PHY/V/CC/10

Student's Copy

2024 (CBCS) (5th Semester) PHYSICS SIXTH PAPER

(Electronics-I)

Full Marks : 75

Time : 3 hours

The figures in the margin indicate full marks for the questions

(SECTION : A-OBJECTIVE)

(Marks: 10)

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

 $1 \times 10 = 10$

1. In an intrinsic semiconductor, the Fermi level lies in which position?

- (a) Right below the conduction band ()
- (b) Right above the valence band ()
- (c) Exactly in the middle of the conduction band and valence band ()
- (d) Exactly in the same level with the valence band ()

2. The purpose of adding impurity in an intrinsic semiconductor is



(d) minority carriers ()

4. A Schottky diode has

- (a) large depletion layer ()
- (b) small depletion layer ()
- (c) no depletion layer ()
- (d) extremely large depletion layer ()

[Contd

- 5. For proper amplification by a transistor circuit, the operating point should be located at the
 - (a) end point of d.c. load line ()
 - (b) middle of load line ()
 - (c) maximum current point ()
 - (d) minimum current point ()
- 6. In a transistor, signal is transferred from a circuit of
 - (a) low resistance to high resistance ()
 - (b) high resistance to high resistance ()
 - (c) low resistance to low resistance ()
 - (d) high resistance to low resistance ()
- 7. In class AB amplifier operation, collector current flows
 - (a) at all times during the full cycle of the input signal ()
 - (b) for just one half cycle of the input signal ()
 - (c) for more than half cycle but less than full cycle of the input AC signal ()
 - (d) for less than one half cycle of the input AC signal ()

[Contd.

8. RC coupling is used for amplification of

- (a) voltage ()
- (b) current ()
- (c) power ()
- (d) energy ()

9. For an OP-AMP with negative feedback, the output is

- (a) equal to the input ()
- (b) increased ()
- (c) fed back to the inverting input ()
- (d) fed back to the non-inverting input ()
- 10. The inputs of the NAND gate are connected together. The resulting gate circuit is
 - (a) NAND ()
 - (b) AND ()
 - (c) OR ()
 - (d) NOT ()

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(SECTION : B-SHORT ANSWERS)

(Marks: 15)

inswer the following :

Unit—I

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

OR

2. What is Hall effect? Explain the formation of Hall voltage.

Unit—II

3. Zener diode can be used to regulate voltage fluctuation. Explain.

OR

4. Explain in brief the working of a solar cell.

UNIT-III

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

OR

6. What are the three sections of a transistor? Explain each section in brief.

UNIT-IV

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

OR

8. Draw the circuit diagram of Harley oscillator and briefly explain its function.

Unit-V

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

OR

10. Distinguish between characteristics of an ideal op-amp and IC 741.

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3×5=15

(SECTION : C-DESCRIPTIVE)

(Marks : 50)

Answer the following :

10×5=:

Co:

Unit—I

1. Discuss the formation of depletion region in a P-N junction diode. Obtain the expression for the barrier width (depletion width)

$$W = \sqrt{\frac{2\varepsilon V_B}{e} \left(\frac{1}{N_a} + \frac{1}{N_d}\right)}$$

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=

OR

 Derive an expression for current in a P-N junction diode. Draw and explain I-V characteristic curve using the diode equation. Explain the reverse saturation current.

Unit—II

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=

OR

- 4. Explain the working principles of the following electronic circuit components/appliances with necessary diagrams : 4+3+3=
 - (a) L-filter and C-filter
 - (b) Solar cell
 - (c) Tunnel diode

UNIT-III

- (a) Draw the circuit diagram of p-n-p transistor in CB configuration. Explain its input and output characteristics.
 2+4=6
 - (b) Explain transistor DC load line and operating point.

OR

- 6. (a) With the help of appropriate circuit diagram, explain the working of voltage divider biasing circuit for CE transistor. Show that this circuit
 - , can achieve stabilization of operating point. 4+3=7
 - (b) Explain the hybrid parameters method of analysing two-port linear circuits.

UNIT-IV

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

OR

- (a) What is Barkhausen's criterion for self-sustained oscillation? Explain the working of a phase-shift oscillator. 2+3=5
 - (b) What are sinusoidal oscillators? Explain the working of Colpitt's oscillators. 2+3=5

UNIT-V

- 9. (a) Draw the circuit diagram of an op-amp in inverting and non-inverting closed-loop configurations. Deduce the expressions for voltage gain in both the cases.
 - (b) Draw the circuit diagram for a basic integrator op-amp. Deduce the relation between output voltage and input voltage. 2+3=5

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Contd.

