance and location strategies, conventional and automated storage systems, overview of automatic identification and data capture, bar code technology, RFID, other AIDC technologies, Production and assembly systems Automated production lines - fundamentals, system configurations, work part transfer mechanisms, storage buffers, control of production line, applications Automated assembly systems - fundamentals, system configurations, parts delivery at work stations, applications, Cellular manufacturing Group technology, part families, parts classification and coding, production flow analysis, Opitz coding system, composite part concept, machine cell design, applications of GT, Flexible manufacturing systems Introduction to FMS, types of FMS, FMS components, applications and benefits, planning and implementation issues in FMS, quantitative analysis of FMS.

MEL-480 (2-0-2) 3-: Mechatronics System Design

Introduction to Mechatronics, Integrated design issues in mechatronics, The mechatronics design process, Mechatronics Key elements, Application in mechatronics, Operator notation and transfer functions, block diagram, manipulations, and simulation, Block diagram modeling direct method and analogy method, electrical system, mechanical translational systems, Mechanical Rotational system, electrical mechanical coupling, fluid system Introduction to sensors and transducers, sensitivity Analysis sensors for motion and position measurement, force, torque and tactile sensors, vibration-acceleration sensors, sensors flow measurement, temperature sensing device, sensor application, Direct current motors, Permanent magnet stepper motor, fluid power actuation, fluid power design elements, piezoelectric actuators. Number system in mechatronics, Binary logic, Karnaugh map minimization, Programmable logic.
controllers, Introducing to signals, systems, and controls, Laplace transform solutions of ordinary differential equations, System representations, linearization of nonlinear systems, Time delays, measured of systems performance, controller design using pole placement method, elements of data acquisition and control system, transducers and signal conditioning, device for data conversing, data conversion process. Application software

MEL-481 (2-1-0) 3:- Advanced Robotics


MEL-486 (2-0-2) 3:- Signal Processing, AI & NN Technique

Characteristics of Neural Networks, Historical Development of Neural Networks Principles, Artificial Neural Networks: Terminology, Models of Neuron, Topology, Basic Learning Laws, Pattern Recognition Problem, Basic Functional Units, Pattern Recognition Tasks by the Functional Units. Feed-forward Neural Networks: Analysis of pattern Association Networks, Pattern Classification Networks, pattern storage Networks, Pattern Mapping Networks, Linear Auto associative FF Networks, Pattern Storage Networks, Competitive Learning Neural Networks & Complex pattern Recognition

**MEL-311 (2-0-2) 3:- Advanced processing of materials and case studies**

Introduction to the fundamentals of mechanical behaviour in metals and alloys, Role of microstructure (grain boundary, precipitation) on the mechanical properties, Preferred crystallographic orientation (texture) in polycrystalline materials, Fundamentals of cold deformation textures pertaining to different forming operations, Mechanical properties and microstructure development of formed products, Softening processes and related texture modification followed by recovery, recrystallization and grain growth, Mechanical behavior at higher temperature: Thermally activated processes, dynamic recovery and recrystallization, Case studies: thermo-mechanical processing steels and aluminum alloys

**Tutorial (T):** Case studies involving different metals and alloys subjected to different deformation conditions and the related phenomena of texture development; Studying the principles and working mechanisms of the instruments involved in the course; Studying papers/video demonstrations to build further understanding on the subjects.

**MEL322 (2-0-2) 3- Metrology**

Calibration, Standards, Limits, Fits, Tolerances, and Interchangeability; Inspection of Geometric parameters: Straightness, Parallelism, Squareness, Concentricity, Circularity; Slip Gauges; Linear and Angular Measurement; Comparators; Gauge design; Surface Finish Measurement: Surface Texture, Meaning of RMS, CLA, Grades of Roughness; Alignment and testing methods; Screw Thread Metrology, Floating Carriage Instruments, Tool Maker's Microscope, Profile Projector. Gear Metrology. Interferometry. Methods and instruments for measurement of various physical parameters.

