Question Bank

Unit-1

Q.1 What is interference? Describe the concept of division of amplitude and division of wavefront.
Q.2 Explain the phenomenon of interference in thin film and obtain conditions for maximum and minimum.
Q.3 Discuss the application of thin film interference to find thickness of thin film.
Q.4 What is diffraction grating? How can it be used to determine wavelength of light?
Q.5 Explain construction and theory of diffraction grating.
Q.6 Define resolving power of grating and derive expression for it.
Q.7 Show that resolving power of grating depends on order of spectrum.
Q.8 Explain the terms polarization, plane of polarization and plane of vibration.
Q.9 Distinguish between polarized and unpolarized light.
Q.10 State and explain law of Malus.
Q.11 Discuss phenomenon of double refraction.
Q.12 Explain the phenomenon of interference in wedge shaped (or variable thickness) thin film and obtain conditions for maximum and minimum. Also show the fringe width is inversely proportional to angle of film.
Q.13 What is optical activity? Explain the rotation of plane of polarization by Fresnel's theory.
Q.14 Explain in detail construction and working of Laurent's half shade polarimeter.
Q.15 Give different applications of polarized light.

Unit 2

Q.1 Explain the terms
i) Spontaneous emission
ii) Stimulated emission
iii) Population inversion
iv)Pumping
v)Active system
Q.2 What is population inversion? Why is it necessary for lasing action?
Q.3 Give brief account of optical pumping.
Q.4 Describe with diagram construction and working of ruby laser.
Q.5 State different characteristics of laser.
Q.6 Give scientific, industrial and medical applications of laser.
Q.7 What is holography? Explain with illustration recording of hologram and reconstruction of image.
Q.8 State and explain principle used in optical fibre.

Q.9 Explain in brief principle and structure of optical fibre and fibre optics cable.
Q.10 Define acceptance angle and state expression for it.
Q.11 Write expression for numerical aperture and state its significance.
Q.12 Write short note on:
i) Classification of optical fibre
ii) Optical fibre as sensor
Q.13 Give different applications of optical fibre.
Q.14 What are advantages of optical fibre?

Unit 3

Q.1. Derive Maxwell's first equation from Gauss law.
Q.2. Using Biot – Savart law, obtain expression for magnetic field produced by long thin current carrying conductor.
Q.3. Explain the Maxwell's concept of displacement current.
Q.4. Derive Maxwell's second equation.
Q.5. Derive Maxwell's third equation from Faraday's law of electromagnetic induction.
Q.6. What is physical significance of Maxwell's second equation.
Q.7. Derive Maxwells' fourth equation.
Q.8. Write Maxwell's electromagnetic equations and their physical significance.
Q.9. Show that light is electromagnetic wave in nature from Maxwell's equations.
Q.10. Deduce expression for velocity of propagation of plane electromagnetic wave in a medium with permittivity ε and permeability μ.
Q.11. Write boundary conditions for electric and magnetic fields.
Q.12. Obtain law of refraction for the electric field at the interface between two dielectrics.
Q.13. Obtain law of refraction for the magnetic field at the interface between two media.
Q.14. Define Poynting vector. Derive expression for it and explain its physical significance for electromagnetic wave in free space.
Q. 15 State and prove Faraday's law.
Q. 16. State and explain Ampere's law.
Q.17. State and prove 3^{rd} and 4^{th} Maxwell's equations.
Q. 18 State and Prove Maxwell's first and second law.
Q.19 Prove that velocity of light is $3x10^{-8}$ m/s in vacuum.
Q. 20. Derive boundary conditions for electric and magnetic fields for dielectric-dielectric interface.

Unit- 4

Q.1 State the de Broglie's hypothesis of matter wave. Derive an expression for wavelength of matter wave in terms of kinetic energy of particle.

Q.2 Give different properties of matter wave.

Q.3 State and explain Heisenberg's uncertainty principle.

Q.4 Elaborate applications of Heisenberg's uncertainty principle.

Q.5 'If an electron is localized in space, its momentum becomes uncertain.' Explain this statement.

Q.6 Define a wave function. Show that it represents probability density of finding the particle at a given position and given time.

Q.7 Explain the concept of wave function and give its physical significance.

Q.8 Derive Schrodinger's time dependent wave equation.

Q.9 Derive Schrodinger's time independent wave equation.

Q.10 Apply the Schrodinger's time independent equation for a particle confined to a rigid box and find its energy levels..

Q.11 Show that the energy of electron confined in one dimensional potential well of length L and infinite depth is quantized. Is the electron trapped in infinite potential well allowed to take zero value? Elaborate the answer.

Q.12 Show that the energy of particle confined in one dimensional potential well of length L is given by

$$E_n = \frac{n^2 h^2}{8mL^2}$$

Unit 5

Q.1 Explain formation of bands in solid. Define valence band, conduction band and forbidden gap.

Q.2 Define valence band, conduction and forbidden gap. Explain classification of solids on the basis of band theory.

Q.3 Define Fermi level in semiconductor and derive expression for Fermi energy in intrinsic semiconductor.

Q.4 Draw neat sketch of energy band diagram and show that Fermi level in intrinsic semiconductor lies at the centre of energy gap.

Q.5 What is effect of temperature on position of Fermi level in extrinsic semiconductor? Illustrate with suitable diagram.

Q.6 Derive expression for Fermi level for n-type semiconductor and explain

effect of temperature and doping concentration.

Q.7 Discuss the effect of impurity concentration on Fermi level in n – type semiconductor.

Q.8 Show that Fermi level drops with increasing amount of dopant in p-type semiconductor.

Q.9 Draw energy band diagram at 0 K for

i) Intrinsic semiconductor

ii) P- and n-type semiconductor

Q.10 What is law of mass action? Show that $np = n_i^2$ where symbols have their usual meaning.

Q.11 Derive the expression for fraction of electrons in conduction band.

Q.12 What is Hall effect? Derive expression for Hall coefficient.

Q. 13 State and explain Bloch function.

Q.14 Describe motion of electron in periodic potential using Kronig-Penny model.

Q. 15. Explain formation of forbidden energy gap using Kronig-Penny model.

Unit- 6

Q.1 Write a note on formation of p-n junction and obtain equation for junction potential.

Q.2. Show that diffusion current and drift current are equal and opposite in unbiased p-n junction.

Q.3. Explain the effect of reverse bias in p-n junction and derive equation for total current.

Q.4. Explain the effect of forward bias in p-n junction and derive equation for total current.

Q.5. Derive diode equation and rectifier equation in p-n junction.

Q.6. Explain construction and working of Schottky diode.

Q.7. Describe construction of JFET and explain I-V characteristics.

Q.8. Illustrate construction of MOSFET and its I-V characteristics with neat diagrams.