Before answering the question paper the candidate should ensure that they have been supplied the correct question paper. Complaints in this regard, if any, shall not be entertained after the examination.

Note: Attempt any five questions and all questions carry equal marks.

1. (a) Explain the structure of Hcp lattice and obtain its packing fraction. (10)
(b) What are Miller Indices? How are they obtained? Also sketch the various planes in cubic unit cells: \((111)\), \((101)\), \((\bar{2}01)\), \((\bar{2}00)\). (2+4+4)

2. (a) What do you mean by matter waves? Obtain a relation between group velocity and particle velocity. (2+8)
(b) Obtain time independent Schrödinger wave equation and explain the physical significance of wavefunction. (8+2)

3. (a) Define damped harmonic oscillations. Solve its differential equation and discuss specifically the case of under-damped motion. (2+5+3)
(b) Derive London equations of superconductivity. (10)

4. (a) What do you mean by Density of states? Obtain an expression of three dimensional density of states. (10)
(b) What do you mean by Fermi distribution function? Show that the average energy of free electrons in metal is \((3/5)\)th of Fermi energy at absolute zero. (3+7)

5. What do you mean by intrinsic semiconductor? Obtain an expression for the intrinsic carrier concentration in an intrinsic semiconductor. Show that Fermi level will be in the middle of forbidden gap in an intrinsic semiconductor. (4+8+8)

6. (a) Explain Langevin’s theory of Diamagnetism? (10)
(b) Write note on any one of following (10)
1. Hall Effect
2. Bragg’s law and Powder method
3. Hysteresis & B-H curve

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