Postgraduate Courses Offered by Department of ME, BUET

The following courses are offered by the Department for both Masters and Ph. D. programs.
Each term only some of the courses (typically 6-9) are offered.

Course No.	Course Title	Credit Hours
ME 6000	Thesis(M. Sc. Engg.)	18
	Project (M. Engg.)	6
	Thesis (Ph. D.)	45
ME 6001*	Seminar	Non credit
ME 6003	Engineering Problem	3
ME 6005	Tribology	3
ME 6101	Classical Thermodynamics	3
ME 6103	Statistical Thermodynamics	3
ME 6111	Solar Energy	3
ME 6113	Energy Engineering	3
ME 6121	Survey of Fluid Mechanics	3
ME 6123	Mechanics of Inviscid Incompressible Fluid	3
ME 6125	Mechanics of Viscous Fluid	3
ME 6127	Mechanics of Inviscid Compressible Flow	3
ME 6129	Turbulence	3
ME 6131	Wind Power	3
ME 6133	Wind Turbines	3
ME 6135	Advanced Aerodynamics	3
ME 6141	Advanced Heat Transfer	3
ME 6143	Advanced Conduction and Radiation Heat Transfer	3
ME 6145	Advanced Convection Heat Transfer	3
ME 6147	Design of Heat Transfer Equipment	3
ME 6149	Heat Transfer Seminar	3
ME 6151	Boiling and Condensation Heat Transfer	3
ME 6153	Inverse Heat Transfer Problems	3
ME 6155	Heat Transfer Enhancement	3
ME 6157	Alternative Fuels for Engines	3
ME 6161	Thermal Environmental Engineering	3
ME 6163	Combustion Engineering	3
ME 6171	Advanced Dynamics	3
ME 6173	Mechanical Vibrations	3
ME 6175	Applied Elasticity	3
ME 6177	Theory of Plates and Shells	3
ME 6179	Elastic Stability of Structures	3
ME 6181	Experimental Stress Analysis	3
ME 6183	Finite Element Methods	3
ME 6185*	Advanced Numerical Analysis	3
ME 6187	Computer and Programming	3
ME 6189	Computational Fluid Dynamics	3
ME 6191	Engineering Acoustics and Noise Control	3
ME 6193	Variational Methods in Structural Mechanics	3
ME 6201	Mechanical Behaviour of Engineering Materials	3
ME 6203	Structure and Properties of Engineering Materials	3
ME 6205	Theory of Plasticity	3
ME 6207	Dislocation Theory	3
ME 6209	Mechanics of Composite Materials	3
ME 6211	Smart Materials	3
ME 6221	Principles of Engineering Production I	3

ME 6223	Principles of Engineering Production II	3
ME 6225	Industrial Engineering Analysis	3
ME 6227	Industrial Management and Planning	3
ME 6229	Linear Programming	3
ME 6235	Econometric Methods	3
ME 6301	Surface Engineering	3
ME 6401	Advanced Mechatronics	3
ME 6213	Fracture Mechanics	**3**

* Compulsory Course. Note: A student must pass at least two courses related to the area of his/her research work

3.2 Syllabuses of the Courses

ME 6001 Seminar (Non credit)
Discussion by postgraduate students of their research project and other topics of current interest in Mechanical Engineering.

ME 6003 Engineering Problems (3 credits)
Selected subjects related to mechanical engineering. No formal lectures: Assigned reading and special problems arranged on an individual basis in consultation with the teacher.

ME-6005 Tribology (3 credits)
Fundamentals of tribology; Engineering surfaces - characterization and statistical description of engineering surfaces; Mechanics of contact - Hertz theory and GW model; Friction and wear; Thermal effects in sliding contact. Lubrication and lubricants; Rheology of lubricants; Regimes of lubrication; Theory and application of hydrodynamic lubrication; Boundary friction and extreme pressure lubrication. Elastohydrodynamic lubrication (EHL) theory; Rolling element bearings; Nanotribology.

ME 6101 Classical Thermodynamics (3 credits)
Fundamentals of classical thermodynamic, first and second laws; Concept of properties. Reversible and irreversible processes, entropy and other characteristic functions. Maxwell's relations. Equation of state and generalized co-ordinates; Equilibrium and stability.

