B.Tech Courses

MEL101 Continuum Mechanics, (3-1-0) 4 credits
Prerequisites: NIL
Continuum Theory, Stress Principles, Kinematics of Deformation and Motion, Fundamental Laws and Equations, Linear Elasticity, Classical Fluids, Nar Elasticity, Linear Viscoelasticity.

MEL102 Energy Science and Technology, (3-1-0) 4 credits
Prerequisites: NIL
Energy resources – salient features and utilization. Renewable and non-renewable sources.Environmental and sustainability issues. Basic concepts and definitions – system, boundary,equilibrium, steady state, etc. Work and heat – definition and applications. 1st Law – internal energy and enthalpy, applications to non flow/closed and flow/open systems. 2nd Law – corollaries,Clausius inequality, entropy. Introduction to availability, irreversibility and exergy. Carnot cycle.Thermodynamic properties of a pure substance – saturated and other states. Basics of gas-vapor mixtures and reacting systems. Vapor power cycles – Rankine cycle and its modifications. Air standard cycles – Otto, Diesel, Brayton cycles. Vapor compression and absorption refrigeration cycles. Introduction to real cycles.

MEP103 Engineering Communication, (0-0-4) 2 credits
Prerequisites: NIL
Introduction to design process and drawings. Drawing standards and their use in industry. Review of sectioning, drawing standards, dimensioning and notes. Standard representations of fastening and joining. Machine assembly drawings with sectioning, exploded views and bill of materials, parts detailing and assembly. Relationship between form and function – limits, fits and tolerances, dimensional and geometric tolerances, surface finish. Process engineering diagrams for manufacturing and assembly. Schematic and process flow diagrams – standard equipment and symbols. Instrumentation and control diagrams. Architectural layout drawings, Sequence control diagrams, Project management charts. A combination of free hand drawing and use of industry standard software packages will be employed.

MEL201 Fluid Mechanics, (3-1-0) 4 credits
Prerequisites: MEL101
Fluid kinematics: Lagrangian and Eulerian descriptions, pathlines, streaklines and streamlines,acceleration. Integral flow analysis: Reynolds transport theorem, conservation of mass/continuity equation and conservation of linear and angular momentum for a control volume in inertial and accelerating reference frames, energy equation, Bernoulli's equation, engineering applications.Differential analysis of flow: Continuity and Navier-Stokes equations. Dimensional analysis and Similitude theory. Inviscid flows: Irrotational flow, circulation, velocity potential and applications. Viscous flows in pipes and ducts. External viscous flows: concept of boundary layer, momentum integral equation, drag and lift, separation. NPSH concept, similarity rules, applications.

MEL202 Manufacturing with Metallic Materials, (3-0-0) 3 credits
Prerequisites: GEL102
Product realization with metals, Material properties, Microstructure, Correlation between microstructure and properties, interfaces and intermetallics, Property modifications-heat treatment and allied process, Casting techniques and analysis, Forming techniques and analysis, Forging technique and analysis, Machining methods, Conventional and Non-conventional and their analysis,Assembly and fabrication techniques, Welding and allied processes, Product testing and

quality control, Advanced applications in general engineering, aerospace, automobile and biomedical industries.

MEL203 Manufacturing with Non-metallic Materials, (3-0-0) 3 credits
Prerequisites: GEL102
Product realization with polymers and composites; Type of polymers - Thermoplastics, Thermosets and Elastomers; Correlation between microstructure and property; Property enhancement by blending, alloying, reinforcing; Manufacturing techniques for general polymer based products and its mold /die design fundamentals; extrusion, injection molding, blow molding, rota molding, etc.;FRP composites . Lamina, laminate and lamination theory; Manufacturing of composites; Autoclave molding, Pultrusion , Filament winding, Compression molding; Carbon – Carbon Composites; Applications ina utomobile, aerospace and general engineering.

MEL204 Machine Element Design, (3-0-0) 3 credits
Prerequisites: MEL101
Engineering design vis-à-vis Solid mechanics, factor of safety, standards and design equations.Application of theories of failure to design. Design procedure and its application to static strength.Design based on static loads: screws including power screws, bolted joints including eccentrically loaded joints, axles, and coupling, clutches and brakes. Introduction to design for fatigue strength.Endurance and modifying factors. Surface strength. Review of design procedure of fatigue failure with application to the design of bolts and springs subjected to fatigue loading. Design of shafts,spur, helical, bevel and worm gears, journal and rolling contact bearings, belts and chains.

