Indraprastha Institute of Information Technology
Department of ECE

Physics of Semiconductor Devices (ECE-210)

Assignment 1, Deadline: Feb 19, 2025

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Note: Show all necessary calculations in step by step manner

Q.1. The primitive translation vectors of a hexagonal space lattice may be taken as A=$(\frac{a\sqrt{3}}{2}\hat{i}+\frac{a}{2}\hat{j})$, B=$(\frac{-a\sqrt{3}}{2}\hat{i}+\frac{a}{2}\hat{j})$ and C=$c\hat{k}$. Show that the volume of the primitive cell is $\frac{\sqrt{3}}{2}a^2c$. Determine the primitive translation vectors of the reciprocal lattice. Also, sketch the first Brillouin zone of the hexagonal space lattice. **[3 marks]**

Q.2. Calculate the interplanar spacing for (3 2 1) plane in a simple cubic lattice of which the lattice constant is $4.3\times10^{-10}m$. If the first-order reflection occurs at an angle of 10°. what will be the wavelength of the x-ray? **[3 marks]**

Q.3. Calculate the tunneling probability, when the kinetic energy of the particle is 0.2MeV, the barrier height is 20MeV, and the width of the barrier is $2.97 \times 10^{-18}m$ (take mass of particle as $6.68 \times 10^{-27}kg$, $\hbar = 1.054 \times 10^{-34}Js$). **[3 marks]**

Q.4. The uncertainty in the position of an electron is $4\mathring{A}$. (a) Determine the minimum uncertainty in momentum. (b) If the nominal value of momentum is 2.4×10^{-23} kg-m/s, determine the corresponding uncertainty in kinetic energy. **[3 marks]**

Q.5. An electron is confined within a one-dimensional infinite potential well with a width of $5\mathring{A}$. (a) Determine the first three energy levels that the electron can occupy. (b) If the electron transitions from the third to the second energy level, calculate the wavelength of the emitted photon. **[3 marks]**