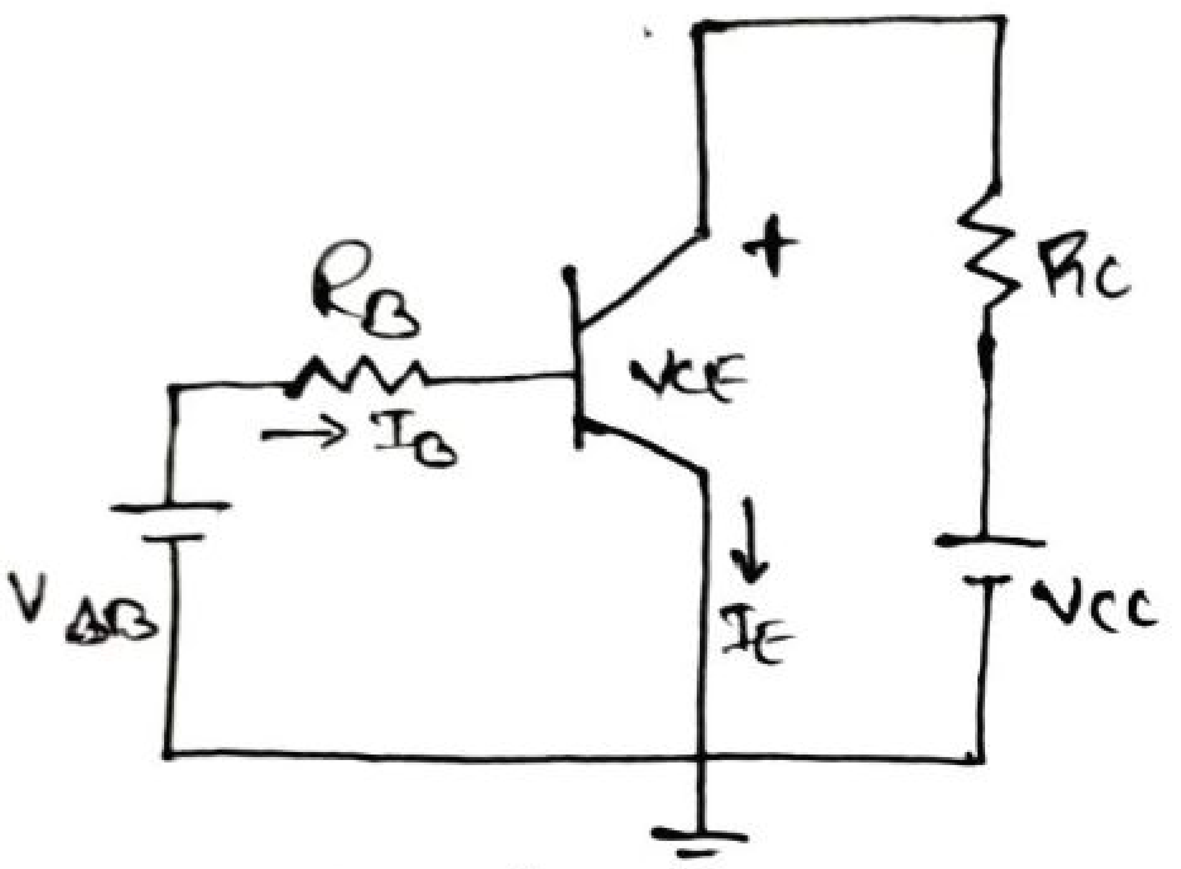
Assignment No:- 01.

1) The operating point:-

The dc currents and voltages in the circuit are established by using a resistive network along with a dc power supply.



characteristics

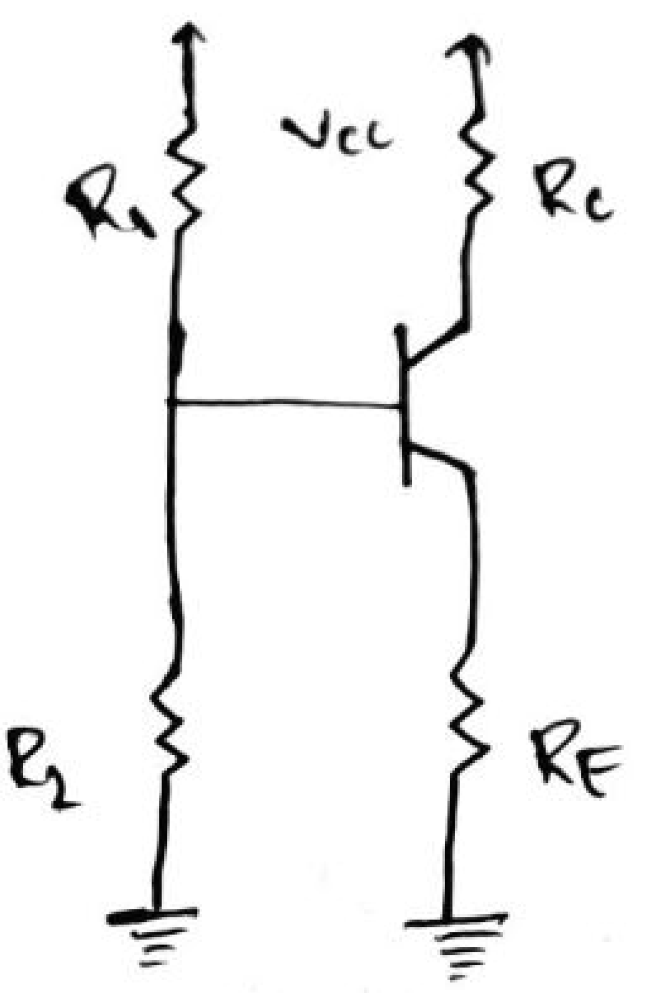
-> there are three region of operations
1) active region 2) cut-off region 3) saturation region

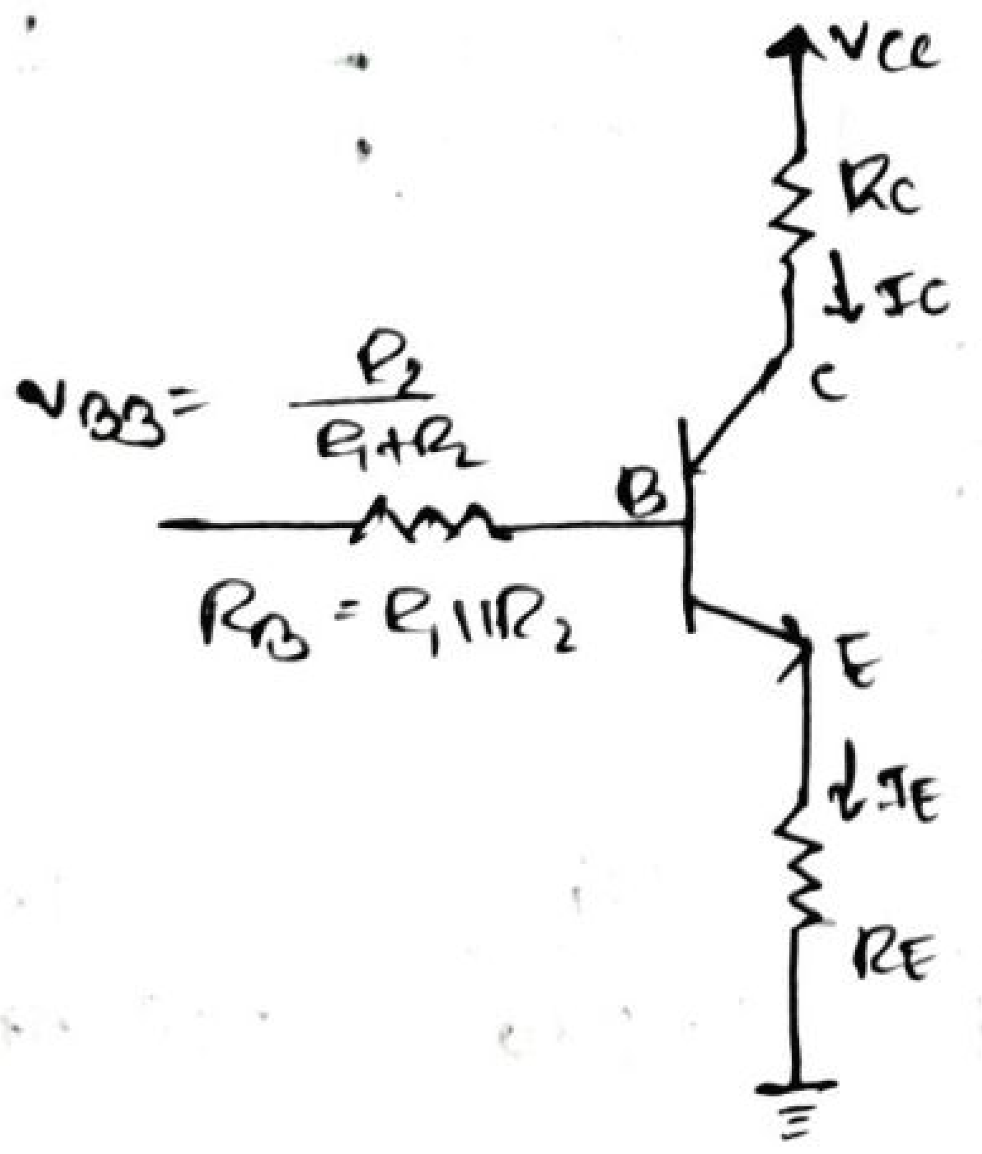
-> the transistor is required to be biased from cut of to saturation

-> the BJT is must be biased in the active region when used an amplifier

-> the transistor functions linearly when its operation is restricted to active region.

