



Answer the following questions

Question 1 [20 marks]

- Find the mobility of both of electrons and holes in intrinsic regions. [5 marks]
- How does the p-n junction work as (i) a rectifier and (ii) a solar cell? [5 marks]
- Explain how you can represent three energy bands of a linear lattice in Brillouin, reduced and periodic zone schemes. [5 marks]
- Use tight binding method (or Wigner-Seitz) to calculate the energy bands. [5 marks]

Question 2 [15 marks]

- Explain the Meissner effect for the types I and II superconductivity (please use suitable equations and illustrating diagrams). [5 marks]
- Give some notations about variations of entropy and heat capacity in both of superconducting and normal states. [5 marks]
- Deduce the London equation for superconducting state. [5 marks]

Question 3 [30 marks]

- Distinguish between diamagnetic and paramagnetic in terms of both atomic structure and magnetic susceptibility (give some examples of substances for each). [5 marks]
- Use quantum theory to find the Curie law for determination the paramagnetic susceptibility. [5 marks]
- Find the paramagnetic susceptibility of conduction electron. [5 marks]
- Define both of the Curie temperature and Néel temperature. [5 marks]
- Find the mean field constant λ (Note that $\lambda = T/C$). [5 marks]
- Use a classical argument to find the magnon dispersion relation in terms of spin reversal. [5 marks]

Question 4 [18 marks]

- Discuss the main characteristic of rubber elastic state in terms of molecular structure and strain behavior. [6 marks]
- Sketch the unit cell, as viewed along c-axis, polyethylene crystal. [5 marks]
- Calculate the density of polyethylene crystal. Take the parameters, a, b and c are respectively, 0.74 nm, 0.495 nm and 0.253 nm. Assume any missing data but with a suitable value. [7 marks]

Question 5 [17 marks]

- What is meant by glass transition temperature specifically in terms of molecular mobility? [5 marks]
- Define the equilibrium melting temperature and discuss its importance in the crystallization kinetics of polymers. [5 marks]
- Give the important characteristic of the three regimes of crystallization growth in polymers. [7 marks]