SEM → 7th

MID-SEMESTER.

Department of Electrical Engineering

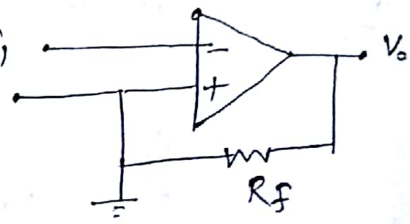
Intelligent Instrumentation.

Q.1.

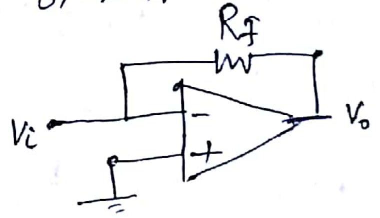
a.) Op-Amps are known as operational amplifier as they are used to perform mathematical operations in many linear, non-linear and frequency dependent Circuits.

b.) Positive feedback :- feedback applied to +ve terminal of an OP-AMP.

Eg:- Schmitt trigger



Negative feedback :- feedback applied to negative termal of OP-AMP.



c.) Pin-Configuration of OP-AMP :-

IC-741

8 Pin IC

1 → Offset Null

2 → Inverting

3 → Non-inverting

4 → Power (V−)

8 → Not-Connected

7 → V+ (Power)

6 → Output

5 → Offset Null

d.) If Gain & Bandwidth of an op-AMP is 1MHz, it means that the gain of device falls to unity at 1MHz. Hence the device is wired for unity gain, it will work upto 1MHz without excessive distortion of signal.

Saleet
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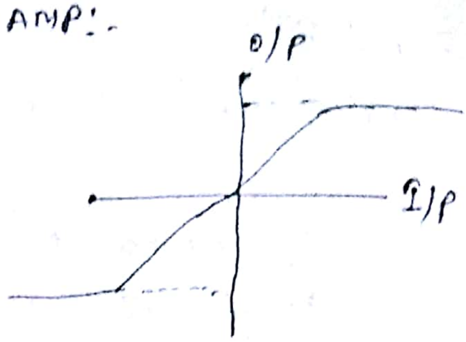
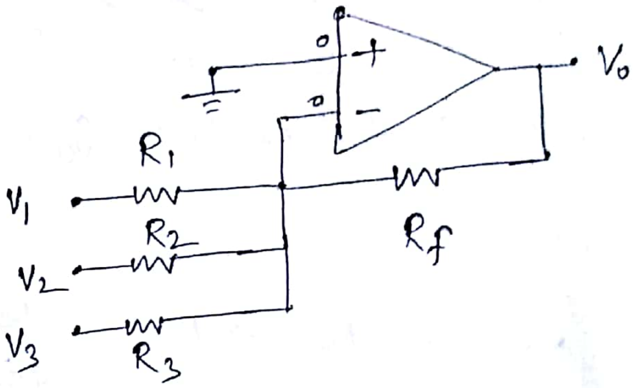
e.) I/P & O/P characteristics of OP-AMP:-



Q.2 . Inverting Summer Amplifier:-

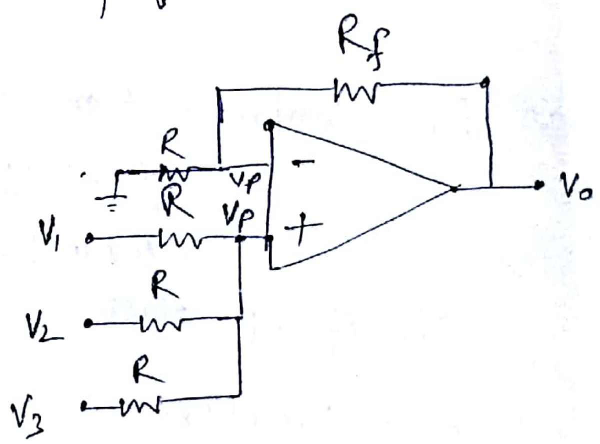
Consider: $R_1 = R_2 = R_3 = R$



$$\frac{-V_1}{R_1} - \frac{V_2}{R} - \frac{V_3}{R} = \frac{V_o}{R_f}$$

$$V_o = -\frac{R_f}{R}(V_1+V_2+V_3)$$

Non-Inverting Summer Amplifier:-



$$\frac{V_p - V_1}{R} + \frac{V_p - V_2}{R} + \frac{V_p - V_3}{R}$$

$$V_p\left[\frac{3}{R}\right] = \frac{V_1+V_2+V_3}{R}$$

$$V_p = \frac{V_1+V_2+V_3}{3} \quad —(1)$$

$$\frac{V_p}{R} + \frac{V_p - V_o}{R_f} = 0$$

$$V_p\left[\frac{1}{R} + \frac{1}{R_f}\right] = \frac{V_o}{R_f}$$

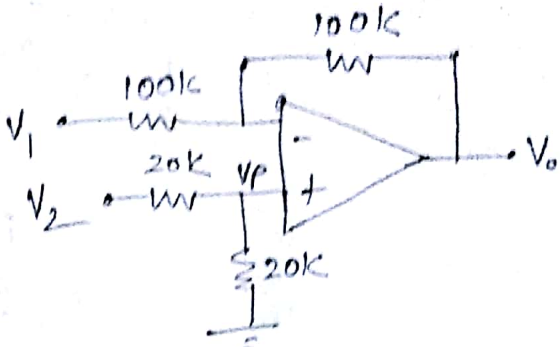
$$V_p\left[1 + \frac{R_f}{R}\right] = V_o \quad —(2)$$

Substituting (1) in (2)

$$V_o = \left[\frac{V_1+V_2+V_3}{3}\right]\left[1+\frac{R_f}{R}\right]$$

Q.3. $V_1 = V_2 = 1V$ (given)