**Practice(P):** Numerical on limits fits & tolerances, practical application of instruments. Presentations and Case studies.
MEL 405 (2-1-0) 3 -Introduction to Biomechanics

Anatomy terminology; Anatomy of the musculoskeletal system; Review of the principles of mechanics, Work and energy, Moment of inertia, Analysis of rigid bodies in equilibrium and motion; Skeletal joints, Forces and stresses in human joints, Biomechanical analysis of hip and knee; Bone structure and composition, Mechanical properties of bone, cortical and cancellous bones, Viscoelastic properties, Maxwell and Voight models, Anisotropy; Structure and functions of cartilage, tendon, ligament, and muscle; Material Properties of soft tissues; Modeling of soft tissues; Review of Basic Fluid Mechanics (types of fluids, laminar flow, Couette flow and Hagen-Poiseuille equation, turbulent flow), Properties of blood, Pulsatile flow in a straight artery, Pulse propagation in arteries; Cardiovascular system, artificial heart valves, testing of valves; Pulmonary system, Mechanism of air flow, Respiratory cycle, Lung ventilation model, Spirometry.

Tutorial (T): Solving numericals, showing videos, case studies.

MEL 409 (2-1-0) 3 – Emerging Automotive Technologies

**Tutorial (T):** Power point presentation by all students on issues pertaining emerging automotive technologies. One mini project based on latest automotive technology.

**MEL 410 (2-1-0) 3 – Design of Thermal Systems**

Types of simulation; Modeling of thermodynamic properties; Modeling of typical thermal equipment; Steadystate simulation; Typical case studies; Dynamic response of thermal systems; Introduction to optimization techniques; Comprehensive case studies of some thermal systems. Introduction of Pinch technology.

**Tutorial (T):** Numerical and case studies

**MEL 414 (2-1-0) 3 – Industrial Tribology**


**Tutorial (T):** Tutorials on wear rate. Numerical problems based on application of Reynolds equation and Energy equation in Tribology. Case studies based on the tribological failure of various machine elements will be discussed.

**MEL 415 (2-1-0) 3 – Maintenance Engineering and Management**

**Tutorial (T):** Case studies with different issues in reliability and maintenance; Cases where different maintenance strategies are practiced; Presentations by students related to preventive, corrective, condition based maintenance; Presentations on different ways of condition based maintenance. Numericals on maintenance and reliability engineering.

**MEL 417 (2-1-0) 3 – Automotive Electronics**

Automotive Fundamentals: Basics of I.C. Engines; Electronics Fundamentals for IC Engines; Electrical and electronic systems in the vehicle; Concept of an electronic engine control system: Open loop and closed loop engine control; Different sensors and actuators in engine control: types and operation, OBD; Electronic fuel injection systems: Multi point fuel Injection System (MPFI), Gasoline Direct Injection system, Common rail Direct Injection System; Starter batteries: basic operation and circuit; Starting systems and circuit: starter motor operation, solenoid; Alternators for vehicles; Electric and hybrid vehicles.

**Tutorial (T):** Numerical solving and conduct of experiments.
MEL 520 (2-1-0) 3 – Advanced Thermodynamics

Recapitulation of zeroth, 1st, 2nd laws, concepts of irreversibility, availability, energy, analysis of simple closed and open systems, pinch technology, multi-component system, concept of fugacity, chemical potential, general conditions for thermodynamic equilibrium, instability of thermodynamic equilibrium and phase transition (gases to liquid), thermodynamics of reactive mixtures, thermodynamics of Combustion Chemistry, elements of irreversible thermodynamics.

Tutorial (T): Case studies, Group Discussions, solving the numerical problems, video demonstration and presentations.

MEL 530 (2-1-0) 3 – Advanced Manufacturing processes

Advanced Machining Processes- Introduction, Process principle, Material removal mechanism, Parametric analysis and applications of processes such as ultrasonic machining (USM), Abrasive jet machining (AJM), Water jet machining (WJM), Abrasive water jet machining (AWJM), Electrochemical machining (ECM), Electro discharge machining (EDM), Chemical Machining(CHM), Electron beam machining (EBM), Laser beam machining (LBM) processes; Advanced Casting Processes- Squeeze casting, Vacuum mould casting, Evaporative pattern casting, Ceramic shell casting; Advanced Welding Processes- LBW, EBW; Advanced Metal Forming- - Details of high energy rate forming (HERF) process, Electro-magnetic forming, explosive forming, Electro-hydraulic forming, Stretch forming, Contour roll forming; Rapid Prototyping and Rapid tooling- principle of Rapid Prototyping (RP) and Rapid tooling, comparison with conventional machining processes, various techniques for RP

Tutorial (T): Lab visits to understand the advanced machining processes, Casting & welding Processes, metal Forming and Unconventional machining process. Industrial Exposure in the form of Expert Lecture/Industry Tour. One research
paper each student should be able to present in the topic allotted for presentation and should be able to write a brief review paper on the same.

