

BTBSC301	BSC 7	Engineering Mathematics-III	4 Credits
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Note : Syllabus for the Third Semester of Academic Year 2020-21 only

Unit 1: Laplace Transform

[05 Hours]

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by tn , scale change property, transforms of functions divided by t , Evaluation of integrals by using Laplace transform

(Topic for Self –study Mode: transforms of integral of functions, transforms of derivatives, Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.)

Unit 2: Inverse Laplace Transform

[05 Hours]

Introductory remarks ; Inverse transforms of some elementary functions ; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms

(Topic for Self- study Mode - Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients)

Unit 3: Fourier Transform

[05 Hours]

Definitions – Integral transforms ; Fourier integral theorem (without proof) ; Fourier sine and cosine integrals ; Fourier sine and cosine transforms

(Topic for Self- study Mode- Complex form of Fourier integrals, Properties of Fourier transforms ; Parseval's identity for Fourier Transforms.)

Unit 4: Partial Differential Equations and Their Applications

[05 Hours]

Applications to find solutions of one dimensional heat flow equation $\left(\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}\right)$, and two dimensional heat flow equation (i.e. Laplace equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$).

(Topic for Self-study Mode- Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations, Method of separation of variables)

Unit 5: Functions of Complex Variables (Differential calculus)

[05 Hours]

Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; bilinear transformation; Conformal mapping.

(Topic for Self-study Mode - Limit and continuity of $f(z)$; Derivative of $f(z)$; Harmonic functions in Cartesian form; Mapping: Translation, magnification and rotation, inversion and reflection)

Unit 6: Functions of Complex Variables (Integral calculus)

[05 Hours]

Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs).

BTMEC302	ESC 11	Materials Science and Metallurgy	4 Credits
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Unit 1: Structure of Materials

[05 Hours]

Crystal structures, indexing of lattice planes, Indexing of lattice directions, Imperfections in crystals-point defects, line defects, surface and bulk defects, Mechanism of plastic deformation, deformation of single crystal by slip, plastic deformation of polycrystalline materials.

[Topics for Self-study Mode: Imperfections in crystals- point defects, bulk defects, line defects.]

Unit 2: Mechanical Properties and their Testing

[05 Hours]

Tensile test, engineering stress-strain curve, true stress-strain curve, types of stress-strain curves, compression test, bend test, torsion test, formability, hardness testing, different hardness tests-Vickers, Rockwell, Brinell, Impact test, fatigue test, creep test.

[Topics for Self-study Mode: Compression test, bend test, torsion test, formability, fatigue test, creep test.]

Unit 3: Equilibrium Diagrams

[05 Hours]

Definitions of terms, rules of solid-solubility, Gibb's phase rule, solidification of a pure metal, plotting of equilibrium diagrams, lever rule, Iron-iron carbide equilibrium diagram, critical temperatures, solidification and microstructure of slowly cooled steels, non-equilibrium cooling of steels, property variation with microstructures, classification and application of steels, specification of steels, transformation products of austenite, TTTdiagram, critical cooling rate, CCT diagram.

[Topics for Self-study Mode: Definitions of terms, rules of solid-solubility, Gibb's phase rule property variation with microstructures, classification and application of steels, critical cooling rate.]

Unit 4: Heat Treatment

[05 Hours]

Heat treatment of steels, cooling media, annealing processes, normalizing, hardening, tempering, quenching and hardenability, surface hardening processes-nitriding, carbo-nitriding, flame hardening, induction hardening.

[Topics for Self-study Mode: Hardenability, Flame hardening, induction hardening.]

Unit 5: Metallography

[05 Hours]

Microscopy, specimen preparation, polishing abrasives and cloths, specimen mounting, electrolytic polishing, etching procedure and reagents, electrolytic etching, optical metallurgical microscope, macroscopy, sulphur printing, flow line observations, examination of fractures, spark test, electron microscope.

[Topics for Self-study Mode: Sulphur printing, flow line observations, examination of fractures, spark test, electron microscope.]

Unit 6: Strengthening Mechanisms and Non-destructive Testing

[05 Hours]

Refinement of grain size, cold working/strain hardening, solid solution strengthening, dispersion strengthening, Precipitation hardening. Magnetic particle inspection, dye Penetrant inspection, ultrasonic inspection, radiography, eddy current testing, acoustic emission inspection.

[Topics for Self-study Mode: Cold working/strain hardening, solid solution strengthening, acoustic emission inspection.]

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BTMEC305	ESC 12	Thermodynamics	4 Credits
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Unit 1: Fundamental Concepts and Definitions

[05 Hours]

Thermodynamic systems, properties, processes and cycles, Quasi-static process, Macroscopic vs. Microscopic viewpoint, Work and heat Transfer: Work transferred and other types of work, Heat transfer, Zeroth law of thermodynamics, specific heat and latent heat

(Topic for Self-study Mode: Thermodynamic equilibrium, temperature and its measurement (principle of measurement, various instruments etc., Point function path function)

Unit 2: First Law of Thermodynamics

[05 Hours]

First law of thermodynamics for a closed system undergoing a cycle and change of state, Energy, Enthalpy, PMM-I control volume.

(Topic for Self-study Mode: different forms of energy, Application of first law of steady flow processes (nozzle, turbine, compressor pump, boiler, throttle valve etc.)

Unit 3: Second Law of Thermodynamics

[05 Hours]

Limitation of first law of thermodynamics, refrigerator and heat pump, Kelvin- Planck and Clausius statements and their equivalence, Carnot cycle, Carnot theorem,

(Topic for Self-study Mode: cycle heat engine, Reversibility and Irreversibility, Absolute thermodynamic temperature scale)

Unit 4: Entropy

[05 Hours]

Introduction, Clausius theorem, T-s plot, Clausius inequality, Entropy and Irreversibility, Entropy principle and its application, combined I and II law,

(Topic for Self-study Mode: Entropy and direction, Entropy and disorder)

Unit 5: Availability

[05 Hours]

Available energy pertaining a cycle, Quality of energy, Dead state, Availability in steady flow and non-flow processes, Second law efficiency.

(Topic for Self-study Mode: law of degradation of energy, maximum work in a reversible process)

Unit 6: Ideal Gas

[05 Hours]

Avogadro's law, Equation of state, ideal gas and process, relation between C_p and C_v , other equation of states.

Properties of Pure Substance: Phase change of pure substance, phase diagram of pure substance, p-v, T-s, and h-s diagrams properties of steam, property table,

(Topic for Self-study Mode: representation of processes of steam on p-v, T-s, and diagrams, Dryness fraction and its measurement.)