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

Α	В	С	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	

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

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(SECTION : A-OBJECTIVE)

(Marks: 10)

Tick (1) the correct answer in the brackets provided :

 $1 \times 10 = 10$

1. In an intrinsic semiconductor, the Fermi level lies in which position?

(a) Right below the conduction band ()

(b) Right above the valence band ()

- (c) Exactly in the middle of the conduction band and valence band ()
- (d) Exactly in the same level with the valence band ()

- The purpose of adding impurity in an intrinsic semiconductor is ¢,
- to increase the number of free electrons and holes (a)
- (b) to decrease the number of holes (
- to decrease the number of electrons <u>ن</u>
- to equalize the number of free electrons and holes (q)
- The leakage current in a crystal diode is due to ë
- (a) junction voltage (
- (b) barrier potential (
- (c) majority carriers (
- (d) minority carriers (
- 4. A Schottky diode has
- (a) large depletion layer (
- (b) small depletion layer (
- (c) no depletion layer ()
- (d) extremely large depletion layer

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Contd.

For proper amplification by a transistor circuit, the operating point should be located at the ທ່

(a) end point of d.c. load line ()

(b) middle of load line

(c) maximum current point (

(d) minimum current point (

6. In a transistor, signal is transferred from a circuit of

low resistance to high resistance (a)

high resistance to high resistance (a

(c) low resistance to low resistance (

high resistance to low resistance (q) 7. In class AB amplifier operation, collector current flows

at all times during the full cycle of the input signal (a)

for just one half cycle of the input signal (q)

than half cycle but less than full cycle of the input AC for more signal <u></u>

for less than one half cycle of the input AC signal (q)

3

Contd.

8. RC coupling is used for amplification of

- (a) voltage (
- (b) current (
- (c) power (
- (d) energy (
- 9. For an OP-AMP with negative feedback, the output is
- (a) equal to the input (
- (b) increased ()
- (c) fed back to the inverting input (
- fed back to the non-inverting input (q)
- 10. The inputs of the NAND gate are connected together. The resulting gate circuit is
- () (a) NAND ()
- () **DND** (9)
- (c) OR ()
- (d) NOT (b)

(SECTION : B-SHORT ANSWERS

(Marks : 15)

Answer the following :

UNIT-I

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

OR

What is Hall effect? Explain the formation of Hall voltage. ci

UNIT-II

3. Zener diode can be used to regulate voltage fluctuation. Explain.

OR

4. Explain in brief the working of a solar cell.

UNIT-III

What are class A and class B amplifiers? How do they differ from each other? 10

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What are the three sections of a transistor? Explain each section in brief. . ف

UNIT-IV

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

OR

8. Draw the circuit diagram of Harley oscillator and briefly explain its function.

UNIT-V

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

OR

10. Distinguish between characteristics of an ideal op-amp and IC 741.

10

3×5=15

(SECTION : C-DESCRIPTIVE)

(Marks : 50)

Answer the following :

10×5=50

UNIT-I

1. Discuss the formation of depletion region in a P-N junction diode. Obtain the expression for the barrier width (depletion width)

$$W = \sqrt{\frac{2\varepsilon V_B}{e} \left(\frac{1}{N_a} + \frac{1}{N_d}\right)}$$

3+5+2=10where 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.

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4+4+2=10Derive an expression for current in a P-N junction diode. Draw and explain the reverse curve using the diode equation. Explain saturation current. I-V characteristic ci

UNIT-II

1+6+3=10Draw 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. ė

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- 4+3+3=10circuit electronic principles of the following components/appliances with necessary diagrams working the Explain 4
- (a) L-filter and C-filter
- (b) Solar cell
- (c) Tunnel diode

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UNIT-III

- 2+4=6 CB configuration. transistor Explain its input and output characteristics. d-u-d Draw the circuit diagram of Ø ທ່
- Explain transistor DC load line and operating point. Q

4

0R

- 4+3=7 With the help of appropriate circuit diagram, explain the working of voltage divider biasing circuit for CE transistor. Show that this circuit can achieve stabilization of operating point. Ø , 9
- 3 Explain the hybrid parameters method of analysing two-port linear circuits. (q)

UNIT-IV

- Deduce the general expression for gain with negative feedback in terms What are positive and negative feedbacks in an amplifier circuit? of gain without feedback. 7. (a)
- Explain the working of RC-coupled amplifier at high frequencies (above 20 kHz). q

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- 2+3=5 What is Barkhausen's criterion for self-sustained oscillation? Explain the working of a phase-shift oscillator. ø œ.
- 2+3=5 Colpitt's JO working Explain the oscillators? sinusoidal What are oscillators. (q)

UNIT-V

- 2+3=5 Draw the circuit diagram of an op-amp in inverting and non-inverting closed-loop configurations. Deduce the expressions for voltage gain in both the cases. (a) 6
- 2+3=5Draw the circuit diagram for a basic integrator op-amp. Deduce the relation between output voltage and input voltage. (a)

Contd.

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OR

Draw the equivalent logic circuit diagram for the following truth table. Simplify the corresponding Boolean expression using sum of product rules : 10. (a)

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Y	0	0	1	ч	0	1	1	-
U	0	1	0	1	0	1	0	Ч
В	0	0	1	1	0	0	Г	٦
Α	0	0	0	0	1	1	1	Ţ

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

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