POSTAL Book Package 2023

GATE • PSUs

Instrumentation Engineering

Objective Practice Sets

Analog Electronics

Contents

Sl.	Topic	Page No.
1.	Diode Circuit and Power Supply	2 - 16
2.	BJT Biasing and Thermal Stabilization	17 - 29
3.	FET and MOSFET Circuit	30 - 38
4.	Frequency Response and Multistage Amplifiers	39 - 54
5.	Feedback Amplifiers	55 - 61
6.	Oscillators	62 - 68
7.	Operational Amplifiers	69 - 85
8.	Sources and Effects of Noise and Interference in Electronic Circuits	86 - 87
9.	Miscellaneous	88 - 92

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1 CHAPTER
Diode Circuit and Power Supply

MCQ and NAT Questions

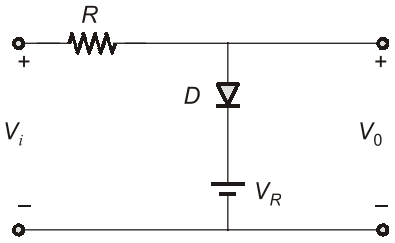
Q.1 The voltage across diode at temperature T_1 is 0.76 V. If temperature is increased by 20°C at constant current the new voltage across diode is

(a) 0.65 V (b) 0.81 V
(c) 0.71 V (d) 0.7 V

Q.2 A diode whose terminal characteristics are related as $i_D = I_s e^{V/V_T}$, where I_s is the reverse saturation current and V_T is thermal voltage (V_T = 25 mV), is biased at I_D = 4 mA. Its dynamic resistance is

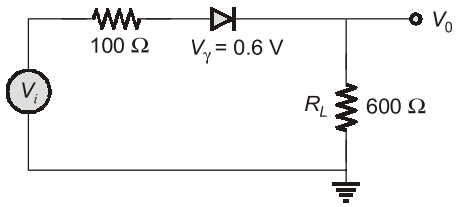
(a) 12.5 Ω (b) 50 Ω
(c) 6.25 Ω (d) 25 Ω

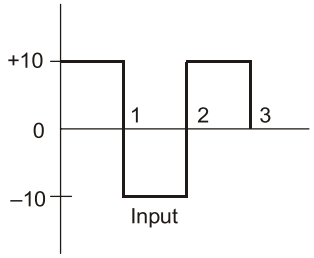
Q.3 In the circuit shown below the input V_i has positive and negative swings. V_o is the output.



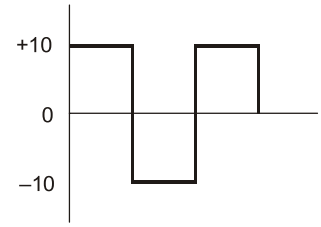
(a) $V_o = 0$ for negative V_i
(b) $V_o = V_R$ for positive V_i
(c) $V_o = V_R$ for $V_i > V_R$
(d) $V_o = V_R$ for all V_i

Q.4



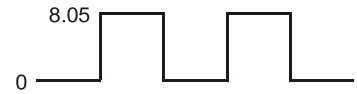


The output waveform is

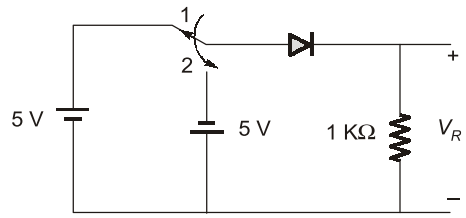
(a)


(b)


(c)

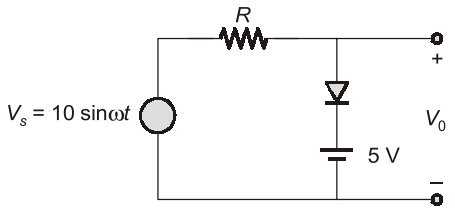

(d)