ME 6103 Statistical Thermodynamics (3 credits)
Kinetic theory of gases; Thermodynamic theory of radiation; Maxwell-Boltzman distribution, equipartition theorem; Mean free path; Bose-Einstein and Fermi-Dirac statistics; Entropy transport properties; Fluctuation. Thermodynamics of noise.

ME 6111 Solar Energy (3 credits)
Energy demand and conventional sources; Alternative sources; Solar energy, solar radiation-extraterrestrial and terrestrial; measurements, data and estimation; Direct utilization of solar energy, collection devices, storage; Solar water heaters, solar stills, solar refrigeration and other special topics.

ME 6113 Energy Engineering (3 credits)
Sources of energy, Energy consumption patterns: Life-cycle cost calculations; Energy demand forecasting. Energy conversion methods. Energy use in industry, residential, commercial, and transport sector and its future trend; Energy efficiency; Energy management and conservation; Impacts of energy utilization on Environment.

ME 6121 Survey of Fluid Mechanics (3 credits)
Survey of principal concepts and methods of continum fluid mechanics, conservation equations for mass, momentum and energy for control volume; Eulerian and lagrangian viewpoints; Governing equations of motion of fluid in non-accelerating and accelerating co-ordinate system. Introduction to hydrodynamics and boundary layer theory.

ME 6123 Mechanics of Inviscid Incompressible Fluid (3 credits)
Kinematics of a fluid medium, the fundamental hydrodynamic equations for an ideal fluid; The simplest cases of motion of an ideal fluid; Vortex motion of an ideal fluid; The plane motion of a body in an ideal fluid; The three dimensional motion of a body in an ideal fluid.

ME 6125 Mechanics of Viscous Fluid (3 credits)
Equations of motion for viscous fluid; Boundary layer analysis for laminar and turbulent flow; Theories of turbulence; Jets, wakes and separated flows.

ME 6127 Mechanics of Inviscid Compressible Flow (3 credits)
Shock waves; Analysis of subsonic, supersonic and hypersonic flow fields, characteristic method and perturbation technique; Compressible flow in closed conduit.

ME 6129 Turbulence (3 credits)
Introduction to Origin of Turbulence, Equations for Reynolds stresses, Estimation of Reynolds stresses for different boundary conditions, Homogeneous and Isotropic Turbulence, Correlations between Turbulence Qualities, Integral Scale of Turbulence, Taylor's one dimensional Energy spectrum, Hot Wire techniques in the measurement of Turbulent Flows.

ME 6131 Wind Power (3 credits)
General introduction, wind energy assessment, wind site selection characteristics, site survey; Theory of power systems, Aerodynamics, turbulence, wind shear, drag and lifting translators; Wind machine fundamentals, machine characteristics, performance, system design for generation of electricity and water pumping, structural system, storage device.

ME 6133 Wind Turbines (3 credits)
Introduction, General Aerodynamics, Classification of Wind turbines, Theories of Wind turbines, Centrifugal force effect, blade tip effect and other effects on turbine performance; Aerodynamic design of wind turbines, constant and variable speed design, structural analysis, vibration and stress analysis; control system, safety system.

ME 6135 Advanced Aerodynamics (3 credits)
Introduction to incompressible inviscid flow; Vortex motion; Lifting line theory; induced velocity; Aerofoil theory; Joukowaskis transformation; Theories of propulsion; Axial momentum, Blade element, Cascade and vortex; Aerodynamic characteristics of aerofoils; Shock waves.

ME 6141 Advanced Heat Transfer (3 credits)
Modes of heat flow and basic laws of heat transfer, General condition equations, steady and unsteady heat conductions; Analytical and numerical analysis. Thermal radiation phenomena and heat exchange by radiation, convection; Forced and natural, external and internal flows, analytical and experimental results, condensation and evaporation, combined heat transfer.

ME 6143 Advanced Conduction and Radiation Heat Transfer (3 credits) Steady and unsteady state conduction, solutions by analytical, numerical **and** analogue methods, Thermal radiation processes and evaluation of heat exchange by different methods.

ME 6145 Advanced Convection Heat Transfer (3 credits)
Convection fundamentals. Forced convection, natural convection, transport equations, differential similarity, boundary layer and pipe flow solutions. Transport in rarefied gases. Condensation and evaporation, convective mass transfer.

ME 6147 Design of Heat Transfer Equipment (3 credits)
Forced convection, natural convection, heat exchange theories; Application to the design of heat transfer devices; Different types of heat exchangers, analysis and design.

