DEPARTMENT OF APPLIED PHYSICS

Syllabus for Special capsule courses
For Five year Integrated M.Sc. & M.Sc. (Tech.)

Semester-III

APR 93101 **Mechanics-I** **[4 - 0 – 0]**

Law of motion, motion in a uniform field, components of velocity and acceleration in different coordinate systems, uniformly rotating frame, Centripetal acceleration, Coriolis force and its applications.
Motion under central force, Kepler's law, Gravitational law and field, Potential due to a spherical body, Gauss and Poisson equations for gravitational self-energy, Earthquakes, Seismic waves and Seismographs, Galitzin's Seismograph, Determination of the Epicentre and the focus, Modern application of seismology.
System of particles, Centre of mass, equation of motion, conservation of linear and angular momenta, Conservation of energy, single stage and multistage rockets, elastic and inelastic collisions.
Rigid body motion, Rotational motion, Moment of inertia and their products, principal moments and axes, Euler's equations, precessional motion, top, Gyroscope.
Kinematics of moving fluids, equation of continuity, Bernoulli's theorem, viscous fluids, streamline and turbulent flow, Poiseulle's law, capillary tube flow, Reynold's number, Stoke's law.
Surface tension and surface energy, molecular interpretation of surface tension, pressure on a curved liquid surface, wetting.

APR 93102 **Optics** **[4 - 0 – 0]**

Geometrical Optics:
Fermat's Principle: Principle of extremum path, aplanatic points of a sphere and other applications.
General theory of image formation: Cardinal points of an optical system, general relationship, thick lens and lens combinations. Lagrange's equation of magnification, telescopic combination, telephoto lenses and eyepieces.
Aberration in images: Chromatic aberrations, achromatic combination of lenses in contact and separated lenses, Monochromatic aberrations and their reductions; aspherical mirrors and Schmidt corrector plates, aplanatic points, oil immersion objectives, meniscus lens.
Optical instruments: Entrance and exit pupils, need for a multiple lens eyepiece, common types of eyepieces.
Physical Optics:
Interference of light: The principle of superpositions, two-slit interference, coherence requirement for the sources, optical path retardations, lateral shift of fringes, Rayleigh

refractometer and other applications. Localised fringes; thin films, applications for precision measurements for displacements.
Haidinger fringes: Fringes of equal inclination. Michelson interferometer, its application for precision determination of wavelength, wavelength difference and the width of spectral lines. Twymann-Green interferometer and its uses. Intensity distribution in multiple beam interference, Tolansky fringes, Fabry-Perot interferometer and etalon.
Fresnel diffraction: Fresnel half-period zone plates, straight edge, rectilinear propagation
Fraunhoffer diffraction: Diffraction at a slit, half-period zones, phasor diagram and integral calculus methods, the intensity distribution, diffraction at a circular aperture and a circular disc, resolution of images, Rayleigh criterion, resolving power of telescope and microscope systems, outline of phase contract microscopy.
Diffraction gratings: Diffraction at N parallel slits, intensity distribution, plane diffraction grating, reflection grating and blazed gratings. Concave grating and different mountings. Resolving power of a grating and comparison with resolving powers of prism and of a Fabry-Perot etalon
Double refraction and optical rotation: Refraction in uniaxial crystals, its electromagnetic theory. Phase retardation plates, double image prism. Rotation of plane of polarization, origin of optical rotation in liquids and in crystals, Applications.

APR 93103 Waves & Oscillation [4 - 0 – 0]

Waves:
Waves in a one-dimensional chain of particles; classical wave equation; wave velocity, boundary conditions and normal modes, dispersion relations, dispersive waves, acoustic and optical modes.
Waves in continuous media: Speed of transverse waves on a uniform string, speed of longitudinal waves in a fluid, energy density and energy transmission in waves, typical measurements, dispersion in waves, group velocity and phase velocity, their measurements.
Superposition of waves: Linear homogeneous equations and the superposition principle, interference in space and energy distribution; beats and combination tones.
Ultrasonic: Production, detection and applications of ultrasonic waves.
Oscillations:
Free oscillations of simple systems: Equilibrium; concept of potential well, small oscillations, approximate solutions, linear and transverse oscillations of a mass between two springs, diatomic molecule, reduced mass concept.
Damped and forced oscillations: Damped oscillations; critical damping, Q of an oscillator. Forced oscillator with one degree of freedom; Transient and steady state oscillations, resonance energy absorption, low and high frequency responses.
Free oscillations of system with two degrees of freedom: Two dimensional oscillator; normal modes, longitudinal and transverse oscillation of coupled masses, energy transfer between modes, coupled pendulum.
Fourier analysis: Fourier series and Fourier coefficients; simple examples, use of exponential representation for harmonic oscillations, expression for Fourier coefficients. Non-periodic disturbance; representation by Fourier integral, Fourier transform. Case of a wave train of finite length, constancy of $\Delta x.\Delta k$ (the uncertainty product), applications.