2) classical discrete-circuit bias:-





Kvl to input

$$V_{BB} = R_B I_B + R_E I_E + V_{BE}$$

$$= I_B R_B + V_{BE} + (1+\beta) I_B R_E$$

$$= I_B (R_B (1+\beta) R_E + V_{BE}$$

$$\boxed{I_B = \frac{V_{BB} - V_{BE}}{R_B + (1+\beta) R_E}}$$

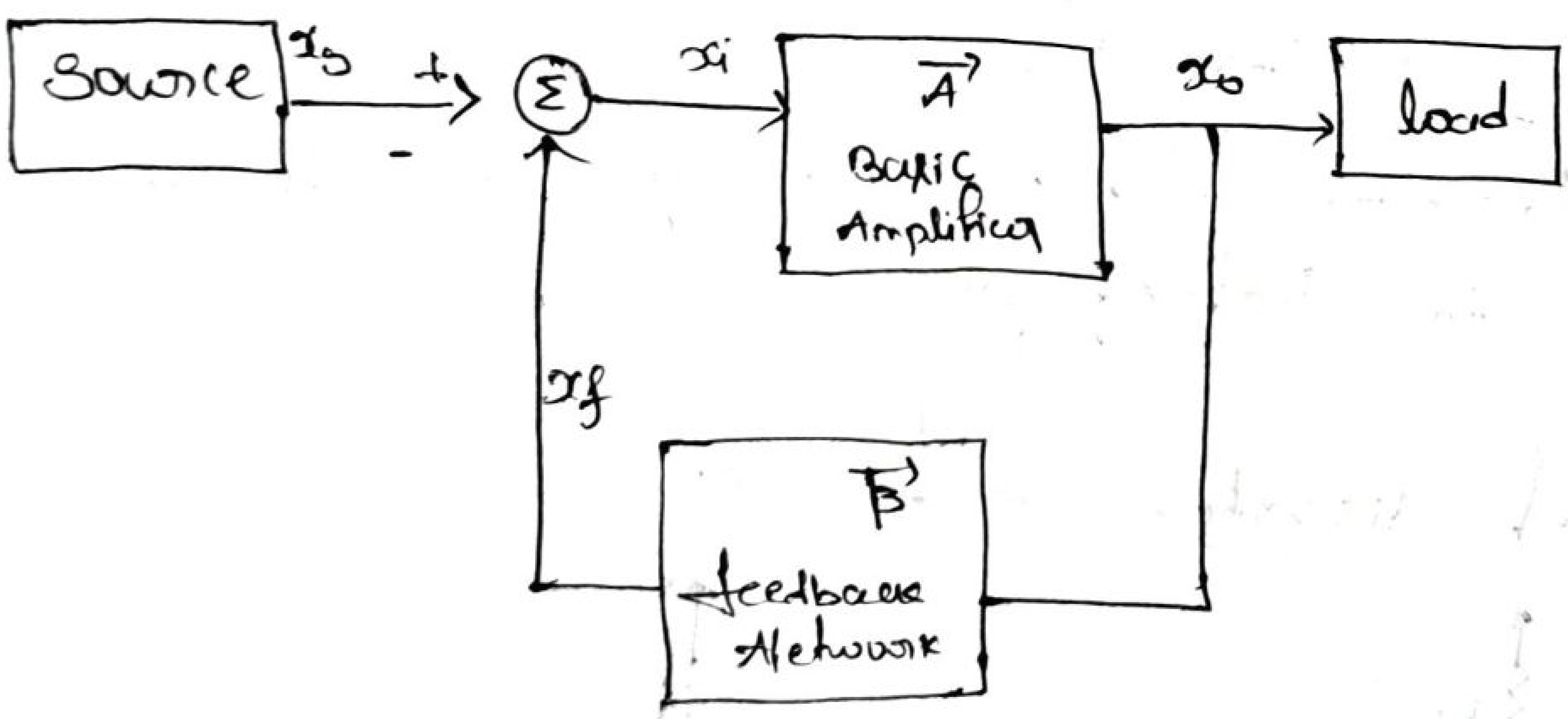
Kvl to output

$$V_{CC} - R_C I_E - R_E I_E = 0$$

$$V_{CC} - R_C I_E - V_{CE} + R_E I_E = 0$$

$$\boxed{I_C = \frac{V_{CC} - V_{CE}}{R_E + R_C}}$$

3] The General feedback structure:-



$$x_o = A x_i \rightarrow (1)$$

$$x_f = \beta x_o \rightarrow (2)$$

$$x_i = x_s - x_f - (3)$$

$$A_f = \frac{x_o}{x_s} = \frac{x_o}{x_i + x_f} = \frac{A x_i}{x_i + \beta x_o} = \frac{A x_i}{x_i + A\beta x_i} = \frac{A}{1 + A\beta} \rightarrow (4)$$

$$\boxed{\therefore A_f = \frac{x_o}{x_s} = \frac{A}{1+A\beta}}$$

$$x_f = \beta x_o = \frac{A\beta . x_o}{1+A\beta} \quad \text{from eqn (4).}$$

$$\boxed{x_f = \frac{A\beta}{1+A\beta} . x_s} \rightarrow (5)$$

4] Properties of negative feedback

1) Gain desensitivity

$$A_f = \frac{A}{1+\beta A} \rightarrow (1)$$

diff w.r.to 'A'

$$\frac{dA_f}{dA} = \frac{d}{dA}\left(\frac{A}{1+\beta A}\right)$$

$$\frac{(1+\beta A) . A \beta}{(1+\beta A)^2}$$

$$= \frac{1+\cancel{A\beta} . \cancel{A\beta}}{(1+\beta A)^2}$$

$$\boxed{\frac{dA_f}{dA} = \frac{1}{(1+\beta A)^2}} \rightarrow (2)$$

divide eqn (2) by (1)

$$\frac{\frac{dA_f}{dA}}{A_f} = \frac{\frac{1}{(1+\beta A)^2}}{\frac{A}{1+\beta A}}$$

$$= \frac{1}{(1+\beta A)^2} \times \frac{(1+\beta A)}{A}$$

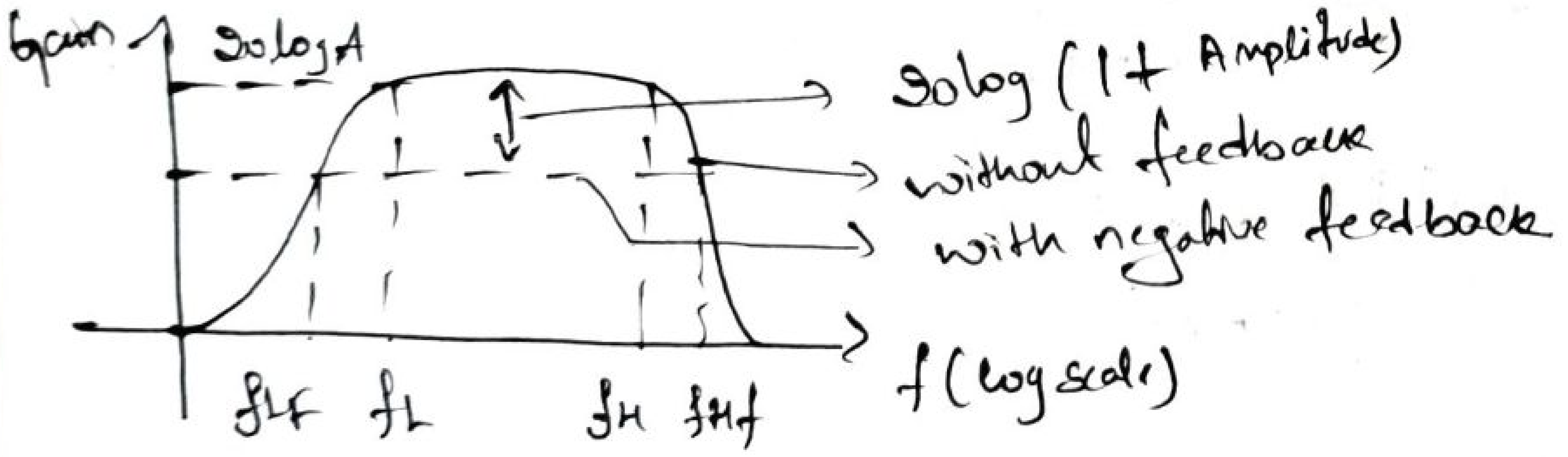
$$\boxed{\frac{dA_f}{dA} \times \frac{1}{A_f} = \frac{1}{A(1+\beta A)}}$$

