PHY/V/CC/10

Student's Copy

2023

(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 (\checkmark) the correct answer in the brackets provided :

- 1. In a P-N junction diode with no externally applied voltage, the drift and diffusion components of the hole and electron currents
 - (a) must sum up to unity separately ()
 - (b) must sum up to zero ()
 - (c) must sum up to unity ()
 - (d) must sum up to zero separately ()
- 2. The leakage current across a P-N junction is due to
 - (a) minority carriers (
 - (b) majority carriers ()
 - (c) both minority and majority carriers ()
 - (d) junction capacitance ()

1×10=10

		5 m				- 1-	1	
43 .	Awit	specially designed diode that can op hout damaging the junction is	erat	e at	the b	reak	down	voltage
	(a)	tunnel diode ()	(b) Z	ener d	iode		()
	(c)	avalanche diode ()	(d) S	chottk	y dio	de	()
4.	For rec	r a half-wave or full-wave rectifier, t tifier is always	the	peak	inver	se vo	oltage	of the
	(a)	greater than the input voltage	()				
	(b)	smaller than the input voltage	()				
	(c)	equal to the input voltage ()		-			
	(d)	greater than the input voltage for the the half-wave rectifier ()	full-	wave	rectifie	er an	d sma	aller for
5.	The	e approximate efficiency of class A an	nplifi	er is				
	(a)	0% ()	(b)	25	%	()	
	(c)	45% ()	(d)	73	%	()	
6.	Tra	insistor in active region can function	as					
	(a)	an oscillator ()						
	(b)	an attenuator ()						
	(c)	a switch ()						
	(d)	an amplifier ()						
7.	An	oscillator differs from an amplifier be	caus	e it				
	(a)	has more gain ()						
	(b)	requires no input signal ()						
	(c)	requires no d.c. supply ()						
	(d)	always has the same input ()					
8.	Free	quency of oscillation of phase-shift osc	illat	or is				
	(-)			01 15	1			
	(a)	$J = \frac{1}{2\pi RC} $	(b)	<i>f</i> =	$2\pi\sqrt{RC}$	2	() .
	(c)	$f = \frac{1}{2\pi R \sqrt{C}} \qquad (\qquad)$	(d)	<i>f</i> =	$\frac{1}{2\pi RC_{V}}$	6	()
1								
/145	0.0	2						[Contd.

9. The output impedance of an ideal OP-AMP is

- (a) zero ()
- (b) infinite ()
- (c) very high ()
- (d) low ()

10. The 2's complement for the binary number 011001 is

- (a) 100110 () (b) 000111 ()
- (c) 011111 () (d) 100111 ()

(SECTION : B-SHORT ANSWERS)

(Marks: 15)

Answer the following :

UNIT-I

1. What do you mean by drift velocity and mobility of an electron?

OR

2. What are intrinsic and extrinsic semiconductors? Does the number of both the charge carriers equal in intrinsic semiconductors? Explain in brief.

UNIT-II

3. What is a ripple factor? Write its value for half-wave and full-wave rectifier.

OR

4. Explain the working of a centre-tap full-wave rectifier with diagram.

UNIT-III

 Explain how operating point of a transistor is influenced by temperature fluctuation.

OR

6. Define α and β in a transistor. Obtain the relation between them.

/145

 $3 \times 5 = 15$

UNIT-IV

7. Mention any three advantages of negative voltage feedback in amplifiers.

OR

8. Write Barkhausen criterion of sustained oscillation.

Unit—V

9. Convert the decimal number 58.725 into binary number.

OR

 Write the symbol, truth table and boolean expression for Exclusive-OR (XOR) gate.

(SECTION : C-DESCRIPTIVE)

(Marks : 50)

Answer the following :

Unit—I

- (a) Explain the formation of potential barrier in a P-N junction diode using an illustrative figure. Derive an expression for the barrier potential in a diode.
 - (b) What are donor and acceptor levels? Explain them with appropriate energy band diagram.
 - (c) What is an ideal diode? How does it differ from a real diode?

OR

- (a) What is Hall effect? Using suitable diagram, explain the formation of Hall voltage. Also, obtain the expression for Hall coefficient for an *n*-type semiconductor. 1+3+3=7
 - (b) An *n*-type semiconductor has a resistivity of 20×10^{-2} ohm-m. The mobility of electrons through a separate experiment was found to be 10^{-3} m²V⁻¹s⁻¹. Find the number of electron carrier per m³.

10×5=50

2

2

Contd.

Unit—II

- Explain the working principles of the following electronic circuit components/appliances with necessary diagrams : 4+3+3=10
 - (a) LED (with its characteristics)
 - (b) Solar cell
 - (c) Schottky diode

OR

- **4.** (a) Describe with a diagram, the use of zener diode as voltage stabilizer for both load and line regulation.
 - (b) 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. 3+3=6

Unit—III

- 5. (a) What do you understand by transistor biasing? Describe voltage divider bias method in detail. Explain how stabilization of operating point is achieved by this method.
 1+3+3=7
 - (b) For the given circuit, draw the d.c. load line :



OR

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

/145

4

6

[Contd.

