

AMIETE – ET (OLD SCHEME)

Code: AE25

Subject: PHYSICAL ELECTRONICS AND SOLID STATE DEVICES

Time: 3 Hours

Max. Marks: 100

DECEMBER 2009**NOTE: There are 9 Questions in all.**

- Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.
- Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.
- Any required data not explicitly given, may be suitably assumed and stated.

Q.1 Choose the correct or the best alternative in the following: (2×10)

a. With the increase in the temperature of the intrinsic semiconductor

- (A) energy of the atom increases
- (B) holes are generated in the conduction band
- (C) resistance of the semiconductor increases
- (D) atomic radius decreases.

b. The Fermi-Dirac statistics is based on

- (A) electron and photons
- (B) photons and protons
- (C) electrons and holes
- (D) gas molecules

c. The energy required to dislodge electrons from n type Si is

- (A) 0.05 eV
- (B) 0.5 eV
- (C) 5.0 eV
- (D) 50.0 eV

d. The reverse saturation current I_{CO} of Si diode varies as

- (A) T^2
- (B) T^3
- (C) $T^{1/2}$
- (D) $T^{3/2}$

e. A Schottky diode has

- (A) a large voltage drop than that of an ordinary diode .
- (B) good ohmic resistance
- (C) a negligible storage time.
- (D) due to minority charge carriers.

f. In a MOSFET, the threshold voltage can be lowered by

- (A) increasing the gate oxide thickness
- (B) reducing the substrate concentration
- (C) increasing the substrate concentration

- (D) using the dielectric of lower constant
- g. The efficiency of an LED for generating light is directly proportional to the
- (A) temperature (B) voltage applied
(C) level of doping used (D) current injected
- h. The fill factor for the solar cells is approximately
- (A) 0.2 (B) 0.1
(C) 0.7 (D) 1.0
- i. The Hall coefficient for a particular material was found to be zero. The material is
- (A) metal (B) intrinsic semiconductor
(C) insulator (D) extrinsic semiconductor
- j. Varactor diode has variable
- (A) Resistance (B) Capacitance
(C) Inductance (D) None of above

Answer any FIVE Questions out of EIGHT Questions.

Each question carries 16 marks.

- Q.2** a. How does the conductivity or resistivity of the semiconductor materials vary with temperature? Do metals also exhibit the same behaviour? (8)
- b. Differentiate between direct band gap and indirect band gap semiconductors with examples. (8)
- Q.3** a. A silicon semiconductor has the intrinsic carrier concentration of 10^{16} m^{-3} and donor density 10^{20} m^{-3} . Extra carriers are produced in the semiconductor by the process of injection. If the extra carrier density at a point is equal to 10^{18} m^{-3} , determine the ratio of hole concentration to electron concentration at that point. Also estimate the percentage increase in p and n resulting from injection? (8)
- b. Explain Hall effect and discuss its application for semiconductor. (8)
- Q.4** a. How rectifying contacts differ from ohmic contacts. Explain with examples. (8)
- b. A Zener diode has $N_D = 10^{20} \text{ m}^{-3}$ and $N_A = 10^{23} \text{ m}^{-3}$. Avalanche breakdown occurs in the diode when the electric field reaches 10^7 Vm^{-1} . Calculate the breakdown voltage. Assume $(\epsilon = \epsilon_r \epsilon_0)$ to be 10^{-10} Fm^{-1} . (8)
- Q.5** a. Explain following terms for Bipolar transistors. (8)
- (i) Emitter injection \uparrow (ii) Current crowding
(iii) Kirk effect (iv) Base transport factor
- b. Discuss briefly switching action in BJT. (8)
- Q.6** a. Explain subthreshold operation of MOSFET and draw its characteristics. (8)

- b. Discuss briefly various short channel effect present in small geometry MOS devices (8)
- Q.7** a. What are the limiting conditions of a solar cell? Explain measures to improve the efficiencies of solar cells. (8)
- b. Explain the working of Gunn diode and write its applications. (8)
- Q.8** a. Discuss with the help of figures, wafer preparation. How it differs from crystal growth? (8)
- b. Explain Hybrid circuits. How these are different from monolithic circuits? (8)
- Q.9** Write short notes (Any **FOUR**) (4×4)
- (i) Band to band tunneling (ii) Semiconductor Lasers
(iii) CMOS Latch up (iv) Photodetectors
(v) Heterojunctions (vi) Charge transfer Device