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(CBCS)

(2nd Semester)

ELECTRONICS

SECOND PAPER

(Semiconductor Physics)

Full Marks : 75

Time : 3 hours

(PART : A—OBJECTIVE)

(*Marks* : 25)

The figures in the margin indicate full marks for the questions

SECTION—A

(*Marks* : 10)

Tick (✓) the correct answer in the brackets provided : 1×10=10

1. The leakage current across a *p-n* junction is due to

(a) minority carriers ( )

(b) majority carriers ( )

(c) junction capacitance ( )

(d) impurity ( )

2. In a semiconductor, the energy gap between valence and conduction bands is about

(a) 15 eV ( )

(b) 10 eV ( )

(c) 5 eV ( )

(d) 1 eV ( )

3. The primary function of a filter is to

(a) minimize a.c. input variations ( )

(b) suppress odd harmonics in the rectifier output ( )

(c) stabilize d.c. level of the output voltage ( )

(d) remove ripples from the rectified output ( )

4. An ideal crystal diode is one which behaves as a perfect _____ when forward biased.

(a) conductor ( )

(b) insulator ( )

(c) resistance material ( )

(d) capacitance material ( )

5. Zener diodes are used primarily as

(a) amplifiers ( )

(b) voltage regulators ( )

(c) rectifiers ( )

(d) oscillators ( )

6. The device associated with voltage-controlled capacitance is

(a) LED ( )

(b) photodiode ( )

(c) varactor diode ( )

(d) zener diode ( )

7. In a *p-n-p* transistor, the current carriers are

(a) acceptor ions ( )

(b) donor ions ( )

(c) free electrons ( )

(d) holes ( )

8. The element that has the biggest size in a transistor is

(a) collector ( )

(b) base ( )

(c) emitter ( )

(d) collector-base junction ( )

9. The lower and upper cut-off frequencies of transistor amplifier are also called

(a) sideband frequencies ( )

(b) resonant frequencies ( )

(c) half-resonant frequencies ( )

(d) half-power frequencies ( )

10. The d.c. load line of a transistor circuit

(a) has a negative slope ( )

(b) is a curved line ( )

(c) gives graphic relation between I_C and I_B ( )

(d) does not contain the *Q*-point ( )

SECTION—B

(*Marks* : 15)

Answer the following questions : 3×5=15

1. What do you mean by a hole in a semiconductor? Discuss the formation of hole current.

OR

Explain the capacitive effects of junction capacitance.

2. What are the important electrical properties of a capacitor and an inductor in making a filter circuit?

OR

Compare half-wave and full-wave bridge rectifiers.

3. Explain the working of a Zener diode as peak clipper.

OR

Describe the construction of thermistor.

4. What is thermal runaway? How will you avoid this in a transistor?

OR

A transistor has 0 98, I_B 100 A and I_{CO} 6 A. Calculate I_C and I_E.

5. Explain frequency response curve and bandwidth of an amplifier with necessary diagram.

OR

Explain how a transistor acts as an amplifier.

(PART : B—DESCRIPTIVE)

(*Marks* : 50)

The figures in the margin indicate full marks for the questions

1. *(a)* Discuss the behaviour of a *p-n* junction under forward and reverse biasing. 2+2=4

(b) Explain the salient features of Bohr's atomic model. 4

(c) Which are the most commonly used semiconductors and why? 2

OR

2. *(a)* What is a *p-n* junction? Explain the formation of potential barrier in a *p-n* junction. 1+2=3

(b) What are intrinsic and extrinsic semiconductors? How is *p*-type of extrinsic semiconductors formed? 2+2=4

(c) Give the energy band description of conductors, semiconductors and insulators. 3

3. *(a)* Explain with a diagram, how semiconductor diode can be used as a full-wave rectifier. Show that its maximum efficiency is 81·2%. 2+3=5

(b) What do you understand by d.c. and a.c. resistances of a semiconductor diode? 2

(c) Describe the filtering action of a capacitor filter. 3

OR

4. *(a)* Show that the value of ripple factor for half-wave rectifier is 1·21. 2

(b) Explain approximate equivalent circuit of semiconductor diode. 2

(c) Describe the filtering action of -filter. 3

(d) A full-wave rectifier uses two diodes, the internal resistance of each diode may be assumed constant at 20 . The transformer r.m.s. secondary voltage from centre tap to each end of secondary is 50 V and load resistance is 980 . Find—*(i)* the mean load current and *(ii)* the r.m.s. value of load current. 3

5. *(a)* Explain the operation and characteristics of a photodiode. 2+2=4

(b) Describe the operation and applications of Schottky diode. 3

(c) Explain the working of a tunnel diode oscillator. 3

OR

6. *(a)* Describe the operation and diode resistance of a PIN diode. 3

(b) Explain any three applications of varactor diode. 3

(c) What is tunnelling effect? Explain the *V-I* characteristics of tunnel diode. 1+3=4

7. *(a)* With diagram, discuss the working of *n-p-n* transistor. 3

(b) Define and of a transistor. Show the relation ——, where the 1 symbols have their usual meanings. 2+3=5

(c) What is meant by transistor biasing? What are the important biasing rules? 1+1=2

OR

8. *(a)* Explain with diagram, the input and output characteristics of CE configuration in an *n-p-n* transistor. 5

(b) With diagram, explain the three primary currents which flow in a properly-biased *p-n-p* transistor. 3

(c) In CB connection, 0 9. If the emitter current is 1 mA, determine the value of base current. 2

9. *(a)* Explain the terms input resistance, output resistance, current gain, voltage gain and power gain of a transistor amplifier. 5

(b) For a single-stage transistor amplifier, the collector load is R_C 2 k and the input resistance R_i 1 k . If the current gain is 50, calculate the voltage gain of the amplifier. 2

(c) Using the output characteristics along with the d.c. load line of CE transistor circuit, explain the terms cut-off, saturation and active region. 3

OR

10. *(a)* Describe class–A, class–B, class–C and class–AB amplifiers. 4

(b) A change of 200 mV in base-emitter voltage causes a change of 100 A in the base current. Find the input resistance of the transistor. 2

(c) How will you draw d.c. load line on the output characteristics of a transistor? What is its importance? 2+2=4

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