ME 6149 Heat Transfer Seminar (3 credits)
Discussion of current topics in heat transfer, consideration and summarization of major recent works.

ME 6151 Boiling and Condensation Heat Transfer (3 credits)
Introduction; Boiling - Pool and forced convection, subcooled and saturated; fundamentals of two phase flow, mathematical and emperical methods, hydrodynamic instability; enhanced boiling heat transfer, estimation methods; burnout; condensation- modes, gas phase heat and mass transfer, filmwise condensation on horizontal and inclined tubes and surfaces; condensation promoters.

ME 6153 Inverse Heat Transfer Problems (3 credits)
Statements and use of inverse problems in studying heat transfer processes. Analysis of statements and solution methods for IHTPs. Analytical forms of boundary inverse heat conduction problems. Solutions of boundary IHCPs by direct numerical methods and by Laplace transform techniques.

ME 6155 Heat Transfer Enhancement (3:00 Credits)
Concept of enhanced heat transfer surfaces; Its application; Performance evaluation criteria, Extended plate and Fin surfaces; Internally finned tubes and annuli; Insert devices; Externally finned tubes; Integral roughness; Enhancement by additives for gases and liquids; Enhancement in magnetic and electric fields; Swirling and flow structures in enhanced surfaces; Fouling on enhanced surfaces; Application in two-phase systems; Boiling and condensation; Enhancement rate in laminar and turbulent flows; Enhanced heat transfer correlations and estimation.

ME 6157 Alternative Fuels For Engines (3:00 Credits)
Alternative fuels: Sources, Properties, Applications; Natural gas: Physical forms, Supply, Storage and Dispensing systems; Safety standards; Dedicated and retrofitted engines; Bi-fuel and Dual fuel engines; Engine performance. CNG conversion systems for automobiles; Liquefied petroleum gas: Supply and Dispensing systems, Safety standards; Biogas: Production and Dispensing systems; Digester design parameters: effect on production rate and fuel quality. Potential of Alcohols, Bio-diesel, Vegetable oils and Hydrogen as fuel for internal combustion engines.

ME 6161 Thermal Environmental Engineering (3 credits)
Refrigerants: Mechanical vapour compression refrigeration systems and details of their components; Absorption refrigeration system and cycle analysis; Miscellaneous refrigeration processes; Cryogenics; Refrigeration applications with special reference to food preservation; Psychrometry; Direct contact transfer processes between moist air and water including evaporative cooling; Heating and cooling of moist air by extended surfaces; Condensation of vapour within walls; Heat transmission in buildings and solar radiation effects upon structures; Air conditioning applications; Air conveying and distribution systems.

ME 6163 Combustion Engineering (3 credits)
Fuels, Thermodynamics and Chemical Kinetics of Combustion.
Flames, Gas-fired furnace combustion, Premixed charge engine combustion, Detonation of gaseous mixtures. Spray formation and droplet behavior, Oil-fired furnace combustion, Gas turbine spray combustion, Direct injection engine combustion, Detonation of liquid-gaseous mixtures. Solid fuel combustion mechanism, Fixed-bed combustion, Suspension burning, Fluidized bed combustion.

ME 6171 Advanced Dynamics (3 credits)
Lagrange's equations; Small oscillation; Dynamics of rigid bodies in three dimensions; Gyroscopic motion; Introduction to Hamiltonian mechanics.

ME 6173 Mechanical Vibrations (3 credits)
Single degree of freedom system; Coupled two mass systems. Energy methods. Forced vibrations. Different types of damping. Polar plots. Vibration isolation. Effects of couple modes. Multidegree of freedom systems. Shock loading. Normal modes of continuous systems.

ME 6175 Applied Elasticity (3 credits)
Three dimensional stress system: Governing equations. Assumptions to reduce three dimensional to two dimensional stress system; Stress functions; Stress concentrations; St. Venant's principle. Concentrated and line loads. Superposition. Composite bodies. Energy methods for solution. Principle of stationary potential energy. The reciprocal theorem of Maxwell and Beth.

ME 6177 Theory of Plates and Shells (3 credits)
Classical theory of plates; Large deflection theory of plates; Membrane theory of shells; Bending theory of shells applied to shells of revolutions and cylindrical shells.

ME 6179 Elastic Stability of Structures (3 credits)
General stability theory: Discrete and continuous systems. Introduction to calculus of variation. Approximate methods. Buckling of column frames, flexure elements, plates and shells.

