

**PHYSICS**

**B.Sc.- SECOND YEAR**

|              |  | <b>Max. Marks</b> |
|--------------|--|-------------------|
| PAPER I      | PHYSICAL OPTICS AND LASERS   | 50                |
| PAPER II     | ELECTROMAGNETICS   | 50                |
| PAPER III    | ELEMENTS OF QUANTUM MECHANICS,<br>ATOMIC AND MOLECULARS SPECTRA    | 50                |
| PRACTICAL    | TWO PRACTICALS (30 MARKS) + VIVA (10<br>MARKS) + RECORD (10 MARKS) | 50                |
| <b>TOTAL</b> |  | <b>200</b>        |

Candidate must obtain minimum pass marks in Theory and Practical Examinations separately.

## PAPER I - PHYSICAL OPTICS AND LASERS

### UNIT-I

**Interference of a light:** The principle of superposition, 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. Twyman Green interferometer and its uses. Intensity distribution in multiple beam interference, Tolansky fringes, Fabry-Perrot interferometer and etalon.

### UNIT -II

**Fresnel diffraction:** Fresnel half-period zones, plates, straight edge, rectilinear propagation.

**Fraunhofer 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 microscopic systems, outline of phase contrast 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-Perrot etalon.

### UNIT - III

Polarization, Double refraction in uniaxial crystals, Nicol prism, polaroids and retardation plates, Babinet's compensator. Analysis of polarised light.

Optical activity and Fresnel's explanation, Half shade and Biquartz polarimeters.

Matrix representation of plane polarized waves, matrices for polarizers, retardation plates and rotators, Application to simple systems.

#### UNIT-IV

**Laser system:** Purity of a spectral line, coherence length and coherence time, spatial coherence of a source, Einstein's A and B coefficients, spontaneous and induced emissions, conditions for laser action, population inversion.

**Application of Lasers:** Pulsed lasers and tunable lasers, spatial coherence and directionality, estimates of beam intensity; temporal coherence and spectral energy density.

#### Text and Reference Books

A K Ghatak, "Physical Optics" (Tata McGraw Hill).

D P Khandelwal; "Optics and Atomic Physics" (Himalaya, Publishing House, Bombay, 1988).

F Smith and JH Thomson; "Manchester Physics series; Optics" (English Language Book Society and John Wiley, 1977).

Born and Wolf; "Optics"

KD Moltey; "Optics" (Oxford University Press).

Sears; "Optics".

Jonkins and White; "Fundamental of Optics" (McGraw-Hill).

Smith and Thomson; "Optics" (John Wiley and Sons).

B.K; Mathur; "Optics".

P.K. Srivastava; "Optics" (CBS).

B.B. Laud; "Lasers" (New Age).

## PART II- ELECTROMAGNETICS

### UNIT-I

#### **Electrostatics**

Coulomb's law, Electric Field and potentials, Field due to a uniform charged sphere, Derivations of Poisson and Laplace Equations, Gauss Law and its application: The Field of a conductor. Electric dipole, Field and potential due to an electric dipole, Dipole approximation for an arbitrary charge distribution, Electric quadrupole, Field due to a quadrupole, Electrostatic Energy of a charged uniform sphere, Energy of a condenser.

#### **Magnetostatics**

Magnetic field, Magnetic force of a current, Magnetic Induction and Biot-Savart Law, Lorentz Force, Vector and Scalar Magnetic potentials, Magnetic Dipole, Magnetomotive force and Ampere's Circuital theorem and its applications to calculate magnetic field due to wire carrying current and solenoid.

### UNIT-II

#### **Electromagnetic Induction**

Laws of Induction, Faraday's laws and Lenz's Law. Mutual and Self Induction, Vector potential in varying Magnetic field, Induction of current in continuous media, Skin effect, Motion of electron in changing magnetic field, Betatron, Magnetic energy in field, Induced magnetic field (Time varying electric field), Displacement current, Maxwell's equations, Theory and working of moving coil ballistic galvanometer.

### UNIT-III

#### **Dielectrics**

Dielectric constant, polarization, Electronic polarization, Atomic or ionic Polarization Polarization charges, Electrostatic equation with dielectrics, Field, force and energy in Dielectrics.

#### **Magnetic Properties of Matter**

Intensity of magnetization and magnetic susceptibility, Properties of Dia, Para and Ferromagnetic materials, Curie temperature, Hysteresis and its experimental determination.

### UNIT -IV

#### **Electromagnetic Waves**

The wave', equation satisfied by E and B, plane electromagnetic waves in vacuum, Poynting's vector, reflection at, a plane boundary of dielectrics, polarization by reflection and total internal reflection, Faraday effect; waves in a conducting medium, reflection and refraction by the ionosphere

#### **Text and Reference Books**

Berkeley Physics Course; Electricity and Magnetism, Ed. E.M. Purcell (Mc GrawHill). Halliday and Resnik; "Physics", Vol 2.