Find $V_0 = ?$

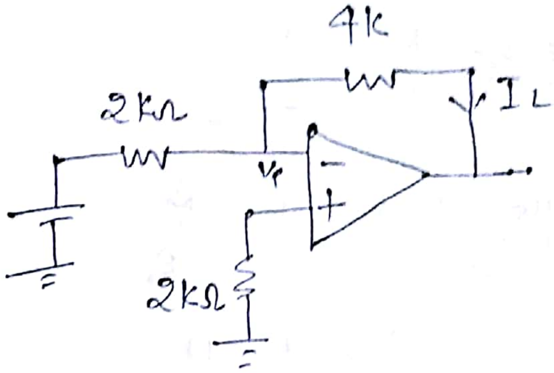


$V_p = \frac{1 \times 20}{40} = 0.5V$ — (1)

$$\frac{0.5 - V_1}{100} + \frac{0.5 - V_0}{100} = 0$$

$1 - V_1 = V_0 \Rightarrow 1 - 1 = V_0 \Rightarrow \underline{V_0 = 0V}$.

Q.4. Find $I_L = ??$



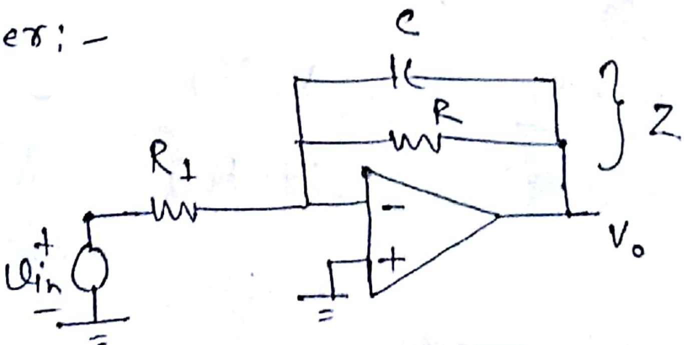
$\frac{V_p - 0}{2} = 0 \Rightarrow V_p = 0V$ — (1)

$$\frac{0 - 10}{2} = -5A$$

$-5 + I_L = 0$

$\therefore I_L = 5mA$.

Q.5. Low-Pass Filter:-



$$\frac{0 - V_{in}}{R_1} + \frac{-V_0}{Z} = 0$$

$$V_0 = -\frac{V_{in}(Z)}{R_1}$$

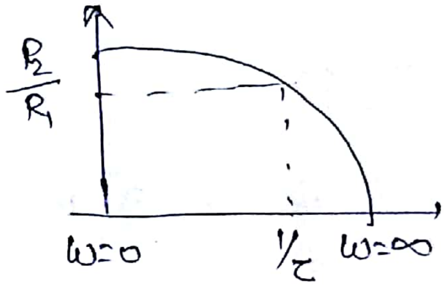
$$Z = \frac{1}{R_2} + SC_2 .$$

$$\frac{V_o}{V_{in}} = -\frac{1}{R_1}\left[\frac{R_2}{1+R_2SC_2}\right]$$

$$= -\frac{R_2}{R_1}\left[\frac{1}{1+R_2SC_2}\right]$$

$$\left|\frac{V_o}{V_{in}}\right| = \left|\frac{R_2/R_1}{1+R_2SC_2}\right| = \frac{K}{1+S\tau}$$

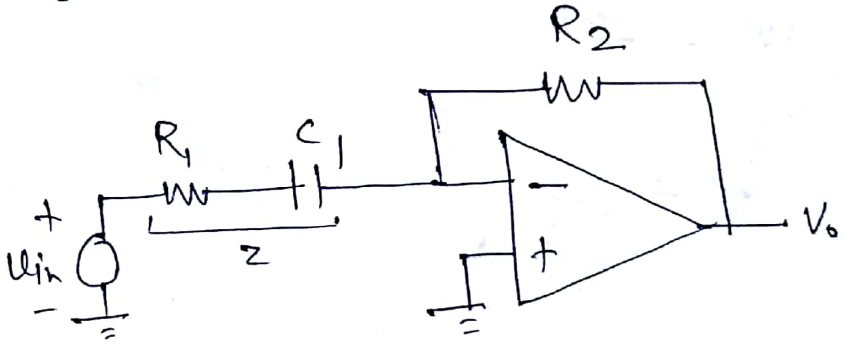
$$\omega_{3dB} = \frac{1}{\tau} = \frac{1}{R_2C_2}$$



DC gain at $\omega = 0 = \frac{R_2}{R_1}$

$\omega = \infty \quad 0$

HPF :-

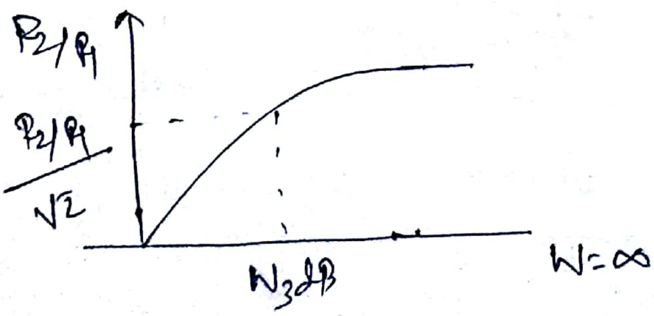


$$\frac{-V_{in}}{Z} = \frac{V_o}{R_2}$$

$$\left|\frac{V_o}{V_{in}}\right| = \frac{-R_2}{Z} = -\frac{R_2SC_1}{1+SR_1C_1} = \frac{KS}{1+S\tau}$$

$\omega = 0 \quad 0$

$\omega = \infty \quad \frac{R_2}{R_1}$



$$\frac{1}{\tau} = \frac{1}{R_1C_1}$$