Arab Academy for Science & Technology & Maritime Transport
(AASTMT – Cairo Branch)
College of Engineering & technology
Electronics & Communication Engineering Department

Course : Solid State Electronics
Course Code : EC210

Sheet #10

TextBook
'Principles of Electronic Materials and Devices', Third Edition, S.O. Kasap © McGraw-Hill, 2006

Constants:

$\varepsilon_o = 8.85\times10^{-12}\,\mathrm{Fm^{-1}}$

Charge of electron $(q) = 1.6\times10^{-19}\,\mathrm{C}$

Mass of electron $(m_e) = 9.1\times10^{-31}\,\mathrm{kg}$

Plank's Constant $(h) = 6.63\times10^{-34}\,\mathrm{Js}$

Solve the following problems

[1] Consider an electron in a hydrogen atom, the attractive force between the electron and the nucleus is given as:

$$F(r) = \frac{Ze^2}{4\pi\varepsilon_o r^2}$$

a. Derive an expression for the electron potential energy.
b. Plot the potential energy of interaction between the nucleus (at the origin) and the electron versus the distance r between them.
c. For two hydrogen atoms with inter-atomic separation given by r=0.074nm, plot the electron potential energy interaction.
d. If an electron makes a transition from the n = 4 to the n = 1 Bohr orbital in a hydrogen atom, determine the wavelength of the light emitted.

[2] If an electron makes a transition from the *n* = 4 to the *n* = 1 Bohr orbital in a hydrogen atom, determine the wavelength of the light emitted.

[3] A photon incident on a hydrogen atom causes the electron to make a transition from the n = 1 orbital to the n = 3 orbital. What is the wavelength of the photon, and what are the possible wavelengths of the emitted radiation when the electron returns to the n = 1 state?

[4] Write Schrodinger Equation if:
a. An electron with energy of 3eV is incident on a semi-infinite rectangular potential barrier of height 2eV
b. An electron with energy of 1eV is incident on a semi-inifnite rectangular potential barrier of height 2eV.