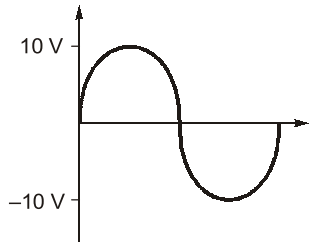
Q.5 In the circuit shown below, the switch was connected to position 1 at $t < 0$ and at $t = 0$, it is changed to position 2. Assume that the diode has zero voltage drop and a storage time t_s. For $0 < t \le t_s$, V_R is given by (all in Volts)

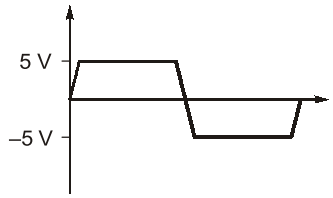


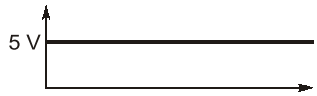
(a) $V_R = -5$ (b) $V_R = 0$
(c) $0 \le V_R < 5$ (d) $-5 < V_R < 0$

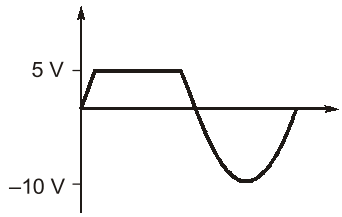
Q.6 For the circuit shown below assuming ideal diode, the output waveform V_0 is



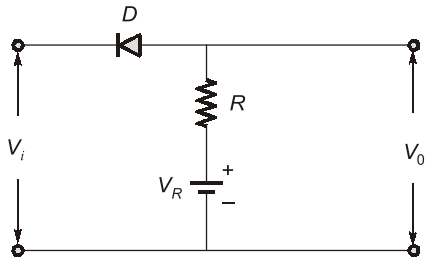
(a)


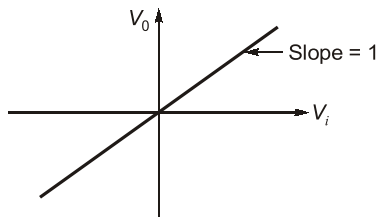
(b)


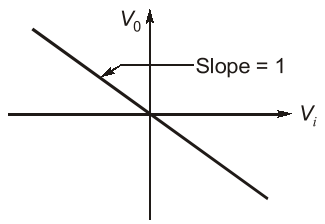
(c)


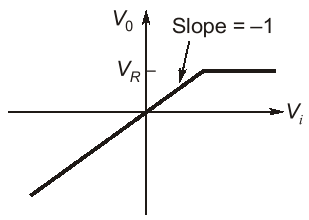
(d)


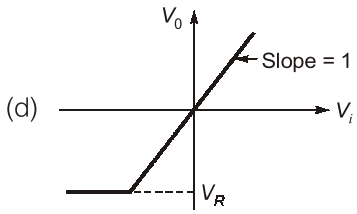
Q.7 The transfer characteristic of the network shown below is represented as



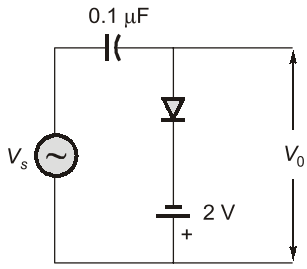
(a)


(b)


(c)


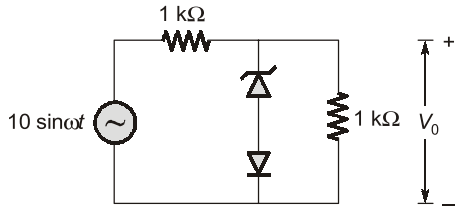
(d)


Q.8 For an input of $V_s = 5 \sin\omega t$, (assuming ideal diode), circuit shown below will behave as a



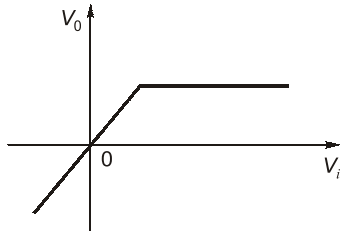
(a) clipper, sine wave clipped at –2 V
(b) clamper, sine wave clamped at –2 V
(c) clamper, sine wave clamped at zero volt
(d) clipper, sine wave clipped at 2 V

Q.9 The cut-in voltage of both Zener diode D_z and D shown in figure is 0.65 V, while breakdown voltage of the Zener is 3 V. Diode is considered to be ideal. The value of peak output voltage V_O.



