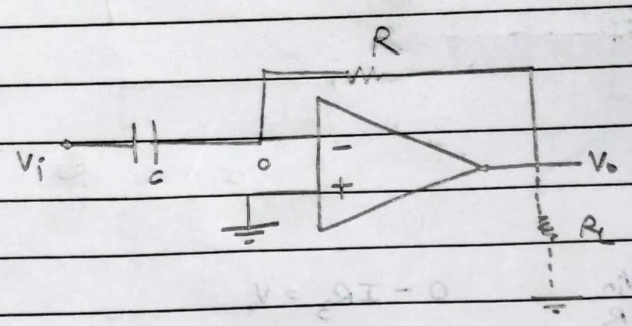
Lab 2

1 OpAmp based Negative feedback circuits

(a) After a value of 15V, the amplifier gets saturated.

(b)

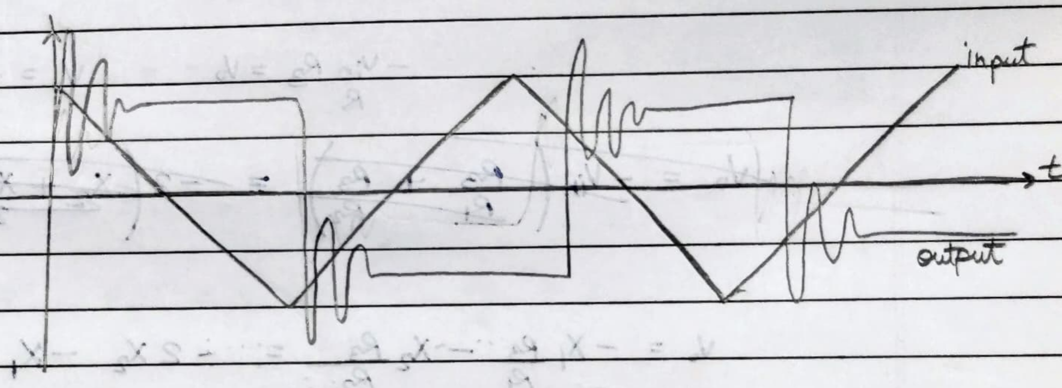


$q = CV$

$I = C\dfrac{dV_i}{dt}$

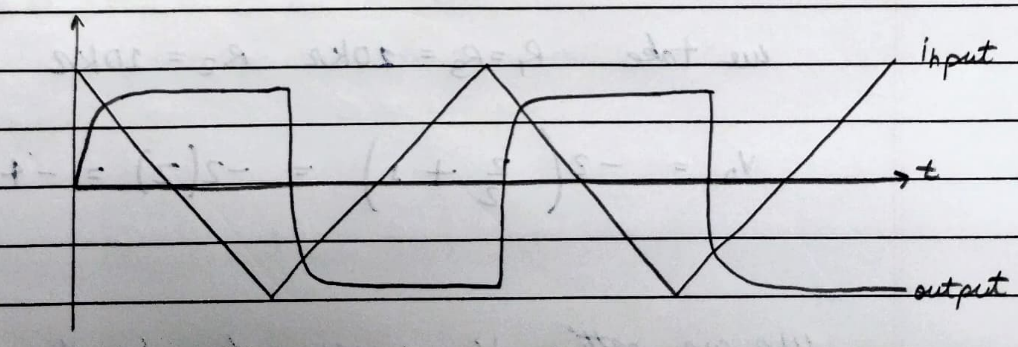
$V_o = -CR\dfrac{dV_i}{dt}$

(i)



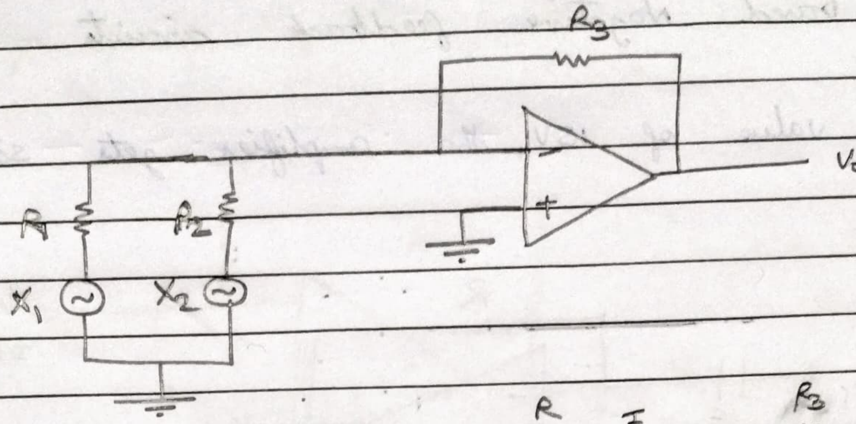
The reason we are getting ripples is Gibb's Phenomenon.