$$\frac{dA_f}{A_f} = \frac{dA}{A}\left(\frac{1}{1+\beta A}\right)$$

$$\frac{\frac{dA_f}{A_f}}{\frac{dA}{A}} = \left(\frac{1}{1+\beta A}\right)$$

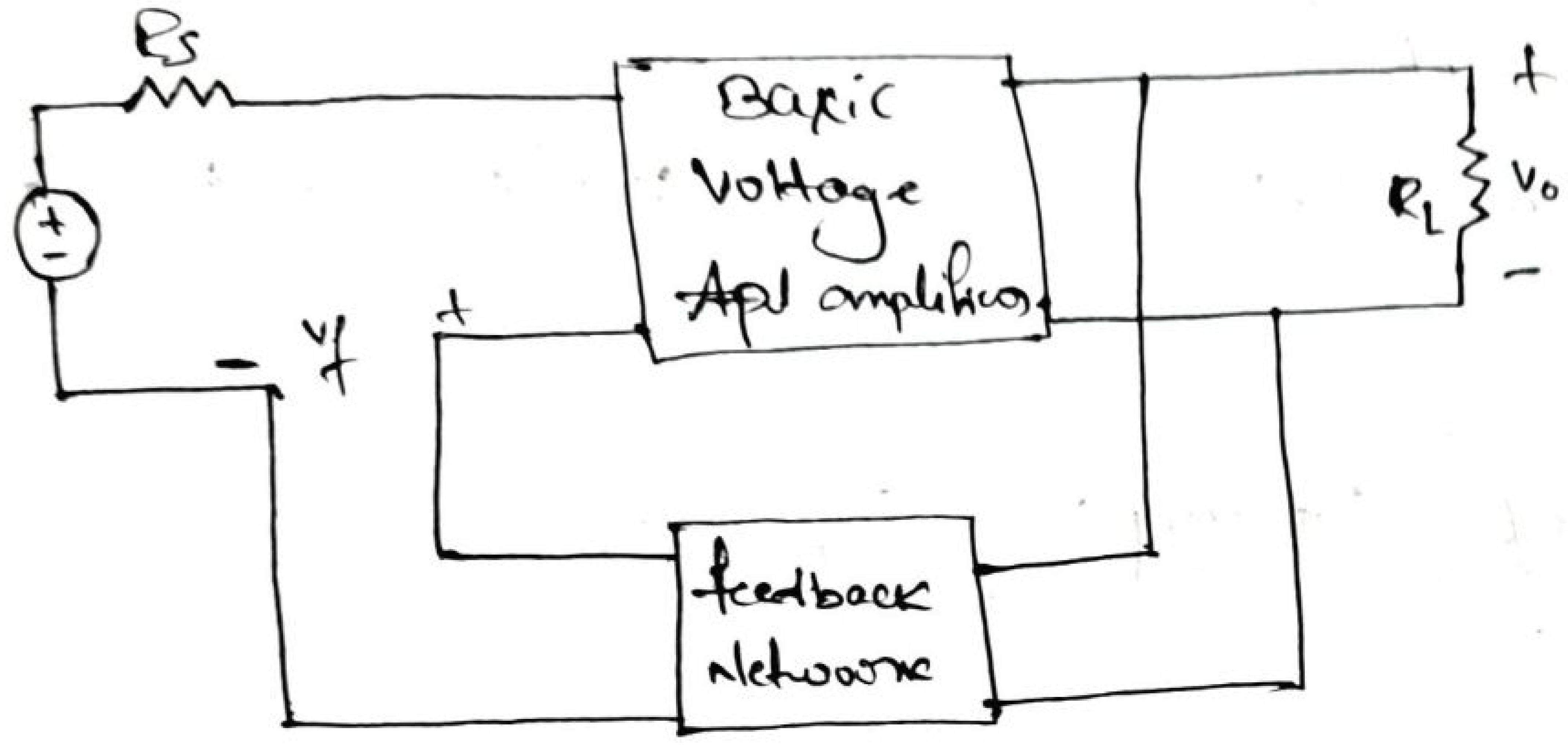
$$\boxed{S = \frac{1}{1+\beta A}} \rightarrow (3)$$

5) Band width improvement:-



(6) Feedback topologies :.

i) Voltage Series topology :- [e vm, vs]



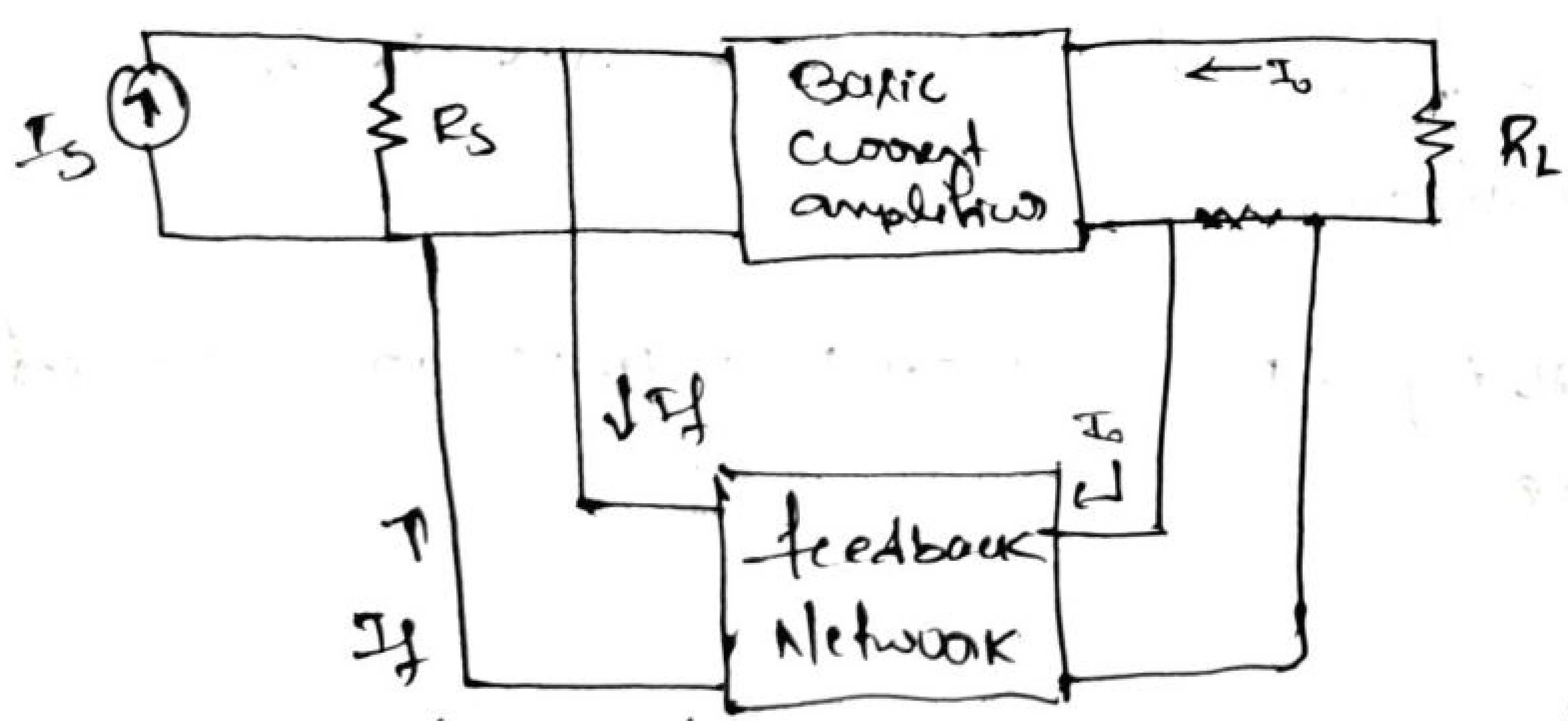
→ voltage amplifier are intended to amplify an input voltage signal and provide output voltage

→ the input impedence is required to be high output impedence required to low

→ the voltage amplifier is essentially a voltage - controlled voltage source

→ A Suitable feedback topology for voltage amplifier is a voltage mixing . voltage sampling.

ii) Current amplifier :. [cm ,vs] [current shunt topology]



→ the input signal in a current amplifier is current

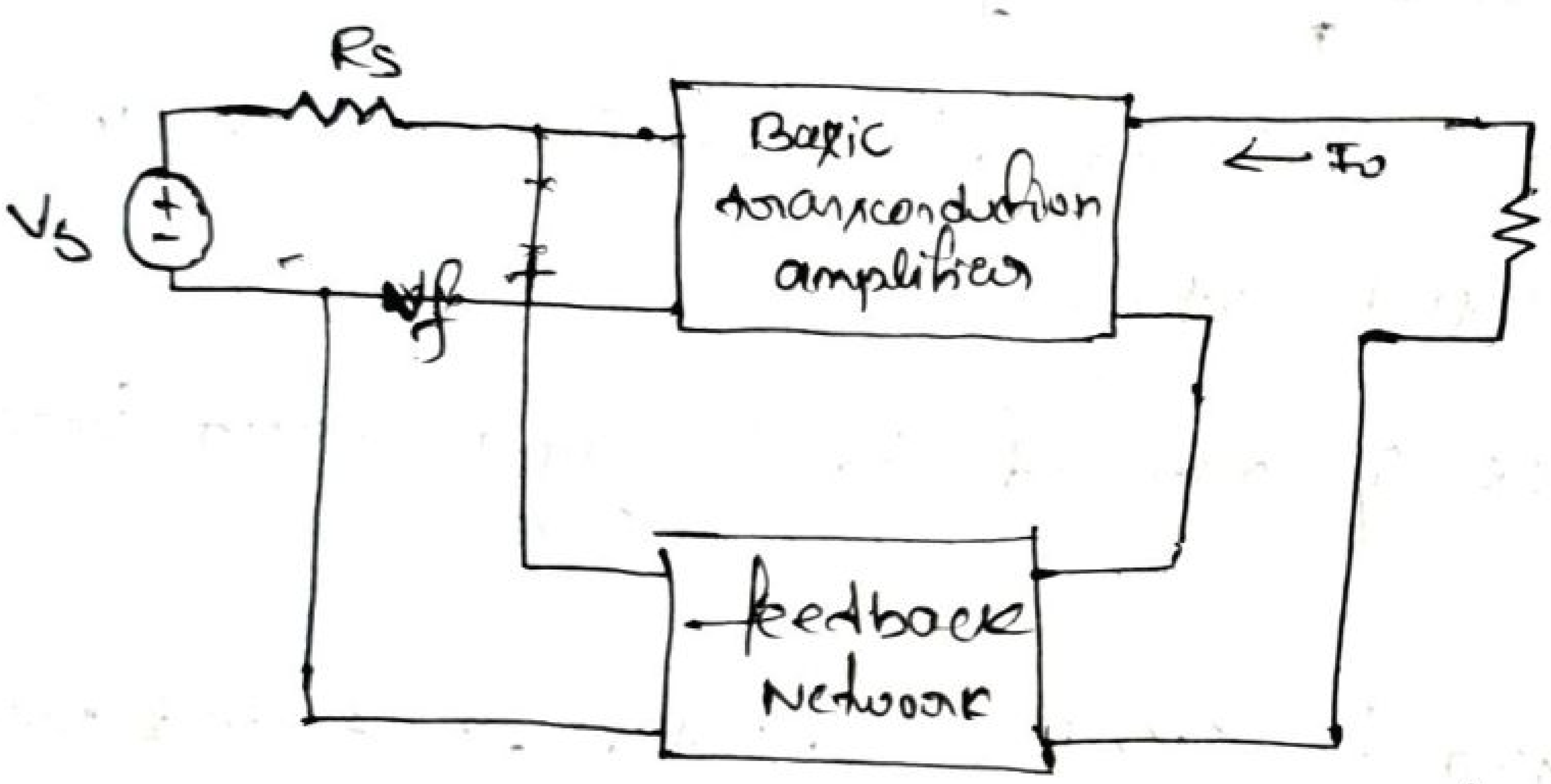
→ the output quantity of interest is current , feed back network should be sample the output current

