CORE COURSES

CHM 101 **CHEMISTRY LABORATORY**

L-T-P-D-[C]
0-1-3-0-[2]

Permanganometric Titrations, Acid - Base titrations, Iodometric titrations, Complexometric titrations, Dichrometric titrations, Recycling of aluminium, Preparation and analysis of a metal complex, Polynuclear metal complexes with multidentate briding ligands, Chromatography of natural pigments, Viscosity of solutions, Chemical kinetics, Heterogeneous equilibrium, Photochemical oxidation - reduction, Application of free electron model, Spectrophotometric estimation, Synthesis of antioxidants used as food preservatives, Preparation of polymer films, Preparation of azo-dyes and dyeing, Resolution of commercial Ibuprofen.

CHM 201 **CHEMISTRY**

L-T-P-D-[C]
3-1-0-1-[4]

Physical Principles: Experimental methods of structure determination, Systems at finite temperature, Molecular reaction dynamics. Chemistry of Molecules: Introduction to molecules, Principles and applications of Transition Metal ion chemistry, Organometallic chemistry, Green chemistry, Structure of organic molecules, Synthesis of organic molecules, Photochemistry of organic and biomolecules, Chemistry of life processes, Biotechnology and Biomedical applications.

ESC 101 **FUNDAMENTALS OF COMPUTING**

L-T-P-D-[C]
3-1-3-0-[5]

introduction to Linux, the programming environment, write and execute the first program, introduction to the object oriented (OO) approach-classes, objects, state through member variables, interface through member functions/ methods. Give many examples of (OO) approaches to problem solving in science and engineering, Procedural programming, Introduction to basic input-output - Assignment and expressions, Control: if, if-then-else, case, go, continue, break, Loops, interators, enumerations examples form algebraic equation solving, Function as a procedural abstraction, argument passing, references, Basic containers: Array, Vector, examples from solving systems of linear equations, Recursion, Object-oriented aspects, Programming using classes and objects, Scope, encapsulation, visibility, Inheritance, subtypes, static-dynamic binding, Primitive types, classes as types, wrapper classes for primitive types

Java i/o system, More container classes-list, hashtable, set, sortedset, algorithms which use these classes, Interfaces.

ESC 102 **INTRODUCTION TO ELECTRONICS**

L-T-P-D-[C]
3-1-3-1-[5]

Passive components, Signal sources, DC circuit analysis, Time domain response of RC and RL circuits, Discrete electronic devices, Sinusoidal steady state response, phasor, impedance, Two port network, basic feedback theory, frequency response, transfer function, DC Power supply, BJT biasing, Simple transistor amplifier, differential amplifier, Op-amp, Circuits using op-amp, Waveform generators, 555 timer, Simple active filters, Logic gates, multiplexers, combinatorial circuits, Combinatorial circuit design, K-map, Sequential circuits, Flip-flops, Counters, shift registers, sequence generators, DA converters, AD converters, Basic micro-computer architecture.

Laboratory Experiments : Familiarization with passive components, function generator and oscilloscope, Step and frequency response of RC and RL circuits, Some electronic components and their characteristics, DC power supply, Voltage amplifiers using op-amp, Comparators, Schmitt trigger and Active filters, Waveform generators using op-amp and 555 timer, Combinatorial circuits, Sequential circuits, Digital-to-analog converters and analog-to-digital converters.

ESO 202 **THERMODYNAMICS**

L-T-P-D-[C]
3-1-0-1-[4]

Definitions & concepts: SI Units; System; Property; Energy; Thermodynamic Equilibrium; Work, State Postulate; Zeroth Law of Thermodynamics; Temperature Scale, Thermodynamic Properties of Fluids: Mathematical, Tabular and Graphical representation of data; Ideal gas Van der Waals Equation of state; Compressibility chart; Thermodynamic Diagrams including Mollier diagram; Steam Tables, First law of Thermodynamics & its applications to Non flow processes, Applications of First Law of Thermodynamics of Flow Processes; Steady state Steady flow and Transient flow processes, Applications of First Law of Thermodynamics to Chemically Reacting Systems Second Law of Thermodynamics & its Applications, Thermodynamic Potentials, Maxwells Relations; Thermodynamic Relations and Availability, Power Cycles, Refrigeration Cycles; SI Units, Definitions & Concepts: System, Property, Energy, Thermodynamic Equilibrium, Work interaction & various modes of work, Heat, State Postulate, Zeroeth Law of Thermodynamics, Temperature Scale, IPTS.

