POKHARA UNIVERSITY

Level: Bachelor Semester:Fall Year : 2020
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) The normalized wave function for electron in infinite potential is $\psi_n = (\frac{2}{L})^{1/2} \text{Sin } \frac{n\pi x}{L}$, where symbols have their usual meaning. Find the expected value of position and momentum for the electron. 8
   b) What do you mean by effective mass of an electron? Derive an expression $m^* = h^2/(d^2E/dk^2)$. 7
2. a) What is tunneling in quantum mechanics? Explain with the necessary mathematical expression, the nature of wave function in different regions in case of tunneling. 8
   b) Describe ionic conduction in electrolyte and show that ionic conduction in electrolyte depends on temperature. 7
3. a) What is polarization? Derive the Clausius –Mossetti equation for ionic polarization. 7
   b) Describe about Hysteresis loop. Differentiate between hard and soft magnetic materials. 8
4. a) Define intrinsic and extrinsic semiconductors. Deduce mass action law and derive $\mathbf{n_i = (N_cN_v)\ exp(-E_g/2K_BT)}$ where symbols have their usual meanings. 8
   b) Find the resistance of a $1cm^3$ pure Silicon crystal. What is the resistance when the crystal is doped with one Arsenic in 10^9 Silicon atoms? Given: Atomic concentration is Si is $5 \times 10^{22}\ cm^{-3}$, $n_i = 1.45 \times 10^{10}\ cm^{-3}$, $\mu_e = 1350\ cm^2\ V^{-1}\ S^{-1}$ and $\mu_h = 450\ cm^2V^{-1}S^{-1}$. 7
5. a) A heavily doped p side with accepter concentration of $10^{18}cm^{-3}$ is connected to n –side with donor concentration of $10^{16}\ cm^{-3}$. Calculate the built in potential, depletion width in n-side and p-side , total depletion width and electric field at the junction. Relative permittivity of material is 11.9 , $K=1.38\times10^{-23}$, $e=1.6\times10^{-19}C$ 8
   b) What is diffusion? Derive Einstein's relation between diffusion coefficient and mobility of electrons. 7
6. a) The crystal of sodium chloride has state dielectric constant of 5.6 and optical index of refraction 1.5. Calculate the percentage contribution of ionic polarizability. 7
   b) Explain the ion implantation process with neat sketch. 8
7. Write short notes on: **(Any Two)** 2×5
   a) Fermi-Dirac distribution
   b) Effect of temperature and frequency on dielectric
   c) Czochralski method of Crystal Growth