Time: 2hrs **[Max Marks: 60]**

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions from Q2.to Q6.
(3) Assume suitable data, if required and state it clearly.
(4) Figures to the right indicate marks.

Q1. Attempt any **FIVE** [15]

(a) Find the miller indices of the plane in a cubic crystal having intercepts a, b/2, infinity and draw the plane for the same.
(b) Explain with reason if it is a bright or dark fringe at the edge in wedge shaped thin film set up in reflected light system.
(c) What is the probability of an electron being thermally excited to conduction band in Silicon at 20°C if the bandgap is 1.12 eV. (Given: k=8.6 x 10^{-5}eV/K)
(d) Define the following terms: Wave packet, Phase velocity and Group velocity.
(e) What is energy density and power density?
(f) What are Multiferroic materials? Differentiate between Type I and Type II Multiferroics.

Q2. (a) Explain the construction and working of Light Emitting Diode with the help of neat diagrams. State the merits, demerits and applications. [8]
(b) Derive the equations for optical path difference in a parallel thin film in reflected light system. Also find the conditions for maxima and minima. [7]

Q3. (a) Derive the expression for interplanar spacing in cubic crystals. The unit cell dimension of NaCl is 5.63 A°. If x-ray beam of wavelength 1.1 A° falls on a family of planes with a separation of $\frac{a}{\sqrt{5}}$, how many orders of diffraction are visible? [8]
(b) Write the expression for Schrodinger's time dependent equation of matter waves and derive Schrodinger's time independent equation. [7]

Q4. (a) Distinguish between Type I and Type II superconductors. [5]
(b) Define liquid crystals. Explain different phases with the help of neat diagrams. [5]
(c) A copper strip 0.02m wide and 2mm thick is placed in a magnetic field B= 2.5 Wb/m^2. If current of 300Amp is set up in the strip, calculate Hall voltage and charge density that appears across the strip. Given, R_H= 6 x 10^{-7} m^3/C [5]

Q5. (a) Explain the construction and working of electrolytic double layer capacitor (EDLC) with diagram. [5]
(b) Show that fermi energy level is placed in the center of the energy bandgap in intrinsic semiconductor. [5]
(c) An electron is bound in a one-dimensional potential well of width 5 A° but of infinite height. Find its energy values in the ground state and in first two excited states. [5]

Q6. (a) Explain the effect of doping concentration on fermi level in n-type semiconductor. [5]

(b) State de' Broglie hypothesis and derive an expression for de' Broglie wavelength. Mention three properties of matter waves. [5]

(c) In Newton's rings experiment the diameter of n^{th} and $(n+10)^{th}$ bright rings are 5.2mm and 8.5mm respectively. Radius of curvature of the lower surface of lens is 200cm. Determine the wavelength of light? [5]