Thermodynamic Properties of Fluids: Pure substance. Phase, Simple compressible substance, Ideal gas Equation of state, van der Waals Equation of State; Law of corresponding states, Compressibility chart, Pressure-volume; Temperature-volume and Phase diagrams; Mollier diagram and Steam tables.

First Law of Thermodynamics & its consequences, Applications of First Law for elementary processes, First Law analysis of Non-flow processes; Use of steam tables & Mollier diagram, Application of First Law of Thermodynamics for Flow Process-Steady state, steady flow processes, Throttling process; Transient Flow Processes-Charging & discharging of tanks.

First Law Applications to Chemically Reacting Systems: Fuels & Combustion, Theoretical Air/Fuel ratio, Standard heat of Reaction and effect of temperature on standard heat of reaction, Adiabatic flame temperature.

Second Law of Thermodynamics & its Applications: Limitations of the First Law of Thermodynamics, Heat Engine, Heat Pump/Refrigerator. Second Law of Thermodynamics - Kelvin Planck and Clausius statements & their equivalence, Reversible & irreversible processes, Criterion of reversibility, Carnot cycle & Carnot principles, Thermodynamic Temperature scale, Clausius inequality, Entropy, Calculations of entropy change, Principle of entropy increase, T- S diagram, II Law analysis of Control volume.

Thermodynamic Potentials; Maxwell relations; Available energy, Availability; Second law efficiency. Thermodynamic relations, Jacobian methods, Clapeyron and Kirchoff equations, Phase rule.

Power Cycles: Rankine cycle- Ideal, Reheat and Regenerative Rankine cycles. Gas Power Cycles: Otto cycle, Diesel cycle, Dual cycle and Brayton cycle, Refrigeration Cycles: Vapor compression refrigeration, Absorption refrigeration and Gas refrigeration Cycles.

ESO 204 **MECHANICS OF SOLIDS, 3-1-0-1-4**

L-T-P-D-[C]
3-1-0-1-[4]

Free body diagram, Modelling of supports, Conditions for Equilibrium, Friction Force-deformation relationship and geometric compatibility (for small deformations) with illustrations through simple problems on axially loaded members and thin-walled pressure vessels, Force analysis (axial force, shear force, bending moment, and twisting moment diagrams) of slender members *(singularity functions not to be used)*, Concept of stress at a point, Transformation of stresses at a point, Principal stresses, Mohr's circle (only for plane stress case), Displacement field, Concept of strain at a point, Transformation of strain at a point, Principal strains, Mohr's circle (only for plane strain case), Strain Rosette, Modelling of problem as a plane stress or plane strain problem, Discussion of experimental results on 1-D material behaviour, Concepts of elasticity, plasticity, strain-hardening, failure (fracture/yielding), idealization of 1-D stress-strain curve, Concepts of isotropy, orthotropy, anisotropy, Generalized Hooke's law (without and with thermal strains), Complete equations of elasticity, Torsion of circular shafts and thin-walled tubes (*plastic analysis and rectangular shafts not to be discussed*), Bending of beams with symmetric cross-section (normal and shear stresses) (*shear centre and plastic analysis not to be discussed*), Combined stresses, Yield criteria, Deflection due to bending, Integration of the moment-curvature relationship for simple boundary conditions, Superposition principle (*singularity functions not to be used*), Concepts of strain energy and complementary strain energy for simple structural elements (those under axial load, shear force, bending moment, and torsion), Castigliano's theorems for deflection analysis and indeterminate problems, Concept of elastic instability, Introduction to column buckling, Euler's formula (*post-buckling behaviour not to be covered*)

ESO 208 **EARTH SCIENCE**

L-T-P-D-[C]
2-1-2-0-[4]

EARTH AS PLANET IN THE SOLAR SYSTEM: Introduction; Earth in relation to moon, meteorites and other members of the solar system; Comparison of internal structures; origin;

ATMOSPHERE AND OCEANS: Origin and evolution; Atmosphere-ocean interaction; Air pollution, Green house effect, Ozone layer; Ocean currents and waves

SOLID EARTH AND EARTH MATERIALS: Interior of the earth; Magmas, volcanoes and igneous rocks; Sediments and sedimentary rocks; Metamorphism and metamorphic rocks; Rock forming minerals; Crystal structure; Crystallographic methods; Optical properties; Radiometric age; Geological time scale.

