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(Pre-CBCS)

(2nd Semester)

ELECTRONICS

SECOND PAPER

(Semiconductor Physics)

(Revised)

Full Marks : 55

Time : 2½ hours

(PART : A—OBJECTIVE)

(Marks : 20)

The figures in the margin indicate full marks for the questions

SECTION—A

(Marks : 5)

Tick (✓) the correct answer in the brackets provided :

1×5=5

1. Diffusion capacitance is observed in a *p-n* junction diode when

- (a) reverse biased ()
- (b) forward biased ()
- (c) leakage current is small ()
- (d) leakage current is large ()

2. The ripple factor of a full-wave rectifier is

- (a) 0.48 () (b) 0.81 ()
(c) 1.21 () (d) 1.11 ()

3. The current amplification factor α_{dc} is given by

- (a) $\frac{I_C}{I_E}$ () (b) $\frac{I_C}{I_B}$ ()
(c) $\frac{I_B}{I_E}$ () (d) $\frac{I_B}{I_C}$ ()

4. The maximum peak-to-peak output voltage swing is obtained when the Q-point of a circuit is located

- (a) near saturation point ()
(b) near cut-off point ()
(c) at the centre of the load line ()
(d) at least on the load line ()

5. The dimension of h_{ie} parameter is

- (a) mho ()
(b) ohm ()
(c) farad ()
(d) Dimensionless ()

SECTION—B

(Marks : 15)

Answer any *five* questions of the following :

3×5=15

1. Give the mechanism of hole current flow in a semiconductor.
2. Compare the differences between an ordinary junction diode and a Zener diode.
3. Write a short note on the leakage currents in a transistor for CB and CE configurations.
4. Write a note on the characteristics of class A and class B amplifiers.

5. What are the advantages and disadvantages of transformer-coupled amplifier?
6. Why do conduction band electrons possess higher energy than those electrons in the valence band?
7. Define β of a transistor. Show that $I_E = (1 + \beta)I_B$.
8. Explain the formation of n -type semiconductor.

(PART : B—DESCRIPTIVE)

(Marks : 35)

The figures in the margin indicate full marks for the questions

1. (a) Classify solids in terms of the energy band diagram. Explain the formation of p -type semiconductor materials. 2+3
- (b) What is the significance of a potential barrier in a diode? 2

OR

- (a) Write down the diode equation. Explain with suitable diagram, the V - I characteristics of a p - n junction diode. 1+3
- (b) What is space-charge capacitance of a p - n junction? What is the typical value of space-charge capacitance? 3
2. (a) Describe briefly the working of a p - n junction full-wave rectifier. Give the expression for efficiency of a full-wave rectifier. 3+1
- (b) Describe briefly the working of a capacitor filter. 3

OR

- (a) What is ripple factor? Derive the value of ripple factor for a half-wave semiconductor diode. 1+3
- (b) Explain how Zener diode maintains constant voltage across the load. 3

3. (a) Define α of a transistor. Show that $\beta = \frac{\alpha}{1-\alpha}$, where the symbols have their usual meanings, in a transistor. 1+3
- (b) Explain the working of a $p-n-p$ transistor. 3

OR

- (a) Explain with diagram the input, output and current transfer characteristics of CE configuration in an $n-p-n$ transistor. 5
- (b) What is thermal runaway? 2
4. (a) Explain in brief, the frequency response curve of an amplifier. What is the resonant frequency? 2+1
- (b) Write down the steps for construction of d.c. load line. Also explain the terms cut-off and saturation point. 2+2

OR

- (a) Describe class A, class B, class C and class AB of amplifiers. Illustrate your answer with suitable diagrams. 5
- (b) Define bandwidth in terms of dB for an amplifier having maximum voltage gain 100. 2
5. (a) Draw a hybrid equivalent circuit of CE transistor. 1
- (b) Deduce an expression for input impedance, current gain and voltage gain in CE transistor. 2+2+2

OR

- (a) The h parameters of a transistor are given to be $h_{fe} = 330$, $h_{ie} = 4500 \Omega$, $h_{re} = 2 \times 10^{-4}$ and $h_{oe} = 2 \times 10^{-4} \text{ mho}$. The transistor is used in a CE amplifier with a load resistance of $5 \text{ k}\Omega$ and a source resistance of $10 \text{ k}\Omega$. Calculate the current gain, voltage gain and input impedance. 5
- (b) Explain the frequency response curve of transformer-coupled amplifier. 2

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