3003

B. Tech. 1st Semester (CSE) Examination – March, 2021

SEMICONDUCTOR PHYSICS

Paper : BSC-PHY-103-G

Time : Three Hours]　　　　　　　[Maximum Marks : 75

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Attempt *five* questions in all, selecting *one* question from each Unit. Question No. **1** is *compulsory*. All questions carry equal marks.

1. Attempt any *six* parts :　　　　　　2.5 × 6 = 15

   (i) What are main drawbacks of classical free electron theory ?

   (ii) When does an intrinsic s/c behave as an insulator ? Explain giving examples of intrinsic s/c.

   (iii) What is meant by density of states in metals ?

   (iv) Define stimulated and spontaneous emission.

(v) Why is Schottky junction diode preferred over Pn junction diode for high frequency device application ?

(vi) What is the significance of Fermi energy level ? Under what condition Fermi-Dirac distribution function changes to Boltzmann distribution ?

(vii) What is band gap theory ?

(viii) What is meant by latch-up in a CMOS structure ?

UNIT – I

2. (a) What is density of states function ? Derive expression for density of states. 5

(b) Consider a P-type silicon at 300 K doped with boron. Assume that the limit of the Boltzmann approximation occurs when $E_f - E_a = 3KT$. Determine the Fermi level position and the maximum doping at which the Boltzmann approximation is still valid. 5

(c) What is expression for probability of function of electrons and holes in the donor and acceptor states ? Discuss complete ionization and freeze out condition for suitable band-energy diagrams. 5

3. (a) Discuss the Kronig-Penny model for the motion of an e^- in a periodic potential. 8

(b) What is Fermi level ? Derive an expression for the Fermi-energy in terms of the number of electrons per unit volume. 7

UNIT – II

4. (a) Discuss the drift and diffusion phenomenon in semiconductor, which is more often present in semiconductor devices ? 6

(b) Explain how the resistivity of intrinsic semiconductor varies with temperature. 6

(c) What is Fermi-Dirac distribution function ? 3

5. (a) Explain Schottky Effect. Show that actual Schottky barrier height proportionately related to position of maximum barrier height due to Schottky effect.

10

(b) Design an ohmic contact for n-type Ga As using In As. With an intervening graded in In Ga As region. 5

UNIT – III

6. (a) What is Drude Model ? 9

(b) Define and explain optical loss and gain. 6

7. (a) How optical transitions takes place in Bulk Semiconductors ? 6

(b) Define spontaneous emission and absorption in detail. Why population inversion is necessary for stimulated emission ? 9

UNIT – IV

8. (a) Write the concept of band gap by UV–VIS spectroscopy. 9

   (b) Write parameter extraction from diode IV characteristics. 6

9. Write and explain design fabrication and characterization techniques for quantum wells, wires and dots. 15

———————