Course Syllabi
Department of Mechanical Engineering

MEL101 ENGINEERING DRAWING (3-0-2-4)
Pre-requisite: NIL.

Contents:
- Scales-concept of representative fraction, importance of scales, Orthographic projections, Projections of points, Projections of Straight lines and practical applications, Projections of planes, Projections of solids(right and regular prisms, pyramids ,cones and cylinders), Auxiliary Views of Planes and Solids, Sections of solids, Development of surfaces of solids, Isometric projections.

Practical: Practicals as per course contents.

Text Book:

Additional Books:

MEL201 MECHANICAL BEHAVIOUR OF MATERIALS (3-0-0-3)
Pre-requisite: NIL.

Contents:

Text Book:

Additional Books:

MEL202 ENGINEERING THERMODYNAMICS (3-2-0-4)
Pre-requisite: NIL.

Contents:

Text Book:

Additional Books:

MEL203 FLUID MECHANICS (3-0-2-4)
Pre-requisite: NIL.

Contents:
- Introduction, fluid properties, classification, fluid statics, rigid body motions, kinematics of fluid motions, Reynolds transport theorem, mass, momentum and energy laws with applications, governing equations for Newtonian fluids, exact solutions, laminar and turbulent pipe flow, Introduction to boundary layer theory, Dimensional analysis and modeling, open channel flow.

Practical: Practicals as per course contents.

Text Books:

Additional Books:

MEL204 SOLID MECHANICS (3-0-2-4)
Pre-requisite: NIL.

Contents:
- Design of thin and thick pressure vessels and pipes. Design of shrink fit.

Practical: Practicals as per course contents.

Text Books:

Additional Books:
MEL205 KINETICS OF MACHINES
(3-2-0-4)
Pre-requisite: NIL.
Contents:

Text Book:

Additional Books:

MEL206 MACHINE DRAWING (3-2-0-4)
Pre-requisite: NIL.
Contents:

Text Book:

Additional Books:

MEL207 CASTING, WELDING AND FORMING (3-0-2-4)
Pre-requisite: NIL.
Contents:
Study of metal casting processes; Study of welding and other joining processes; Study of metal forming processes; Processing of plastics; Process planning and process analysis casting, Economic and quality issues in casting; Welding and forming processes.

Practical: Practicals as per course contents.

Text Book:

Additional Books:

MEL208 MACHINING AND MACHINE TOOLS (3-0-2-4)
Pre-requisite: NIL.
Contents:
Introduction to machine tools and machining operations: Mechanics of metal machining. Cutting forces, friction, cutting fluids and surface finish, lubrication, temperatures and heat transfer and its measurement, tool life and tool wear aspects. Theoretical models of shear angle solution, Basic concepts of cost and economics of metal cutting operations, Tool nomenclature, chip control and design for machining. Electrical discharge Machining, Electrochemical Machining, Ultrasonic machining, Abrasive Jet Machining, Laser Beam Machining, Water Jet and Electron Beam machining.

Practical: Practicals as per course contents.

Text Book:

Additional Books:

MEL301 APPLIED THERMODYNAMICS (3-0-2-4)
Pre-requisite: NIL.
Contents:

Practical: Practicals as per course contents.

Text Books:

NITUK Course Book-2016

**Additional Books:**


**MEL302 FLUID MACHINES (3-0-2-4)**

**Pre-requisite:** NIL

**Contents:**

Impact momentum principle, dynamic action of jet on fixed and moving flat plates and curved vanes, series of plates and vanes, water wheels, velocity triangles and their analysis, jet propulsion of ships; Principles and classification of hydraulic machines, element of hydroelectric power plant. Impulse turbines like Pelton wheel. Reaction turbines like Francis turbines, propeller turbine, Kaplan turbine and bulb turbine. Radial flow, axial flow, and mixed flow turbines. Principle of operation, construction, design, installation, characteristics, governing, accessories, selection, model testing, degree of reaction, velocity diagram and analysis, unit and specific quantities.Centrifugal pump, reciprocating pump and rotary pumps. Introduction to axial pump, mixed flow pump, self priming pump, gear pump, sliding vane pump, screw pump & hand pump. Principle of operation, classification, components installation, priming, velocity triangles and their analysis, slip factor, performance characteristics, multistaging of pumps, design, indicator diagram, cavitation, air vessels, model testing, NPSH, unit and specific quantities. Airlift pumps, hydraulic rams, bore hole pumps, submersible pumps, jet pumps, regenerative pumps. Industrial hydraulic components such as pumps, valves, accumulators, actuators. Hydraulic systems integration. Fluid leakage. Hydraulic, calculus for hydraulic presses, hydraulic cranes etc. Fluid couplings and torque converters.

