(Time: 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**   **(15)**

  (a) The resistivity of cu is 1.72×10^{-8} ohm-m. Calculate the mobility of electron in Cu. Given that the number of electrons per unit volume is $10.41 \times 10^{28}/m^3$

  (b) Draw the following with reference to cubic unit cell:
      (110),(011) and (101)

  (c) Why do we see beautiful colors in thin film when it is exposed to sunlight?

  (d) What are the properties of matter waves?

  (e) Explain the principle & importance of super capacitors

  (f) Explain the construction of LCD

  (g) State de Broglie's hypothesis. Deduce an expression for the wavelength of de Broglie's matter waves.

Q.2 (a) What is thin film? Derive the conditions for maxima & minima due to interference of light reflected from thin film of uniform thickness   **(08)**

  (b) Derive Bragg's law. The Braggs angle corresponding to the first order reflection from (111) planes of a crystal is 30^0.wavelength of X-rays is $1.75 \ A^0$.Determine lattice constant of the crystal.   **(07)**

Q.3 (a) Explain phase velocity & group velocity of a matter waves. Derive the one dimensional time dependent Schrodinger wave equation for matter waves.   **(08)**

  (b) What is photovoltaic effect? Explain the principle, working & applications of solar cell.   **(07)**

Q.4 (a) Calculate electron and hole concentration in intrinsic silicon at room temperature if its electrical conductivity is 4×10^{-4} mho/m. (mobility of electron=$0.14 \ m^2/V\text{-}s$ & mobility of hole=$0.04 \ m^2/V\text{-}s$)   **(05)**

  (b) Show that the energy of an electron in a box varies on the square of the natural numbers.   **(05)**

  (c) In Newton's ring experiment the diameter of 4th and 12th dark rings are 0,40cm and 0.70cm.find diameter of 20th dark ring in reflected light.   **(05)**

Q.5 (a) Write the applications of superconductors.   **(05)**

  (b) Show that Fermi energy level is placed in the center of the energy band gap in intrinsic semiconductors.   **(05)**

(c) Explain Heisenberg's uncertainty principle with example & give its physical significance **(05)**

Q.6 (a) What is Meissner Effect? With the help of this effect show that superconductors are diamagnetic in Nature. **(05)**

(b) A parallel beam of light (wavelength-5870) is incident on a glass plate of Refractive Index is 1.5,such that the angle of refraction into the plate is 60 ^{0}.calculate the smallest thickness of the glass plate which will appear dark by reflection **(05)**

(c) If the uncertainty in position of an electron is 4×10^{-10} m, calculate the uncertainty in its momentum. **(05)**