Indraprastha Institute of Information Technology

Department of ECE

Physics of Semiconductor Devices (ECE-210)

Assignment 1, Deadline: Feb 15, 2024

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Q.1. Consider a particle moving in a one-dimensional finite square well defined by

$$V_x = \begin{cases} -V_0 & |x| < a \\ 0 & |x| > a \end{cases}$$

Solve the time-independent Schrodinger equation for the system and obtain the bound state energy eigenfunctions. Discuss how the energy levels can be obtained graphically.

[5 marks]

Q.2. The normalized wave function is given as

$$\psi\left(x\right) = \frac{\sqrt{31}}{2a^{\frac{3}{2}}}\left(a^3 x^{\frac{3}{2}} - x^{\frac{5}{2}}\right)$$

and is present in 1D potential well given as

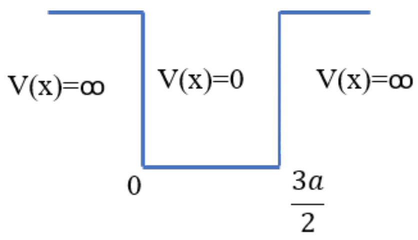

Figure 1:

Find the ground state energy using the expectation value $< E >$. **[5 marks]**

Q.3. Using the uncertainty principle, estimate the ground state energy of the helium atom. **[5 marks]**

Q.4. Derive the reciprocal lattice of fcc and bcc crystal. **[5 marks]**

Q.5. An α-particle having energy 10MeV approaches a square potential barrier of height 30MeV. Determine the width of the barrier if the transmission coefficient is 2×10^{-3}. Given: mass of an α particle $= 6.68 \times 10^{-27}$kg, $\hbar = 1.054 \times 10^{-34}$ Js **[5 marks]**

Q.6. Two potential barriers are shown in Figure 2, namely A and B, and they have the height $\frac{V_0}{2}$ and $3V_0$. Find the ratio of $\frac{T_A}{T_B}$ (tunneling probability) given E $= \frac{V_0}{100}$. **[5 marks]**

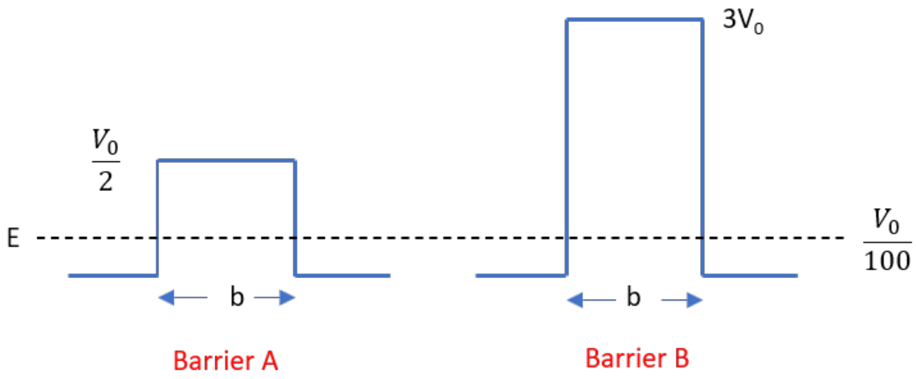

Figure 2:

Best wishes