-> the feedback signal should should be current so that it may be mixed in shunt source signal

-> the feedback topology suitable for a current is cm, cs topology.

-> parallel connection at the input and series connection at output

3) current series topology :- (vm, cs)



-> transconductance amplifier the input signal is a voltage and the output signal is a current

-> the feedback topology is VM - CS topology,

-> series connection at both the input & output given the feedback topology,

-> the series connection at the input results in an increased input resistance

-> the series sampling at the output results in increased output resistance

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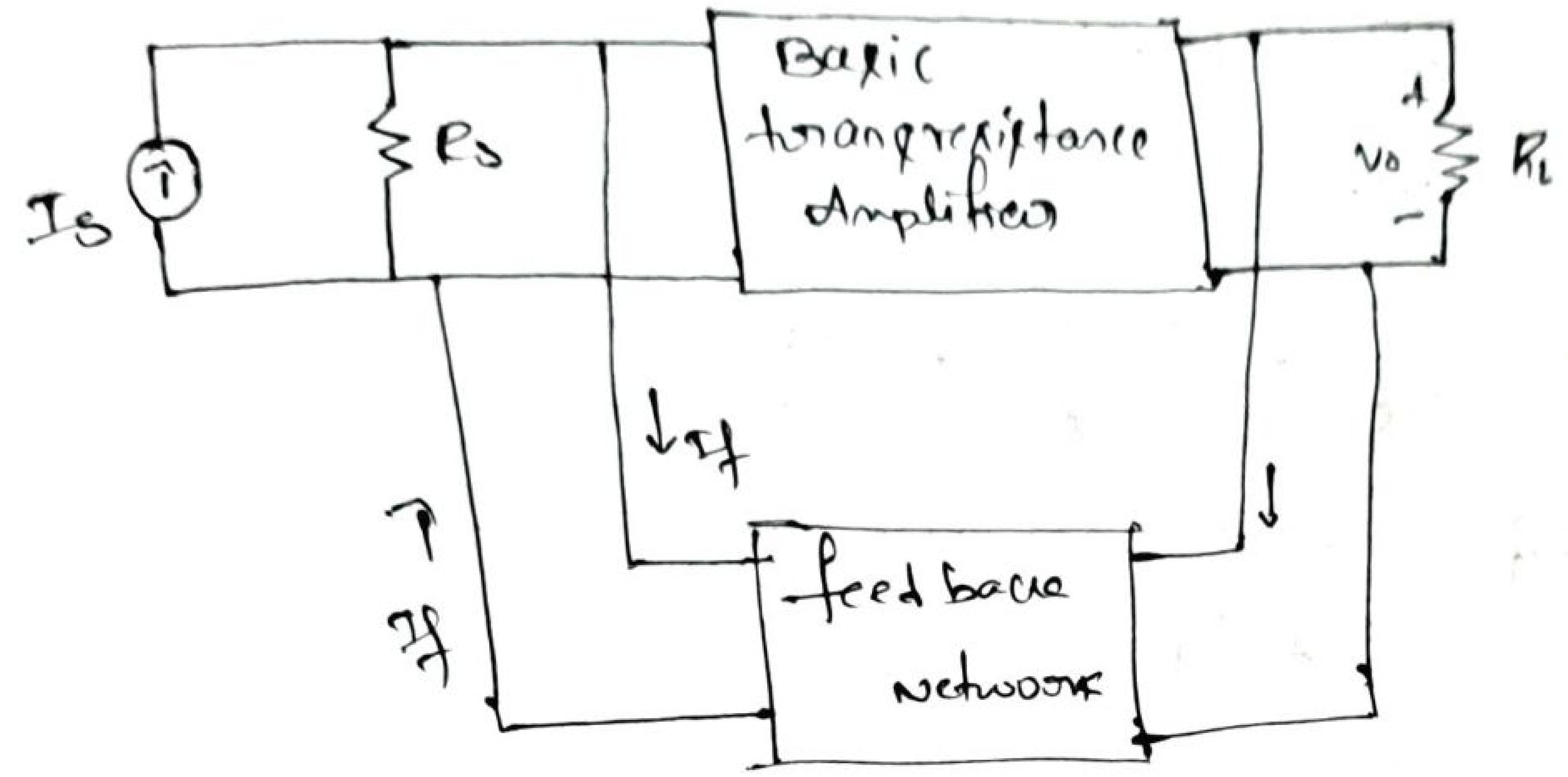
9] Voltage - shunt topology :- (Cm . V13)



→ transresistance amplifier input signal is current and output signal is voltage

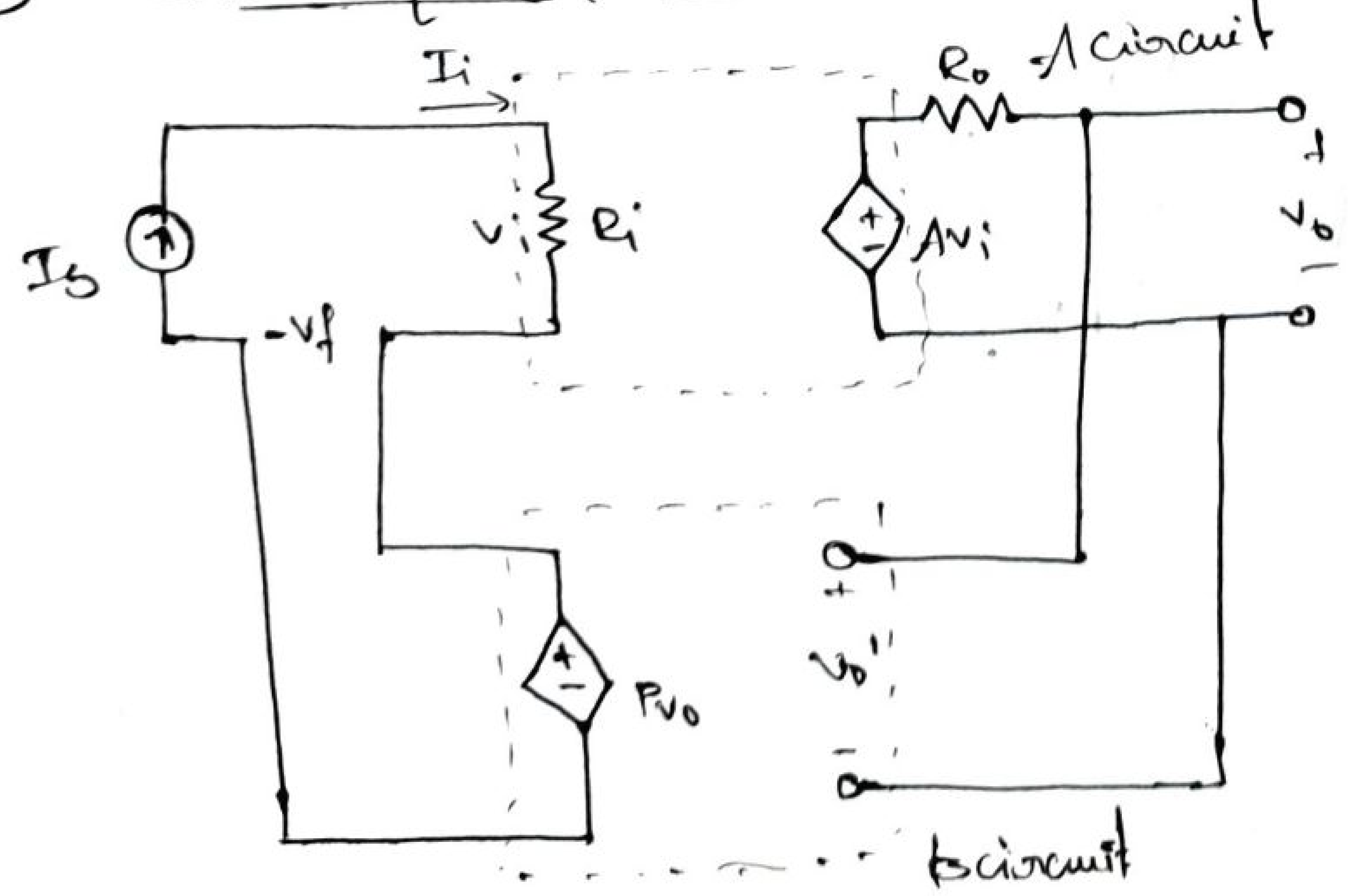
→ feedback topology is current mixing . voltage sampling

