MODEL TEST PAPER

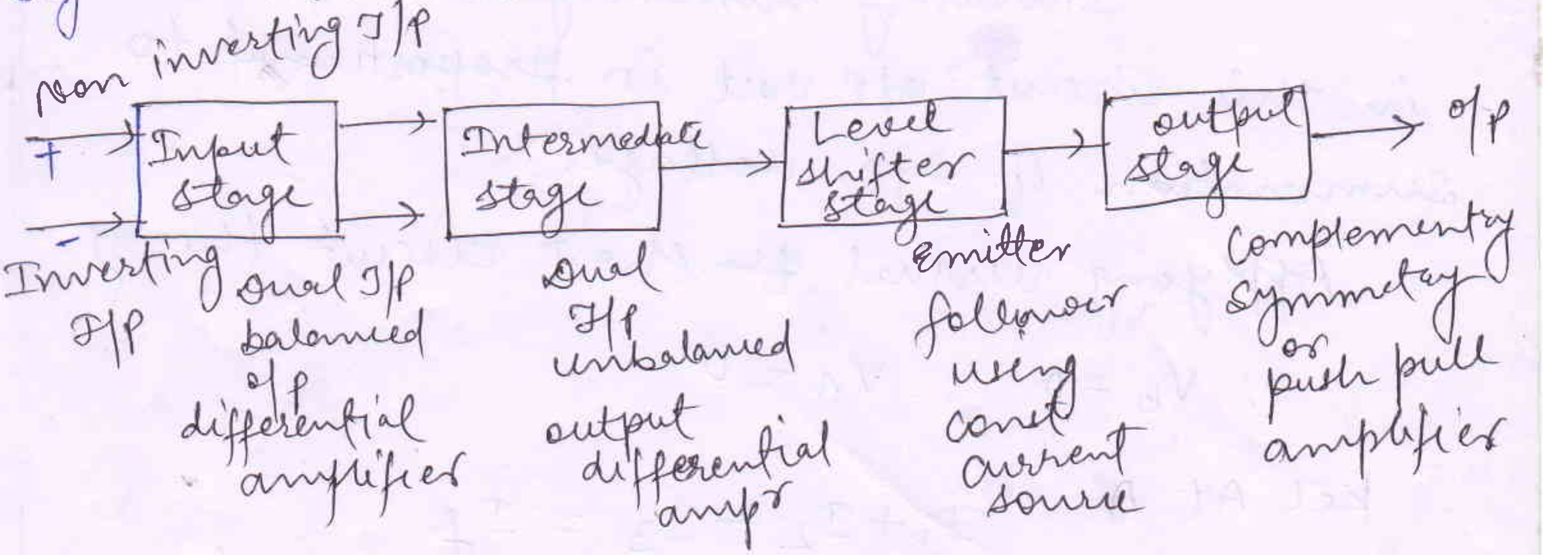
SUB CODE : 307

EL III year

Attempt any 5 questions

Q:1 What is op-Amp. explain its block diagram? 1+4

it is high volt. gain direct coupled amplifier which can perform operation on analog signals. it is available as IC 741.



op-Amp block diagram

I/P stage is dual i/p balanced o/p differential ampr. It provides volt gain & I/P impedence. Next stage is dual i/p unbalanced o/p differential amplifier. Two diffr amplifier are used to achieve high volt gain. Its o/p has DC voltage. if this DC volt reaches at o/p than it creates distortion in final o/p. So a level shifter stage is used to eliminate DC present in o/p of inter-mediate stage. Level shifter stage has high i/p impedence which prevents loading effect on intermediate stage. o/p stage is complimentary symmetry or push pull power amplifier. so that op-Amp can provide large AC power to load & low o/p resistance

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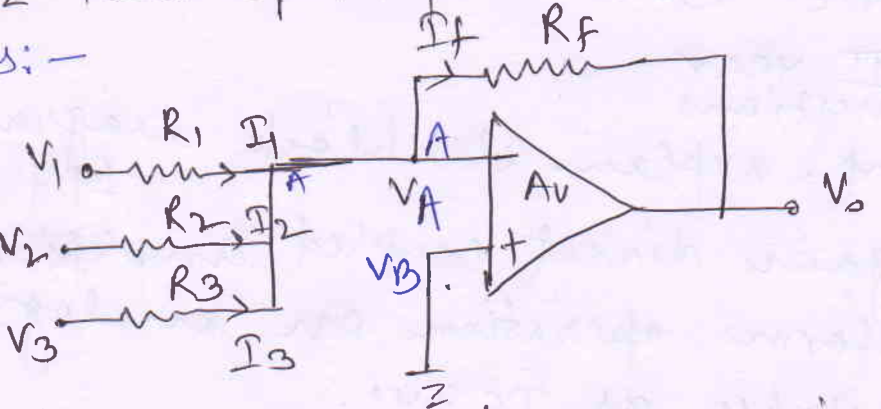
Q:2 How op-Amp can be used as Adder? Explain!

