B.Sc. Semester-II Examination, 2022-23

ELECTRONICS [Honours]

Course ID : 21711 Course Code : SH/ELC/201/C-3(T3)

Course Title : Semiconductor Devices

Time : 1 Hour 15 Minutes Full Marks : 25

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

1. Answer any **three** of the following: 1×3=3

   a) Name two factors on which electrical conductivity of a pure semiconductor depends?

   b) What is an extrinsic semiconductor?

   c) What is depletion region of a pn-junction?

   d) Doping of indium with silicon leads to which type of semiconductor?

   e) Why collector of a transistor is made larger than emitter and base?

   f) Write down the relation between mobility and Hall co-efficient.

2. Answer any **three** of the following: 2×3=6

   a) What is a BJT? Why is it called so?

   b) In a transistor, doping level in base is increased slightly. How will it affect (i) collector current and (ii) base current?

   c) A semiconductor has equal electron and hole concentration of $6\times10^{8}m^{-3}$. On doping with certain impurity, electron concentration increases to $8\times10^{12}m^{-3}$. Identify the new semiconductor and calculate the new hole concentration.

   d) A germanium diode has a reverse saturation current of $10\mu A$ at $300K$. Find the reverse saturation current at $400K$.

   e) Mention one advantage and one disadvantage of JFET.

   f) Differentiate between intrinsic and extrinsic semiconductor.

3. Answer any **two** of the following: 5×2=10

   a) The built-in potential of a pn-junction diode is 0.7 Volts at room temperature. What will be the approximate value of built-in potential if the doping concentrations on both sides are doubled?

b) Explain physically the mechanism of conduction of drift current and diffusion current through a semiconductor. Write down their mathematical expressions.

c) What are 'Hall effect' and 'Hall field'? Explain briefly the physical origin of the Hall effect. Mention some uses of this effect.

d) Derive the relationship $I_C = \beta I_B + (1+\beta) I_{CO}$ where I_C and I_B are respectively the collector and base currents of a transistor, β is the current gain for CE mode and I_{CO} is the reverse saturation current when the emitter is open circuited and collector junction is reverse biased.

4. Answer any **one** of the following: $6 \times 1 = 6$

a) Derive the current-voltage relationship for a pn-junction diode. Also draw the characteristic curve.

b) Explain with a neat sketch the structure and working of p-channel enhancement-type MOSFET. Draw its typical drain characteristics curves.

c) Describe the different modes of operation of SCR with the help of its static I-V characteristics. Define latching and holding currents as applicable to an SCR and show them on the static I-V curve.

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