JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST-1 EXAMINATION -SEPTEMBER 2018

Ph.D 1st Semester (PMS)

COURSE CODE: 18P1WPH111   MAX. MARKS: 15

COURSE NAME: COMPOUND SEMICONDUCTORS

COURSE CREDITS: 03   MAX. TIME: 1 Hr

Note: All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means.

Que 1 (a) what is difference between boundary condition and periodic boundary condition for an electron in periodic potential?

(b) Explain the formation of energy band gap in periodic potential using probability density. Also, plot the Variation of potential energy of a conduction electron in the field of the ion cores of a linear lattice.   **[1+2=3]**

Que 2 (a) n number of electrons and m number of protons are trapped in finite potential well of depth V_0. Write the full Hamiltonian and Schrödinger equation for this system. (Please ignore the spin of particles).

(b) If, n=2 and m=0, consider the spin of electron as ±1/2, construct the Hamiltonian for this system. On the basis of constructed Hamiltonian explain the formation of magnetic domains and Heisenberg exchange interaction.   **[3+3=6]**

Que 3. Design/suggest some physical method for calculating ground state energy of above said system.   **[3]**

Que 4. Instead of periodic potential in real crystal suppose you have amorphous solid, Chalcogenide glass or heavily doped crystal in which lattice potential distribution is random as shown in figure below. How the solution of K-P model varies for this system. Also give your insight into Metal to Insulator transition, pinning of Fermi energy for this type of systems.   **[3]**

$V(y) = $ random in strength & width.