Ans:-



Inverting summing amplifier

in this circuit o/p volt is proportional to summation of i/p voltages

Applying virtual ~~th~~ short circuit theory

$\because V_B = 0 \quad \therefore V_A = 0$

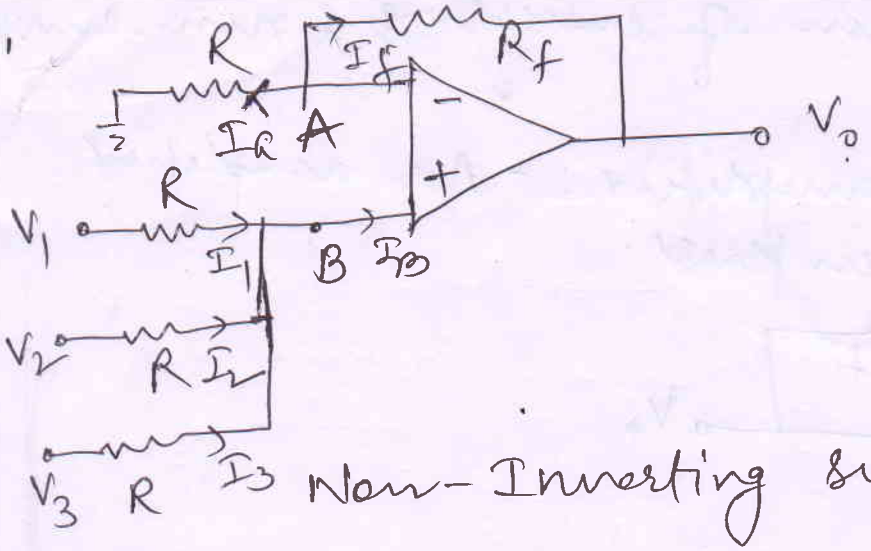
KCL At A $\quad I_1 + I_2 + I_3 = I_f$

$$\frac{V_1 - 0}{R_1} + \frac{V_2 - 0}{R_2} + \frac{V_3 - 0}{R_3} = \frac{0 - V_o}{R_f}$$

$$V_o = -R_f\left(\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3}\right)$$

if $R_1 = R_2 = R_3 = R$

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



Non-Inverting summing amplifier.

Applying KCL At node B

$$\frac{V_1 - V_B}{R} + \frac{V_2 - V_B}{R} + \frac{V_3 - V_B}{R} = 0$$

(∵ I/P impedence of op Amp is very high)

$$V_B = \frac{V_1 + V_2 + V_3}{3}$$

Now According to virtual ground theory

$$V_A = V_B$$

Apply KCL at node A ⇒ $I_a + I_f = 0$

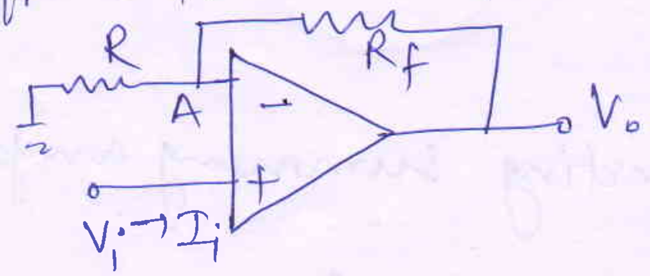
$$\frac{V_B - 0}{R} + \frac{V_B - V_0}{R_f} = 0 \Rightarrow V_B\left[\frac{R_f + R}{R \cdot R_f}\right] = \frac{V_0}{R_f}$$

$$V_0 = \left(1 + \frac{R_f}{R}\right)\left(\frac{V_1 + V_2 + V_3}{3}\right)$$

$$\text{Amplification factor} = \frac{1}{3}\left(1 + \frac{R_f}{R}\right)$$

Q:3 Calculate the gain of inverting & non-inverting amplifier ?.