**MEL 550 (2-1-0) 3 – Advanced Heat and Mass Transfer**

Recapitulation of laws governing heat & mass transfer; General conduction equation - in rectangular cylindrical and spherical coordinates; Unsteady state conduction- large plane walls, cylinder and spheres; Heat transfer from extended surfaces- proper length of a fin; Multidimensional conduction; Numerical solution of conduction problems; Thermal radiation gray body radiation, radiation shields; Natural and forced convection; Heat exchangers- effectiveness-NTU; Phase Change heat transfer- flow boiling and film condensation; Special topics in heat transfer.

**Tutorial (T):** Experiments will be carried out in lab on different test setups; numerical on heat transfer problems.

**MEL 560 (2-1-0) 3 – Advanced Machine Design**

Design methodology (Phases of a design project, Need identification and problem formulation, Designing to codes and standards); Failure theories (static failure theories, fatigue failure, fracture mechanics); Stress analysis and design of machine elements under conditions of impact, inertial forces, thermal, and residual stresses; Surface Failure (Surface geometry, Friction, Adhesive wear, Abrasive wear, Corrosion wear, Surface fatigue, Spherical contact, Cylindrical contact); Reliability engineering (Distribution models, Probabilistic approach to design, Definition of reliability, Constant and variable failure rates, System reliability, Maintenance and repair, Design for reliability, FMEA, Fault tree analysis).

**Tutorial (T):** Presentations and case studies by students related to the course content; Presentations and case studies by students related to their mini projects; case studies; solving problems related to the syllabus.

**MEL 570 (2-1-0) 3 – Production and Operations Management**
Production and Operations function- Production systems, Product Strategy and integrated product development, Process planning, Capacity Planning, Facilities Location Strategies, Methods study and Work Measurement, Line balancing, Group Technology, Cellular Manufacturing, Flexible manufacturing system, Aggregate production planning, Master Production Scheduling, Shop Scheduling and Shop Floor Control; Inventory control- JIT purchasing, Lead-time control; Maintenance Planning and Management- Corrective, Preventive and Predictive maintenance; Manpower Scheduling-Techinques of manpower scheduling, Service Operations Management. Value flow and application of VSM. QFD.

**Tutorial (T):** Real time Case studies (national and international) about Methods study and Work Measurement, Line Balancing; Manufacturing Planning and Control, Group Discussions, solving the numerical in project management (PERT/CPM) and presentations related to applications in Industry. Industrial Exposure in the form of Expert Lecture/Industry Tour. One research paper each student should be able to present in the topic allotted for presentation and should be able to write a brief review paper on the same.

**MEL 580 (2-0-2) 3 – Advanced Fluid Dynamics**


**Tutorial (T):** Numerical, problem solving on CFD software and presentations.

**MEL 590 (2-1-0) 3 - Selected Topics in Mechanical Engineering**

This course structure will be devised at the time of the running the semester by the concerned faculty member. The content should be based on the selected recent/emerging areas in the field of Mechanical Engineering. It will be based on the availability of faculty/industrial expert. This course can be taught by mix industry expert(s) and/or faculty member(s).
MED-600: Major Project Part -1

(4 Credits)
Every student will carry out Major Project under the supervision of supervisor(s). The topic will be approved by the committee formed by the Head of Department. The Major Project work should involve extensive literature survey, design, development, analysis and computer simulation (if applicable), fabrication and experimentation work. The project report is expected to show clarity of thought and expression and analytical or experimental or design skills. Every student will be required to present two Major Project seminar talks. First at the beginning of the Major Project to present the scope of the work and to finalize the topic, and the second towards the end of the semester, presenting the work carried out by him/her in the semester. The committee constituted by the Head of the Department will screen both the presentations so as to award grades. The grading shall be done on the basis of “NCU Course credit Regulation-Engineering.”