D J Griffith; "Introduction to Electrodynamics" (Prentice-Hall of India). Reitz and Milford; "Electricity and Magnetism (Addison-Wesley).

A S Mahajan and A A Rangwala; "Electricity and Magnetism" (Tata McGraw-Hill). A M Portis; "Electromagnetic Fields".

Pugh and Pugh; "Principles of Electricity and Magnetism" (Addison-Wesley).

Panofsky and Phillips; "Classical Electricity and Magnetism" (India Book House). S S Atwood; "Electricity and Magnetism" (Dover).

## PART III - ELEMENTS OF QUANTUM MECHANICS, ATOMIC AND MOLECULAR SPECTRA

### UNIT-I

#### Matter Waves

Inadequacies of classical mechanics, Photoelectric phenomenon, Compton effect, wave particle duality, de- Broglie matter waves and their experimental verification, Heisenberg's Uncertainty principle, Complementary principle, Principle of superposition, Motion of wave packets.

### UNIT -II

#### Schrodinger Equation and its Applications

Schrodinger wave equation Interpretation of wave function, Expectation values of dynamical variables, Ehrenfest theorem, Orthonormal properties of wave functions, One dimensional motion in step potential, Rectangular barrier, Square well potential, Particle in a box, normalization Simple Harmonic Oscillator.

### UNIT - III

#### Atomic spectra

Spectra of hydrogen, deuteron and alkali atoms, spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d, and f states, selection rules. Singlet and triplet fine structure in alkaline earth spectra, L-S and J-J couplings. Weak spectra: continuous X-ray spectrum and its dependence on voltage, Duane and Haunt's law. Characteristics X-ray, Moseley's law, doublet structure and screening parameters in X-ray spectra, X-ray absorption spectra.

### UNIT -IV

#### Molecular spectra

Discrete set of electronic energies of molecules, quantisation of vibrational and rotational energies, determination of internuclear distance, pure rotation and rotation- vibration spectra, Dissociation limit for the ground and other

electronic states, transition rules for pure vibration and electronic vibration spectra.

### **Text and Reference Books**

H S Mani and G K Mehta; "Introduction to Modern Physics" (Affiliated East-West Press 1989). A Beiser, "Perspectives of Modern Physics".

H E White; "Introduction to Atomic Physics".

Barrow; "Introduction to Molecular Physics".

R P Feynmann, R B Leighton and M Sands; "The Feynmann Lectures on Physics, Vol. III (B I Publications. Bombay. Delhi, Calcutta, Madras).

T A Littlefield and N Thorley; "Atomic and Nuclear Physics" (Engineering Language Book Society).

Eisenberg and Resnik; "Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles" (John Wiley).

D P Khandelwal; "Optics and Atomic Physics", (Himalaya Publishing House, Bombay, 1988).

### **PRACTICALS**

Every institution may add any experiment of the standard in the subject.

#### **Physical optics**

1. Study of interference of light (biprism or wedge film).
2. Study of F-P etalon fringes.
3. Study of diffraction at a straight edge or a single-slit.
4. Use of diffraction grating and its resolving limit.
5. Resolving limit of a telescope system.
6. Polarization of light by the reflection.
7. Study of optical rotation for any system.

#### **Electrostatics**

1. Characteristics of a ballistic galvanometer.
2. Setting up and using an electroscope or electrometer.

### **Moving charges and magnetostatics**

1. Use of a vibration magnetometer to study a field.
2. Study of field due to a current.
3. Measurement of low resistance by Carey-Foster bridge or otherwise.
4. Measurement of inductance using impedance at different frequencies.
5. Measurement of capacitance using impedance at different frequencies.
6. Study of decay of currents in LR and RC circuits.
7. Response curve for LCR circuit and resonance frequency and quality factor.

### **Varying fields and electromagnetic theory**

1. Sensitivity of a cathode-ray oscilloscope.
2. Characteristic of a choke.
3. Measurement of inductance.
4. Study of Lorentz force.
5. Study of discrete and continuous LC transmission lines.

### **Atomic Physics**

1. Study of spectra of hydrogen and deuterium (Rydberg constant and ratio of masses of electron to proton).
2. Absorption spectrum of iodine vapour.
3. Study of alkali or alkaline earth spectra using a concave grating.
4. Study of Zeeman effect for determination of Lande g-factor.

### **Molecular Physics**

1. Analysis of a given band spectrum.
2. Study of Raman spectrum using laser as an excitation source

### **Lasers**

1. Study of laser as a monochromatic coherent source
2. Study of divergence of a laser beam

### **Text and Reference Books**

D.P. Khandelwal, "A Laboratory Manual for Undergraduate Classes (Vani Publishing

House, New Delhi).

S.P. Singh, "Advanced Practical Physics" (Pragati Prakashan, Meerut).

Worsnop and Flint- Advanced Practical physics for students.

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| PAPER I   | ... | ... |
| PAPER II  | ... | ... |
| PAPER III | ... | ... |
| PRACTICAL | ... | ... |
| TOTAL     | ... | ... |

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