(a) 3 V in the positive half cycle and 0.65 V in the negative half cycle.
(b) 3.65 V in the positive half cycle and –5 V in the negative half cycle.
(c) 3 V in positive half cycle and –5 V in the negative half cycle
(d) –3.65 V in positive half cycle and 5 V in the negative half cycle

Q.10 The voltage transfer characteristic as shown in the figure will relate to a



Q.43 Match **List-I (Circuits)** with **List-II (Applications)** and select the correct answer using the codes given below the lists:

List-I

A. Diode comparators
B. Diode clampers
C. Astable multivibrator
D. Diode clippers

List-II

1. Slicer
2. Oscillator
3. DC level to an AC signal
4. Square wave from a sine wave

Codes:

	A	B	C	D
(a)	3	4	2	1
(b)	4	1	2	3
(c)	3	4	1	2
(d)	4	3	2	1

Q.44 Consider the following statements associated with the diode rectifier circuits:

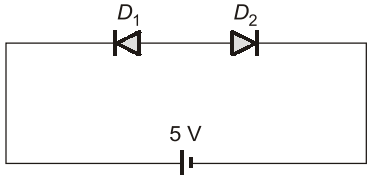
1. The maximum reverse voltage, which can be applied before the breakdown point is reached, is called the "peak inverse voltage".
2. In a full-wave rectifier, the current in each of the diode flows for the whole input signal cycle.
3. The ratio of direct or average value of the output to the effective value of AC component present in the rectifier output is called the "ripple factor".
4. Availability of low-cost silicon diodes has made bridge circuit arrangement more economical than centre trapped transformer arrangement despite its requirement of four diodes.

Which of the above statements are correct?

(a) 1, 2 and 3 (b) 1 and 4
(c) 2, 3 and 4 (d) 2 and 4

Q.45 Two identical diodes, D_1 and D_2 are connected back to back as shown in figure below. The reverse saturation current I_0 of each diode is 10^{-8} A and the breakdown voltage is 50 V. The voltage drop across diodes D_1 and D_2 will be respectively

(Assume, $\frac{kT}{q}$ = 25 mV ; η = 1)



(a) 4.931 V and 0.0693 V
(b) 0.0173 V and 4.983 V
(c) 0.0693 V and 4.931 V
(d) 4.983 V and 0.0173 V

Q.46 **Assertion (A) :** A rectifier with inductor filter is more efficient for high load current.

Reason (R) : In rectifier with inductor filter we can use a larger choke to reduce ripple, larger choke will have higher dc resistance which will result in lower dc output voltage for higher load current.

(a) Both A and R are individually true and R is the correct explanation of A
(b) Both A and R are individually true but R is not the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

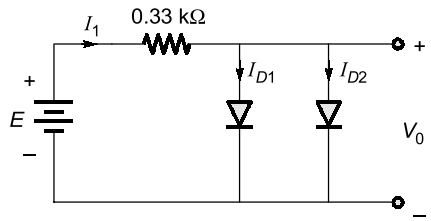
Q.47 **Statement (I):** Centre tap transformer is essential for a centre-tapped rectifier.

Statement (II): In half wave rectification minimum two diodes are required.

(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I).
(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is not the correct explanation of Statement (I).
(c) Statement (I) is true but Statement (II) is false.
(d) Statement (I) is false but Statement (II) is true.

Multiple Select Questions (MSQs)

Q.48 For the circuit shown below :

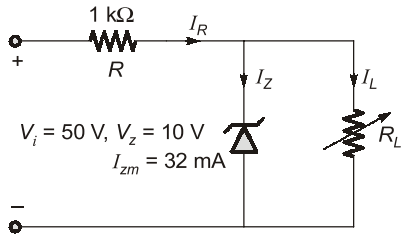


Which of the following statement is correct?

