

Roll No.

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 P_n 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
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