**Practical:** Practicals as per course contents.

**Text Book:**


**Additional Books:**


**MEL303 HEAT AND MASS TRANSFER (3-0-2-4)**

**Pre-requisite:** NIL

**Contents:**


**Practical:** Practicals as per course contents.

**Text Books:**


**Additional Books:**


**MEL304 DYNAMICS OF MACHINES (3-0-2-4)**

**Pre-requisite:** NIL

**Contents:**


**Practical:** Free and forced vibration. Governors

**Text Book:**


**Additional Books:**


**MEL305 METROLOGY AND SQC (3-0-2-4)**

**Pre-requisite:** NIL

**Contents:**

Definition, need, Precision & Accuracy, Standards of Measurements, linear and angular measurements, Comparators: Mechanical, Fluid displacement & Pneumatic, Electrical.

**Text Book:**


**Additional Books:**


**MEL306 OPERATIONS MANAGEMENT (3-2-0-4)**

**Pre-requisite:** NIL

**Contents:**

NIL

Text Book:

Additional Books:
1. Martinich, J.S., Production and Operations Management, Wiley India, 2009

MEL307 DESIGN OF MACHINE ELEMENTS

(3-2-0-4)
Pre-requisite: NIL.

Contents:
Design of elements subjected to simple loading: screws including power screws, axles, and couplings, clutches and brakes. Introduction to design for fatigue strength. Endurance and modifying factors. Surface strength. Design procedure of fatigue failure with application to the design of bolted joints including eccentrically loaded joints, springs and shafts subjected to fatigue loading. Design of spur, helical, bevel and worm gears, journal and rolling contact bearings, belts and chains. Selection of motors.

Text Books:

Additional Books:

MEL308 MECHANICAL MEASUREMENTS

(3-0-2-4)
Pre-requisite: NIL.

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

Text Books:

Additional Books:

MEL401 OPERATIONS RESEARCH TECHNIQUES

(3-2-0-4)
Pre-requisite: NIL.

Contents:

Text Book:

Additional Books:

MEL402 AUTOMATIC CONTROL

(3-0-0-3)
Pre-requisite: NIL.

Contents:

Text Books:

Additional Books:

MEL403 FLUID DYNAMICS

(3-0-0-3)
Pre-requisite: NIL.

Contents:
Concept of boundary layer, flow over a flat plate, Navier-Stokes’s equations and it’s use. Von-Karmann Momentum Equation. General properties of boundary layer. Exact solution of two-dimensional methods. Correlation coefficient. Concept of compressible flow, one dimensional isentropic flow, normal shock, flow with frictional heat transfer.

Text Book:

Additional Books:
MEL405 COMPUTER AIDED DESIGN (3-2-0-4)
Pre-requisite: NIL

Contents:

Text Book:

Additional Books:

MEL406 FINITE ELEMENT METHODS (3-2-0-4)
Pre-requisite: NIL

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

Text Book:

Additional Books:

MEL407 LUBRICATION (3-0-0-3)
Pre-requisite: NIL

Contents:

Text Book:

Additional Books:

MEL408 MECHATRONICS (3-0-2-4)
Pre-requisite: NIL

Contents:

Text Book:

Reference Book:
1. Hamliton’s principle, derivation of equilibrium, consistent and variation modelling.
2. Practical: Practical as per course contents.

MEL409 THEORY OF ELASTICITY (3-0-2-4)
Pre-requisite: NIL

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

Text Book:

Additional Books:

MEL410 MECHANICAL VIBRATIONS (3-0-2-4)
Pre-requisite: NIL

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

Text Book:

Reference Book:
1. Hamliton’s principle, derivation of equilibrium, consistent and variation modelling.
2. Practical: Practical as per course contents.

MEL411 THEORETICAL MECHANICS (3-0-2-4)
Pre-requisite: NIL

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

Text Book:

Reference Book:
1. Hamliton’s principle, derivation of equilibrium, consistent and variation modelling.
2. Practical: Practical as per course contents.

Practical: Practicals as per course contents.