→ the parallel connect of both the input and output makes feedback topology known as shunt - shunt feed back

→ the shunt connection at the input causes the input resistance

→ the shunt connection at the output stabilizes the output voltage

10] Shunt series feedback amplifier



(1) closed loop gain

$$A_f = \frac{I_o}{I_f} = \frac{A}{1+A\beta} \longrightarrow (1)$$

(2) Input resistence

$$R_{if} = \frac{V_i}{I_f} = \frac{R_i I_i}{I_f} = \frac{R_i I_i}{I_f}$$

$$R_{if} = \frac{R_i I_i}{I_f + I_i}$$

$$= \frac{I_i R_i}{I_i(1+A\beta)}$$

$$\boxed{R_{if} = \frac{R_i}{1+A\beta}}$$

(3) Output resistence

$$R_{op} = \frac{V_E}{V}$$

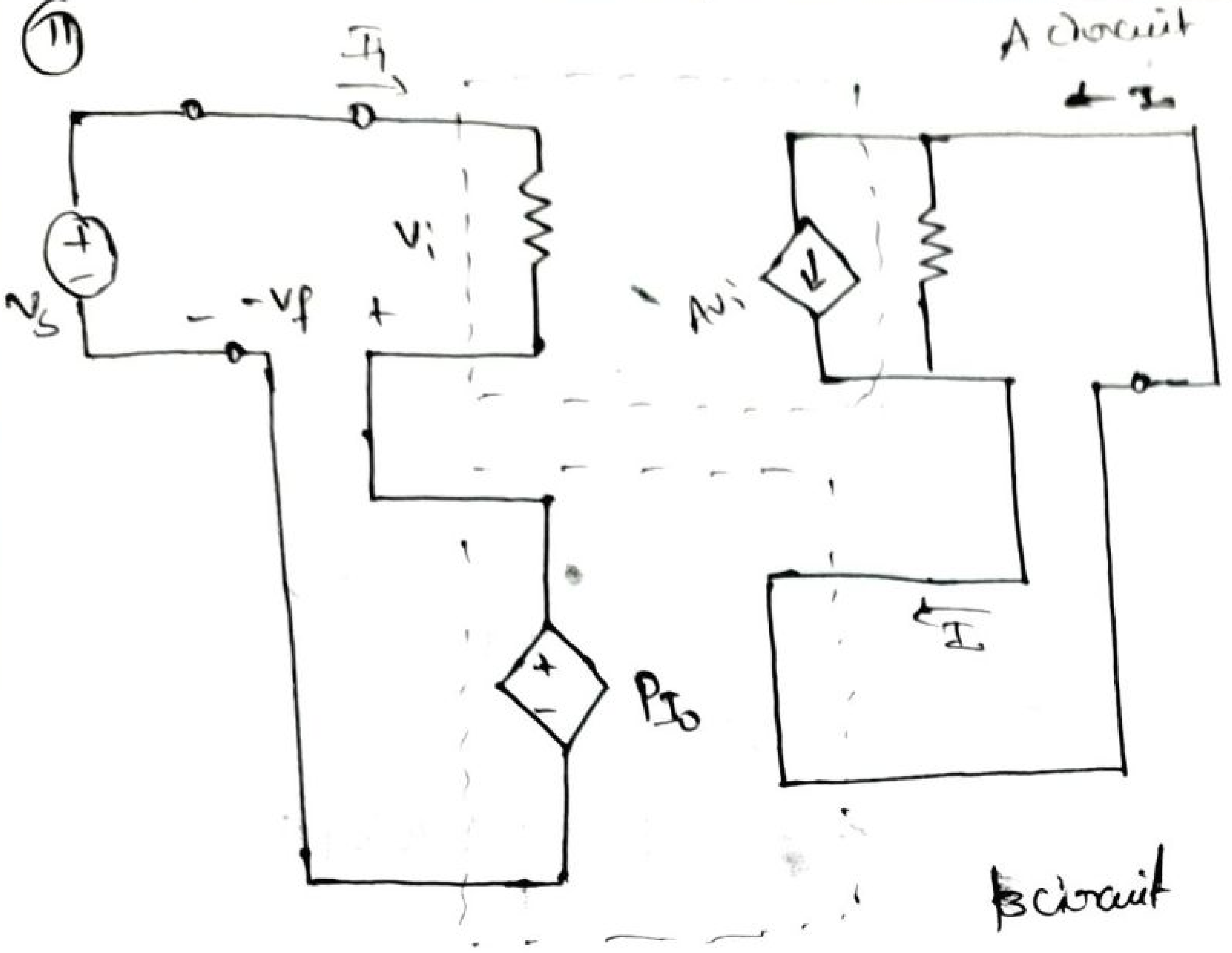
$$I = \frac{V_f - AV_i}{R_o}$$

$$V = \frac{V_f + A\beta V_A}{R_o}$$

$$\boxed{R_{of} = \frac{R_o}{1+A\beta}}$$

Shunt - shunt feedback amplifier circuit

(11)



(1) closed - loop gain

$$A_f = \frac{I_o}{V_s} = \frac{A}{1+A\beta} \rightarrow (1)$$

(2) Input resistance

$$R_{if} = \frac{V_s}{I_i} = \frac{V_s}{I_i / R_i} = R_i \frac{V_s}{I_i}$$

$$\Rightarrow R_i \frac{V_i + \beta V_o}{V_i} \Rightarrow R_i \frac{V_i + \beta V_i}{V_i}$$

$$\boxed{\therefore R_{if} = R_i(1+A\beta)} \rightarrow (2)$$

(3) output resistance

$$V_{of} = \frac{V_o}{I_o} \rightarrow (a)$$

$$I_o = \frac{V_o(1+A\beta)}{R_o} \rightarrow (b)$$

Sub eqn (b) in (a)