(a) $I_1 > I_{D1} > I_{D2}$ (b) $I_{D1} < I_{D2} < I_1$

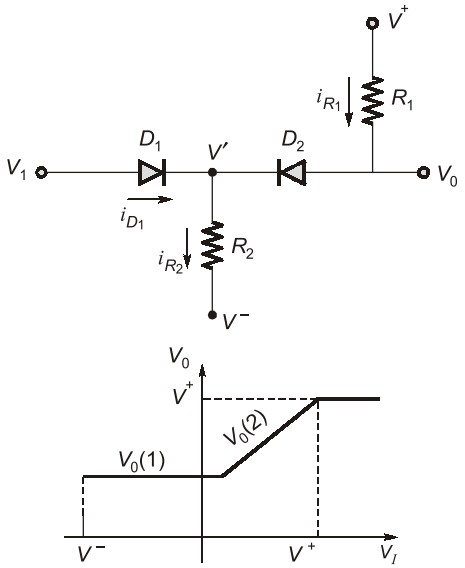
(c) $I_{D1} = I_{D2} = \frac{I_1}{2}$ (d) I_1 = 28.18 mA

Q.49 For the network shown below, which of the following option(s) is/are correct regarding the range of R_L and I_L that will result in V_{RL} being maintained at 10 V.



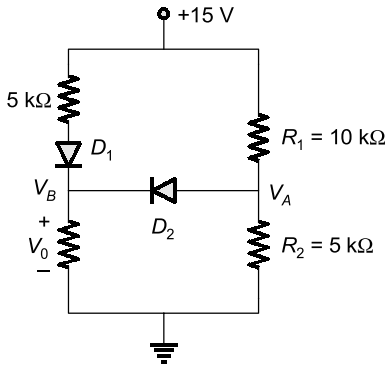
(a) $R_{L\,min} = 250\ \Omega$ (b) $I_{L\,min} = 8$ mA
(c) $R_{L\,max} = 1.25$ kΩ (d) $I_R = 40$ mA

Q.50 For the circuit shown below :



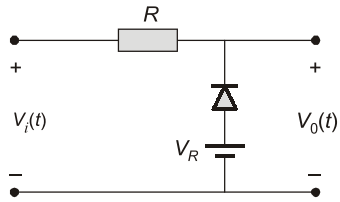
Assume the circuit parameters are $R_1 = 5$ kΩ, $R_2 = 10$ kΩ, $V_\gamma = 0.7$ V, $V^+ = +5$ V and $V^- = -5$V
(a) For $V_1 = 0$, $i_{R1} = 0.62$ mA
(b) For $V_1 = 4$ V, $i_{R1} = 0.2$ mA
(c) For $V_1 = 4$ V, $i_{R2} = 0.83$ mA
(d) For $V_1 = 4$ V, $i_{D1} = 0.63$ mA

Q.51 For the circuit shown below :



Which of the following are correct?
(a) $V_A = 7.62$ V (b) $V_B = 6.92$ V
(c) $V_A = 5$ V (d) $V_B = 9.53$ V

Q.52 Assuming ideal diode characteristics, the input/output voltage relationship for the circuit shown in figure is



(a) When $V_i(t) \le V_R$; $V_0 = V_R$
(b) When $V_i(t) \le V_R$; $V_0 = V_i(t)$
(c) When $V_i(t) > V_R$; $V_0 = V_R$
(d) When $V_i(t) > V_R$; $V_0 = V_i(t)$

■■■■

Answers Diode Circuit and Power Supply

1. (c)	2. (c)	3. (c)	4. (d)	5. (a)	6. (d)	7. (c)
8. (b)	9. (b)	10. (a)	11. (a)	12. (c)	13. (a)	14. (c)
15. (d)	16. (4)	17. (0)	18. (d)	19. (b)	20. (a)	21. (a)
22. (c)	23. (c)	24. (a)	25. (c)	26. (b)	27. (d)	28. (c)
29. (b)	30. (b)	31. (a)	32. (d)	33. (c)	34. (a)	35. (c)
36. (c)	37. (d)	38. (c)	39. (d)	40. (b)	41. (c)	42. (b)
43. (d)	44. (b)	45. (d)	46. (c)	47. (c)	48. (c, d)	49. (a, b, c, d)
50. (a, b, c, d)	51. (c , d)	52. (a, d)				