MEP205 Product Design and Realization – Intermediate, (0-0-4) 2 credits
Prerequisites: MEP103 , GEL101
Fabrication of a finished product through: (a) Identification of engineering solution parameters like materials, manufacturing and configuration variables, (b) Study and improvement of existing designs, (c) Open ended design problems for generating innovative designs/solutions and engineering problem solving, and (d) Product design with other life-cycle considerations in mind such as manufacturing, maintenance and environmental considerations (e) application of core mechanical engineering principles and practices.

MEL301 Heat and Mass Transfer, (3-1-0) 4 credits
Prerequisites: MEL201
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.

MEP302 Manufacturing Laboratory, (0-0-6) 3 credits
Prerequisites: MEL202, MEL203
Practice on the use of processes to produce high precision and multifunction components with metals and non-metals.

MEL303 Theory of Machines, (3-0-0) 3 credits
Prerequisites: MEL204, PHL103
Kinematic pairs, diagram and inversion. Mobility and range of movements. Displacement, velocity and acceleration analysis of planar linkages. Dimensional synthesis for motion, function and path generation. profile synthesis. Gears. Dynamic force analysis, flywheel, inertia forces and their balancing for rotating and reciprocating machines.

MEP304 Design Laboratory, (0-0-4) 2 credits
Prerequisites: MEL303
Laboratory experiments on motion, forces, stresses and durability of mechanical components.

MEP305 Control Engineering Laboratory, (0-0-3) 1.5 credits
Prerequisites: EEL205
Laboratory experiments on the design and use of pneumatic, hydraulic, and electronic controllers for control of parameters like displacement/position, pressure, flow rate, temperature, level, speed,etc.

MEP401 Thermo-fluids Laboratory, (0-0-3) 1.5 credits
Prerequisites: MEL201, MEL301, MEL102
Experiments in fluid mechanics and heat transfer.

MEL402 Manufacturing Systems, (3-0-0) 3 credits
Prerequisites: IIP201
Generalized model of a production system. Financial evaluation of new product polices. Profit Volume Charts, Risk analysis, Product mix decisions, Location and layout analysis, Product,process and cellular layouts, Demand forecasting, Aggregate production planning, Materials planning, MRP and inventory management, scheduling in job and flow shops.

LIST OF PROGRAMME ELECIVES
MEL411/ MEL451 Transportation Mechanics, (3-0-2) 4 credits
Prerequisites: PHL103
Basic features of surface transport on land and water. Mechanics of passenger transport equipment - hand carts, bicycle, tri-cycle, cycle rickshaw, motorized 2-wheelers, automobile, bus, train, trams,cable cars,etc. Freight transport – trucks, tractor trailers, trains, etc. Water transport – manual and motor powered boats, ships, and hovercraft. Earth moving equipment – bulldozers, backhoe,dumper, etc. Topics will include powering device, transmission, drive train aspects, ride comfort and stability, and safety features, amongst others.

MEL412 / MEL452 Propulsion Technologies, (3-0-2) 4 credits
Prerequisites: MEL102 & 90 credits
Prime movers – I.C. engine, gas turbine, steam turbine, electric motor. I.C. engine fundamentals covering mechanisms, thermodynamics, controls and operation, and components, their materials and manufacture; applications in land and water propulsion; Jet propulsion – fundamentals, types of engines, their characteristics and applications; construction features and materials; applications in surface (land and water) transport and aircraft propulsion. Rocket propulsion – basics, solid and liquid propelled engines, construction features, multi-stage rockets. Energy and environmental impacts.

MEL413/MEL453 Indoor Environment Control, (3-0-2) 4 credits
Prerequisites: MEL102, MEL201, MEL301
Air quality and comfort – temperature and humidity, dust and contaminants; standards, ambient air quality, measurement techniques; Space cooling techniques – ceiling fans, evaporative cooling and air-conditioning, fundamentals, systems and components, construction features; vapour compression and vapour absorption systems; cooling load estimations. Space heating techniques –fire place, electric and gas heating, solar heating; load estimations. Clean room – classification and systems. Applications for domestic, office, transport, and specialized uses, such as, hospitals,factories, assembly areas, etc. Energy and environmental impact.

