

4. (a) Calculate the critical radius ratio of an ionic crystal in ligancy 4 configuration.
(b) Determine the concentration of conduction electron in a sample of Silicon if one in every million Silicon atom is replaced by a Phosphorous atom. Assume every Phosphorous atom to be singly ionized. Si has a molar mass of 0.028 kg/mole and density of 2300 kg/m³.
(c) If a gas contains 1.2×10^{27} atoms/m³ and radius of atom is 0.53 Å, then calculate electronic polarizability and dielectric constant. Find the capacitance of a parallel plate capacitor having this gas inside, with plate area 1 cm² and plate separation 0.12 cm.
5. (a) Find Miller Indices of a plane whose intercepts are a, 4a and a, where a is the lattice constant. Draw (102), [201] and $(0\bar{4}0)$ in a cubic unit cell.
(b) In a semiconductor with Hall coefficient 145 cc/C having width of 2 cm and thickness 0.2 cm with a magnetic field induction of 2T along the smaller dimension, a current of 150 mA is passing. Calculate the current density and Hall voltage.
(c) Write Sabine's formula explaining each term. Explain how this formula can be used for the determination of absorption coefficient of a given material.
6. (a) Write five distinct differences between Frenkel and Schottky defect.
(b) Explain how a voltage difference is generated in a p-n junction when it is used in a photovoltaic solar cell.
(c) Explain the principle, construction and working of a magnetostriction oscillator to produce ultrasonic waves.