PROCESSES THAT SHAPE THE EARTH'S SURFACE: Geomorphic processes and landforms; Weathering and soils; Streams and drainage pattern; Ground water, wind; Glacier; Shore processes; Impact of human activity; Natural hazards.

THE EVOLVING EARTH: Crustal deformation; Geologic structures and their representation; Applications of remote sensing; Isostasy; Continental drift; Sea-floor spreading; Paleo-magnetism, Plate tectonics; MINERAL RESOURCES: Ore-forming processes; Metallic and non-metallic deposits; Fossil fuels; Mineral resources of the sea; Geology of India and distribution of economic mineral deposits; *Tutorials*, *Laboratory Sessions*.

ESO 209 **PROBABILITY AND STATISTICS, 3-1-0-1-4** **Prereq. MTH 101**

L-T-P-D-[C]
3-1-0-1-[4]

Probability, Axiomatic Definition, Properties, Conditional probability, Bayes rule and Independence of Events, Random variables, Distribution function, Probability mass and density functions, Expectation, Moments, Moment generating function, Chebyshev's inequality; Special distributions: Bernoulli, Binomial, Geometric, Negative Binomial, Hypergeometric, Poisson, Uniform, Exponential, Gamma, Normal, Joint Distributions, Marginal and Conditional Distributions, Moments, Independence of random variables, Covariance, Correlation, Functions of random variables, Weak law of large numbers, P.levy's Central limit theorem (i.i.d. finite variance case), Normal and Poisson approximations to Binomial; *STATISTICS: Introduction*: Population, sample, parameters; *Point Estimation*: Method of moments, MLE, Unbiasedness, Consistency, Comparing two estimators (Relative MSE), Confidence Interval, Estimation for mean, difference of means, variance, proportions. Sample size problem. *Tests of Hypotheses*: N-P Lemma, examples of MP and UMP tests, p-value, Likelihood ratio test, Tests for means, variance, two sample problems, Test for proportions, Relation between confidence intervals and tests of hypotheses, Chi-Square goodness of fit tests, contingency tables, SPRT *Regression Problem:* Scatter diagram, Simple linear regression, Least squares estimation; Tests for slope and correlation, prediction problem, Graphical residual analysis, Q-Q plot to test for normality of residuals, Multiple Regression; Analysis of Variance: Completely randomised design and Randomised block design, Quality Control, Shewhart control charts and Cusum charts

ESO 210 **INTRODUCTION TO ELECTRICAL ENGINEERING**

L-T-P-D-[C]
3-1-2-0-[5]

Introduction to Single-Phase Circuits, Power Calculations, Magnetic Circuits, Mutually Coupled Circuits, Transformers, Equivalent Circuit and Performance, Analysis of Three-Phase Circuits, *Direct-Current Machines*: Construction, Equivalent Circuit, Torque-Speed Characteristics, Applications; *Induction Machines*: Construction Equivalent Circuit, Torque-speed Characteristics, Speed Control, Starting, Applications *Synchronous Machines*: Construction, Equivalent Circuit, Generator & Motor Operation Power Angle Characteristics, Hunting, Pull-Out, Stepper Motors and controls, Principles of Industrial Power Distribution.

ESO 211 **DATA STRUCTURES AND ALGORITHMS-I**

L-T-P-D-[C]
3-0-0-0-[4]

Order Analysis: Objectives of time analysis of algorithms; Big-oh and Theta notations, Data Structures:- Arrays, Linked lists, Stacks (example: expression evaluation), Binary search trees, Red-Black trees, Hash tables, Sorting and Divide and Conquer Strategy:- Merge-sort; D-and-C with Matrix Multiplication as another example, Quick-sort with average case analysis, Heaps and heap-sort, Lower bound on comparison-based sorting and Counting sort, Radix sort, B-trees, Dynamic Programming: methodology and examples (Fibonacci numbers, matrix sequence, multiplication, longest common subsequence, convex polygon triangulation), Greedy Method: Methodology, examples (lecture scheduling, process scheduling) and comparison with DP (more examples to come later in graph algorithms), Graph Algorithms:- Basics of graphs and their representations, BFS, DFS, Topological sorting, Minimum spanning trees (Kruskal and Prim's algorithms and brief discussions of disjoint set and Fibonacci heap data structures), Shortest Paths (Dijkstra, Bellman-Ford, Floyd-Warshall).

