Unit-I (Interference, Diffraction and Polarisation)

Essay questions

1. Illustrate the theory of **thin films** and derive conditions for constructive and destructive interference in case of reflected system.
2. Illustrate the formation of **Newton's rings** and derive the wavelength and refractive index of the monochromatic light using Newton's rings experiment.
3. Explain with necessary theory the Fraunhofer diffraction due to '**single' slit** and derive the intensity expression diffraction.
4. Explain with necessary theory the Fraunhofer diffraction due to '**double slit** and derive the intensity expression diffraction.
5. Illustrate the theory of Fraunhofer diffraction due to 'n' slits and determine the wavelength of the light source using diffraction grating.
6. Illustrate the principle, construction and working of Nicol Prism with neat diagram
7. Discuss quarter and half wave plates.
8. Illustrate the concept of polarization and the types of polarizations of light
9. Explain the methods to produce polarized light

Short answers

1. Explain Principle of superposition of waves
2. Discuss the necessary conditions for obtaining interference fringes?
3. Distinguish between Fresnel and Fraunhofer diffractions.
4. Discuss a note on Resolving power grating
5. Gsdsh

Unit-II (Lasers & Fiber Optics)

1. Derive the relation between the Einstein coefficients.
2. Explain the working of Ruby laser with the help of neat energy level diagram.
3. Explain the principle, construction and working of He-Ne laser
4. Explain acceptance angle and Numerical aperture, derive the expression for acceptance angle & Numerical aperture of an optical fiber
5. Classify the optical fibers based on refractive index profile and modes

Short answer questions

1. Explain the characteristic properties of lasers.
2. Explain the Spontaneous emission,Stimulated Emissions and Population inversion
3. Explain different pumping schemes
4. Discuss the applications of lasers
5. Explain Propagation of electromagnetic wave through optical fibers
6. Identify the applications of optical fibers in various fields

Unit-III (quantum mechanics Free e theory and Band theory of solids)

1. Derive the Schrodinger time independent wave equation
2. Derive the Schrodinger time dependent wave equation
3. Derive Eigen values and Eigen functions for a particle in a one dimensional potential box
4. Discuss the merits and drawbacks of classical free electron theory
5. Derive an expression for electrical conductivity of a conducting material based on quantum mechanical treatment
6. Explain Fermi-Dirac distribution function and its temperature dependence
7. Explain Fermi function and derive an expression for the Fermi energy in conductors
8. Derive an expression for the density of energy states in a material (metal) by using Fermi distribution function
9. Illustrate with suitable mathematical expressions, the motion of an electron in a periodic potential.
10. Classify the solids on the basis of band theory
11. Derive an expression for the effective mass of an electron moving in energy bands of a solid

Short answer questions

1. List out the properties of matter waves
2. Discuss the Heisenberg's uncertainty principle
3. Explain the physical significance wave function
4. Explain Quantum free electron theory
5. Explain Bloch theorem
6. Explain the concept of hole
7. Explain origin of energy band formation in solids

Unit-IV (Magnetic properties and dielectric Properties)

1. Define electric polarization and derive an expression for electric polarisability.
2. Define ionic polarization and derive an expression for ionic polarisability.
3. Derive an expression for Lorentz internal field
4. Derive an expression for clausius mossotti equation
5. Explain origin of magnetic moment and derive an expression for Bohr Magneton
6. Classify the magnetic materials in to Dia, Para and Ferro magnetic
7. Describe the domain theory of ferromagnetism
8. Discuss the Hysteresis curve

Short answer questions

1. Define Dielectric polarization**,** Dielectric polarizability, Susceptibility and Dielectric constant
2. Explain orientation polarization
3. Explain Piezoelectricity.
4. Write the applications of dielectrics
5. Derive the relation between B,H and I

6. Classify the magnetic materials in to Antiferro and Ferri magnetic
7. Classify soft and hard magnetic materials
8. Discuss the applications of magnetic materials.

Unit-V (Semiconductors and super conductors)

1. Derive the expression for Density of charge carriers in intrinsic semiconductors
2. Explain Drift and Diffusion and derive expressions for Drift and Diffusion currents.
3. State the Hall effect and Derive expression for Hall coefficient
4. Explain the critical parameters that destructs superconductivity.
5. State and explain the Meissner Effect
6. Classify superconductors based on Meissner effect. (Or) Explain Type I and Type II superconductors.
7. Illustrate the Josephson effects

Short answer questions

1. Derive Einstein's relations.
2. Explain the properties of superconductors
3. Explain BCS theory.
4. Explain SQUIDs – High Tc superconductors
5. Discuss Applications of superconductors.