- (b) Explain how the output of CE amplifier has a phase shift of 180° in comparison to its input.
- (c) Mention any two reasons why we need to stabilize the operating point of a transistor.

Unit—IV

 What are sinusoidal oscillators? Explain, with a diagram, the principle and working of a Hartley oscillator. Mention its advantages and disadvantages.

1+3+3+3=10

OR

- 8. (a) Using appropriate circuit diagram, explain the working of R-C coupled amplifier. Draw and explain its frequency-response curve. 3+4=7
 - (b) What is positive feedback of an amplifier? Obtain the relation between open-loop and closed-loop gain under positive feedback.

Unit—V

9. (a) Express the following truth table as the minimal sum of product and implement them by logic gate :
 4+2=6

	Α	В	C	Y
	0	0	0	1
	0	0	1	0
	0	1	0	1
L	0	1	1	1
L	1	0	0	0
1		0	1	0
1		1	0	1
1		1	1	1

3

3

- (b) Determine the output voltage for the inverting amplifier shown below, if—
 - (*i*) $V_{in} = 20 \text{ mV d.c.};$
 - (ii) $V_{in} = -50 \ \mu V$ peak sine wave.

The OP-AMP has the following specification :

A = 200000; $R_{in} = 2 \text{ M}\Omega$; $R_o = 75 \Omega$; $+V_{CC} = +15 \text{ V}$; $-V_{EE} = -15 \text{ V}$ and output voltage swing = $\pm 14 \text{ V}$



OR

- 10. (a) Discuss the circuit operation for an integrator OP-AMP. From the circuit, deduce the relation between output voltage and input voltage.
 Plot the corresponding output waveform for square-wave input. 3+1=4
 - (b) Simplify the boolean functions $Y = A \cdot B + A \cdot \overline{B} + \overline{B} \cdot C$ and implement them by logic gate. 2+2=4
 - (c) Trace the output waveform of the circuit given in the figure below : 2



2+2=4

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 - 2. The leakage current across a P-N junction is due to
 - (a) minority carriers
 - (b) majority carriers ()
 - (c) both minority and majority carriers ()
 - (d) junction capacitance ()

3. A specially designed diode that can operate at the breakdown volt without damaging the junction is	age						
(a) tunnel diode () (b) Zener diode ()						
(c) avalanche diode () (d) Schottky diode (ĩ						
 For a half-wave or full-wave rectifier, the peak inverse voltage of t rectifier is always 	he						
(a) greater than the input voltage							
(b) smaller than the input voltage ()							
(c) equal to the input voltage (
(d) greater than the input voltage for the full-wave rectifier and smaller f the half-wave rectifier	or						
5. The approximate efficiency of class A amplification							
(a) 0% () (b) 0% ()							
(c) 45% (b) 25% (c)							
6. Transistor in active region and (d) 73% ()							
(a) an oscillator							
(b) an attenuator							
(c) a switch							
(d) an amplifier							
7. An oscillator disc							
(a) here							
(a) has more gain ()							
(b) requires no input signal ()							
(c) requires no d.c. supply ()							
(a) always has the same input ()							
8. Frequency of oscillation of phase-shift oscillator is							
(a) $f = \frac{1}{2\pi RC}$ (b) $f = \frac{1}{2\pi \sqrt{RC}}$ (c)	<u>2</u> ;						
(c) $f = \frac{1}{2\pi R \sqrt{C}}$ () (d) $f = \frac{1}{2\pi R C \sqrt{6}}$ ()	ð.						
/145							

/145

9. The output impedance of an ideal OP-AMP is

- (a) zero ()
- (b) infinite ()
- (c) very high ()
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10. The 2's complement for the binary number 011001 is

(a)	100110	()	(b)	000111	()
(c)	011111	()	(d)	100111	()

(SECTION : B-SHORT ANSWERS)

(Marks: 15)

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Unit—I

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[Contd.

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UNIT-IV

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[Contd.

3

10×5=50

2

Unit—II

- 3. Explain the working principles of the following electronic circuit components/appliances with necessary diagrams : LED (with its characteristics) 4+3+3=10(a)

 - Solar cell (b)
 - Schottky diode (c)

OR

- 4. (a) Describe with a diagram, the use of zener diode as voltage stabilizer for both load and line regulation.
 - (b) 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 3+3=6

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UNIT-V

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+2=0

A	B	С	Y
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

/145

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 - (b) Simplify the boolean functions $Y = A \cdot B + A \cdot \overline{B} + \overline{B} \cdot C$ and implement them by logic gate. 2+2=4
 - (c) Trace the output waveform of the circuit given in the figure below : 2



* * *

2+2=4