MEL414 / MEL454 Electric Power Generation, (3-0-2) 4 credits
Prerequisites: MEL102
Centralized and de-centralized electric systems, grid and its management, demand variation and forecasting; Thermodynamics, systems, components and construction features of diesel generating sets, coal/oil/gas burning, combined cycle, solar thermal, geothermal, ocean thermal power plants.Nuclear power plants – types, basic nuclear physics and construction features, fuel, moderator and coolant, steam cycle; Hydro electric plants – fundamentals, construction features; Fuel cells; Solar photovoltaic systems; Carbon footprint and future trends.

MEL415 / MEL455 Biomechanics, (3-0-2) 4 credits
Prerequisites: PHL103
Basics of kinematics and dynamics; Physiology of various life forms, structural aspects.Locomotion principles. Properties of tissue, analysis of motion and forces. Mechanics of injuries and ageing effects; Design and use of implants their materials of construction features and manufacture.

MEL416 / MEL456 Tribology, (3-0-2) 4 credits
Prerequisites: MEL204
Tribology basics, surfaces and their characterization and measurement; Apparent and real area of contact; Contact pressure and deformation. Genesis of friction, friction in contacting surfaces, sliding and rolling friction, laws and theory of friction. Stick-slip friction behaviour, frictional heating and temperature rise. Wear: types, mechanisms - adhesive, abrasive, corrosive, erosion, fatigue, fretting, etc. Wear models, rates their control and damage. Lubrication – types, hydrodynamics lubrication regimes, lubricating oils, their specification, contamination in use; lube oil systems for engineering equipment, such as, hydraulic and steam turbines, IC engines, industrial machinery, brakes and clutches, etc. Micro- and nano-tribology.

MEL417 / MEL457 Noise and Vibration, (3-0-2) 4 credits
Prerequisites: MEL204
Introduction to engineering acoustics. Noise – properties, loudness and weighing networks, octave and FFT analysis, Sound power, intensity; Measurements and diagnostics. Noise control techniques; Noise from machines, such as, fans, engines, bearings, turbines, motors, jets, etc. Noise standards. Introduction to vibration engineering, Spatial, modal and response models; Lumped parameter and distributed parameter modeling; free- and forced-vibrations and single- and multi-degree of freedom systems. Balancing of rotating and reciprocating machines; vibration isolators and shock absorber design, construction and properties. Flow-induced vibrations. Measurement and instrumentation.

MEL418 / MEL458 Robotics, (3-0-2) 4 credits
Prerequisites: MEL303
Evolution of automatons, manipulators and autonomous systems, Forward and inverse kinematics, velocity control; Jacobian control of systems; singular value decompositions and null spaces; Interpolation in 3-D spaces, dual numbers, quaternions and screws, dynamics of manipulators, ELand NE formulations, Parallel manipulators, basics of vision systems, Robotic AI paradigms and navigation.

MEL419 / MEL459Mechatronics, (3-0-2) 4 credits
Prerequisites: EEL205
Introduction to mechatronics systems and components; Basics, interfacing and integration of microprocessors, sensors, actuators, and other hardware; Interfacing, AD and DA converters, software and hardware tools; component selection including: sensors – encoders and resolvers, actuators – stepper and servo motors, solenoids; transmission elements – ball screws; controllers.Analysis and synthesis of systems for robotics, CNC and industrial applications.

MEL421 / MEL460 Medical Devices and Equipment, (3-0-2) 4 credits
Prerequisites: 90 credits
Basic anatomy and physiology of human systems, such as, circulation, respiration, etc. and organs and associated tissues; Requirement of devices and equipment for various procedures, e.g. surgery, dental procedures, dialysis, etc.; inserts, implants, artificial limbs; etc. – design, manufacturing, installation and use.

MEL422 / MEL461 Composite Materials, (3-0-2) 4 credits
Prerequisites: MEL203
Types of composites, natural composites; fiber types, forms and properties; lamina and laminate; micro- and macro-mechanical analysis and properties, failure theories; primary and secondary manufacturing – lay-up, filament winding, pultrusion, compression moulding, RTM, RIM, SRIM; Machining, drilling, joining, routing, etc.; Applications – metal matrix composites, ceramic matrix composites, etc. – components and processing techniques.