ESO 212 **FLUID MECHANICS AND RATE PROCESSES**

L-T-P-D-[C]
3-1-0-1-[4]

FLUID MECHANICS: Introduction to fluids, Fluid statics; pressure as a scalar, manometry, forces on submerged surfaces (NO moments NOR center of pressure), Description of flows; field approach, Euler acceleration formula, streamlines, streaklines, etc., Reynolds' transport theorem Conservation of mass; stream function, Linear (NOT angular) Momentum balance, Navier-Stokes' (NS) equation; *elementary* derivation; application; Poiseuille flow, Couette flow, Energy equation-Bernoulli equation, applications including flow measurement (Pitot tube, Orifice meters); Pipe flows and losses in fittings; Similitude and modelling: using non-dimensionali-zation of N-S equations and boundary conditions, simplifications for cases without free surfaces and without cavitation (scale factor approach should NOT be done); High Re flow: Prandtl's approximation; basic inviscid flow; need for boundary layer; Magnus effect (mathematical derivations be avoided), Boundary layers-elementary *results* for flat plates. Separation, flow past immersed bodies (bluff, streamlined); physics of ball-games (qualitative) *Heat Transfer:* Introduction, rate law and conservation law, Conduction equation; non-dimensionalization, various approximations, Steady state conduction-concept of resistances in series and of critical thickness of insulation, Unsteady conduction; significance of Biot and Fourier numbers, Heissler charts; Low Bi case; penetration depth, Essential nature of convection: transpiration cooling; writing energy equation without dissipation and pressure terms; one example (heat transfer to fluid flowing in a tube); non-dimen-sionalization, Nusselt number and correlations; *MASS TRANSFER*: Simple ideas of mass transfer; definitions (mass basis only), similarity with heat transfer. Use of steady 'conduction' concepts to solve simple steady cases in dilute solutions as well as in stationary solids, only.

Boundary conditions, Illustrative example: One example involving all three transport phenomena should be discussed, possibly from the bio-world or from microelectronics processing.

ESO 214 **Nature and Properties of Materials**

L-T-P-D-[C]
3-1-3-1-[5]

Examples of materials highlighting Structure-Processing-Property-performance relations. 14 space lattices, unit cells, cubic and HCP structures, Miller indices, Packing, interstitials, different ceramic structures; Non-crystalline/nanocrystalline materials-definitions, concept of Tg, local order, different polymer structures.

Structure determination using X-ray diffraction (Bragg's diffraction and structure factor for cubic lattices); Point defects, edge and screw dislocations-their notation and concepts, energy of a dislocation, stacking fault, grains and grain boundaries, bulk defects;

PHASE EVOLUTION: Definition of diffusivity, concept of activation energy, examples of diffusion process; Definition of a phase, phase rule, unary and binary (eutectic, eutectic with terminal solid solutions) systems and examples, phase diagrams of important metal and ceramic systems, Nucleation and growth (homogeneous and heterogeneous), Introduction to TTT curves, examples of various transformations;

MECHANICAL BEHAVIOUR: Measures of mechanical response (fundamental measurable mechanical properties), engineering and true stress-true strain response, concept of yield point and Elastic modulus (composite materials) viscoelesticity, fracture toughness, stress intensity factor, fracture energy, comparison of these properties for different engineering materials.

Deformation of single and polycrystalline materials, slip systems, critical resolved shear stress, mechanisms of slip and twinning; Fatigue and creep properties of materials with suitable examples, Strengthening mechanisms, Fracture in ductile and brittle (Griffith's Theory) solids, ductile to brittle transition,

ELECTRONIC PROPERTIES: Drude theory of metals, free electron theory (density of states, Fermi energy, Fermi-Dirac statistics, band theory of solids, existence of metals and insulators, Brillouin zones), Semiconductors (structures of elements and compounds), equilibrium properties of semiconductors, conductivity as a function of temperature, measurement of band gap, doping, law of mass action, Hall effect, carrier concentration of mobility of non-generate semiconductors, Excess carrier generation, optical properties of semiconductors, concept of lifetime, I-V characteristics of p-n junction and their applications as LEDs, lasers and solar cells, Introduction to semiconductor crystal growth and processing modern methods of expitaxy (brief introduction to quantum wells and superlattices, if time permits), Dia-, para-ferro- and ferri magnetism; soft/hard magnetic materials.

