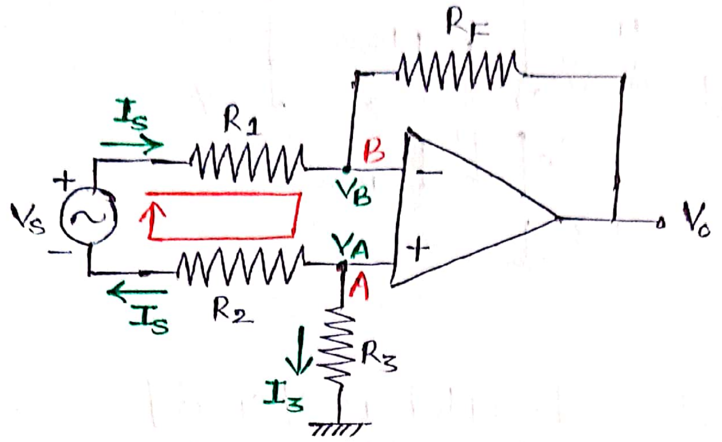
BE ASSIGNMENT-4 RUBRIC

SOL(1):



Here $V_A = V_B = V$ (let) (due to virtual short)

KVL in mesh –

$$-V + I_S R_2 - V_S + I_S R_1 + V = 0$$

$$V_S = I_S (R_1 + R_2)$$

$$\therefore I_S = \frac{V_S}{R_1 + R_2} \quad \text{—(a)}$$

KCL at Node-A —

$$I_S + I_3 = 0$$

$$\therefore I_3 = -I_S = \frac{-V_S}{R_1+R_2} \quad \text{—(b)}$$

& $V_A = V = I_3 R_3 = \dfrac{-R_3 V_S}{R_1 + R_2}$ —(c)

KCL at Node-B —

$$I_S = \frac{V_B - V_o}{R_F}$$

$$\frac{V_S}{R_1+R_2} = \frac{V - V_o}{R_F}$$

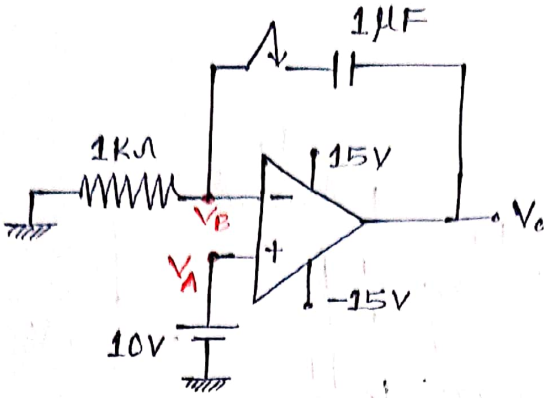
$$\frac{R_F V_S}{R_1+R_2} = \frac{-R_3 V_S}{R_1+R_2} - V_o$$

$$V_o = \frac{-R_3 V_S}{R_1+R_2} - \frac{R_F V_S}{R_1+R_2}$$

$$\therefore V_o = \frac{-(R_3+R_F)}{(R_1+R_2)} V_S \quad \text{—(d)}$$

(8 Point)

SOL(2):



Part (I)

* at time $t = 0^- $ sec [switch is opened]

$V_c(0^-) = 0V$ (Capacitor works as O.C.)

$V_o(0^-) = 15V$ $\left\{ \begin{array}{c} V_A > V_B \\ V_A = 10V \\ V_B = 0V \end{array} \right\}$

* at time $t = 0^+$ sec [switch is closed]

$V_c(0^+) = 0V$ (Capacitor works as S.C.)

$V_o(0^+) = 10V$ $\left\{ \begin{array}{c} V_A = V_B \\ V_A = 10V \\ V_B = 10V \end{array} \right\}$

* at time $t = \infty$ sec [switch is closed]

$V_c(\infty) = 15V$ (Capacitor works as O.C.)

$V_o(\infty) = 15V$ $\left\{ \begin{array}{c} V_A > V_B \\ V_A = 10V \\ V_B = 0V \end{array} \right\}$