Text Book:

MEL411 ROBOTICS (3-0-2-4)
Pre-requisite: NIL
Contents:
1. Introduction to Kinematics & Dynamics, drives, control, sensors and grippers. Application of robotics in handling, welding, painting, assembly, machining and other areas. Selection of robots.
2. Additional Books:

MEL412 AUTOMATION IN PRODUCTION (3-0-0-3)
Pre-requisite: NIL
Contents:
2. Additional Books:
3. MEL413 ADVANCED MANUFACTURING TECHNIQUES (3-0-0-3)
Pre-requisite: NIL
Contents:
1. Introduction to CIM, Types of Manufacturing, CIM hardware and software, Elements of CIM, Product development through CIM Introduction, Database requirements of CIM, Database, Database management, Database Models, Product Data Management (PDM), Advantage of PDM, Manufacturing cell, Group Technology, Cellular Manufacturing, Introduction to FMS, Manufacturing integration model, flexible manufacturing strategy, Components of Flexible Manufacturing-Pallets and fixtures, machining centers, inspection equipment, material handling stations, storage system, In-process storage, manually operated stations, allied operation centers integration of the industrial robot into CIM system, product design of automatic manufacture of robots, computer aided inspection using robots, Principles of networking, Network Techniques, Local area network (LAN), networking standards, Design Activities in a networked environment, networking in a manufacturing company, hardware elements of networking, Collaboration Engineering.
2. Text Book:
3. Additional Books:
   - Shover, R.N., An Analysis of CAD/CAM Application with Introduction to CIM, Prentice Hall.

MEL414 POWER PLANT ENGINEERING (3-0-0-3)
Pre-requisite: NIL
Contents:

MEL415 RENEWABLE ENERGY SOURCES (3-0-0-3)
Pre-requisite: NIL
Contents:
1. Need for alternative sources of energy, various options available, principles of energy conversion using solar energy, wind energy, Ocean energy, Geothermal energy and MHDP power generation. Introduction, Spectral distribution of solar radiation, beam and diffused radiations, measurement of solar radiation, pyranometer, pyrheliometer, sunshine recorder. Solar radiation geometry, radiation on tilted surface, tilt factors. Liquid flat plate collector & their analysis, collector efficiency factor and heat removal factor, collector efficiency, Concept of selective surfaces, some novel designs of solar collectors, Solar air heaters and their analysis. Cylindrical parabolic collectors, compound parabolic collectors, parabolic collectors, their construction and principle of operation, advantages and drawbacks, tracking systems Solar energy storage. Water heating, space heating, drying, refrigeration, distillation, cooking, PV systems. Introduction to biogas generation, fixed dome & floating drum biogas plants, their constructional details, factors affecting generation of biogas, utilization of biogas. Introduction, methods of obtaining energy from biomass, incineration, 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
tional components and materials Review of fuel, cooling and lubrication

Practical: Apparatus, air flow ducts, air quality. Control and optimization of HVAC systems

Text Book:

CARRIER Handbook

MEL417 AUTOMOBILE ENGINEERING

Pre-requisite: NIL

Contents:

Practical: Practicals as per course contents.

Text Book:

Additional Books:
2. Srinivasan, S., Automotive Engines, Tata McGraw Hill, New Delhi, 2004

MEL418 I. C. ENGINES

Pre-requisite: NIL

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

Practical: Practicals as per course contents.

Text Book:

Additional Books:

MEL419 TOOL DESIGN

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:

MEL420 MACHINE TOOL DESIGN

Pre-requisite: NIL

Contents:

Text Book:

Additional Book:

MEL421 MATERIAL RESOURCE PLANNING

Pre-requisite: NIL

Contents:

Text Book:

Additional Book:

Additional Books:

MEL 422 NON-METALLIC MATERIALS
(3-0-0-3)
Pre-requisite: NIL

Contents:

Text Book:

Additional Books:

MEL423 DESIGN AND ANALYSIS OF EXPERIMENTS
(3-0-0-3)
Pre-requisite: NIL

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

Text Book:

Additional Books:

MEL424 NON TRADITIONAL MANUFACTURING PROCESSES
(3-0-0-3)
Pre-requisite: NIL

Contents:

Text Book:

Additional Books:

MEL425 THEORY OF PLASTICITY AND METAL FORMING PROCESSES
(3-0-0-3)
Pre-requisite: NIL

Contents:
- Elements of theory of plasticity, formulation of plastic deformation problems and different methods of solution, stress-strain relations in elastic and plastic deformations, yield criteria for ductile metals, work hardening and anisotropy in yielding, flow curves, slip line field theory, effect of temperature and strain rate in metal working, friction and lubrication in cold and hot working, technology and analysis of important metal forming processes—forging, rolling, extrusion, wire drawing, sheet metal forming processes like deep drawing, stretch forming, bending.