Non inverting amplifier :- An amplifier whose o/p & i/p are in phase.



R & Rf creates negative feedback.
due to negative feedback
V_d = very small

$V_d \simeq 0$.

$V_i - V_A = 0$

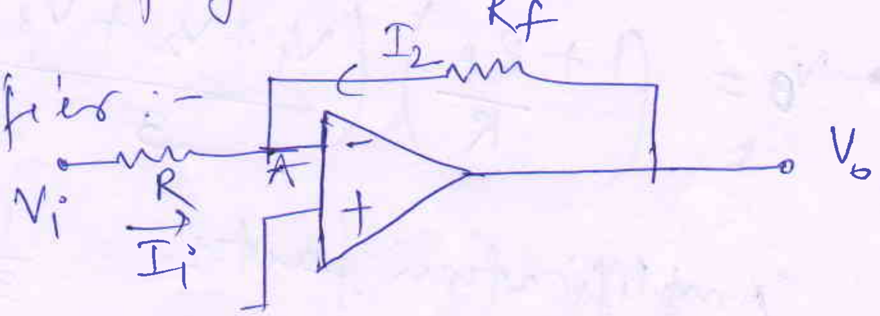
$$V_A = V_o \times \frac{R}{R+R_f}$$

$$V_i = V_o \times \frac{R}{R+R_f}$$

$$V_o = \left(1+\frac{R_f}{R}\right) \cdot V_i \Rightarrow \boxed{A_{CL} = \frac{V_o}{V_i} = 1+\frac{R_f}{R}}$$

A_{CL} → closed loop gain

Inverting amplifier :-



An amplifier whose i/p & o/p are out of phase by 180°.

R & Rf creates -ve feedback.
Due to -ve feedback virtual short circuit will be present b/w two i/p nodes.

$\therefore V_A = 0$

KCL at node A $\rightarrow I_1 + I_2 = 0$

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

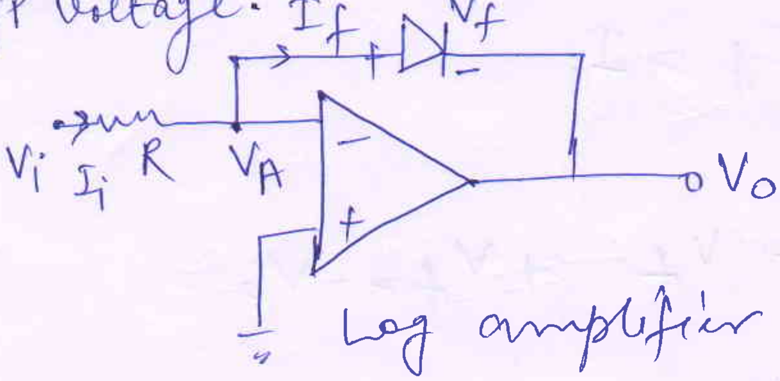
$$V_o = \frac{-R_f}{R} \cdot V_i$$

close loop gain

$$A_{CL} = \frac{V_o}{V_i} = \frac{-R_f}{R}$$

Q:4 → explain Log amplifier ?

In this amplifier o/p volt is proportional to logarithmic of i/p voltage.



Log amplifier

Current for p-n Junction diode

$$I_f = I_0 \left(e^{V_f/\eta V_T} - 1\right)$$

I_f = forward bias current

V_f = forward volt drop

$= V_T = \frac{KT}{q}$ = ~~Boltzmann~~

I_0 = saturation current

for Ge ⇒ $\eta = 1$

for Ge ⇒ $\eta = 2$

$$I_f = I_0 e^{V_f/\eta V_T} \qquad \left(\because \frac{V_f}{\eta V_T} >> 1\right)$$

$$V_f = \eta V_T \log\left(\frac{I_f}{I_0}\right)$$

$$I_f = \frac{V_i - V_A}{R}$$

Apply virtual ground theory

$$V_A = 0$$

$$I_i = I_f = \frac{V_i}{R}$$

Apply KCL At A

$$I_f = I_i$$

$$0 - V_0 = V_f \Rightarrow V_f = -V_0$$

$$V_0 = -\eta V_T \log\left(\frac{V_i}{R \cdot I_0}\right)$$

$$\boxed{V_0 \propto \log V_{in}}$$

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