Part (II) General eqn for Capacitor response—

$$V_c(t) = [V_c(0^+) - V_c(\infty)]\, e^{-t/\tau} + V_c(\infty)$$

$$V_c(t) = [0 - 15]\, e^{-t/(10^3 \times 10^{-6})} + 15$$

$$V_c(t) = 15\,(1 - e^{-10^3 t})$$

$$\therefore V_c(1 msec) = 15\,(1 - e^{-10^3 \times 1 \times 10^{-3}})$$

$$= 9.48 \text{ Volt} \quad \text{—(a)} \quad \rightarrow (3.0 \text{ Point})$$

Part (III) General eqⁿ for current through capacitor

$$I_c(t) = \left[I_c(0^+) - I_c(\infty)\right] e^{-t/\tau} + I_c(\infty)$$

Here $I_c(0^+) = \frac{10}{10^3} = 10\ mA$

$I_c(\infty) = 0\ A$

$\tau = RC = 10^3 \times 10^{-6} = 10^{-3}\ sec$

$\therefore I_c(t) = (0 + 10)\, e^{-t/10^{-3}} + 0$

$= 10\, e^{-10^3 t}$

$\therefore I_c(1\ msec) = 10\, e^{-(10^3)(10^{-3})}$

$= 3.67\ mA$ —— (b) → (3 Point)

Part (IV) at time $t = 1\ msec$

$V_B(1\ msec) = I_c(1\ msec) \times (1 \times 10^3)$

$= 3.67 \times 10^{-3} \times 10^3$

$= 3.67\ Volt$

$\therefore V_o(1\ msec) = V_c(1\ msec) + V_B(1\ msec)$

$= 9.48 + 3.67$

$= 13.15\ Volt$ —— (c) → (2 Point)

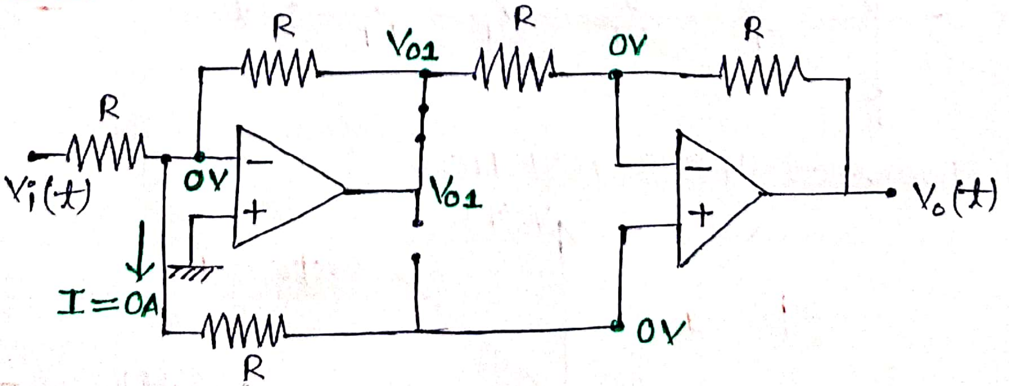
SOL (3): Part (I)

Case (I):

If $V_i(t) = (+ve)$ then—

D_1 is ON

D_2 is OFF

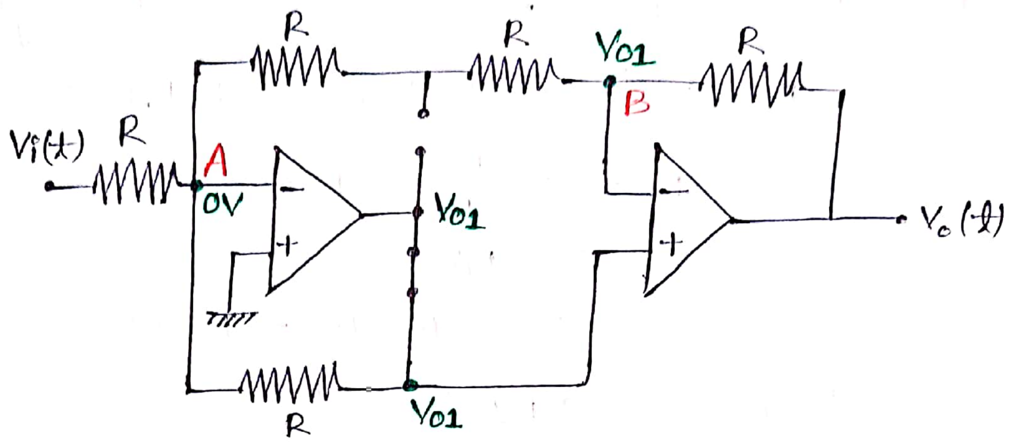


$\therefore V_{o1} = \left(-\frac{R}{R}\right) V_i = -V_i$

$\therefore V_o(t) = \left(-\frac{R}{R}\right) V_{o1} = V_i(t)$ —— (a) → (1.5 Point)

Case(II):