ME 6181 Experimental Stress Analysis (3 credits)
Resistance strain gauges and associated circuits; Strain gauge rosettes. Semiconductor strain gauges. Other electrical, mechanical, pneumatic, and optical strain measuring devices. Recording of dynamic strain measurements. Stress probing. Residual stress. Principles of photoelasticity. Isoclinic and isochromatic fringes. Compensation techniques. Stress freezing Oblique incidence and scattered light methods, Photoelastic coating techniques. Brittle lacquer technique. Analysis of experimental results.

ME 6183 Finite Element Methods (3 credits)
A review of variational methods and energy theorems. The displacement method. The design of elements for plane stress and plane strain. Three dimensional and axisymmetric elements. Plates and shells. Vibrating elements. The development of finite element program.

ME 6185 Advanced Numerical Analysis (3 credits)
Computer programming; Components of a digital computer and their functions; Computer programming in FORTRAN. Numerical Analysis: Evaluations of determinants, matrix operations; Eigenvalue and eigen-vectors; Solution of algebraic and transcendental equations. Ordinary differential equations: Initial value problems of linear and nonlinear system of equations; Finite-difference technique of solving ordinary differential equations; Multisegement method of solving unstable system of equations. Partial differential equations, finite difference method of solving of both the linear and non-linear partial differential equations.

ME 6187 Computer and Programming (3 credits)
Schematic diagram and components of **a** computer. Peripheral units of a computer. Modes of storage in computers, computer memory. Access time for different data storage system. Software of a computer. Executive, macros, library system, monitoring and editing of a program. Batch processing, time shearing, paging, Computer languages.

ME 6189 Computational Fluid Dynamics (3 credits)
Equations of motion, Discretisation, Solution algorithm, Parabolic and parabolic-elliptic flows, Turbulent flows calculation, Handling of irregular geometry.

ME 6191: Engineering Acoustics and Noise Control (3 Credits)
Origin of sound; Wave equation and its solution in gases and liquids; Reflection and transmission of plane waves; Wave equation and its solution in solids; Energy methods: relation between wave theory and energy-based methods; Sound generation and propagation mechanisms; Sound field characterization. Sound propagation in ducts; Silencers: Principles and design of silencers. Systemic approach to noise control: Noise control at source; Noise control along path; Noise control at the receiver. Sound control materials: absorber, barrier and damper. Flow induced noise and vibration in pipes: Noise generation, transmission and radiation; Noise control techniques. Noise measurement: Equipment and procedure, impedance, power, intensity, directivity, microphones, sound intensity probes, sound level meters, sound dose meters, frequency analyzers.Human response to noise: Hearing mechanism; Hearing loss and protection, OSHA standards; Noise regulations.

ME 6193: Variational Methods in Structural Mechanics (3 Credits)
General concept and principles of statics: system configuration and coordinates, work and energy, principle of virtual work, complementary work and complementary energy, principle of virtual complementary work, strain energy, potential energy. Principles of solid continuum mechanics: state of stress and strain, constitutive relations for materials, compatibility and equilibrium conditions, formulation of problems for stress analysis. Principles of variational calculus, concept of functional and its variation, Delta operator, Euler-Lagrange equations; Direct methods of variational calculus: Castigliano's theorem, stationary total potential energy method, Least-squares method, Rayleigh-Ritz

method, Collocation method, Galerkin's method; Application of variational methods to beam problems, torsion problems and plate problems; Application of variational methods to finite element formulation for stress analysis of structural components.

ME 6201 Mechanical behaviour of Engineering Materials (3 credits)
Deformation, elastic behaviour, plastic behaviour, creep and creep rupture; Plastic behaviour, fatigue fracture, brittle fracture, ductile fracture.

ME 6203 Structure and Properties of Engineering Materials (3 credits)
Atomic forces, atomic bonding, diffusion, dislocation, motion of dislocation, kinetics of dislocation, mechanical behaviour of single crystal, mechanical behaviour of polycrystals: Strain hardening, alloy hardening, solution hardening; Precipitation hardening, cracks, nucleation and propagation, Plastic wave propagation.

ME 6205 Theory of Plasticity (3 credits)
Phenomenological nature, stress analysis, strain analysis, yield criteria of metals, stress-strain relations, strain hardening characteristics, plasticity conditions, deformation equations, buckling, necking, some methods bf solving forming problems, extrusions, drawing, slip-line solution.