MEL423 / MEL462 Micro-manufacturing, (3-0-2) 4 credits
Prerequisites: GEL101 & 90 credits
Overview of micro- and nano-maechanical systems and their applications; MEMS microfabrication methods, silicon micromachining, laser micromachining, mechanical micromachining; nanomanufacturing methods, CAD and CAM tools for micro- and nano-manufacturing techniques.

MEL424 / MEL463 Finite Elements Analysis, (3-1-0) 4 credits
Direct Approach for Discrete System-(e.g. Spring system). One Dimensional Continuum Problem (1D axially loaded bar, 1Dheat conduction),Governing differential equations for such problems, Equivalent functional form, Calculus of variation:- simple variational problems, Euler-Lagrange equations, variable end-point problem, and discussion on boundry conditions (natural and necessary boubdry conditions. Drichlet and Neuman boundry conditions),Minimization of functional as solution of governing equations(Rayleigh Ritz methods), Weak formulations and galerkin methods, Piece-wise polynomials as approximate solutions (Interpolation functions), :Stiffness" matrix, "force" and "Displacement" vectors, Programming and numerical integration (gauss quadrature). Two Dimensional Continuum Problem: 2D contimuum problems (heat and 2D elasticity problems),

Calculus of variations for several independent variables, Solutions using Triangular (CST and LST) elements, Isoparametric elements (4-noded). Beam and frame Elements.

MEL425 / MEL464 Engineering Optimization, (3-1-0) 4 credits
Optimization Studies: Problem formulation, Solution Strategies, Performance Criteria, Classification of Optimization Techniques, One-dimensional Optimization: Optimality criteria- necessary and sufficient conditions, Direct search methods, Gradient Methods, Sensitivity Analysis, Multi-dimensional Optimization: Optimality criteria Gradient-based methods. Conjugate-direction methods, Quasi-Newton methods, Constrained Optimization: Constrained Optimization Criteria, Penalty Methods, Direct search methods, linearization Methods, Quadratic Approximation, and Concept of Duality, Linear Programming: Formulation of problems, Analytical and Graphical Solutions, Sensitivity Analysis, Integer Programming, Interior Point methods, Duality Theory, Applications of Unconstrained and Constrained Optimization, Multi-Objective Optimization, Evolutionary optimization(EO): Genetic Algorithms(GA), Multi-Objective Evolutionary Algorithms (MOEA), Global Optimization, Importance of Simulated Annealing.

MEL426 / MEL465 Introduction to Biomedical Engineering, (3-0-2) 4 credits
Lecture: Basic concepts of Biomedical Engineering, Genetic Engineering, Cell Culture Engineering, Cell Communication and Immunology, General Concepts of Bimolecular Engineering, Engineering of Immunity, Cardiovascular Physiology, Renal Physiology, Biomechanics and Orthopedics, Bioimaging, Tissue Engineering, Biomedical Engineering and Cancer, Artificial Organs. Laboratory: Biosignals: instrumentation, signal processing, ECG, nerve and muscle excitation, control system: Mass transfer; dialysis, respiratory system, digestion; Medical imaging: ionizing radiation, gamma camera, nuclear magnetic resonance, ultrasound, image processing.

MEL466 CFD and Heat Transfer, (3-1-0) 4 credits
Prerequisites: MEL201, MEL301
Intorduction;Partial differential equations (PDEs), Classification of PDEs; Finitedifference method (FDM) discretization schemes; convergence, Stability, and consistency criterion of different FDM schemes; FDM schemes for steady and unsteady heat conduction problems and boundary layer problems, Stream function vorticity method, Finite volume method(FVM) for fluid flow and heat transfer problems, Approaches adopted in FDM, finite element method (FEM) and FVM formulations , Concept of mesoscopic approach, Introduction to lattice boltzmann method for solving transient heat conduction problems.