If $V_i(t) = (-Ve)$
then—
D_1 is OFF
D_2 is ON



KCL at Node-A,

$$\frac{0-V_i}{R} + \frac{0-V_{o1}}{R} + \frac{0-V_{o1}}{2R} = 0$$

$$V_{o1} = \left(-\frac{2}{3}\right) V_i$$

KCL at Node-B,

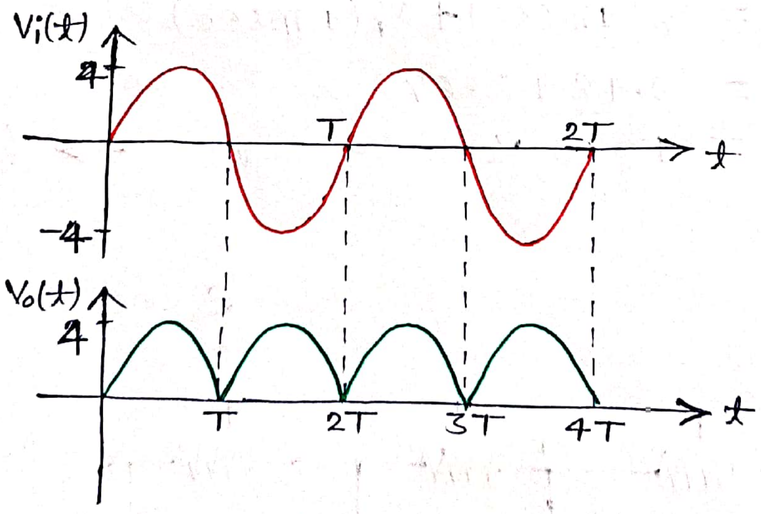
$$\frac{V_{o1}-0}{2R} + \frac{V_{o1}-V_o}{R} = 0$$

$$V_o = \frac{3}{2} V_{o1} = -V_i$$

$$\therefore V_o(t) = -V_i(t) \quad \text{——— (b)}$$

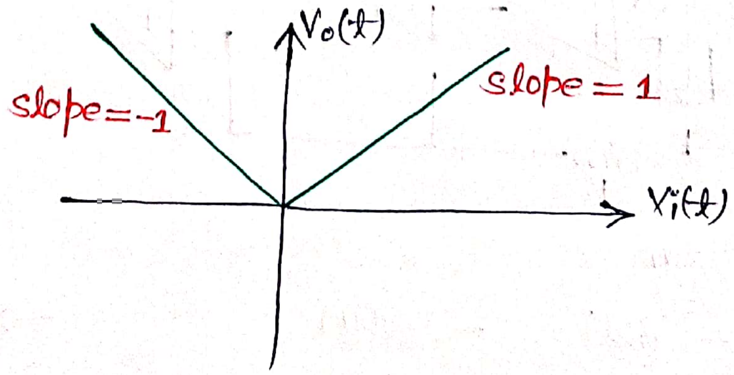
→ (1.5 Point)

Part(II)



→ (2 Point)

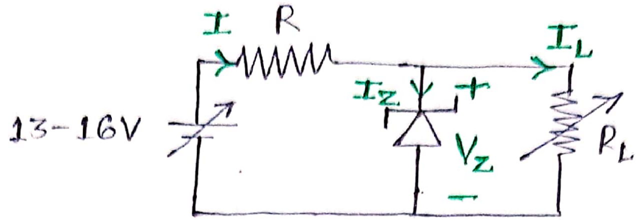
Part(III) Transfer Characteristics



→ (2 Point)

Part (IV) Given circuit is work as Full Wave Rectifier. → 1 Point

SOL(4) :



Given Parameters – Zener Voltage, $V_z = 10V$

Load Current, $I_L = 10mA - 85mA$

Min^m Zener Current, $I_{Zmin} = 15mA$

Input Voltage, $V_i = 13-16V$

$I = I_Z + I_L$

I ↓ Variable

I_Z ↓ Given Min^m Value

I_L ↓ Variable

$\therefore \quad I_{Min} = I_{ZMin} + I_{LMax}$ → (2 Point)

$\left(\frac{V_i - V_z}{R}\right) = I_{ZMin} + I_{LMax}$ → (2 Point)

$\left(\frac{13-10}{R}\right) = 15 + 85$

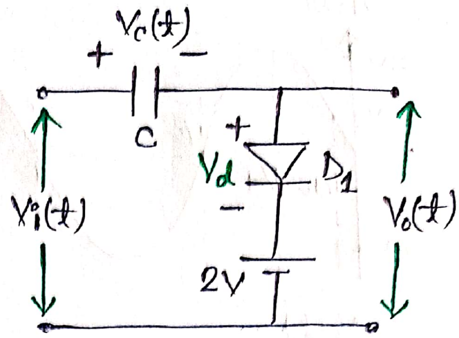
$\frac{3}{R} = 100$

$\therefore R = 30\Omega$ → (4 Point)

