

B.Tech I Year(RR) Supplementary Examinations, May 2010**SOLID STATE PHYSICS**

(Common to Electrical & Electronic Engineering, Electronics & Communication Engineering, Computer Science & Engineering, Electronics & Instrumentation Engineering and Bio-Medical Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Explain the forces between the two interacting atoms when they are brought nearer to form a molecule.
(b) Derive the expression for the equilibrium spacing of two atoms for which the potential energy is minimum and hence obtain the dissociation energy. [6+10]
2. (a) What are Miller indices? How are they obtained?
(b) Explain Schottky and Frankel defects with the help of suitable figures. [6+10]
3. (a) Derive time independent Schrodinger's wave equation for a free particle.
(b) Explain the physical significance of wave function.
(c) An electron is bound in a one-dimensional infinite well of width 1×10^{-10} m. Find the energy values in the ground state and first two excited states. [8+4+4]
4. (a) Explain the origin of energy bands in solids.
(b) Assuming the electron - lattice interaction to be responsible for scattering of conduction electrons in a metal, obtain an expression for conductivity in terms of relaxation time and explain any three drawbacks of classical theory of free electrons.
(c) Find the temperature at which there is 1% probability of a state with an energy 0.5 eV above Fermi energy. [6+6+4]
5. (a) With usual notation show that $P = \epsilon_0 (\epsilon_r - 1)E$
(b) What is dipolar relaxation? Discuss the frequency dependence of orientational polarization.
(c) A solid elemental dielectric, with density 3×10^{28} atoms / m^3 shows an electronic polarisability of 10^{-40} farad- m^2 . Assuming the internal electric field to be a Lorentz field, calculate the dielectric constant of the material. [6+6+4]
6. (a) What are paramagnetic materials? Explain.
(b) Obtain an expression for paramagnetic susceptibility (χ). How does the paramagnetic susceptibility of a material vary with temperature?
(c) A paramagnetic material has 10^{28} atoms per m^3 . Its susceptibility at 350 K is 2.8×10^{-4} . Calculate the susceptibility at 300 K. [4+8+4]
7. (a) When donor impurities are added to a semiconductor, the concentration of holes decreases. Explain with reasons.
(b) Show that the Fermi level is nearer to the conduction band in a n-type semiconductor. Discuss the variation of conductivity with temperature of an n-type semiconductor. [8+8]
8. (a) Derive expressions for the numerical aperture and the fractional index change of an optical fiber.
(b) Explain the advantages of optical communication system.
(c) The numerical aperture of an optical fiber is 0.39. If the difference in the refractive indices of the material of its core and the cladding is 0.05, calculate the refractive index of material of the core. [8+4+4]
