Roll No. | | | | | | | | | | | | | Total No. of Pages : 02

Total No. of Questions : 09

B.Tech. (Only for ECE) (2018 Batch) (Sem.–1)

SEMI-CONDUCTOR AND OPTOELECTRONICS PHYSICS

Subject Code : BTPH-105-18

Paper ID : [75363]

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION - B & C. have FOUR questions each.
3. Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.
4. Select atleast TWO questions from SECTION - B & C.

SECTION-A

Q1 Explain why? Limit your answer to 25-30 words.

a) Effective mass can be negative.

b) Fermi level is a natural reference point in calculation of carrier concentration in semiconductors.

c) The number of free electrons and holes in an intrinsic semiconductor is the same.

d) Hall measurement is not useful for metals.

e) Extent of splitting of 1s energy level is smaller than that of 2s.

f) Most luminescent mechanisms are considered 'cold processes'.

g) No net current can flow across the junction at equilibrium.

h) Photodiodes are usually operated in the third quadrant of its I-V characteristic.

i) Four probe method is more appropriate for measurement of resistivity of a semiconductor than the two-probe method.

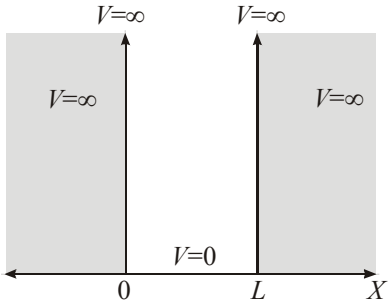
j) Free electrons in a metal cannot escape from the metal.

SECTION-B

Q2 Consider a proton in a one-dimensional infinite potential well as shown in the figure.

a) Solve the Schrodinger's equation and derive an expression for the allowed energy states of the proton.

b) Calculate the energy difference (in units of eV) between the lowest possible energy and the next higher energy state for L = 4 Å . (6 + 2)



Q3 a) State the assumptions of free electron theory and compare its merits and demerits.

b) Plot and explain the temperature dependence of conductivity in a doped semiconductor. (4 + 4)

Q4 Graphically represent the band diagram, density of states, Fermi-Dirac distribution and the carrier concentration for the intrinsic and p-type semiconductors at thermal equilibrium. Highlight the main two differences. (8)

Q5 a) Calculate for silver the energy at which the probability that a conduction electron state will be occupied is 90%. Assume E_F = 5.52 eV for silver and temperature T = 800 K.

b) State Bloch theorem. Explain its significance in the physics of semiconductors. (4 + 4)

SECTION-C

Q6 a) Explain how the population inversion is achieved in a semiconductor-based LASER.

b) Draw the V-l characteristic curve of a typical diode. What information can you get from this curve? (4 + 4)

Q7 Describe the working principle of photo-detectors. How are PIN and avalanche photo-detectors are different from each other? (4 + 4)

Q8 Describe the Hall effect with schematic diagrams. Derive expressions for Hall coefficient and resistivity of a doped semiconductor. (8)

Q9 a) Explain the role of direct and indirect recombination processes in designing a light emitting device.

b) Draw a labelled fourth quadrant portion of a solar cell characteristic. What is fill factor for a solar cell? (4 + 4)