POKHARA UNIVERSITY

Level: Bachelor | Semester: Fall | Year : 2021
Programme: BE | Full Marks: 100
Course: Electrical Engineering Materials | Pass Marks: 45
Time : 3hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Derive the wave function for an electron confined in the infinite potential well. 8
   b) Define the term electrons drift velocity and mobility. How are they related? Show that the conductivity of electrons with in metallic conductor is product of charge density and mobility. 7
2. a) Show that ionic conduction in liquid decreases with increase in temperature and increases with increases in electric field. 7
   b) What are different types of polarization in dielectric medium? Explain orientational polarization in detail. 8
3. a) Explain the Hysteresis loop and define hard and soft magnetic materials. 7
   b) Derive the expression for density state per unit volume and per unit energy. 8
4. a) In intrinsic Semiconductor, Prove that the Fermi Level lies at the center of valence band and conduction band. 8
   b) A heavily doped p-side with acceptor concentration of 10^{18} cm^{-3} is connected to n-side with donor concentration of 10^{16} cm^{-3}. Calculate the built in potential and depletion width. 7

   Assume T = 300 K and $n_i = 1.45 \times 10^{10} cm^{-3}$.
5. a) Derive the Ideal diode Equation for PN junction. 8
   b) Calculate the resistance of pure silicon cubic crystal of 1 cm^3 at room temperature. What will be the resistance of the cube when it is doped with 1 arsenic in 10^9 Silicon atoms and 1 boron atom per billion silicon atoms? Atomic concentration of silicon is $5*10^{22}$ cm^{-3}, intrinsic concentration $n_i=1.45*10^{10} cm^{-3}$. Assume the mobilities of electron and hole are 1350 and 450 $cm^2V^{-1}s^{-1}$. 7

6. a) Explain the ion implantation process with a neat sketch. 7
   b) A parallel plate capacitor has an area of 20cm^2 and a separation of 0.5 mm. The space between the plates is filled with polyethylene. An alternative voltage with amplitude of 12V is applied at a frequency of 1.5 MHz. At this frequency, the real part of the relative permittivity is 2.25 and the loss tangent is 4×10^{-4}. Calculate the energy dissipated per second. 8
7. Write short notes on: (**Any two**) 2×5
   a) Degenerate and Non-degenerate Semiconductor
   b) Fermi Dirac distribution function
   c) Diffusion and depletion layer capacitance