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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. The Hall voltage is

(a) formed due to magnetic field action on stationary charge ( )

(b) always aligned along the applied electric field ( )

(c) always aligned along the applied magnetic field ( )

(d) always aligned perpendicular to both applied electric and magnetic fields ( )

2. The expression for concentration of minority charge carriers (n_p) in p-type semiconductors in terms of number density of acceptor atoms (N_A) and intrinsic carrier concentration (n_i) is

(a) $n_p \quad n_i^2 N_A$ ( )

(b) $n_p \quad \frac{n_i^2}{N_A}$ ( )

(c) $n_p \quad \sqrt{n_i^2 N_A}$ ( )

(d) $n_p \quad \frac{n_i}{N_A}$ ( )

3. In full-wave rectifier, power conversion efficiency and ripple factor are

(a) 40·6% and 1·21 respectively ( )

(b) 40·6% and 0·48 respectively ( )

(c) 81·2% and 0·48 respectively ( )

(d) 81·2% and 1·21 respectively ( )

4. Zener diode when configured as a voltage regulator will have

(a) constant current passing through the diode ( )

(b) constant current passing through the load resistance ( )

(c) variable current through the diode ( )

(d) zero current through the diode ( )

5. In output characteristics of *n-p-n* transistor in *CE* configuration, the cut-off region is

(a) above I_B 0 and on the left side of small V_{CE} ( )

(b) below I_B 0 ( )

(c) the region where both the emitter-base junction and collector-base junction are in forward bias ( )

(d) the region where emitter-base junction is forward biased while collector-base junction is reverse biased ( )

6. In an expression for collector current in a transistor I_C I_B (1)I_{CO}, the quantity which is highly dependent on temperature fluctuation is

(a) a reverse saturation current I_{CO} ( )

(b) base current I_B ( )

(c) base current amplification factor ( )

(d) both base current and reverse saturation current ( )

7. The main reason for using capacitor as a coupling device in multistage amplifier is

(a) to isolate d.c. value of one stage to the next stage ( )

(b) to supply output signal of one stage to the next stage ( )

(c) to have good amplification over all the frequencies ( )

(d) it has higher impedance than induction coil for a.c. current ( )

8. An oscillator produces

(a) damped oscillation ( )

(b) undamped oscillation ( )

(c) modulated oscillation ( )

(d) unmodulated oscillation ( )

9. The value of CMRR in ideal op-amp is

(a) zero ( )

(b) one ( )

(c) 100 dB ( )

(d) infinity ( )

10. In Boolean algebra, X ($\overline{X}$ Y) equals

(a) XY ( )

(b) Y ( )

(c) X ( )

(d) 1 ( )

SECTION—B

(*Marks* : 15)

Answer the following questions : 3×5=15

1. What are intrinsic and extrinsic semiconductors? Are the number of both the charge carriers, free electrons and holes equal in intrinsic semiconductors? If yes, explain the reason.

OR

2. Write an expression for Hall coefficient for both the two types of charge carriers in semiconductors. Also write down the three uses of Hall effect.

3. Show that I_{dc} in full-wave rectifier is $\frac{2I_m}{}$, where I_m is peak current.

OR

4. Draw the circuit diagram for centre tap full-wave rectifier and explain its working.

5. Define and in a transistor. Obtain their relation.

OR

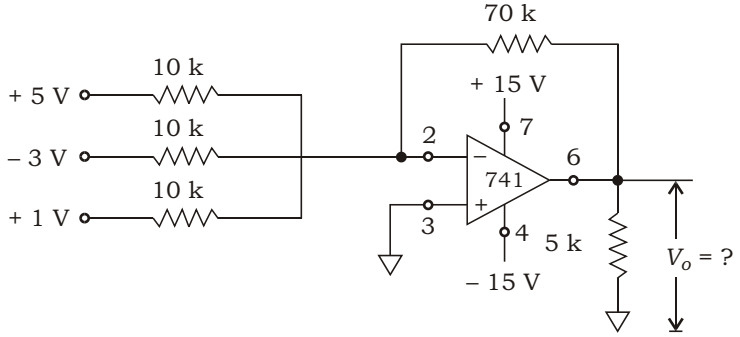
6. Draw the d.c. load line for *CE* emitter configuration. Explain the load line and identify the operating point.