$$\Rightarrow R_{of} = \frac{V_o}{\frac{V_o(1+A\beta)}{R_o}}$$

$$\boxed{R_{of} = \frac{R_o}{1+A\beta}} \rightarrow (3)$$

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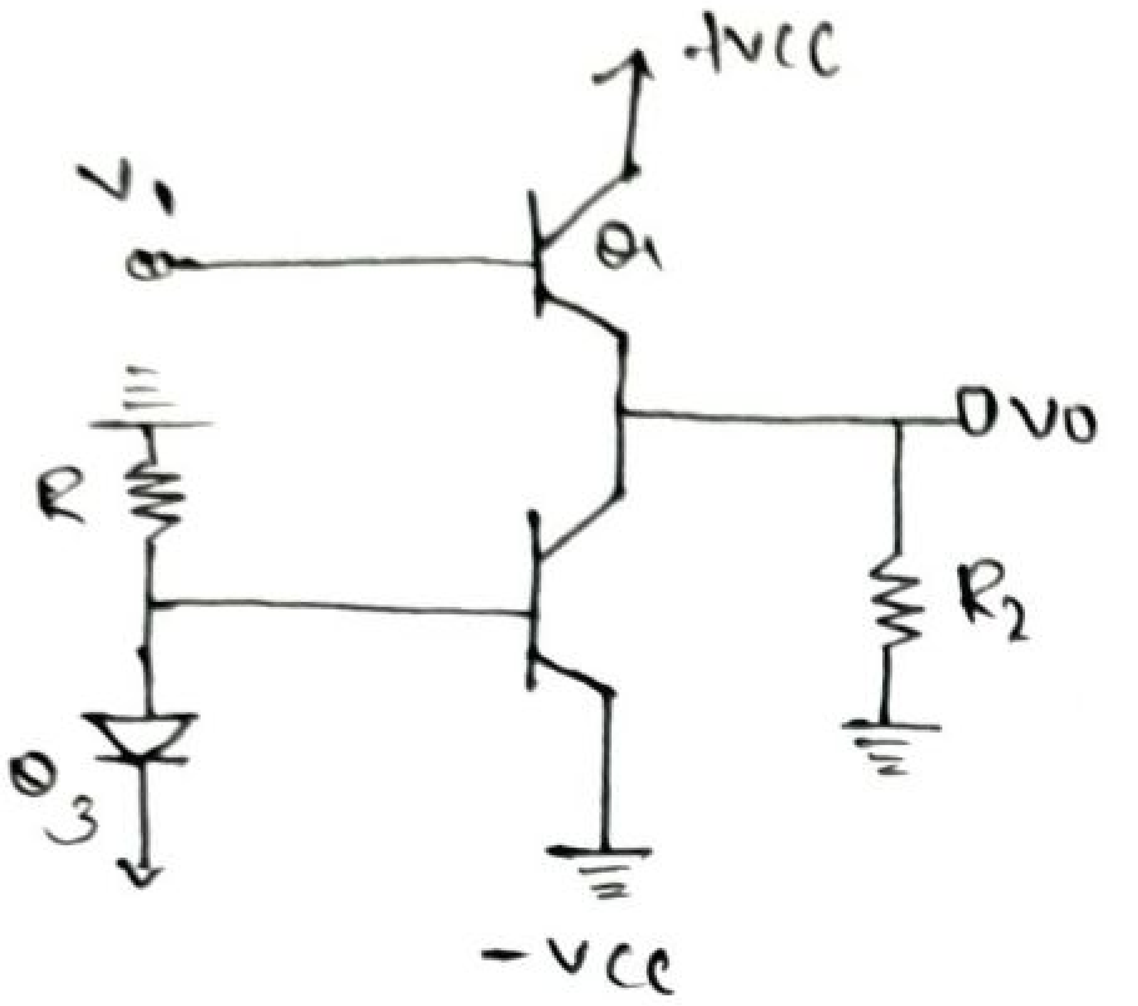
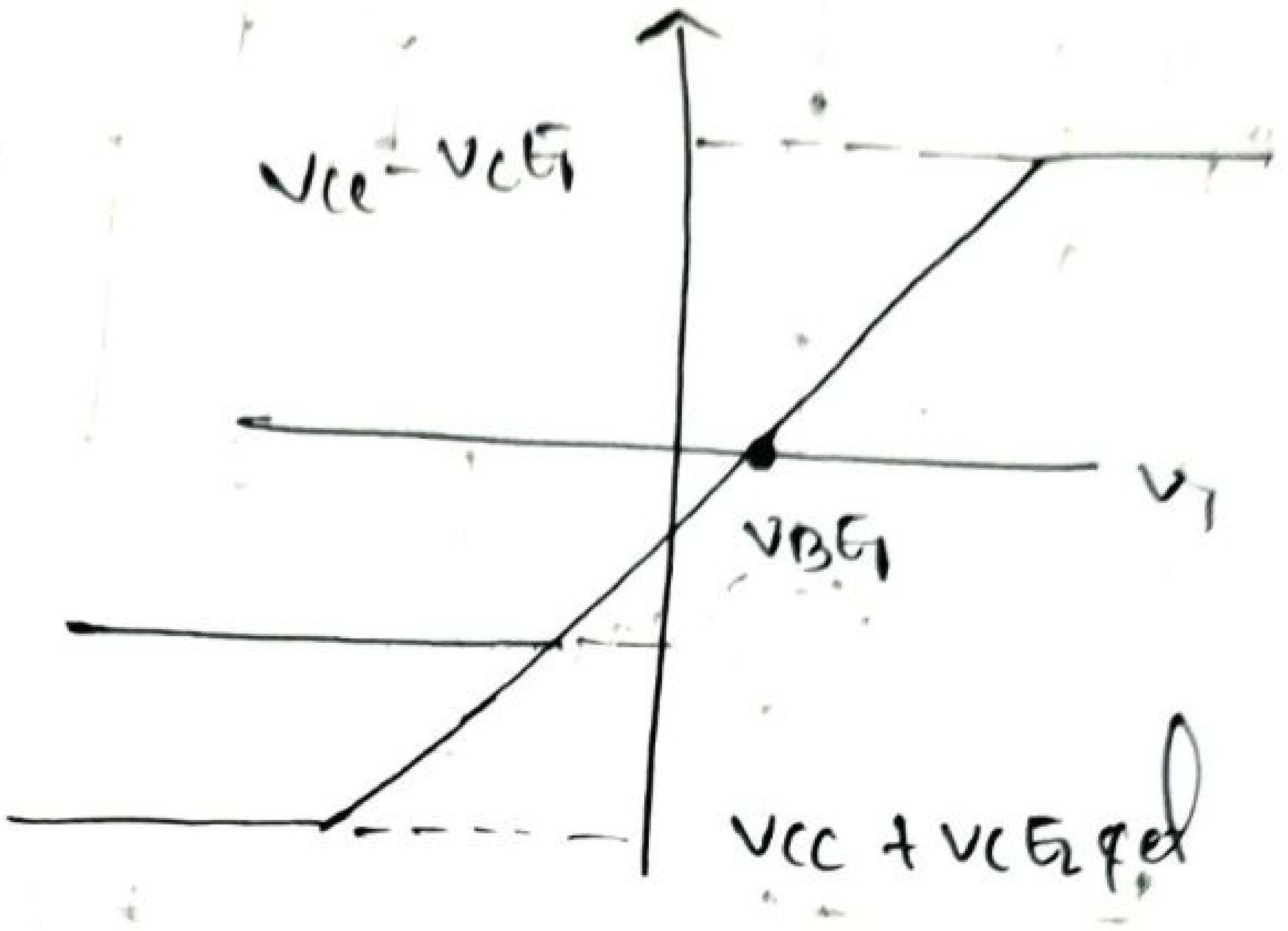
(12) power amplifier types.

class A: output stage :-





output operation

$$V_0 = V_1 - V_{BE_1} \rightarrow (1)$$

transfer characteristic

$$V_1 = V_{BE_1} + V_0$$

$$\boxed{V_0 = V_1 - V_{BE_1}} \rightarrow (1)$$

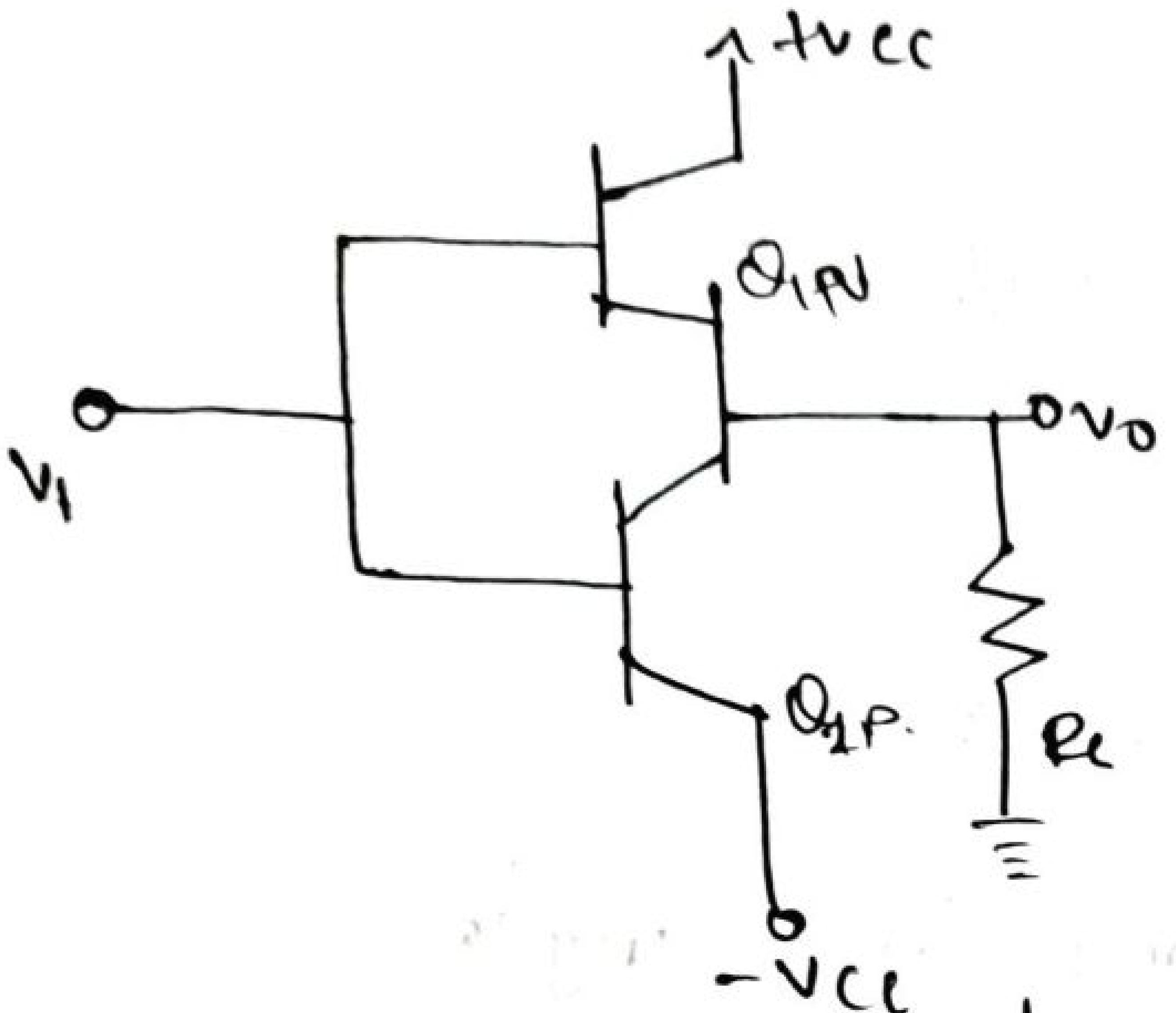
$$\boxed{V_{omax} = V_{CC} - V_{CE_1}} \rightarrow (2)$$

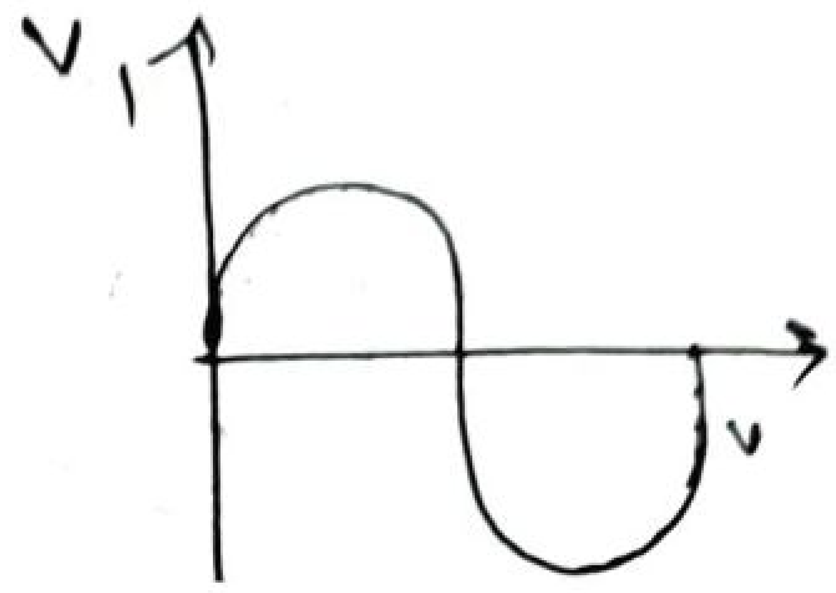
from $Q_1 \rightarrow$ $V_{omin} = -IR_L \rightarrow (3)$