5):

Here $V_i(t) = 5\sin(\omega t)$

$V_i(t) = V_c(t) + V_d + 2$

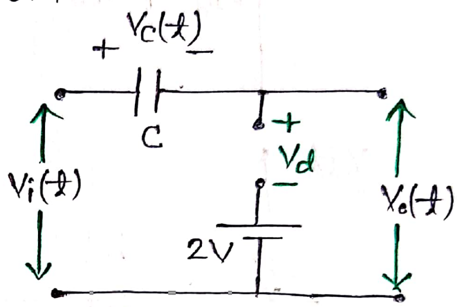


Part (I)

Case(I): For $0 \le V_i \le (2)$, Diode is OFF.

$\therefore V_c(t) = 0\,V$

$\therefore V_o(t) = V_d = V_i(t)$



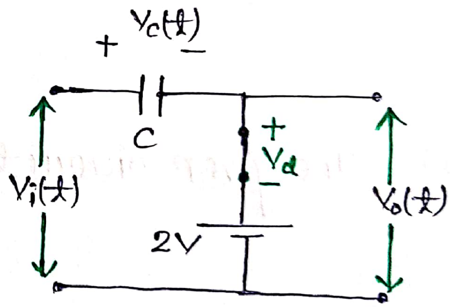
→ (1 Point)

Case(II): For $(2) < V_i < (5)$, Diode is ON.

$$\therefore V_c(t) = V_i(t) - V_d - 2$$
$$= V_i(t) - 0 - 2$$
$$= [V_i(t) - 2]$$

at $t = (T/4)$, $V_c(t) = (5-2) = 3V$

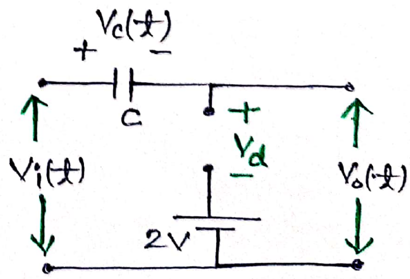
$\therefore V_o(t) = 2\,V$



→ (1 Point)

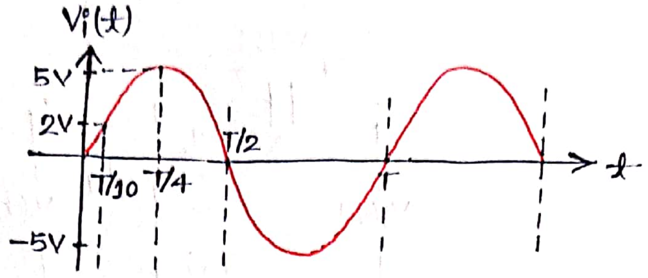
Case(III): For $V_i > (5)$, Diode is OFF.

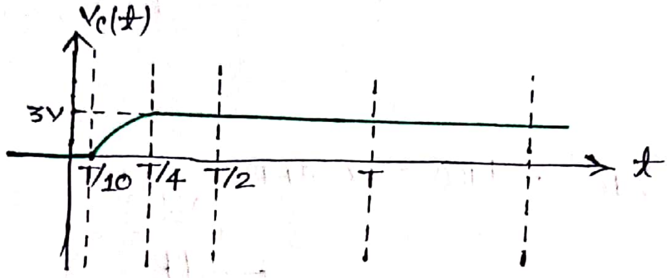
$$V_o(t) = V_d = V_i(t) - V_c(t)$$
$$= [V_i(t) - 3]$$



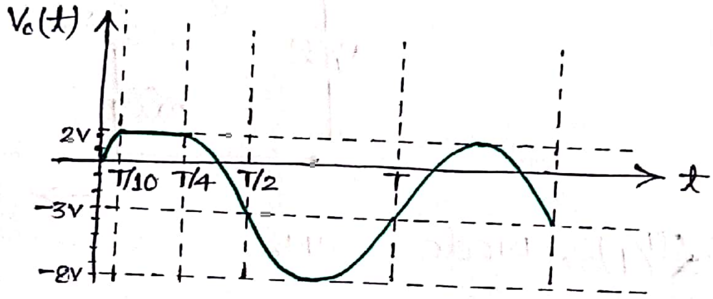
→ (1 Point)

Part (II):





→ (2 Point)



→ (2 Point)

Part (III): The given circuit is working as a clamper circuit.

→ (1 Point)