

Roll No.

Total No. of Pages : 02

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**B.Tech. (ECE/CSE) (Sem.-1,2)**  
**SEMI-CONDUCTOR AND OPTOELECTRONICS PHYSICS**

Subject Code : BTPH-105-18

M.Code : 75363

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) Define Density of state.
- b) Out of direct and indirect band gap materials, which are used for the production of light?
- c) At what temperature we can expect a 5% probability that electrons in silver have an energy which is 1% above the Fermi energy? The Fermi energy of silver is 4.0 eV.
- d) Write a note on metal-semiconductor junctions.
- e) Highlight the importance of extrinsic semiconductor.
- f) Calculate the wavelength of light emitted from LED made using semiconductor material with band gap 1 eV.
- g) Discuss radiative recombination mechanism.
- h) A 10 mW laser has a beam diameter of 3.2 mm. What is the intensity of the light assuming that it is uniform across the beam?

- i) What information can be obtained from capacitance-voltage measurement?
- j) What are the necessary conditions for applying Van der Pauw method?

### SECTION-B

- 2. Explain the classical free electron theory of metals. Discuss its assumptions, successes, and limitations in explaining the electrical conductivity of metals.
- 3. What is Kronig-penny model? Solve Schrödinger wave equation for periodic potential and explain the origin of energy bands in solids.
- 4. Explain the working of a p-n junction. Discuss the formation of the depletion region, built-in potential and the effect of forward and reverse bias on the junction.
- 5. Obtain the expression for electron density in an intrinsic semiconductor. Estimate the fraction of electron in conduction band at room temperature in Ge with band gap 1.0 eV.

### SECTION-C

- 6. What is a photo-detector? Explain the principle, construction and working of an Avalanche photodiode. Discuss its advantages.
- 7. What is stimulated absorption, Spontaneous emission and Stimulated emission? Obtain the relation between different Einstein's coefficients and discuss the result.
- 8. Explain any method to measure the wavelength of laser light. Can the same method be used for measuring wavelength of white light?
- 9. a) What is Four-point probe method? Explain the measurement of resistivity using it.  
b) The resistivity of an intrinsic semiconductor is  $5.5 \Omega\text{m}$  at  $30^\circ\text{C}$  and  $3.0 \Omega\text{m}$  at  $42^\circ\text{C}$ . Find the band gap.

**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.**