Explanations Diode Circuit and Power Supply

1. (c)

$$\frac{dV_D}{dT} = -2.5\ \text{mV/°C}$$

$$\Delta V_D = 20 \times (-2.5\ \text{mV}) = -0.05\ \text{V}$$

$$\therefore \quad V_D + \Delta V_D = V_2 = 0.71\ \text{V}$$

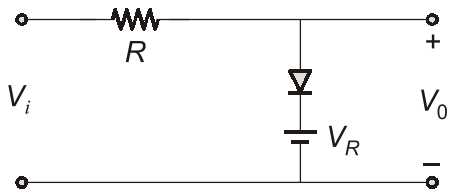
2. (c)

$$\frac{1}{r_d} = \frac{\partial I_D}{\partial V} = \frac{I_D}{V_T}$$

r_d : dynamic resistance.

$$\therefore \quad r_d = \frac{V_T}{I_D} = \frac{25}{4} = 6.25\ \Omega$$

3. (c)



Considering ideal diode :

for $V_i < V_R$, diode is OFF hence there is no current through R and $V_0 = V_i$.

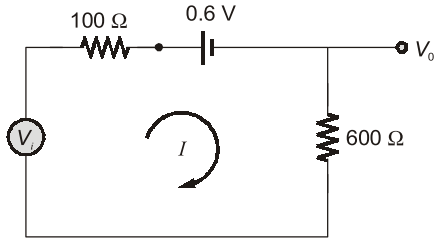
For $V_i > V_R$, diode is ON hence

$$V_0 = V_R$$

(as diode will act as short circuit)

4. (d)

For $0 \le t \le 1$, diode is ON



$$I = \frac{V_i - 0.6}{100 + 600} = \frac{10 - 0.6}{700}$$

$$= 0.01343\ \text{A}$$

$$\therefore \quad V_0 = 600 \times 0.01343 = 8.058\ \text{V}$$

for $1 < t < 2$, diode is OFF, there will be no current in the circuit and hence

$$V_0 = 0\ \text{V}$$

Hence output waveform can be given as shown below:

5. (a)

For $0 < t < t_s$ diode will remain ON and hence

$$V_R + 5 = 0$$

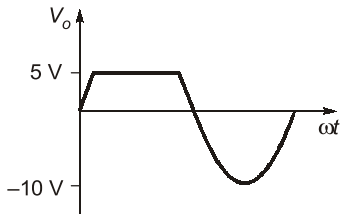
$$\therefore \quad V_R = -5\ \text{V}$$

6. (d)

For $0 \le V_i < V_R$ = diode is OFF $\Rightarrow V_0 = V_i$

For $V_R \le V_i \Rightarrow$ diode is ON $\Rightarrow V_0 = 5$ V

Hence output waveform can be as shown below

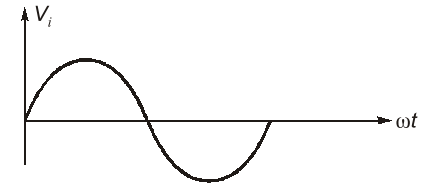


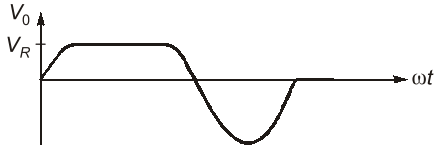
7. (c)

For $V_i < V_R$ = Diode is OFF $\Rightarrow V_0 = V_i$

For $V_i > V_R$ = Diode is ON $\Rightarrow V_0 \simeq V_R$

Hence for a sinusoidal input, output can be shown as below





Hence characteristic can be as shown below