Dielectric and ferroelectric materials ($BaTiO_3$ as an example); linear and non-linear behaviour.

ESO 216 **SIGNAL PROCESSING AND INSTRUMENTATION** **Prereq. ESc 101**

L-T-P-D-[C]
3-1-0-1-[4]

Physical quantities and their measurement. Different grades of measurability, scales and scale-invariant properties. Errors, precision (resolution), accuracy and calibration standards. Study of quantities; mechanical (position, force, velocity, acceleration (electrical voltage, current, position, frequency, time), chemical (flow, pressure, temperature, pH), psychophysical (brightness, loudness) etc., Sensors (e.g. stain guages, pH electrodes, photodiodes, accelerometers, etc), actuators (eg. Relays, solenoids, valves, stepper motors), sources (eg. Voltage, current, light sources), Introduction to the study of signals and their processing. Familiarization and use of Virtual Instrumentation software, Signals and noise; signal representation and noise characterisation. Analog and digital signals; signal sampling and quantisation. The Fourier series and the Fourier Transform; magnitude and phase spectra; the DFT; Signal and noise filtering; noise reduction techniques; windowing, boxcar intergration, lock-in amplifiers, multipoint averaging; Signal conversion: A/D and D/A conversion techniques. Multiplexing; Basic instrumentation: meters, guages, milli and micro voltmeters. Various bridges for impedance and frequency measurement. Examples of advanced instrumentation: oscilloscopes and spectrum analyzers. NMR.

Data Acquisition and computer control. Interfacing with microcontrollers and personal computers. Virtual (Software) instrumentation.

ESO 218 **COMPUTATIONAL METHODS IN ENGINEERING**

L-T-P-D-[C]
3-1-0-0-[4]

Introduction, Engineering Systems, Physical and Mathematical Modeling, Error Analysis - Approximations and round off and Truncation errors, Roots of Equations- single variable -Method of Bisection, Method of Interpolation, Secant Method, One point Methods, Newton Raphson method, Secant Method, Multiple roots, Solution of Linear Simultaneous Equations-Direct Methods-Gauss Elimination, Gauss-Jordan, LU decomposition; Iterative Methods-Gauss-Seidel, Conjugate Gradient, Banded and Sparse systems, Solution of Nonlinear Simultaneous Equations, Curve Fitting-Least Square regression, Interpolation including splines, Fast Fourier Transforms, Regression Analysis for Multivariable, Eigen Values and Eigen Vectors- Power method, Relaxation Method, Diagonalization method. Numerical Differentiation and Integration-High-Accuracy Differentiation Formulas, Derivatives of Unequal Spaced Data. The trapezoidal Rule, Simpson's rule, Integration with unequal segments, Open Integration Formulas, Ordinary Differential Equations- Finite Difference method, Method of Weighted Residuals, Analytical versus Numerical Methods, Initial Value and Boundary Value Problems-Euler's method, Improvement of Euler's method, Runge-Kutta Method, Multiple Steps Method, Partial Differential Equations-Elliptic and parabolic Equations, Explicit and Implicit Methods, Crank Nicholson Method, ADI method; Introduction to Finite Element Method, Applications.

MTH 101 **MATHEMATICS - I**

L-T-P-D-[C]
3-1-0-1-[4]

Real numbers; Sequences; Series; Power series, Limit, Continuity; Differentiability, Mean value theorems and applications; Linear Approximation, Newton and Picard method; Taylor's theorem (one variable), Approximation by polynomials Critical points, convexity, Curve tracing; Riemann Integral; fundamental theorems of integral calculus Improper integrals; Trapezoidal and Simpson's rule; error bounds; Space coordinates, lines and planes, Polar coordinates, Graphs of polar equations, Cylinders, Quadric surfaces; Volume, Area, length; Continuity, Differentiability of vector functions, arc length, Curvature, torsion, Serret-Frenet formulas, Functions of two or more variables, partial derivatives. Statement only, of Taylor's theorem and criteria for maxima/minima/saddle points; Double, triple integrals, Jacobians; Surfaces, integrals, Vector Calculus, Green, Gauss, Stokes Theorems

