Exam.Code:0009
Sub. Code: 0731

2012
B.A./B.Sc. (Hons.) Fifth Semester
Physics
Paper – V: Physics of Semiconductors

Time allowed: 3 Hours

Max. Marks: 44

NOTE: *Attempt five questions in all, including Question No.7 (Unit-III) which is compulsory and selecting two questions each from Unit I- II. Use of non-programmable calculator is allowed.*

x-x-x

UNIT –I

1. (a) For a bcc lattice of identical atoms with a lattice constant of 5 Å, calculate the maximum packing fraction and the radius of the atoms treated as hard spheres with the nearest neighbors touching. **(4)**

   (b) Discuss the Lattice-Matching technique in Epitaxial Growth of an oriented single-crystal layer on a substrate wafer. **(5)**

2. (a) What is the difference between density of states and effective density of states? Why is the latter such a useful concept? **(2)**

   (b) Does mobility have any meaning at very high field? Explain **(2)**

   (c) How do you measure mobility and carrier concentration? **(2)**

   (d) The intrinsic resistivity of *Ge* at 300 K is 47 Ω. What is the intrinsic concentration when electron and hole mobilities in *Ge* at 200K are 3900 cm^2/volt sec and 1900 cm^2/volt sec respectively? **(3)**

3. (a) A 100 mW laser beam with wavelength λ = 6328 A is focused onto a GaAs sample that is 0.5 μm thick. The absorption coefficient at this wavelength is 3×10^4 cm^{-1}, the bandgap is E_g = 1.42 eV at 300 K, and $m^*_e = 0.067\ m_o$.

   i) Find the number of photons emitted per second by radiative recombination in the GaAs, assuming perfect quantum efficiency.

   ii) What is the power delivered to the sample as heat? **(6)**

   (b) Discuss the phenomenon of Optical absorption and photo luminescence **(3)**

UNIT-II

4.(a) A Zener diode is marked to have its breakdown at 12 Volt, with maximum power dissipation of 480 m Watt. How much current it can handle? **(5)**

P.T.O.

(b) Fermi level of an intrinsic semiconductor lies near the middle of forbidden gap but for the n-type semiconductor it lies near the conduction band. Explain? **(4)**

5. (a) Explain the two basic types of capacitance associated with p-n junction **(4)**

(b) Explain the working mechanism of a PN junction under the effect of

(i) Forward bias (ii) Reverse bias and discuss its I-V characteristics. **(5)**

6. (a) Explain the Typical Schottky Barriers and discuss and plot the Fermi level pinning by the interface states in Compound semiconductors : (a) n-type GaAs (b) n-type InAs **(5)**

(b) Explain what is the need of doping a pure semiconductor? Name the various types for an n-type and p-type impurities. **(4)**

UNIT - III

7. Attempt any eight of the following:-

a) What is junction capacitance? How it varies with bias?

b) How does a semiconductor behave at 0 K ?

c) How will you define Doping and Dopant?

d) Distinguish between a lattice and a crystal? How many different 1-D lattices can you have?

e) Define heterojunction.

f) In general how many components of conduction current can you have in a semiconductor device? What are they?

g) What is an example of a deep trap in Si?

h) Do absorption coefficients of photons increase or decrease with photon energy? Why?

i) Which are mostly commonly used semiconductors and why?

(8×1=8)

x-x-x