ME 6207 Dislocation Theory (3 credits)
Concept of dislocations, structures, nature and types of dislocations, stress fields and energy, line tension, multiplication, elastic interaction, super dislocations, partial dislocation, stacking fault; separation of partial dislocation, recombination energy.

ME 6209 Mechanics of Composite Materials (3 credits)
Composite materials and their characteristics; Stiffness of unidirectional composites; Transformation of stress and strain; Off-axis stiffness of unidirectional composites; In-plane stiffness of symmetric laminates; Flexural stiffness of symmetric sandwich laminates; Behaviour of general laminates; Strength of composite materials and their modes of failure; Micromechanics; Functionally graded materials (FGM).

ME 6211 Smart Materials (3 credits)
Review of mechanical behaviour of conventional engineering materials, Residual stresses, Hysteresis under loading-unloading cycles; Introduction to smart materials and theory of their functional characteristics: Shape memory alloy, Shape memory effect and superelasticity, piezoelectric materials, magnetorheological fluid and electrorheological fluid; Behaviour and applications of smart materials.

ME 6221 Principles of Engineering Production 1(3 credits)
Metallurgical fundamentals of materials **and** their properties; Effective stress and strain; Yield conditions; Plastic potential; Shape of yield surface; mechanics of chip formation work; Three dimensional machining operations; Build-up edge formation; Tool wear; Crater and wear land, tool wear geometry, mathematical derivation of crater and wear land growth; Tool life and machinability.

ME 6223 Principles of Engineering Production II (3 credits)
Theory of metal forming operationals; Surface finish; Unconventional machining operations; Machining economics: Variables, criteria and restrictions for selecting economic conditions, economic lot size, multiple tool cost analysis; Machine tool vibration.

ME 6225 Industrial Engineering Analysis (3 credits)
Analysis and development of analytical techniques for the solution of problems in Industrial Engineering viz. application of statistical methods to uncertainty problems; Linear programming, Queueing theory and their applications to maintenance, inventories and other fields. Case study of different industries.

ME 6227 Industrial Management and Planning (3 credits)
The significance of Industrial Production and Management; problems of management in under developed countries; The economic environment; Capital financing and budgeting; Investment decision making; Application of operations research; Planning. Development Problems: The strategy of industrial development; Capital intensity vs. labour intensity in industries; The making of feasibility studies.

ME 6229 Linear Programming (3 credits)
Linear Algebra related to linear programming; An overview of simplex algorithm-Theoretical fundamentals; Duality; Dual simplex and post optimality analysis; Transportation; Primal and dual algorithms, Revised simplex; Decomposition principle; Network flows; An introduction to MPSX programs.

ME 6235 Econometric Methods (3 credits)
Linear normal regression model; Two variable model, least-square estimators, correlation co-efficient. Analysis of variance, extensions of two variable linear model; General linear model, least square estimators, significance test and confidence interval. Errors in variables; Auto-correlation; Miscellaneous single equation problems: Heteroscadisticity, lagged variable, dummy variables. Simultaneous equation problems: System, estimation methods, limited information single equation, two stage least square, full information maximum likelihood, three stage least square. Monte Carlo studies.

ME 6301 Surface Engineering (3 credits)
Mechanical properties of surface and its relevance to tribology; Surface characteristics of engineering material; Surface interaction with environment and its degradation; Review of conventional methods to improve the quality of surfaces; Coating materials; Surface coating techniques: Thermal spraying, Chemical vapor deposition (CVD), Physical vapor deposition (PVD) and Miscellaneous Techniques; Characterization of mechanical properties of coating.

ME 6401 Advanced Mechatronics (3 Credits)
Mechatronics systems overview; Sensors, transducers and actuators; System responses, transfer functions and closed loop controllers; Signals, interfacing, data processing and communications; Microprocessors and programmable logic controllers; Machine vision, industrial automation and robotics; Case studies.

ME 6213 Fracture Mechanics (3 Credits)
Introduction and overview; Linear elastic fracture mechanics (LEFM): modes of fracture failure, stress concentration and singularities, stress intensity factor, stability of crack propagation; Elasto-plastic fracture mechanics: crack tip plasticity, small scale yielding, experimental methods for fracture toughness (K_{IC}) determination, J-integral; R-curves; Fatigue crack growth; Micromechanisms of failure; Post mortem failure analysis.