

(2 Hours)

[Total Marks:60]

- N.B.: (1) Question. 1 is **compulsory**.
 (2) Attempt any **three** questions from the remaining questions N0.2 to 6.
 (3) **Assume** suitable **data** wherever required.
 (4) **Figures** to the **right** indicate **marks**.

1. Attempt any **five** questions from the following- 15
 - (a) Calculate atomic packing fraction of HCP unit cell.
 - (b) Express de-Broglie wavelength in various forms.
 - (c) Draw the energy band diagram for p-n junction diode in forward and reverse bias condition.
 - (d) Define: persistent current, critical temperature, critical magnetic field.
 - (e) What is reverberation time? Explain its formula.
 - (f) With the help of diagram state direct and inverse piezoelectric effect.
 - (g) The resistivity of intrinsic material at room temperature is 2×10^{-4} Ohm-cm. If the mobility of electron is $6 \text{ m}^2/\text{V-sec}$ and mobility of hole is $0.2 \text{ m}^2/\text{V-sec}$. Calculate its intrinsic carrier density.
- 2 (a) Arrive at the statement that electron can not survive inside the nucleus. 8
 An electron has a speed of 300m/s with uncertainty of 0.01% . Find the accuracy in its position.
- (b) A sample of semiconductor is placed in uniform magnetic induction B with sample current I and thickness w then obtain the expression for (a) Hall voltage and (b) Hall coefficient. 7
- 3 (a) With neat diagram of unit cell explain the structure of diamond crystal. 8
 (b) Explain variation of Fermi level with temperature in n-type semiconductor. 7
 What is the probability of an electron being thermally excited to the conduction band in Si at 30°C . The band gap energy is 1.12eV ($k=1.38 \times 10^{-23} \text{ J/K}$)
- 4 (a) Distinguish between Type I and Type II superconductors. 5
 (b) A class room has dimension of $(20 \times 15 \times 10) \text{ m}^3$; the reverberation time is 3 sec. 5
 Calculate the total absorption of its surfaces and average coefficient of absorption
- (c) How ultrasonic waves are produced using quartz crystal in an oscillator? 5
- 5 (a) Show that for an intrinsic semiconductor, the Fermi level lies half way between conduction and valence band. 5
 (b) State and explain principle of SQUID and explain its working to determine the strength of magnetic field. 5
 (c) The lowest energy of an electron trapped in a one dimensional box is 5
 $3.2 \times 10^{-18} \text{ J}$. Calculate the width of the box. Also calculate the next two energies in eV the particle can have?
- 6 (a) Define ligancy and critical radius ratio. Calculate critical radius ratio for ligancy 6. 5
 (b) Obtain one dimensional time dependent Schrodinger equation 5
 (c) Explain photovoltaic effect and write a note on solar cell. 5