MEL467 Design Research, (2-0-2) 3 credits
Prereuisites: GEL101
Introduction to research, product design, design research, types of research, research areas of design, hypothesis, publications; steps of conducting research, design research methodology, tools used in research, research using instruments: Think Aloud Protocol, usability study: research will people: interview (face to face, telephonic, computer assisted), observational study. interventional study, literature research, questionnaire; writing an article; introduction to statistics, experiments and experimental designs, Probability, Distribution, Sampling, Inferential statistics, Significance testing, Correlation, Multi-level analysis, ANOVA, choosinga significance test, t test, Chi Square, ethical issues in research, technical english, reference styles.

MEL206/ MEL468 Mechanics of Materials, (3-1-0) 4 credits

Stress, Strain, Axial Deformation of Bars: Statically Determinate Systems. Axial Deformation of Bars: Statically Indeterminate Systems. Generalized Hooke's Law: Pressure Vessels. Torsion. Beam Statics. Symmetric Beam Bending. Unsymmetric (Skew) Beam Bending. Shear Stresses in Beams. Stress and Strain Transformation: Mohr's Circle. Yield and Fracture Criteria. Elastic Stress Analysis. Beam Deflections by Direct Integration. Beam Deflections by the Moment-area Method. Columns. Energy and Virtual Work. Classical Energy Methods. Elastic Analysis of Systems. Plastic Limit Analysis.

MEL427/ MEL469 Clean And Sustainable Energy Engineering, (3-0-2) 4 credits
Prerequisites:MEL102, MEL201, MEL301
Overview of various clean and sustainable energy sources - such as Solar thermal, Solar Photo-Voltaic, Wind, Bioenergy, Hydro, Geothermal, Tidal, Wave; Active & passive solar heating; Daylighting; Basic principles of PV in silicon; Combustion/Pyrolysis of biomass; Energy storage; Hydro & tidal turbines; Aerodynamics of wind turbines; Wave energy technology; Economics of clean energy; Environmental impact and safety; Current and future trends.

MEL470 Combustion & Emissions in Reciprocating Engines, (3-0-2) 4 credits
Prerequisites: MEL102
Introduction of basic engine components; Thermodynamics of combustion; Charge preparation in SI and CI engines; Combustion in SI engines, Flame structure and speed, Spark ignition, Abnormal Combustion, Cyclic variations; Combustion in CI engines, Fuel spray behavior, Ignition delay, Mixing-Controlled combustion; Emission control technologies, Emission control by design variables, EGR, Exhaust gas after-treatment, SCR, DOC, DPF; Engine fuels quality and emissions; Alternative automotive power plants, Homogeneous and stratified charge engines; Combustion Diagnostics; Emission standards, test procedures and measurement; Engine laboratories.

MEL471 Materials Characterization Techniques, (3-0-2) 4 credits
Prerequisites: GEL102
XRD: Properties and generation of X-ray, Continuous and characteristics spectra, Bragg's diffraction law, Diffraction methods, Scattering by electron/ atom/ unit cell, Structure-factor calculation, Determination of crystal structures, Quantitative and qualitative analyses, Residual stress measurement; Electron Microscopic Techniques: (a) TEM - Introduction to electron microscopy and principles, Design of TEM, Models of operation, Specimen preparation techniques, Diffraction pattern analysis, STEM, (b) SEM/EDS - principle and operation; Scanning Probe Microscopy: AFM and STM; Simultaneous Thermal Analysis: TGA/MS and DSC; Vibrational Spectroscopic Techniques: IR, NMR, Raman; Mercury Porosimetry and Nitrogen Adsorption methods; Bio Materials Characterization: by nanoindentation technique

MEL472 Automotive Engineering, (3-1-0) 4 credits
Prerequisites: GEL 102, MEL204, MEL 303
Prime movers for automotive applications; Powertrain components; Power generation characteristics of internal combustion engines; Engine dynamics; Design and structural analysis of engine components; Vehicle longitudinal dynamics, Clutch fundamentals, Different type of clutches; Vehicle Transmission Systems: Basic Design Principles, Automatic and manual transmissions, Matching Engine and Transmission, Gear-shifting Mechanisms; Electronic Transmission Control; Driveline Systems and Vehicle Performance, Front, Rear and all-wheel drivelines; Suspension Systems; Steering Systems and Steering Dynamics; Automotive brake systems; Automotive tyres and wheels; Automotive electrical systems: starting, charging, lighting, engine management