MTH 102 **MATHEMATICS - II** **Prereq. : MTH 101**

L-T-P-D-[C]
3-1-0-1-[4]

Matrices; Matrix Operations (Addition, Scalar Multiplication, Multiplication, Transpose, Adjoint) and their properties; Special types of matrices (Null, Identity, Diagonal, Triangular, Symmetric, Skew-Symmetric, Hermitian, Skew-Hermitian, Orthogonal, Unitary, Normal), Solution of the matrix EquationAx=b; Row-reduced Echelon Form; Determinants and their properties, Vector Space R^n (R); Subspaces; Linear Dependence / Independence; Basis; Standard Basis of R^n; Dimension; Co-ordinates with respect to a basis; Complementary Subspaces; Standard Inner product; Norm; Gram-Schmidt Orthogonalisation Process; Generalisation to the vector space C^n (C), Linear Transformation from R^n to R^m (motivation, X - AX); Image of a basis identifies the linear transformation; Range Space and Rank; Null Space and Nullity; Matrix Representation of a linear transformation; Structure of the solutions of the matrix equation Ax = b, Linear Operators on R^n and their representation as square matrices; Similar Matrices and linear operators; Invertible linear operators; Inverse of a non-singular matrix; Cramer's method to solve the matrix equation Ax=b, Eigenvalues and eigenvectors of a linear operator; Characteristic Equation; Bounds on eigenvalues; Diagonalisability of a linear operator; Properties of eigenvalues and eigenvectors of Hermitian, skew-Hermitian, Unitary, and Normal matrices (including Symmetric, Skew-Symmetric, and Orthogonal matrices), Implication of diagonalisability of the matrix $A + A^r$ in the real Quadratic form $X^T AX$; Positive Definite and Semi-Positive Definite Matrices, Complex Numbers, geometric representation, powers and roots of complex numbers, Functions of a complex variable, Analytic functions, Cauchy-Riemann equations; elementary functions, Conformal mapping (for linear transformation) Contours and contour integration, Cauchy's theorem, Cauchy integral formula, Power Series, term by term differentiation, Taylor series, Laurent series, Zeros, singularities, poles, essential singularities, Residue theorem, Evaluation of real integrals and improper integrals.

MTH 203 **MATHEMATICS - III** **Prereq. : MTH 102**

L-T-P-D-[C]
3-1-0-1-[4]

Introduction & Motivation to Differential Eqns., First Order ODE, y'=f(x,y)-geometrical interpretation of solution, Eqns. reducible to separable form, Exact Eqns., integrating factor, Linear Eqns., Orthogonal trajectories, Picard's Thm. for IVP (without proof) & Picard's iteration method, Euler's Method, Improved Euler's Method, Elementary types of eqns. F(x,y,y')=0: not solved for derivative; Second Order Linear differential eqns: fundamental system of solns. and general soln. of homogeneous eqn, Use of known soln. to find another, Existence and uniqueness of soln. of IVP, Wronskian and general soln of nonhomogeneous eqns. Euler-Cauchy Eqn., extensions of the results to higher order linear eqns., Power Series Method - application to Legendre Eqn., Legendre Polynomials, Frobenius Method, Bessel eqn. Prop of Bessel functions, Sturm Liouville BVP, Orthogonal functions, Sturm comparison Thm., Laplace transform, Fourier Series and Integrals, Introduction to PDE, basic concepts, Linear and quasi-linear first order PDE, 2^{nd} order PDE and classification of 2^{nd} order semi-linear PDE (Canonical form), D'Alemberts formula and Duhamel's principle for one dimensional wave eqn., Laplace and Poisson's eqn., maximum principle with application, Fourier Method for IBV problem for wave and heat equation, rectangular region, Fourier method for Laplace equation in 3 dimensions, Numerical Methods for Laplace and Poisson's eqn.

PHY 101 **PHYSICS LABORATORY**

L-T-P-D-[C]
0-0-3-0-[2]

Introduction to Error Analysis and Graph Drawing; Spring Oscillation Apparatus; Trajectory of a Projectile on an inclined plane; Moment of Inertia of a bicycle wheel; Bar Pendulum; Torsional Pendulum; Coupled Pendulum; Study of collisions on an Air Track; Gyroscope; Current Balance; Measurement of Capacitance using Galvanometer; Charging of a plate capacitor; Electromagnetic Induction; Prism Spectrometer; Fraunhofer Diffraction using He-Ne laser; Magnetic Field in Helmholtz Coil; Resonance in Electrical Circuits.