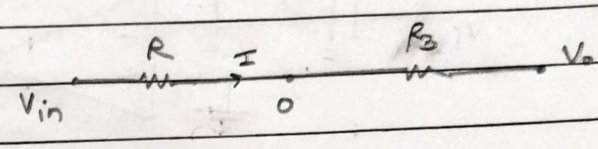
(ii)



By connecting the capacitor in parallel to the resistor, the output waveform gets smoothen out by the capacitor's high frequency filtering effect.

(c)





$$I = \frac{V_{in}}{R} \qquad 0 - IR_3 = V_o$$

$$-\frac{V_{in}}{R} R_3 = V_o \qquad V_o = -V_{in}\frac{R_3}{R}$$

$$\cancel{V_o = -V_{in}\left(\frac{R_3}{R_1} + \frac{R_3}{R_2}\right) = -2\left(\frac{X_2}{2} + \frac{X_1}{2}\right)}$$

$$V_o = -X_1\frac{R_3}{R_1} - X_2\frac{R_3}{R_2} = -2X_2 - X_1$$

$$\frac{R_3}{R_1} = 1 \qquad \frac{R_3}{R_2} = 2 \qquad X_1 = V_{pp} \sin$$

$$R_1 = R_3 \qquad R_2 = \frac{R_3}{2} \qquad X_2 = 1V\ DC$$

we take $R_1 = R_3 = 20k\Omega$ $\quad R_2 = 10k\Omega$

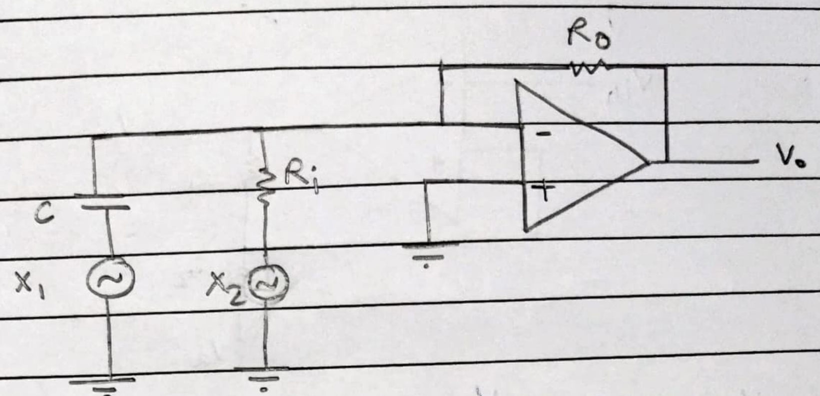
$$V_o = -2\left(\frac{2}{2} + 1\right) = -2(2) = -4$$

We are getting V_o corresponding to the values of X_1, X_2, R_1, R_2 and R_3.

(d)

$$V_o = -\left(0.0001 \frac{d}{dt} X_1 + 2X_2\right)$$

$$V_o = -0.0001 \frac{d}{dt} X_1 - 2X_2$$



$$V_o = -R_o C \frac{dX_1}{dt} - X_2 \frac{R_o}{R_i} = -0.0001 \frac{dX_1}{dt} - 2X_2$$

$$\Rightarrow \quad R_o C = 0.0001 \qquad \frac{R_o}{R_i} = 2$$

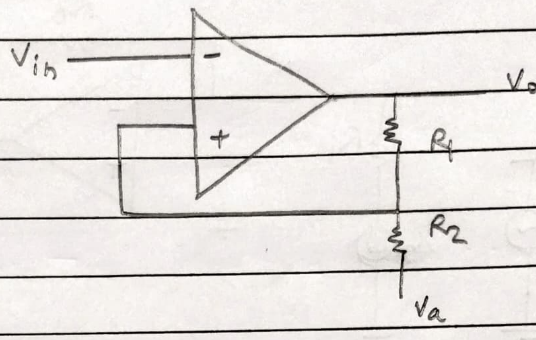
let $R_i = 5k\Omega$ & $R_o = 10\,k\Omega$ & $C = \frac{10^{-4}}{R_o} = \frac{10^{-4}}{10 \times 10^3} = 10^{-8}\,F$

V_{pp} of output = 20.2V

frequency of output = 500 Hz

2. Op Amp Based Positive Feedback Circuits

(a) Schmitt Trigger Circuit



$V_{TH} = 2.5\,V$ $\quad V_{TL} = -2.5$ $\quad V_a = 0$

$$V_{TH} = V_a + \frac{R_2}{R_1+R_2} V_{supply}$$

$$2.5 = 0 + \frac{R_2}{R_1+R_2}(15)$$

$$\frac{25}{150} = \frac{R_2}{R_1+R_2} = \frac{1}{6}$$

~~2.5 = R1~~ $\quad \frac{R_2+R_1}{R_2} = 6 = \frac{R_1}{R_2} + 1$

$$\Rightarrow \frac{R_1}{R_2} = 5 \quad \Rightarrow R_1 = 5R_2$$

let $R_2 = 1\,k\Omega$ $\quad R_1 = 5\,k\Omega$

(iii) V_{Th} (measured) $= 2.6\,V$ $\qquad V_{Th}$ (calculated) $= 2.5\,V$

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(iv) $V_{Th} = V_a + \frac{R_2}{R_1+R_2} V_{supply}$ $R_1 = 5k\Omega$, $R_2 = 1k\Omega$