$Q_2 \Rightarrow$ $V_{omin} = -V_{CC} + V_{CE_2} \rightarrow (4)$

$$\boxed{I \geq \frac{-V_{CC} + V_{CE_2}}{R_L}}$$

(13) class B- output stage





During +ve half cycle of I/p signal

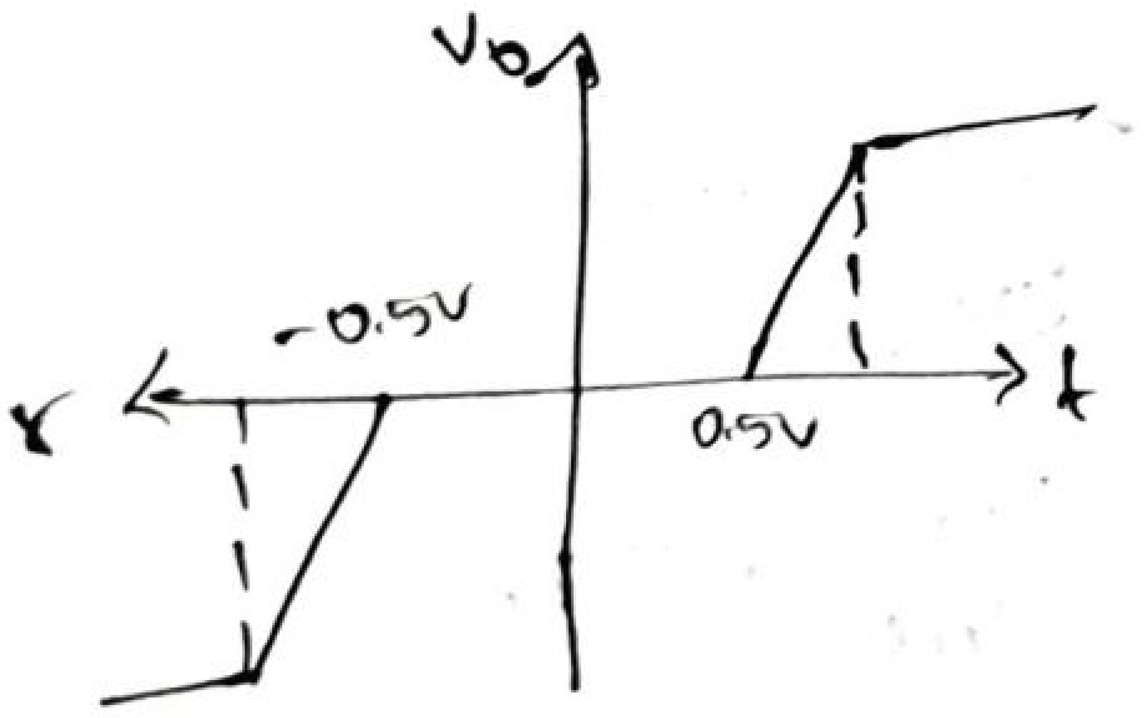
$V_0 = V_1 - V_{BEN} \rightarrow (1)$

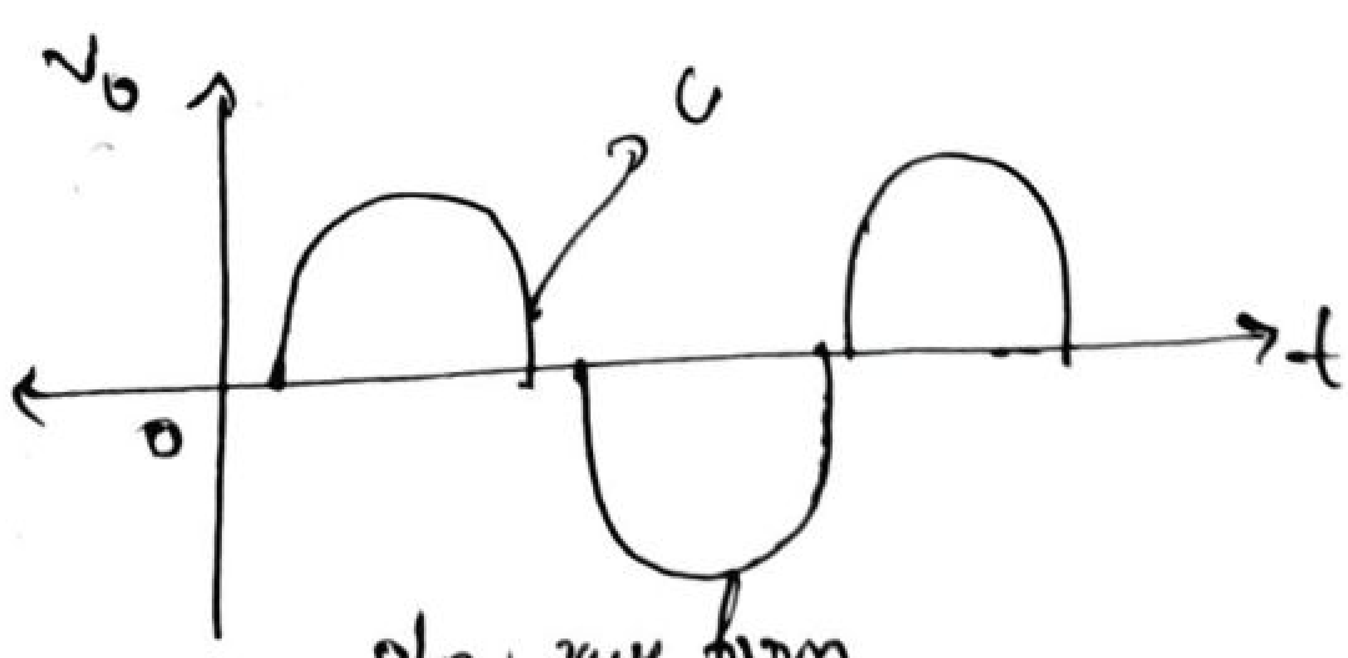
$$\boxed{V_0 = V_1 - V_{BEN}}$$

During -ve half cycle of I/p signal,

$$\boxed{V_0 = V_1 + V_{BEP}}$$

characteristic of class B





o/p wave form

(14) power conver efficiency of class B. maximum efficiency of 78%.

$$\eta\% = \frac{\text{load power } P_L}{\text{Source power } P_S} * 100\% \rightarrow (1)$$

avg load power is

$$P_L = \frac{1}{2}\frac{V_o^2}{R_L} \rightarrow (2)$$

Avg power drawn from two supply is

$$P_{st} = P_S = \frac{1}{\pi}\frac{V_o}{R_L} V_{cc} \rightarrow (3)$$

total power supply is

$$P_S = \frac{2V_o}{\pi R_L} V_{cc} \rightarrow (4)$$

Sub eqn (3) & (4) in (1) we get

$$\eta\% = \frac{\frac{1}{2}\frac{V_o^2}{R_L} V_{cc}}{\frac{2}{\pi}\frac{V_o}{R_L} V_{cc}} \times 100\%$$

$$= \frac{1}{2}\frac{V_o^{\cancel{2}}}{\cancel{R_L}} \times \frac{\cancel{R_L}.\pi}{2\cancel{V_o}.V_{cc}} \times 100\%$$