APR 93201 **Physics Lab-III** **[0-0-3]**

List of experiments

1. Determination of Wavelength of sodium light by Newton's ring.
2. Determination of Wavelength of sodium light by Fresnel's bi-prism.
3. Determination of Refractive index of prim by Spectrometer.
4. Determination of frequency of tunning fork by Melde's experiment.
5. Determination of velocity of sound in the material of the given rod with a Kundt's tube.

APR 93202 **Physics Lab-IV** **[0-0-3]**

List of experiments

1. Determination of Acceleration due to gravity by Kater's pendulum.
2. Determination of Frequency of A.C. by Sonometer.
3. Determination of Resistance/length by Carey Foster's bridge.
4. To compare the E.M. F. of two cells by Potentiometer.
5. Determination of unknown temperature by a thermocouple using potentiometer.

Semester-IV

APR 94101 **Mechanics-II** **[3- 0 – 0]**

Motion in a non-inertial frame: Motion of a point particle in a general (rigid) non-inertial frame of reference, Galilean Relativity, Larmor theorem.

Concept of stress and strain: Normal stress, shear stress, state of stress at a point, ultimate strength, allowable stress, factor of safety , normal strain, shear strain, Hooke's law, Poisson's ratio, Generalised Hooke's law, Analysis of axially loaded members.

Transformation of Stress and Strain: Transformation of stress and strain, Principal stresses, Principal strains, Mohr's circle for stress and strain.

Vector Analysis: Scalar and vector fields, vectors depending on a single parameter (e.g. time), derivative of a vector with respect to the parameter, Linear dependence and independence of vectors, Vector functions of two and three parameters and their derivatives.

Types of binding in solids: Covalent binding and its origin, Ionic binding, energy of binding, transition between covalent and ionic binding, metallic binding, van der Waals binding, hydrogen bond.

APR 94102 **Electricity and Magnetism** **[3- 0 - 0]**

Electric field: Coulomb's law; unit of charge (SI and other systems of units), Conservation and quantisation of charge; field due to different charge distributions, monopole, dipole, quadrupoles, line charge, sheet charge. Torque on a dipole in uniform

field and non-uniform fields, flux of an electric field. Gauss's law; applications to deduce E fields, force per unit area on the surface of a charged conductor.

Potential: Line integral of electric field and electrical potential; field as the gradient of potential. Potential energy of a system of charges; pair of charges, line charge, sheet charge, spherical shell of charge, charged hollow disc. Field equations for E in vacuum. Energy associated with E field. Differential form of Gauss' divergence law, Poisson's equation, Laplace's equation, boundary conditions, and Uniqueness theorems.

Electric field around conductors: Induced charges; field and potential inside a conductor, field near the surface of a conductor, method of images.

Electric fields in matter: Atomic and molecular dipoles; induced dipoles, polarisability tensor, electronic and molecular contributions. Electrical field caused by polarized matter, E and D fields, permittivity, dielectric constant. Capacitor field with a dielectric, field equations in presence of dielectric. The field of a polarized sphere, dielectric sphere in a uniform field. Energy in dielectric systems; polarisability and susceptibility, frequency dependence of polarisability, Clausius-Mossotti equation.

Magnetic effect of current: A critical review.

Magnetic field: magnetic field B seen through Lorentz force on a moving charge, unit for I defined through force on a straight current, torque on a current loop in B field, magnetic dipoles in atoms and molecules, gyromagnetic ratio.

APR 94201 Physics Lab-V [0-0-3]

List of experiments

1. Determination of Refractive index of a liquid by Abbe Refractometer.
2. Study of Operational Amplifier applications.
3. To verify the discrete atomic energy levels by Frank & Hertz experiment.
4. Study of various Logic gates using diodes & transisitors and IC.
5. Determination of Susceptibility of paramagnetic solution by Quinck's tube.

APR 94202 Physics Lab-VI [0-0-3]

List of experiments

1. Determination of coefficient of water by Poiseuille's method.
2. Experiment of Linear air track and 'g' by free fall apparatus.
3. Determination of Inductance by Anderson's bridge.
4. Determination of Capacitance by De-Sauty bridge.
5. Verification of various network theorems.