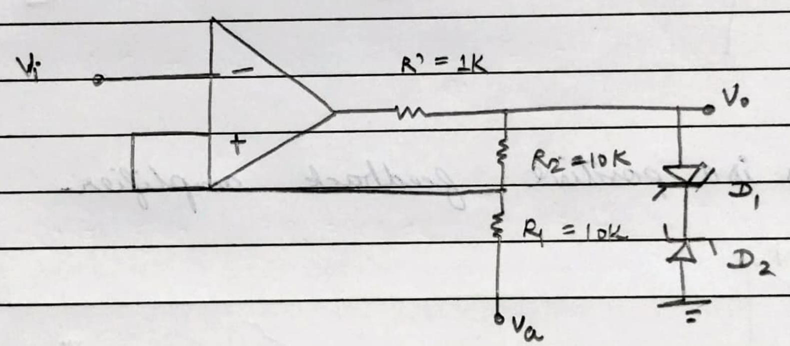
$= 2 + \frac{1}{6}(15) = 2 + \frac{15}{6} = 2 + \frac{5}{2} = 2 + 2.5$
$= 4.5V$

$V_{TL} = 2 - 2.5V = -0.5V$

(v) V_{Th} (measured) $= 4.32V$ V_{Th} (calculated) $= 4.5V$

(vi)

(b)



(ii)

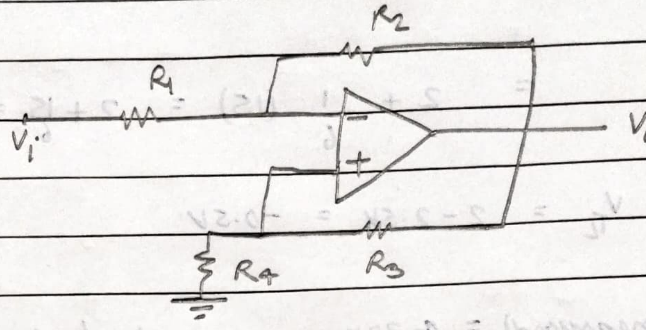
R' limits the current through the zener diode when they clamp the circuit.
When R' is removed, a high current might flow, damaging the circuit.

(iv) $V_{Th} = V_a +$

V_{Th} (~~...~~ measured) $= 3.2V$ V_{TL} (measured) $= -3.2V$

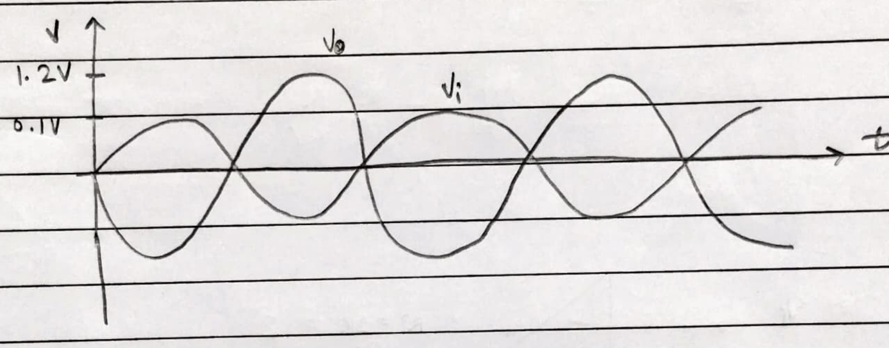
3. Op Amp Based Feedback Circuit

(i)



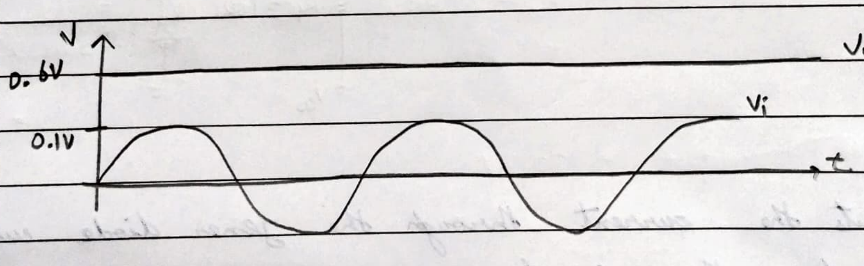
This is a negative feedback amplifier.

(ii)



(iii) This is a positive feedback amplifier.

(iv)



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