Digital Assignment 1 (Fall Semester 2022-2023)

BECE201L- ELECTRONIC MATERIALS AND DEVICES

Submission Deadline: 10 Sept 2022

Submission Mode: Digital (Moodle)

Slot: C1+TC1

Full Marks: 10

Faculty: Dr. Sheena Christabel Pravin

(**All questions are compulsory. Each question carries 1 mark**)

Q1. Derive the Atomic Packing Factor (APF) of a simple cubic structure, body-centered cubic structure and face centered cubic structure.

Q2. What is the crystalline structure of gold ? Calculate the radius of gold. (Au = 197 g mol^{-1}) if its density is 19.3 g cm^{-3}

Q3. An atom crystallises in FCC crystal lattice and has a density of 10 g cm^{-3} with unit cell edge length of 100 pm. Calculate the number atoms present in 1 g of the crystal.

Q4. What crystalline structure is held by Sodium metal? If the distance between the nearest Na atom is 368 pm, calculate the edge length of the unit cell.

Q5. Consider a crystal with BCC structure which has density of 8.55 g cm^{-3}. If its atomic mass is 93, calculate its atomic radius.

Q6. Find the conductivity of silicon (a) in intrinsic condition at a room temperature of 300 K, (b) with donor impurity of 1 in 10^8, (c) with acceptor impurity of 1 in 5 ×

10^7. Given that n_i for silicon at 300 K is 1.5×10^{10} cm^{-3}, μ_n = 1300 cm^2/V^{-s}, μ_p = 500 cm^2/V^{-s}, number of Si atoms per $cm^3 = 5 \times 10^{22}$.

Q7. Consider a silicon PN junction at T = 300 K so that $n_i = 1.5 \times 10^{10}$ cm^{-3}. The N type doping is 1×10^{10} cm^{-3} and a forward bias of 0.6 V is applied to the PN junction. Calculate the minority hole concentration at the edge of the space charge region.

Q8. The mobility of free electrons and holes in pure germanium are 3800 and 1800 cm^2/V^{-s} respectively. The corresponding values for pure silicon are 1300 and 500 cm^2/V^{-s}, respectively. Determine the values of intrinsic conductivity for both germanium and silicon. Assume $n^i = 2.5 \times 10^{13}$ cm^{-3} for germanium and $n_i = 1.5 \times 10^{10}$ cm^{-3} for silicon at room temperature.

Q9. In a P-type semiconductor, the Fermi level is 0.3 eV above the valance band at a room temperature of 300 K. Determine the new position of the Fermi level for temperatures of (a) 350 K, and (b) 400 K.

Q10. In an N-type semiconductor, the Fermi level lies 0.2 eV below the conduction band. Find the new position of Fermi level if the concentration of donor atoms is increased by a factor to (a) 4 and (b) 8. Assume kT = 0.025 eV.