

Five-Year Integrated M.Sc. Examinations 2023

Semester-V

Course: PH-3-5-2 (2016)

(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 four from the following:

- (a) What do you mean by Fermi level of an intrinsic semiconductor? Explain with diagram.
- (b) Explain junction capacitance of a p-n semiconductor diode.
- (c) Explain the terms 'avalanche breakdown' and 'zener breakdown' in a zener diode.
- (d) Define h parameters of a linear circuit.
- (e) What do you mean by 'virtual ground' of an operational amplifier? Explain.
- (f) Explain zero crossing comparator.

4x5 = 20

2. (a) Derive the expressions for free electron and hole concentrations in intrinsic as well as extrinsic semiconductors at thermal equilibrium.
- (b) Show that the product of carrier concentrations is constant for a particular material at a particular temperature for a semiconductor (with or without doping).
- (c) Explain the concept of space charge (space charge distribution and the consequent electric field distribution) at the p-n junction, when p-type and n-type semiconductor materials are sandwiched together.
- (d) Derive an expression for the contact potential developed in a p-n junction diode.

6+3+6+5

3. (a) Explain the current amplification factor for a transistor in CE mode using circuit diagram.
- (b) Draw and explain the input and output characteristics (qualitatively) of a transistor in CE mode.
- (c) Explain transistor amplifier in CE mode (single-stage).
- (d) What are the advantages of a multi-stage transistor amplifier over single-stage transistor amplifier?
- (e) A transistor used in CE mode has $h_{ie} = 1700$, $h_{re} = 1.3 \times 10^{-4}$, $h_{fe} = 38$ and $h_{oe} = 6 \times 10^{-6}$, where $V_{CE} = 5$ V and $I_C = 1$ mA. If $r_L = 2$ k Ω , find input impedance, current gain and voltage gain.

2+4+6+2+6 = 20

4. (a) Write down the basic characteristics of an operational amplifier.
- (b) Explain the operations of (i) inverting and (ii) non-inverting voltage amplifiers using operational amplifier and obtain expressions for the closed-loop gains in terms of the open-loop gain.
- (c) Draw the circuit diagrams for the construction of AND, OR and NOT gates using any one type of the universal gates.

- (d) With the proper circuit diagram, discuss the principle of operation of a three input binary full adder.

$$3+6+6+5 = 20$$

5. (a) Write a note on JFET explaining gate-source cut-off voltage, gate leakage current and high input resistance.
(b) Explain the principle of operation of an RS flip flop using NAND gates.
(c) Write a brief note on ordinary Schmitt trigger.
(d) Explain the working principle of an analog-to-digital converter.

$$6+4+4+6 = 20$$