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(CBCS)

(5th Semester)

PHYSICS

SIXTH PAPER

(Electronics—I)

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. If $_n$ 0 38 m^2/Vs and $_p$ 0 18 m^2/Vs are the mobilities of electrons and holes respectively for an intrinsic germanium crystal at room temperature, also if intrinsic carrier concentration n_i 2 5 10^{19}electrons/m^3, then the conductivity of germanium is (electronic charge e 1 6 10^{19} coulomb)

(a) 2 24 (m) ^{1} ( ) *(b)* 22 4 (m) ^{1} ( )

(c) 0 224 (m) ^{1} ( ) *(d)* 0 0224 (m) ^{1} ( )

2. N-type silicon is obtained on doping intrinsic silicon by

(a) phosphorous ( )

(b) aluminium ( )

(c) boron ( )

(d) gold ( )

3. The voltage across a diode in a bridge rectifier circuit having input voltage of peak value V_m, during its non-conducting period is

(a) 0 ( ) *(b)* V_m ( )

(c) $2V_m$ ( ) *(d)* $4V_m$ ( )

4. A photodiode is normally

(a) forward biased ( )

(b) reverse biased ( )

(c) neither forward nor reverse biased ( )

(d) emitting light ( )

5. In a transistor

(a) I_C I_E I_B ( ) *(b)* I_E I_C I_B ( )

(c) I_B I_E I_C ( ) *(d)* I_C $2I_E$ I_B ( )

6. The phase difference between the input and output voltages of a transistor connected in CE arrangement is

(a) 0° ( ) *(b)* 90° ( )

(c) 180° ( ) *(d)* 120° ( )

7. An oscillator differs from an amplifier because it

(a) has more gain ( )

(b) requires no input signal ( )

(c) requires no d.c. supply ( )

(d) always has the same input ( )

8. For an oscillator to properly start, the gain around the feedback loop must initially be

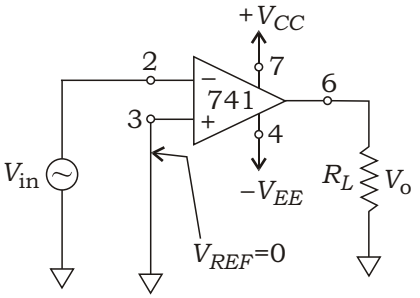
(a) 1 ( )

(b) greater than 1 ( )

(c) less than 1 ( )

(d) equal to attenuation of feedback circuit ( )

9. In the circuit given below, if the input signal is a sinusoidal wave, what will be the output voltage waveform?



(a) Cosine wave ( )

(b) Sine wave ( )

(c) Triangular wave ( )

(d) Square wave ( )

10. In Boolean algebra, the output of X X Y is

(a) X ( ) *(b)* Y ( )

(c) X Y ( ) *(d)* 1 ( )

SECTION—B

(*Marks* : 15)

Answer the following questions : 3×5=15

1. What are drift and diffusion currents? How do they differ from each other?

OR

2. Write down the expression for the diode equation and draw the *I-V* characteristics of a *P-N* junction diode.

3. Draw a circuit diagram of -filter. Explain its working principle in brief.

OR

4. Explain tunnel effect in a tunnel diode.

5. What are class *A* and class *B* amplifiers? How do they differ from each other?

OR

6. Draw *h*-parameter equivalent circuit for a transistor working in CE configuration. Also define all the parameters in the circuit.

7. Explain Barkhausen's criterion for self-sustained oscillations.

OR

8. Explain basic feedback theory. What are negative and positive feedbacks?

9. What are open-loop gain and common-mode gain of Op-Amp? Define common-mode rejection ratio of an Op-Amp.

OR

10. Using Boolean algebra, simplify the expression $Y \quad (\overline{A} \quad \overline{B})\overline{C} \quad \overline{AB}$.

(PART : B—DESCRIPTIVE)

(*Marks* : 50)

The figures in the margin indicate full marks for the questions

1. What is Hall effect? Using appropriate diagram, explain the formation of Hall voltage. Also obtain the expression for Hall coefficient for an *n*-type semiconductor. Mention any three applications of Hall effect. 1+3+4+2=10

OR

2. Explain the formation of space charge region (depletion region) in a *P-N* junction diode. Obtain the expression for barrier width (depletion width)

$$W \quad \sqrt{\frac{2\ V_B}{e}\ \frac{1}{N_a}\quad \frac{1}{N_d}}$$

where V_B is the barrier built in potential, N_a and N_d are acceptor and donor densities respectively. Also discuss how the depletion width changes under forward and reverse bias conditions. 3+5+2=10

3. Draw the circuit diagram for centre-tap full-wave rectifier. Explain the working of the rectifier and obtain the expressions for d.c. (average) current and r.m.s. current. Show that the power conversion efficiency and ripple factor in full-wave rectifier are 81·2% and 0·48 respectively. 1+6+3=10

OR

4. *(a)* Explain the Zener breakdown process in *P-N* junction diode. Describe with a diagram, the use of Zener diode as voltage stabilizer for both load and line regulation. 2+4=6

(b) Explain the principle and working of LED. 4

5. *(a)* Draw the circuit diagram of *n-p-n* transistor in CE configuration. Explain its input and output characteristics. 2+4=6

(b) Define and . Deduce their relation. 4

OR

6. *(a)* Draw a circuit diagram for voltage divider biased method for CE configuration. Analyze the circuit and explain how stabilization of operating point is achieved by this method. 1+5=6

(b) What is an operating point of a transistor? Draw the d.c. load line for CB configuration. Explain the load line and identify the operating point. 1+3=4

7. *(a)* Using appropriate circuit diagram, explain the working of *R-C* coupled amplifier. Draw and explain its frequency-response curve. 3+4=7

(b) Explain how negative feedback stabilizes the gain of an amplifier. 3

OR

8. What are sinusoidal oscillators? Explain with diagram the working of Hartley and Colpitts oscillators. 2+4+4=10

9. *(a)* Distinguish between characteristics of an ideal Op-Amp and IC 741. 4

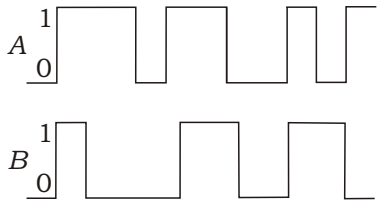
(b) Draw the circuit diagram for a basic differentiator Op-Amp. From the circuit, deduce the relation between output voltage and input voltage. Plot the corresponding output waveform for *(i)* sine-wave input and *(ii)* triangular wave input. 1+3+2=6

OR

10. *(a)* State two De Morgan's theorems. Using sum of product rule, obtain the simplified Boolean expression for the truth table given below : 3+3=6

A	*B*	*C*	*Y*
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

(b) Trace the output of NAND gate, if the two inputs A and B are as shown below : 2



(c) Convert decimal numbers 10·5 and 3·2 into binary numbers. After which, perform subtraction using 2's complement method. 2

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