B.Sc. Part II Syllabus

Paper-I Optics

Cardinal Points of coaxial optical systems. Simple problems on combination of thin lenses, Eyepieces, Aplantic points.

Nature of light, Elementary ideas of electromagnetic wave and photon theories of light. Complex representation of waves and its application (to be used in the theory of various phenomenona).

Conditions for observing interference, Degree of coherence and visibility of fringes, Production of interference fringes and determination of wavelength, Michelson interferometer and its uses, Colour of thin films, Newton's Rings. Theory of Multiple Reflections, FP Etalon.

Temporal and Spatial Coherence. Michelson Stellar interferometer. Stimulated emission, Basic ideas about laser emission, Ruby and He-Ne lasers as examples.

Fresnel's theory of diffraction, Half-period elements. Diffraction from circular obstacle and aperture (Elementary theory), Zone Plate, Cornu's Spiral, Fresnel diffraction by straight edge and single slit.

Fraunhofer's diffraction by single slit and double slit. Theory of plane grating, Width of principal maxima. Rayleigh's criterion of resolution, Resolving power of prism, grating and FP etalon. Limit of resolution for telescope. Concave grating (elementary theory), and its mountings.

Unpolarised, polarised and partially polarised lights. Polarisation by reflection, Double refraction by uni-axial crystals, Polaroids, Huygen's theory of double refraction. Half and quarter waveplates. Production of elliptically polarised light.

Babinet compensator, Analysis of elliptically polarised light by using a Nicol and a quarter wave plate, and by using Babinet compensator. Optical activity. Fresnel's theory of optical rotation, Specific rotation, Biquartz and Laurent's half-shade polarimeters.

Paper II Oscillation, Waves and Electromagnetism

1. **Oscillations:**
   Simple Harmonic Motion, Damped Motion, Steady Forced Oscillations. Resonance. Fourier Series Decomposition. Simple cases of square, Saw-tooth and Rectified Sinusoidal Waves.
2. **One-dimensional Wave-motion in Non-dispersive Media:**
   Wave Equation, Progressive Wave solution, Particle Velocity and Wave Velocity. Equations for Wave in fluids and on Strings. Specific Acoustic Impedance of fluids and Characteristic Impedance of strings. Energy density. Intensity of Energy Transfer. Reflection and transmission of plane Waves at a discontinuity, Standing Wave Solutions. Modes of Natural Oscillations. Energy Considerations.
3. **Ultrasonics:**
   Generation and detection. Measurement of velocity in Liquids, Applications.
4. **Electrostatics in Free Space:**
   Coulomb Law, Electric Field. Simple cases of charge distributions. Gauss Flux Law (Integral and Differential forms). Electric Dipole in Electrostatic Field. Irrotational Nature of Electrostatic Potential. Simple Cases of Charge Distributions.
5. **Electrostatics in Dielectrics :**
   Polarization. Polarization Charges. Field D. Gauss Flux Law (Integral and Differential forms) and simple Applications.Energy of Charge Distribution. Energy as an integral over the Field. Simple Problems (Parallel Plate Condenser, Uniformly charged spherical surface and volume.
6. **Electric Current:**

Current Density Vector. Equation of Continuity, Ohm and Joule's Laws (Integral and differential forms).

7. Magnetostatics:

Ampere's Law, Biot Savart's Law, Law of Force in Magnetic Field on Currents and charged particles. Magnetic Field due to a straight infinite wire. Magnetic Field due to circular loop and solenoid at axial points. Vector potential and its Evaluation for Uniform Magnetic Field and for Straight Infinite Wire. Divergence and Curl of B. Distant Field due to a Loop of Current. Magnetic Moment. Magnetic Materials and Magnetization. Magnetization Current Field H, Curl of H and Calculation of H.

8. Time Varying Fields:

Displacement Current, Curl H. Faraday's Law (Integral and Differential forms). Self and Mutual Inductances. Energy of Coupled Circuits and current distribution. $M \leq \sqrt{L1L2}$ Energy as an Integral over the Magnetic Field. Energy of Solenoid.

9. Electromagnetic Waves in Free-Space:

Maxwell Equations, Plane polarized Plane Wave solution. Characteristics of these Electromagnetic waves.

Paper III Atomic and Nuclear Physics

1. **Atomic Physics:**

   Bohr-Sommerfield Model (Historical developments), Bohr model and the spectra of hydrogenic atoms, Critical resonance and the Ionisation potentials. Frank-Hertz experiment. Characteristic and continuous X-rays, Moseley's law, Bragg's law.

   Space Quantization, Vector atom model and Quantum Numbers, Magnetic moment of the electrons and magneton, Larmor Precession, Electron Spin, Stern-Gerlach experiment, Qualitative concept of various quantum number of an electron, Pauli's exclusion principle and electronic configuration of atoms.

2. **Magnetic Properties of Materials :**

   Diamagnetism, Larmor's theory and diamagnetic susceptibility. Paramagnetism, Langevin's theory and Curie-Weiss Law, Qualitative discussion of Ferromagnetism and antiferromagnetism.

3. **Quantum Concepts:**

   Particle nature of radiation, Photoelectric effect and Compton effect. Wave nature of particles.

   De-Broglie Waves, Davisson-Germer experiment, Wave Packets, Phase velocity and group velocity, Heisenberg's Uncertainty Principle and applications, One dimensional Schrodinger's Wave Equation and concept of probabilities, amplitude, application to one-dimensional potential step and barrier, Quantum Mechanical Tunneling.

4. **Nuclear Physics:**

   Natural radioactivity, Laws of radioactive disintegration, radioactive series, Detection of radiation, GM Counter and Bubble Chamber, Scintillation Counter.

   Kinematics of nuclear reactions, artificial nuclear transmutation, discovery of neutron, radioactive tracers, transuranic elements.

   Cyclotron

   Constitution of nucleus, Binding energy, liquid drop model and the semiempirical mass formula, Elementary theory of α-decay, β-decay and discovery of neutrino Magic numbers and the shell model, exchange forces in nuclei and Yukawa theory (qualitative), Fission and fusion, Nuclear reactors (qualitative), Thermonuclear energy.

   Classification of Elementary Particles, Leptons, mesons and bayrons and their quantum numbers, Conservation Laws.