

Roll No.

Total No. of Pages : 02

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**B.Tech. (AI & ML/CSE/DS/IT/Internet of Things and Cyber Security  
including Block Chain Technology) (Sem.-1,2)**

**SEMI-CONDUCTOR PHYSICS**

Subject Code : BTPH-104-18

M.Code : 75360

Date of Examination:23-12-2024

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**

**1. Write briefly:**

- a) Why are electrons in metals often considered to have free-electron behavior?
- b) Out of direct and indirect band gap materials, which is used to fabricate LED and why?
- c) In a solid, consider the energy level lying 0.01 eV above Fermi level. What is the probability of this level being occupied by an electron at 200 K?
- d) How does doping affect the electrical properties of an intrinsic semiconductor?
- e) Describe the depletion region in a p-n junction.
- f) Explain the term "population inversion" and its importance in lasers.
- g) What is optical loss, and how does it impact the performance of optoelectronic devices?
- h) What is the difference between spontaneous and stimulated emission in semiconductors?

- i) What are the necessary conditions for applying Van der Pauw method?
- j) Can we determine the type of extrinsic semiconductor (n-type or p-type), using hot-point probe?

### SECTION-B

- 2. What are the special features of Classical free electron theory of metals? Derive an expression for the electrical conductivity of a metal.
- 3. What is Kronig-Penny model? Solve Schrödinger wave equation for periodic potential and explain the origin of energy bands in solids.
- 4. Obtain the expression for electron density in n-type extrinsic semiconductor.
- 5. What is the need of extrinsic semiconductors? Discuss the effect of temperature on the Fermi level in extrinsic semiconductors.

### SECTION-C

- 6. What is Fermi's golden rule? Derive the expression for joint density of states.
- 7. Define the Einstein coefficients for spontaneous and stimulated emission and absorption. Derive the relationships among these coefficients and explain their importance.
- 8. Define beam spot and divergence for laser beam. Explain the procedure to measure the divergence of laser beam.
- 9. What is Four-point probe method? How four probe is better than two probe method? Explain the measurement of resistivity using it.

**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.**