(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)**

(a) 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 x 10^{-5}eV/K)

(b) Draw the following with reference to cubic unit cell:
(121), (100) and (011)

(c) Explain why an extensively thin film appears black in reflected light.

(d) What are the properties of matter waves?

(e) Explain at least three applications of super capacitors.

(f) Explain different phases of liquid crystal.

(g) 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 0.819A^0 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 $4x10^{-4}$ mho/m. (mobility of electron=0.14 m^2 /V-s & mobility of hole=0.04 m^2 /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 A°) 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 exited states. **(05)**