

Bihar Engineering University, Patna
B.Tech 1st Semester Exam-2022

Course: B.Tech.

Code: 105101

Subject: Physics (Semiconductor Physics and Introduction to Quantum Mechanics)

Time: 03 Hours

Full Marks: 70

Instructions:-

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory

Q.1 Choose the correct answer of the following (any seven):

[2 x 7 = 14]

- (a) When silicon is doped with _____ an n-type semiconductor is formed.
 - I. Boron
 - II. Aluminium
 - III. Phosphorous
 - IV. Indium
- (b) _____ is a PN Junction. Which is forward biased?
 - I. Light Emitting diode
 - II. Zener diode
 - III. Rectifier
 - IV. Transistor
- (c) The band gap is called _____, if the crystal momentum of electrons and holes is the same in both the conduction band and the valence band; an electron can directly emit a photon.
 - I. Direct
 - II. Indirect
 - III. Crystalline
 - IV. Noncrystalline
- (d) The Fermi level in a P-semiconductor lies close to
 - I. The top of the conduction band
 - II. The top of the valence band
 - III. The bottom of the valence band
 - IV. The bottom of the conduction band
- (e) The Semiconductor material not used in LED is:
 - I. Silicon Carbide
 - II. GaAsP
 - III. GaAs
 - IV. Si
- (f) What is the typical range of the forward voltage of an LED?
 - I. 5-12 v
 - II. 1.7-3.3 v
 - III. 5-12 mv
 - IV. 1.7-3.3 mv
- (g) The PIN diode has a _____ intrinsic semiconductor layer separating P and N regions
 - I. Short
 - II. Wide
 - III. Both (i) and (ii)
 - IV. None of the above
- (h) Which of the following is a characteristic of semiconductor Lasers?
 - I. Output in visible region
 - II. High Efficiency
 - III. Output in UV region
 - IV. Pulsed Output

- Q.1 _____ is the state at which the probability of electron occupation is $\frac{1}{2}$ at any temperature above 0 K.
- Valence level
 - Fermi level
 - Conduction level
 - Density of states

- Q.2 The random motion of holes and free electrons due to thermal agitation is called _____.
- Diffusion
 - Pressure
 - Ionisation
 - None of the above

- Q.2 (a) What is PN Junction? Explain the biasing concept in PN Junction. [7]
 (b) Write a note on I-V characteristics of Silicon and Germanium diode. [7]

- Q.3 (a) What is density of states? Derive an expression for density of states for a semiconducting material. [7]
 (b) Explain Fermi Level. The Fermi level for potassium is 1.9 eV. Calculate the velocity of the electron at the Fermi level. [7]

- Q.4 (a) What are the salient features of free electron theory? Derive an expression for electrical conductivity in a metal? [7]
 (b) Derive an expression for effective mass of an electron. [7]

- Q.5 Discuss laser dynamics, relaxation oscillations and input-output characteristics of lasers. [14]

- Q.6 (a) What are the types of Semiconductor Photodetectors? Explain in details. [7]
 (b) Draw the structure of PIN diode and explain its working. [7]

- Q.7 (a) What do you mean by Wave function and how is it related to the probability density? [7]
 (b) Derive one-dimensional time-independent Schrodinger wave equation. [7]

- Q.8 (a) What is Compton effect? Derive the Compton shift for a photon? [7]
 (b) Calculate Compton shift if x-rays of wavelength 1.0 \AA are scattered from a carbon block. The scattered radiation is viewed at 90° to the incident beam. [7]

- Q.9 (a) Write short notes on any two of the following: [7x2]
 (i) Direct and Indirect Bandgaps
 (ii) LED
 (iii) LASER Dynamics
 (iv) Wave particle duality