MINOR 2: PYL 321

09/10/2015, Marks: 20

1. Consider a single-electron atom under a light field described by the vector potential **A(r,t)**. Show that the force acting on electron due to 'light field' is much smaller than the electrostatic attraction force of the electron with nucleus. [3]

2. Determine the transmission coefficient for a particle with energy $E = V_0$ incident from the left on the rectangular barrier:

$$V(x) = \tfrac{1}{2} V_0 \quad \text{for } -a < x < a$$
$$= 0 \text{ for } |x| > a$$

What width of the barrier result in 10% transmission? Graphically show the variation of Transmission (T%) versus particle's energy (E) curve for a 'step barrier' and a 'rectangular barrier'. [2+2+2]

3. A photon flux with an intensity of $I_v = 0.10$ W/m^2 is incident on the surface of Si (band gap 1.1 eV). The wavelength of the incident photon is 1 μm. Neglecting any reflection from the surface, determine the photon flux density at depth of $x = 5$ μm from the surface. [2]

4. Construct a wave function to describe electrons moving in $+x$ direction at 10^5 m/s and carrying a current density of -1 A/mm^2. [2]

5. Consider a particle of charge q and mass m, in simple harmonic motion along x-axis. A homogeneous electric field $E(t) = E_0 \exp(-t/\tau)$ directed along x-axis is switched on at $t = 0$. If the particle was in the ground state before $t = 0$, find the probability that it will be found in an excited state as $t \to \infty$. [4]

6. What is a resonant tunnelling diode? Plot the I-V characteristics curves for both forward and reverse bias cases. [1+2]