

MANMOHAN TECHNICAL UNIVERSITY
OFFICE OF THE CONTROLLER OF EXAMINATIONS
MODEL QUESTION, 2080 Asar

Level: Bachelor
Faculty: School of Engineering
Program: Electrical & Electronics
Subject: ELECTRICAL ENGINEERING MATERIAL (EG457EE)

Year/Part: I/II
F.M.: 50
P.M.: 20
Time: 3 Hours

Group A [10 × 1 = 10]

Instructions:

- Choose one answer out of four options.
 - Use black ball pen for shading only one circle for correct option of a question in Answer Sheet which you have provided.
 - No mark will be awarded for cutting, erasing, over writing and multiple circles shading
1. Superconductivity is a material property associated with
 - a. cooling with phase change
 - b. frictionless liquid flow
 - c. a loss of thermal resistance
 - d. a loss of electrical resistance
 2. The forbidden energy gap in semiconductors
 - a. lies just below the valence band
 - b. is the same as the valence band
 - c. lies just above the conduction band
 - d. lies between the valence band and the conduction band
 3. The conduction band of a semi-conductor material may be
 - a. completely filled
 - b. partially filled
 - c. empty
 - d. none
 4. The unit of mobility of charge carriers is
 - a. $\text{m}^2/\text{volt-sec}$
 - b. $\text{m}/\text{volt-sec}^2$
 - c. $\text{m}^3/\text{volt-sec}$
 - d. $\text{m}/\text{volt-sec}$
 5. A semi conductor is electrically neutral because it has
 - a. no majority carriers
 - b. no minority carriers
 - c. no free carriers
 - d. equal number of positive and negative carriers
 6. Which of the following atoms can be used as a p-type impurity?
 - a. Boron
 - b. Arsenic
 - c. Antimony
 - d. Phosphorus
 7. Due to the illumination of light, the electron and hole concentrations in a heavily doped n-type semiconductor increase by Δn and Δp respectively. If n_i is the intrinsic concentration then
 - a. $\Delta n < \Delta p$
 - b. $\Delta n > \Delta p$
 - c. $\Delta n = \Delta p$
 - d. $\Delta n \times \Delta p = n_i^2$
 8. The current density J_o of electrons through any conductor carrying current is given by
 - a. $J_o = \frac{ne\tau E}{m}$
 - b. $J_o = \frac{ne\tau E^2}{m}$
 - c. $J_o = \frac{ne^2\tau E}{m}$
 - d. $J_o = \frac{e^2\tau E}{m}$
 9. The potential barrier at a p-n junction is established due to the charge on either side of the junction. These charges are

- a. majority carriers b. minority carriers c. both a and b d. donor and acceptor ions
10. In a crystal diode, the barrier potential offers opposition to
- a. free electrons in n-region b. holes in p-region
- c. majority carriers in both regions d. minority carriers in both regions

Group B

Attempt any EIGHT questions [(8 × 2 = 16)]

11. Explain Fermi Energy with diagram.
12. Explain the wave particle duality..
13. Explain Dielectric breakdown of a semi-conductor.
14. What is diffusion? State the expression for diffusion current in a semi-conductor.
15. Define drift velocity and mobility of an electron.
16. What is the significance of doping in a semi-conductor ?
17. Explain the working of p-n junction.
18. Explain the De Broglie's equation.
19. Explain conductors, insulators and semi-conductors in terms of energy band.

Group C

Attempt any SIX questions [6 × 4 = 24]

20. Derive an expansion for the concentration of holes in the valence band of an intrinsic semi-conductor.
21. Discuss the photolithography process in detail.
22. Derive the continuity equation for carriers.
23. Prove that the energy of a particle confined in an infinite potential well is quantized. Also find the expression for normalized wave function.
24. Explain how does the temperature affect the formation of carrier concentration in semi-conductor.
25. Explain the working of BJT band on energy diagram.
26. What is effective mass? Show that the effective mass of a free electron is equal to the mass of the electron in vacuum.