Text Book:

Additional Books:

MEL426 ADVANCED JOINING PROCESSES
(3-2-0-4)
Pre-requisite: NIL

Contents:

Text Book:

Additional Books:

MEL427 QUALITY ASSURANCE
(3-0-0-3)
Pre-requisite: NIL

Contents:

Text Book:

Additional Books:

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

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

**Text Book:**

**Additional Books:**

**MEL429 PROCESSING OF COMPOSITE MATERIALS (3-0-0-3)**

- **Pre-requisite:** NIL
- **Contents:**
  - FRP Composites, fiber types, fiber forms and properties, matrices type and properties, lamina, laminate, composites-macro and micromechanical analysis & properties, failure theories, primary and secondary manufacturing - lay-up, filament winding, pultrusion, compression moulding, RTM, RM, SLM, machining - drilling, routing etc., application Metal Matrix Composites-powder metallurgy, sintering, squeege casting, applications Ceramic Matrix Composites- clays, whiskers, fibers, mixing, mass processing techniques, applications.

**Text Book:**

**Additional Books:**

**MEL430 FRACTURE MECHANICS (3-0-0-3)**

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

**Text Book:**

**Additional Books:**

**MEL431 DYNAMICS OF MECHANICAL SYSTEMS (3-0-0-3)**

- **Pre-requisite:** NIL
- **Contents:**
  - Basic concepts: Inertial coordinate system, laws of motion, mechanics of system of particles, principles of linear and angular momentum, Lagrangian dynamics: Degrees of freedom, generalized coordinates, holonomic and non-holonomic constraints, Lagrange’s equation from d’Alembert’s principles, application of Lagrange’s equation for conservative and non-conservative autonomous systems with holonomic; and non-holonomic constraints, applications to systems with very small displacements; Hamilton principle from D’Alembert’s principle, Lagrange equation from Hamilton’s principle. Multi-body dynamics: Space and fixed body coordinate systems, coordinate transformation matrix, direction cosines, Euler angles, Euler parameters, finite and infinitesimal rotations, time derivatives of transformations matrices, angular velocity and acceleration vectors, equations of motion of multi-body system, Newton-Euler equations, planar kinematic and dynamic analysis, kinematic revolute joints, joint reaction forces, simple applications of planar systems, Stability of motion: Fundamental concept in stability, autonomous systems and phase plane plots, Routh’s criteria for stability.

**Text Book:**

**Additional Books:**

**MEL432 MECHANISM DESIGN (3-0-0-3)**

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

**Text Book:**

**Additional Books:**

**MEL433 TRIBOLOGY IN DESIGN (3-0-0-3)**

- **Pre-requisite:** NIL
- **Contents:**

**Text Book:**

**Additional Books:**

**MEL434 MODELLING AND SIMULATION (3-0-0-3)**

- **Pre-requisite:** NIL
- **Contents:**
  - Systems and models - Examples of models, models for systems and signals. Physical modelling - Principles of physical modelling, basic relationships. Mathematical modelling: Estimating response, spectra and frequency functions, parameter estimation in dynamic models, system identification as a tool for model building. Simulation and Simulation application: Numerical prototyping as modelling for design and synthesis using computational tools. Introduction to techniques for validation of models, Simulation of electromechanical, thermo-mechanical, hydraulic and pneumatic elements. Modelling and Simulation for Optimization: Introduction to the concept of optimization, the basic terminology and notations; modelling process; and illustration with modelling of engineering
problems Local and global optima; necessary and sufficient optimality conditions for unconstrained and constrained multivariate functions.

Text Book:

Additional Books:

MEL435 DESIGN PRINCIPLES (3-0-0-3)
Pre-requisite: NIL.

Contents:

Text Book:

Additional Books:

MEP401 MACHINE SYSTEM DESIGN (1-0-4-3)
Pre-requisite: NIL.

Contents:
Design of a small Mechanical system consisting of shaft, bearing, gear/belt. Only output expected shall be provided. Complete concept shall be developed by tudents.
Final report shall consist of concept, Power and Force calculations, Component design report, Production Drawing of compounds, Assembly and sub assembly drawing of components. This task can be done by a group of not more than 3 students.

Practical: Practicals as per course contents.

Text Book:
1. PSG Design Data Book.