2019

B.Sc.

3rd Semester Examination

ELECTRONICS (Honours)

Paper - C 5-T

[Semi-conductor Devices]

Full Marks : 40 Time : 2 Hours

The question are of equal value for any group/half. The figures in the margin indicate full Marks. Candidates are required to give their answers in their own words as far as practiable. Illustrate the answers wherever necessary.

1. **Answer any 05 (five) questions. Each question carries 02 (two) marks.** 5 × 2

i) What do you understand by a compound semi-conductor? Give some examples. 1 + 1

ii) Draw the position of Fermilevel for intrinsic and extrinsic semi conductors. ½ + 1½

iii) What is Hall effect? 2

iv) How does a Zener diode differ from a normal diode? 2

[Turn Over]

v) Why is the emitter region of a transistor more heavily doped than the base region? 2

vi) Define pinch-off voltage of a JFET. 2

vii) What is the gate source threshold voltage of a MOSFET? 2

viii) What is UJT? Give its equivalent circuit. 1 + 1

2. **Answer any 04 (four) questions. Each question carries 05 (five) marks.** 4 × 5

i) How does the free electron concentration increase over the intrinsic value in an n-type semi-conductor? Will the hole concentration remain constant at the intrinsic value? Explain. 2 + 1 + 2

ii) For an intrinsic semiconductor show that the Hall coefficient is given by

$$R_H = -\frac{1}{n_i e}\left(\frac{\mu_n - \mu_p}{\mu_n + \mu_p}\right)$$

where μ_n and μ_p are mobilities of the electrons and holes, and n_i is the intrinsic carrier concentration. 5

iii) What is a depletion-layer capacitance? Establish the expression of depletion-layer capacitance for a linearly graded junction. 1 + 4

iv) How can you find β and α from the CE output characteristics of a transistor?

A transistor having $\alpha = 0.975$ and a reverse saturation current $I_{co}=10\,\mu A$, is operated in CE configuration. If the base current is $250\,\mu A$, calculate the emitter current and the collector current. 2 + (1½+1½)

v) Why is the MOS transistor commercially more important than the JFET? Compare the performances of n-channel and p-channel MOSFETS. 2½ + 2½

vi) Discuss the principle of operation of a triac. Name its uses. 4 + 1

3. **Answer any 01 (one) question. Each question carries 10 (ten) marks.** 1×10

i) a) What is an Early effect? How can it account for the CB input characteristics?

b) Draw the minority carrier concentration profile of a p-n-p transistor and explain. (2+2) +(3+3)

ii) a) Compare between a FET and a BJT. How can you obtain the static characteristics of a JFET? Give the necessary circuit diagram.

[Turn Over]

b) A n-channel silicon JFET has a donor concentration of 2×10^{21} m^{-3} and a channel width of 4 μm. If the dielectric constant of silicon is 12, find the pinch-off voltage. If the FET operates with a gate-source voltage –2V, what is the saturation voltage V_{Dsat}? (2+2+2) + (2+2)
