

00 JUL 2022

**Roll No.**

**Total No. of Pages : 02**

**Total No. of Questions : 18**

**B.Tech. (Artificial Intelligence & Machine Learning/Artificial Intelligence (AI) and Data Science/Artificial Intelligence/Computer Science & Engineering/Computer Science & Engineering) (Artificial Intelligence & Machine Learning/Computer Science & Engineering (Cyber Security)/Computer Science & Engineering (Data Science)/Computer Science & Engineering) (IOT)/(Data Science)/Information Technology/Mechanical Engineering/CSE (Internet of Things and Cyber Security including Block Chain Technology)/B.Tech. (Computer Engg./CSE) (PIT) (Sem.-1,2)**

## SEMI-CONDUCTOR PHYSICS

**Subject Code : BTPH-104-18**

**M.Code : 75360**

Date of Examination : 08-07-22

**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

**Write briefly :**

- 1) Explain the difference between quantum mechanics and classical mechanics.
  - 2) Give the physical significance of wave function. What does the square of wave function signify?
  - 3) Define Weidemann-Franz law.
  - 4) What is E-K diagram and what do you infer from them?
  - 5) Name three semiconductors along with the value of band gaps.
  - 6) Write short notes on intrinsic and extrinsic semiconductors.
  - 7) State some Column II impurities.
  - 8) Explain the process of formation of electron-hole pairs.
  - 9) What are the three distinct processes by which a transition can take place?
  - 10) What are the necessary conditions for the lasing action to take place?
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## SECTION-B

- 11) Explain the quantum theory of free electrons in metals. Derive an expression for the Fermi-energy at absolute zero.
- 12) Discuss Kronig-Penney model. Using the model show the energy spectrum of electron consisting of a number of allowed energy bands separated by forbidden bands.
- 13) a) Write a short note on Zener diode. Explain how the Zener diode maintains a constant voltage across the load.  
b) For a Si semiconductor with a band gap of 1.12 eV, determine the, position of the Fermi level at 300 K if  $m_n^* = 0.12m_e$  and  $m_p^* = 0.28m_e$ .
- 14) a) Derive an expression for the carrier concentration in an extrinsic semiconductor. What would be the position of the Fermi level? Explain.  
b) Consider the Fermi 0.3 eV below the conduction band at room temperature ( $= 27^\circ\text{C}$ ) in an n-type semiconductor. If the temperature is raised to  $57^\circ\text{C}$ , what would be the new position of the Fermi level?

## SECTION-C

- 15) Explain the characteristics of laser beams. What are the necessary conditions for Lasing action?
- 16) What do you mean by spontaneous emission? Discuss Einstein's coefficients. Derive the relation between them.
- 17) Explain the concept of directionality and monochromaticity as applied to lasers.
- 18) a) What is the divergence of Laser? Write the principle and procedure of calculating the divergence of the laser.  
b) Calculate the divergence of a laser beam at distances of 1 and 10 m from the laser spot and whose diameters are 2 and 4 mm, respectively.

**NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.**