7. What is an emitter bypass capacitor C_E in *RC* coupled amplifier? Explain its function.

OR

8. Draw the circuit diagram of Hartley oscillator. Briefly explain its function.

9. What is the output of the circuit given below?



OR

10. What are slew rate and gain bandwidth of an op-amp?

(PART : B—DESCRIPTIVE)

(*Marks* : 50)

The figures in the margin indicate full marks for the questions

1. *(a)* Explain the concepts of drift current and diffusion current. Write down the mathematical expressions for these currents and define the terms in the expression. 2+2=4

(b) Explain the formation of potential barrier in a *P-N* junction diode using an illustrative figure. Deduce an expression for the barrier potential in a diode. 2+4=6

OR

2. Derive an expression for current in a *P-N* junction diode. Draw and explain IV characteristic curve using the diode equation. Also explain the reverse saturation current. From IV characteristic curves, give your comment on the resistance of a diode under forward biasing and reverse biasing. 4+4+1+1=10

3. What is rectifier circuit? Draw and explain the working of a half-wave rectifier circuit. Deduce the expressions for d.c. current and r.m.s. current for half-wave rectifier. Show that the power conversion efficiency and ripple factor in half-wave rectifier are 40·6% and 1·21 respectively. 1+3+4+2=10

OR

4. Explain the working principles of the following electronic circuit components/appliances with necessary diagrams : 4+3+3=10

(a) L-filter and C-filter

(b) Solar cell

(c) Tunnel diode

5. Explain the hybrid parameters method of analysing two-port linear circuits. Show that a single-stage *CE* amplifier can be analyzed using hybrid parameters approach. Obtain the *h*-parameters equivalent circuit diagram in terms of transconductance. Also obtain the expressions for current gain, voltage gain, input resistance, output resistance and power gain. 3+2+5=10

OR

6. *(a)* Draw the circuit diagram of *p-n-p* transistor in *CB* configuration. Explain its input and output characteristics. 1+4=5

(b) With the help of circuit diagrams and load line graph, explain the workings of Class—A and Class—B amplifiers. 5

7. What are positive and negative feedbacks in an amplifier circuit? Deduce the general expression for gain with negative feedback in terms of gain without feedback. Explain the effects of negative feedback on input impedance, output impedance, gain stability, distortion and frequency response. 2+2+6=10

OR

8. *(a)* What is Barkhausen's criterion for self-sustained oscillations? Draw and explain the working of a phase-shift oscillator. 2+5=7

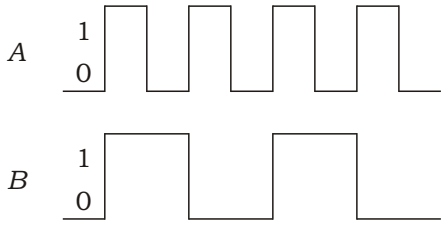
(b) Explain the working of RC coupled amplifier at high frequencies (above 20 kHz). 3

9. *(a)* Draw the circuit diagrams for op-amp in inverting and non-inverting closed-loop configurations. Deduce the expressions for voltage gain in both the cases. 5

(b) Draw the circuit diagram for a basic integrator op-amp. Deduce the relation between output voltage and input voltage. Plot the corresponding output waveform for square-wave input. 5

OR

10. *(a)* Write down the logic symbol and truth table for XOR gate. Draw the output waveform of XOR gate for the following two-input wave : 2



(b) Draw the equivalent logic circuit diagram for the following truth table. Simplify the corresponding Boolean expression using sum of product rules : 6

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

(c) Using 2's complement method, perform binary subtraction of 7 from 22 after conversion into binary numbers. 2

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