MEL473 Statistical Thermodynamics, (3-1-0) 4 credits
Prerequisites: PHL102, MAL112
Principles and methods of statistical mechanics: Classical and quantum statistics, grand ensembles, fluctuations, molecular distribution functions, and other topics in equilibrium statistical mechanics. Topics in thermodynamics and statistical mechanics of irreversible processes. System of interacting particles, Elementary kinetic theory of transport processes, Transport theory using the relaxation time approximation, Near exact formulation of transport theory, Irreversible processes and fluctuations. Kinetic theory of gases, statistical mechanics of ideal gases, classical mechanics, statistical kinetic theory, non-equilibrium thermodynamics, Correlation functions; linear response theory, theory of Brownian motion; projection operator formalism, hydrodynamic fluctuations.

MEL 474 Computer Aided Design and Manufacturing, (2-0-4) 4 credits
Prerequisites: GEL101, MEP205

Introduction to product design, manufacturing and process planning; introduction to CAD/CAM/CAE/CIM; introduction to geometric modelling; types of mathematical representation of curves, surfaces, and solids; solid modelling, solid representation- Brep and CSG; introduction to CNC machine tools, principle of operation of CNC, construction features including structure, drive system, tool-work movement actuation system, machine control system; manual and automated part programming on Lathe and machining centres using G & M codes; ATCs, modern cutting tool materials and their applications, some advanced manufacturing processes, CMM; RP; introduction to group technology; FMS; introduction to different CAD/CAM/ CAE tools.

MEL475 Applied Thermal Engineering, (3-1-0) 4 credits
Prerequisites: MEL102

Overview of energy conversion technologies. Combustion and applications – IC engines, burners, furnaces and components. Compressible flow fundamentals – Mach number, normal shock, adiabatic 1-D flow through variable area passages. Turbo-machinery – flow through a stationary and moving passage, velocity triangles, impulse and reaction principles, characteristics and components of axial and centrifugal turbo-machines. Refrigeration and airconditioning – system analysis, components design, psychrometry, and air-conditioning calculations. Steam generation and its use – power plants, co-generation, combined cycles. Steam and gas turbine construction and performance. Equipment studies and performance calculations in the laboratory will concurrently accompany lectures.

MEL476 Applied Fluid Mechanics, (3-1-0) 4 credits
Fluid kinematics: Governing equations: equation of continuity, momentum equation, energy conservation. Entropy ; Navier-Stokes equations. ;Turbulent flow. Reynolds equations of turbulent flow. Turbulence modeling. Boundary layer theory. ;Hagen - Poiseuille flow. Compressible flow: isentropic flows; normal shock wave relations, oblique shock waves, weak and strong shocks, and shock wave structure; compressible flows in ducts with area changes. Water Turbines: Impulse turbine-Reaction turbines- Significance of specific speed-Unit quantities, Concept of performance characteristics for water turbines. Centrifugal pumps: Pumps in series and parallel, Specific speed, Unit quantities, and characteristics curves, Cavitation in turbines and pumps. Dimensional Analysis: Fundamental dimensions-Physical Quantity and Dimensions-Dimensional Homogeneity- Non Dimensional parameters, p-Theorem dimensional analysis, Choice of variables, Determination of Dimensionless parameters.

MEL477 Sustainability Science and Technology, (3-0-0) 3 credits
Introduction to sustainability science; Identification of human needs, Harmony in nature; Ecological systems; Human relationship and interaction with nature; Framework of sustainable society and development; Human role in sustainability; Sustainable production-work system; Sustainable Health system; Principles of sustainable engineering; Ethics of green/sustainable engineering; Strategies for sustainability, Sustainable energy planning; Sustainable energy technologies; Transportation technologies for sustainability; Restoring and rehabilitating ecosystems; Case studies- holistic technologies and production systems.

MEL478 Engineering Mechanics, (3-1-0) 4 credits
General principles; Force vectors; Equivalent force system and equilibrium of a rigid body; Principles of statics; Free body diagram; Structural mechanics; Analysis of trusses and frames; Virtual work; Interfacial friction; Frictional forces in inclined planes, wedges, screw jacks and belt drives; Centre of gravity and centroid; Moment of inertia; Kinematics and Dynamics of particles and rigid bodies including impulse and momentum (linear and angular) and energy formulations; Work and energy; impact.