MED-610: Major Project Part -2

(12 Credits)
The Major Project Part -I (MED-600) will be continued as Major Project part - II in 4th semester. Major Project will be evaluated and grades will be awarded by the committee of examiners formulated by the Head of the department based on the “NCU Course credit Regulation-Engineering.” As in Major Project part -I.

MEC-620: Seminar

(2 Credits)
Every student will be required to present a seminar on a topic approved by the department except on his/her Major Project. The committee constituted by the Head of the Department will evaluate the presentation and will award one of the grades on the basis of “NCU Course credit Regulation-Engineering.”

MEL 601-TH (2-0-2) 3– CFD and HT
Basic equations of Fluid flow and Heat Transfer; Classification of governing equations, Boundary conditions; Discretisation methods, finite difference method, finite element method and finite volume method; Finite volume method
for diffusion & diffusion-convection problems; SIMPLE algorithm and flow field calculations, variants of SIMPLE; Turbulence and turbulence modelling; Numerical method for radiation heat transfer. Use of ANSYS CFD module

Practice (P): Numerical on CFD, case studies and presentations. Practice on ANSYS CFD module.

**MEL 603-MD (2-1-0) 3– Design for Manufacturing and Assembly**

Advantages and importance of DFMA; Role of DFM in product specification and standardization; Steps for applying DFMA during product design; Methods of material, shape and process selection; Design for various processes (casting and moulding, powder processing, machining, cold working, sheet metal working, surface polishing and coating); Design for quality and reliability; Robust design approaches; Design approaches for assembled products and assembly systems (Economics of assembly, Taxonomy of assembly operations, Entity Relationship Diagram, Assembly sequence analysis, Liaison diagram, Guidelines for design for assembly)

Tutorial (T): Case studies on design for manufacturing and assembly; Solving sample problems; Presentations by students on selected topics.

**MEL 607-MD (2-1-0) 3– Advanced Mechanics of Solids**

3-D analysis of stress. 3-D analysis of strain and deformation. Constitutive Relations (Generalized Hooke's law, 3-D stress-strain relation for linear elastic Isotropic solids, Compatibility equations, 3-D Mohr's circle). Mechanical Behavior of Solids (Role of experiments in solid mechanics; Elastic material behavior; Plastic material behavior; Visco-elastic material behavior; theories of failure). 2-D elasticity boundary value problems (Plane stress deformation, plane strain deformation, St. Venant’s principle, stress concentration problems). Rayleigh, Euler-Bernoulli and Timoshenko beam theories. Torsion of open and closed hollow beams. One-Dimensional Plasticity (Plastic Bending, Plastic “Hinges”, Limit Load (Collapse) of Beams)
**Tutorial (T):** Numericals and case studies on the content of the course; Presentation by students on their mini-projects; Presentations by students on research papers (They should read research paper and explain to the class).

**MEL 609-TH (3-0-0) 3– Modern Power Plants**

Analysis of steam cycles; Fuels for Power Plants - Coal, Natural Gas, Diesel and Biomass; Steam Generators - Types and operation; Steam power plant - Pulverized Coal and Fluidized Bed Technology; Gas turbine and combined cycle power plants - types and operation; Nuclear power plant - Types and operation, Advantage & limitation, Nuclear reactors: types & their relative merits & limitation; Hydroelectric power plant - Construction and operation of different components of hydraulic power plant; Cogeneration, Environmental aspects of power generation - Emissions from power plants, mitigation of emissions, ecology and environmental effects and nuclear waste disposal, Power Plant Economics - Factors affecting power plant operation. Introduction to Solar and Wind energy based power generation.