Unit-I formulae

1. Radius of curvature of plano convex lens $R = \frac{D_m^2 - D_n^2}{4\lambda(m-n)}$
2. Diameter of Bright Rings $D^2 = 2R\lambda(2n - 1)$
3. Diameter of Bright Rings $D^2 = 4Rn\lambda$
4. Refractive Index of Liquid $\mu = \frac{D_{n+p}^2 - D_n^2}{D_{n+p}^{1^2} - D_n^{1^2}}$
5. Resolving power of grating $\frac{\lambda}{d\lambda} = nN$
6. $Max\ number\ of\ orders\ available\ with\ grating\ n \leq \frac{1}{\lambda N}$
7. $Thickness\ of\ \ Quarter$ wave plate $t = \frac{\lambda}{4(\mu_{0-\mu_e})}$
8. $Thickness\ of\ \ Half$ wave plate $t = \frac{\lambda}{2(\mu_{0-\mu_e})}$

Unit-II formulae

1. Acceptance angle of an optical fiber

$$\theta_0 = Sin^{-1}(NA) = Sin^{-1}\sqrt{(\mu_1^2 - \mu_2^2}$$

2. Numerical aperture $NA = \sqrt{(\mu_1^2 - \mu_2^2}$
3. Fractional Refractive index change $\Delta = \frac{\mu_1 - \mu_2}{\mu_1}$
4. Numerical aperture NA=$\mu_{1\sqrt{2\Delta}}$

Unit-III formulae

1. Debroglie wavelength $\lambda = \frac{h}{mv} = \frac{h}{P}$
2. $\lambda = \frac{h}{\sqrt{2mE}}$
3. $\lambda = \frac{12.26}{\sqrt{V}} A^0$
4. Energy $E = \frac{n^2 h^2}{8ma^2}$
5. Drift velocity $V_d = \frac{eE\tau}{m}$
6. Mobility of electron $\mu = \frac{e\tau}{m}$
7. Conductivity $\sigma = \frac{ne^2\tau}{m}$
8. Density of states **Z(E) dE=** $\frac{\pi}{2}\left(\frac{8m}{h^2}\right)^{\frac{3}{2}} E^{\frac{1}{2}} dE$
9. Fermi energy $E_F = \left(\frac{3n}{\pi}\right)^{\frac{2}{3}} \left(\frac{h^2}{8m}\right)$

10.Fermi-Dirac fuction$F(E) = \frac{1}{1+exp(\frac{E-E_F}{KT})}$

Unit-IV formulae

1. Magnetic flux density $B = \frac{\phi}{A}$
2. Permeability $\mu = \frac{B}{H}$
3. Magnetic Susceptibility $\chi = \frac{I}{H}$

4 Relative Permeability $\mu_r = \frac{\mu}{\mu_0}$

5. $B = \mu_0 (H + I)$ and $B = \mu_0 H(1 + \chi)$
6. Relative permeability $\mu_r = 1 + \chi$
7. For a paramagnetic material $\chi = \frac{C}{T}$
8. Electronic polarisability $\alpha_e = 4\pi\varepsilon_0 R^3$
9. Clausius Mosotti equation $\frac{N\alpha_e}{3\varepsilon_0} = \frac{\varepsilon_{r-1}}{\varepsilon_{r+2}}$
10. Lorentz internal field $E_i = E + \frac{P}{3\varepsilon_0}$

Unit-V formulae

1. Carrier concentration in intrinsic semiconductor

   $$n = 2[\frac{2m_e * \pi KT}{h^2}]^{\frac{3}{2}} \exp(\frac{E_F - E_C}{KT})$$

2. Conductivity $\sigma = ne\mu$
3. Hall coefficient $R_{H=} \frac{1}{ne}$
4. Hall coefficient $R_H = \frac{E_H}{BJ}$
5. Einstein's relation $\frac{D_P}{\mu_P} = \frac{D_n}{\mu_n}$
6. Critical magnetic field $H_c = H_0[1 - (\frac{T}{T_C})^2]$
7. Critical current $I_C = 2\pi r H_c$