2025

(CBCS)

(5th Semester)

ELECTRONICS

EIGHTH (B) PAPER

(Solid State Electronics)

Full Marks : 75

Time : 3 hours

The figures in the margin indicate full marks for the questions

Simple calculator may be used in this paper

(SECTION : A—OBJECTIVE)

(*Marks* : 10)

Tick (✓) the correct answer in the brackets provided : 1×10=10

1. Semiconductor materials have _____ bonds.

(a) ionic ( )

(b) covalent ( )

(c) mutual ( )

(d) metallic ( )

2. The periodic arrangement of atoms in a crystal is called

(a) unit cell ( )

(b) lattice ( )

(c) primitive cell ( )

(d) grains ( )

3. Silicon and germanium are called _____ semiconductors.

(a) direct gap ( )

(b) indirect gap ( )

(c) band gap ( )

(d) indirect band gap ( )

4. The area within a semiconductor diode where no mobile current carrier exists when it is formed is called _____ region.

(a) saturation ( )

(b) depletion ( )

(c) potential barrier ( )

(d) space charge ( )

5. Which of the following diodes uses a metal-semiconductor junction?

(a) General purpose diode ( )

(b) Fast recovery diode ( )

(c) Schottky diode ( )

(d) Shockley diode ( )

6. In which region is the temporal response of an MOS capacitor the slowest?

(a) Accumulation ( )

(b) Flat band ( )

(c) Depletion ( )

(d) Inversion ( )

7. The minimum value of current required to maintain conduction in SCR/thyristor is called its _____ current.

(a) commutation ( )

(b) holding ( )

(c) gate trigger ( )

(d) breakover ( )

8. Tunnel diode in comparison to conventional diode, in terms of doping, is

(a) heavily doped ( )

(b) lightly doped ( )

(c) moderately doped ( )

(d) No doping ( )

9. The foundation on which an IC is built is called

(a) insulator ( )

(b) base ( )

(c) wafer ( )

(d) plate ( )

10. The first IC chip was developed by

(a) J. S. Kilby ( )

(b) C. V. Raman ( )

(c) W. H. Brattain ( )

(d) Robert Noyce ( )

(SECTION : B—SHORT ANSWERS)

(*Marks* : 15)

Answer the following : 3×5=15

UNIT—I

1. Define semiconductor. List the types of semiconductor with examples.

OR

2. Briefly explain the crystal properties of semiconductor.

UNIT—II

3. What is meant by complete ionization? Write the equation for charge neutrality for the condition of complete ionization.

OR

4. Explain Fermi energy level.

UNIT—III

5. Briefly explain the possible types of metal-semiconductor contact.

OR

6. Explain *C-V* curve for MOS capacitor at low frequency.

UNIT—IV

7. Write a short note on a tunnel diode.

OR

8. Write a short note on an IMPATT diode.

UNIT—V

9. Explain the classification of IC based on structure and function.

OR

10. Write a short note on linear IC and its advantages.

(SECTION : C—DESCRIPTIVE)

(*Marks* : 50)

Answer the following : 10×5=50

UNIT—I

1. *(a)* Sketch lattice structure and determine the number of atoms per unit cell in *(i)* face-centered cubic and *(ii)* body-centered cubic. 5

(b) Explain the different types of bonding forces in solids. Discuss the nature of each bond, with example of material where each type predominates. 5

OR

2. *(a)* Describe energy bands and using energy band diagram, explain metal, semiconductor and insulator. 6

(b) Discuss the variation energy bands with alloy composition. 4

UNIT—II

3. *(a)* Explain majority and minority charge carriers. Describe the hole formation and its movement. 4

(b) Explain high field effect in semiconductor and relate it to device operation.

3+1=4

(c) Explain why Fermi level must be constant across a device in equilibrium. 2

OR

4. *(a)* Describe intrinsic and extrinsic semiconductor. Explain how intrinsic carrier concentration in a semiconductor depends on temperature. 5

(b) Explain the drift of carriers under the influence of an electric field. Derive current density expression $\vec{J} \quad qn \ \vec{E}$. 2+3=5

UNIT—III

5. Construct the equilibrium energy band diagram appropriate for an ideal *p*-type semiconductor to metal where $_M$ $_S$. Verify that an ideal MS contact formed from a metal and a *p*-type semiconductor will be rectifying if $_M$ $_S$ and ohmic-like if $_M$ $_S$. 5+5=10

OR

6. Construct energy band diagram for MOS capacitor corresponding to *(i)* accumulation, *(ii)* weak inversion, *(iii)* depletion and *(iv)* strong inversion. (Use *p*-type semiconductor). 10

UNIT—IV

7. What are breakdown devices? Explain the construction and working of SCR. 2+8=10

OR

8. Describe the construction and working of BARITT diode. 10

UNIT—V

9. Discuss integrated circuits based on MOS and bipolar technology. 10

OR

10. How many levels of integration are there in integrated circuits? Differentiate between positive photoresist and negative photoresist. 6+4=10

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