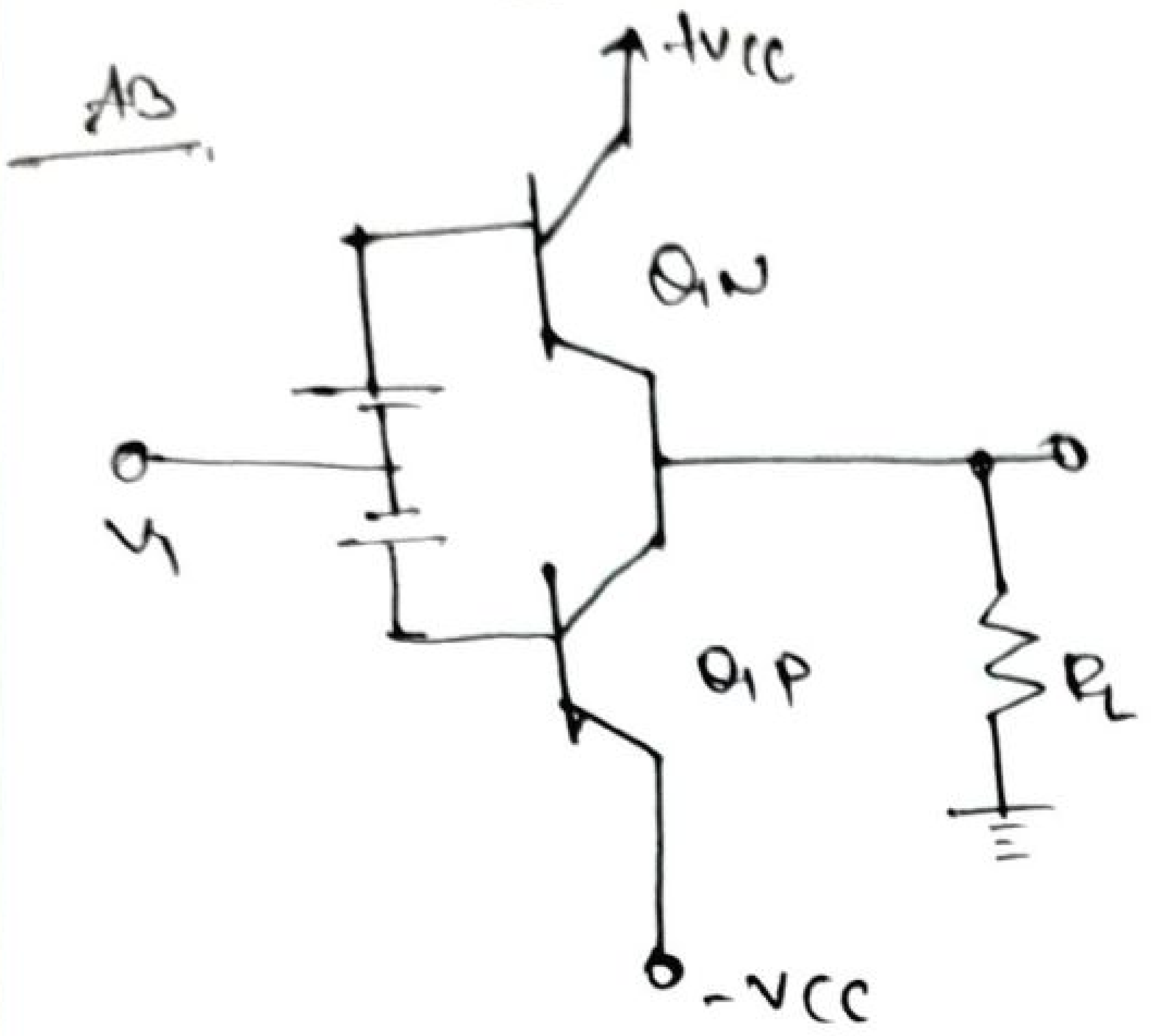
$$\eta\% = \frac{\pi}{4}\frac{V_o}{V_{cc}} * 100\%$$

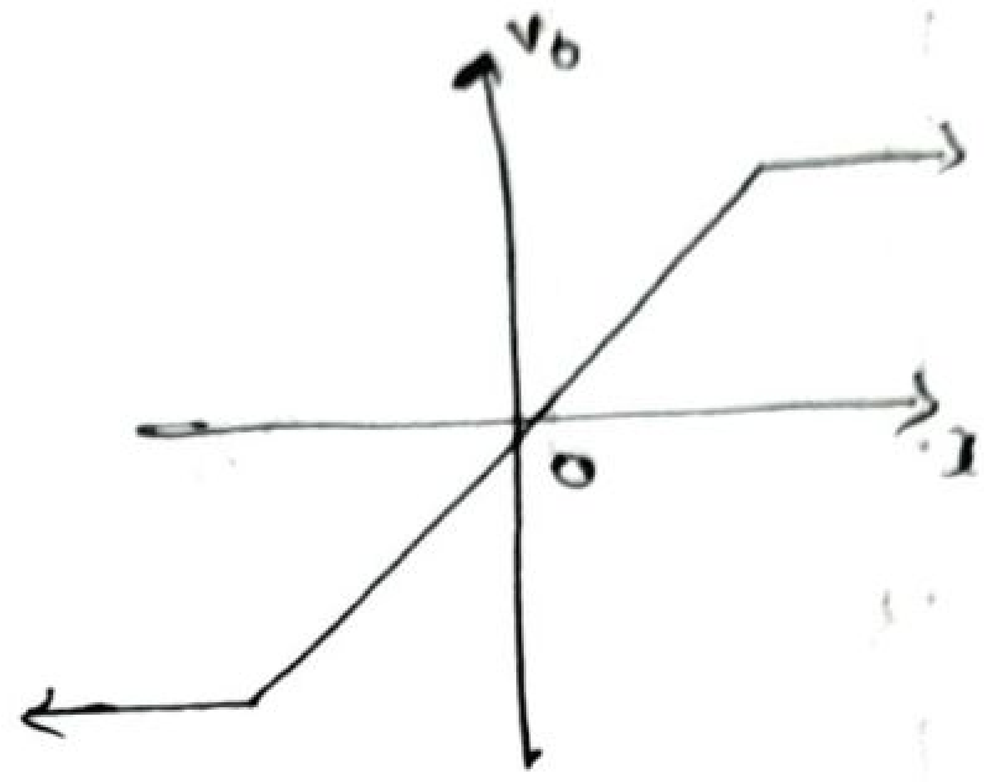
$$\eta\% = \frac{\pi}{4} \times 100\%$$

$$\boxed{\eta = 78.5\%}$$

15 class AB and class C output stage

AB





Apply KVL I/p

$$V_1 + \frac{I_{BB}}{2} = V_{BEN} + V_0$$

$$\boxed{V_0 = V_1 + \frac{I_{BB}}{2} - V_{BEN}} \rightarrow (1)$$

o/p resistance

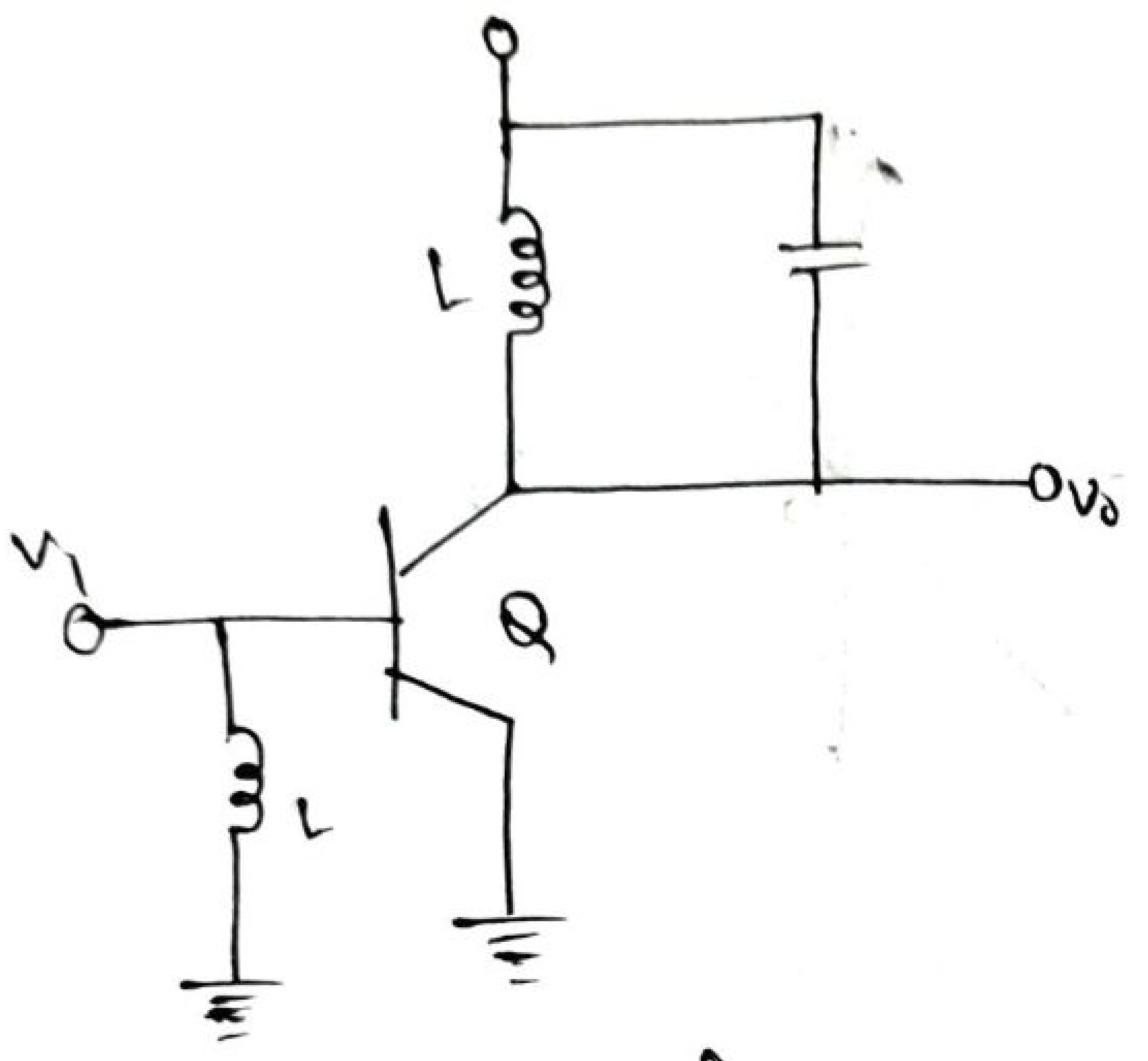
$$R_{out} = r_{CN} \| r_{CP}$$

$$r_{CN} = \frac{V_I}{I_N}$$

$$r_{CP} = \frac{V_T}{I_P}$$

$$\boxed{R_{out} = \frac{V_I}{I_P + I_N}}$$

class C:-



-> Conduct only less than half cycle I/P

-> typical efficiency 78.5%

-> Nearly 100% by Selectic value of L & C

-> tank act by load

-> class C tuned cannot used Audio amplifier