

(2 Hours)

[Total Marks: 60]

- N.B.: (1) Question No. 1 is **compulsory**.
 (2) Attempt **any three** questions from Q.2 to Q.6.
 (3) Assume **suitable** data wherever **required**.
 (4) Figures to the right indicate marks.

- Q.1 Attempt any **FIVE** (All questions carry equal marks) **(15)**
- What is the probability of an electron being thermally excited to conduction band in Silicon at 20°C if the band gap is 1.12 eV. (Given: $k=8.6 \times 10^{-5} \text{ eV/K}$)
 - Draw the following with reference to cubic unit cell:
(121), (100) and (011)
 - Explain why an extensively thin film appears black in reflected light.
 - What are the properties of matter waves?
 - Explain at least three applications of super capacitors.
 - Explain different phases of liquid crystal.
 - State de Broglie's hypothesis. Deduce an expression for the wavelength of de Broglie's matter waves.
- Q.2 (a) State the conditions of Maxima and Minima in Newton's rings and derive expression for the diameter of dark ring in reflected light system. **(08)**
- (b) Explain with neat diagram construction of Bragg's X-ray spectrometer and explain the procedure to determine crystal structure using it. Calculate the maximum order of diffraction if x-ray of wavelength 0.819 \AA is incident on a crystal with lattice spacing of 0.282nm. **(07)**
- Q.3 (a) Discuss Heisenberg's Uncertainty principle and prove that electrons cannot reside inside the nucleus of an atom using the same principle. **(08)**
- (b) Explain the construction and working of Light Emitting Diode with the help of diagrams. State the merits, demerits and applications. **(07)**
- Q.4 (a) Calculate electron and hole concentration in intrinsic silicon at room temperature if its electrical conductivity is $4 \times 10^{-4} \text{ mho/m}$. (mobility of electron = $0.14 \text{ m}^2/\text{V-s}$ & mobility of hole = $0.04 \text{ m}^2/\text{V-s}$) **(05)**
- (b) Write the expression for Schrodinger's time dependent equation of matter waves and derive Schrodinger's time independent equation. **(05)**
- (c) A wedge-shaped film of solution which had refractive index 1.28 was observed normally. The distance between successive bands was 0.15cm. The angle of wedge was 0.01° . Determine the wavelength of light used. **(05)**

- Q.5 (a) Discuss the importance of critical temperature in superconductors. Differentiate between Type I and Type II superconductors. (05)
- (b) Show that Fermi energy level is placed in the center of the energy band gap in intrinsic semiconductor. (05)
- (c) Show that group velocity of matter waves is equal to particle velocity. (05)
- Q.6 (a) What is Meissner Effect? With the help of this effect show that superconductors are diamagnetic in nature. (05)
- (b) Find the minimum thickness of the soap film which appear yellow (wavelength 5896 \AA) in reflection when it is illuminated by white light at an angle of 45° . Given refractive index of the film is 1.33. (05)
- (c) An electron is bound in one dimensional potential well of width $2A^0$ that of infinite height. Find its energy value in the ground state and in first two excited states. (05)
