

Five-Year Integrated M. Sc. Examination 2021-2022

Semester: V

Paper: PH-3-5-2

Subject: Physics (Electronics)

Time: Four Hours

Full Marks: 80

Questions are of value as indicated in the margin

Answer *Question No. 1* and *any three* from the rest

1. Answer any five questions:

5x4 = 20

- (a) Explain the working principle of a light emitting diode.
- (b) Explain with the help of Fermi level diagram why there should be holes as majority carriers in the valence band of a p-type semiconductor.
- (c) Briefly explain the concept of h parameters for transistors.
- (d) For a transistor, $h_{ib} = 50 \Omega$ and $h_{fb} = -0.98$. Determine h_{ie} and h_{fe} approximately.
- (e) Explain Barkhausen criterion and its application using block diagram.
- (f) Draw the circuit diagram of a half adder by using NAND gates only. Explain the diagram with truth table.

2. (a) Explain the concept of space charge (space charge distribution and consequent electric field distribution) at the P-N junction when P-type and N-type semiconductor materials are sandwiched together.

(b) Prove that the product of carrier concentrations is constant for a particular doped semiconductor material at a particular temperature, even if doping is varied.

10+10 = 20

3. (a) Explain the concept of feedback amplifier for positive as well as negative feedback. Show that the closed-loop gain is independent of the open-loop gain when loop-gain $\gg 1$. Discuss advantages and disadvantages of positive and negative feedbacks.

(b) Explain the working principle of a single stage CE voltage amplifier. Also, draw the dc and ac equivalent circuits and determine the ac voltage gain. What are the drawbacks of such voltage amplifier?

(c) Write a brief note on JFET explaining gate-source cut-off voltage, gate leakage current and high input resistance.

$$8+8+4 = 20$$

4. (a) State and explain the basic characteristics of an operational amplifier.

(b) Explain the working principle of a comparator with zero and non-zero trip points.

(c) Explain the working principle of an unclocked RS flip-flop by using (i) NAND and (ii) NOR gates.

$$4+6+10 = 20$$

5. (a) Explain the working principles of a 'depletion type' MOSFET in both depletion and enhancement modes.

(b) Explain the working principle of a digital-to-analog converter.

$$12+8 = 20$$