PHY 102 **PHYSICS-I**

L-T-P-D-[C]
3-1-0-1-[4]

Coordinate Systems, elements of vector algebra in plane polar, cylindrical, spherical polar coordinate systems, Dimensional Analysis; Solutions for 1 dimensional equation of motion in various forms, Frames of reference, relative velocity and accelerations; Newton's laws and applications (to include friction, constraint equations, rough pulleys), Line integrals, gradient, curl, conservative forces, potential, Work-Energy theorems, Energy diagrams; Conservation of linear momentum and collisions, variable mass problems; Central forces, Gravitation, Kepler's law, hyperbolic, elliptic and parabolic orbits, Forced Oscillations, damping, resonance; Waves: Motion in Non-inertial frames, centrifugal and Coriolis forces; Conservation of Angular Momentum and elementary rigid body dynamics; Special Theory of Relativity.

PHY 103 **PHYSICS-II**

L-T-P-D-[C]
3-1-0-1-[4]

Vector Calculus; Electrostatics; Gauss law and applications, electrostatic potential and Curl of E; Work and energy in electrostatics, Laplace's Equation and (first) uniqueness theorem, method of images, multipoles (introduction), force and torque on dipoles; Polarization, bound charges, Electric displacement and boundary conditions, Linear dielectrics, force on dielectrics. Motion of charges in electric & magnetic fields; Magneto-statics: Current Density, Curl and divergence of B, Ampere's law and applications, magnetization, bound currents and bound pole densities, Magnetic field H, Magnetic susceptibility, Ferro, para and diamagnetism, Boundary conditions on, B and H Faraday's law, Energy in magnetic field, Displacement current, Maxwell's equations in Media, Poyntings Theorem, E.M. Waves: Wave equation, plane waves, polarization and types of polarization, Energy and momentum of plane E.M. waves. Propagation through linear media and conductors. Reflection and transmission at normal incidence from dielectric and metal interfaces. Magnetism as a relativistic phenomenon. Relativistic transformations of E B fields (simple illustrations only), Diffraction, Quantum Mechanics,* Photons, Uncertainty Principle, Electron diffraction experiments, De Broglie Hypothesis, Born interpretation, Schrodinger-Equation and application to 1-D box problem.

TA 101 **ENGINEERING GRAPHICS**

L-T-P-D-[C]
2-0-3-1-[4]

Orthographic projections; lines, planes and objects; Principles of dimensioning, sectional views. Machine part assemblies, auxillary views, Space geometry; lines and planes, true lengths and shapes, properties of parallelism, perpendicularity and intersections of lines and planes, simple intersections of solids and development of lateral surfaces of simple solids, Isometric views. Introduction to computer graphics.

TA 201 **INTRODUCTION TO MANUFACTURING PROCESSES**

L-T-P-D-[C]
2-0-6-0-[5]

Introduction to Manufacturing, Historical perspective; Importance of manufacturing; Classification of manufacturing processes, Engineering materials, Casting, Fundamentals of casting, Sand casting, Permanent mold casting including pressure die casting, Shell, investment & centrifugal casting processes, Continuous casting, Casting defects, Metal Forming, Basic concepts of plastic deformation, Hot & cold working, Common bulk deformation processes (Rolling, Forging, Extrusion and Drawing), Common sheet metal forming processes, Machining, Chip formation and generation of machined surfaces, Tool geometry, tool material, tool wear and practical machining operations (turning, milling and drilling), Grinding processes, Finishing processes, Introduction to unconventional machining processes (EDM, ECM, UCM, CHM, LBM) etc., Welding & Other Joining Processes, Fundamentals of welding & classification of welding processes, Gas and arc welding, Brazing and soldering, Adhesive bonding, Mechanical fastening, Heat Treatment, Principles of heat treating; annealing, normalizing, hardening and tempering, Manufacturing of Polymer and Powder Products, Classification of polymers, Introduction to extrusion, injection molding, blow molding, compression and transfer molding , Green compacts from powders including slip casting of ceramics, Sintering, Modern Trends in Manufacturing.