**Tutorial (T):** Numerical on economics of power plants and steam cycles, case studies and presentations.

**MEL 613-AE (2-1-0) 3 – Automotive Safety**

Introduction to Automotive safety, motivation for automotive safety and Indian safety legislation, Indian accidental data, Automotive Safety Regulations, Global NCAP; Vehicle Collision: Mechanics of vehicle collision; Crash tests, crash test dummies, evaluation of crash tests; guidelines for design and evaluation of a good occupant restraint system; Accident Avoidance: Introduction to accidental avoidance, Human factors, comfort and ergonomics, Active Safety Systems: ABS, Traction Control, Electronic Stability Program, Adaptive cruise control, Lane departure warning, Brake by wire, Hill start assist control system, Pre-Crash safety; Passive Safety Systems: Vehicle compartment, Passive Safety Systems: Restraint systems, seatbelts, airbags, collapsible steering column; Automotive Safety Systems: Case studies of safety systems used by Automotive manufacturers: Concept of $360^\circ$ Safety, Volvo safety systems, Mercedes Benz Safety
systems, Integrated safety systems, Advanced Driver Assistance Systems; Crashworthiness, Crash energy management: parameters and structures, crumple zone, energy absorption bars; survival space

**Tutorial (T):** Case studies and presentations.

**MEL 617-MD (2-1-0) 3–Composite Materials**


**MEL 621-TH (2-1-0) 3– Analysis of I.C Engine Systems**
Recapitulation of fundamentals: Engine types, operation, performance parameters, air cycles, fuel injection systems, lubrication and cooling; Engine modeling: modeling of processes in SI and CI; Combustion: Combustion in SI and CI engines: Pressure vs crank angle diagrams, heat release rate, rate of pressure rise, mass fraction burned, and temperature profiles; Engine design for best performance and low emissions; Meeting present and future emission legislation; Engine testing: Instruments and operation, performance, emission measurement and analysis.

Tutorial (T): Engine Testing, Modelling of Engine systems case studies and presentations.

MEL-609-IP 2-0-2 3: Concurrent Engineering

Introduction to concurrent Engineering (CE)-Background, Definition and requirement, benefits of CE, Life cycle design of products, life cycle costs, Support for CE, Classes of support for CE activity, CE organizational, structure CE, team composition and duties, Necessary organizational changes; Design Product for Customer-Industrial Design, Quality Function Deployment, house of quality, Translation process of quality function deployment (QFD), Modeling of Concurrent Engineering Design, Compatibility approach, Compatibility index, implementation of the Compatibility model, integrating the compatibility concerns; Design for Manufacture-Introduction, role of DFM in CE, DFM methods, DFM guidelines, design for assembly, creative design methods, product family themes, design axioms, Taguchi design methods, Computer based approach to DFM; Quality by Design-Quality engineering & methodology for robust product design, parameter and Tolerance design, Taguchi’s Quality loss function and signal to noise ratio for designing the quality, experimental approach; Design for reliability& Maintainability- design for economics, decomposition in concurrent design, concurrent design case studies.

Practise (P): Case studies & Numerical exercises on QFD, Taguchi’s quality loss function and experimental design, Design for reliability and maintainability and other relevant topics to be conducted in the practical component.

MEL-611-IP 2-0-2 3: Product Life Cycle Management

Introduction to PLM-Definition, Scope, benefit, spread; The PLM Environment-Product data issues, complex changing environment, Product pains, product opportunities; Business process in the PLM environment- Introduction, process reality in a typical company, Business process activities in an PLM initiative; Product Data and process in PLM Environment- Reality in a typical company, Product data activities in the PLM initiative; Information system in the PLM
Environment- Introduction to PLM applications, Application activities in the PLM initiatives, Best practice PDM selection system; Organizational change management in the PLM environment- Introduction, participants in change, OCM activities in PLM initiative; Project/program management in the PLM initiative-Introduction, PM activities in a PLM initiative. The PLM Initiative: Introduction, Approaches to PLM initiative, Case Studies.

Practise (P): Case studies, Group Discussions and presentations related to applications of PLM in Industries.

MEP 617 IP 2-0-2 3 Manufacturing Economics and Costing


Practise (P): Practical will consist of case studies and problem solving related to budgeting, replacement analysis, costing (labor, performance, equipment), cost benefit analysis. Case study on Capital budgeting, Case study on Replacement analysis, Case study on Decision making, Case study on Analysis of cost, Fixed cost, variable cost, Case study on Depreciation, Case study on Cost Benefit Analysis, Case study on Activity based costing, Case study on performance by cost, Case study on Labor costing, Materials costing, Case study on Equipment and Tooling cost estimation, Case study on Evaluation of investment alternatives, Target costing.