AEC lec 31 27/9/23

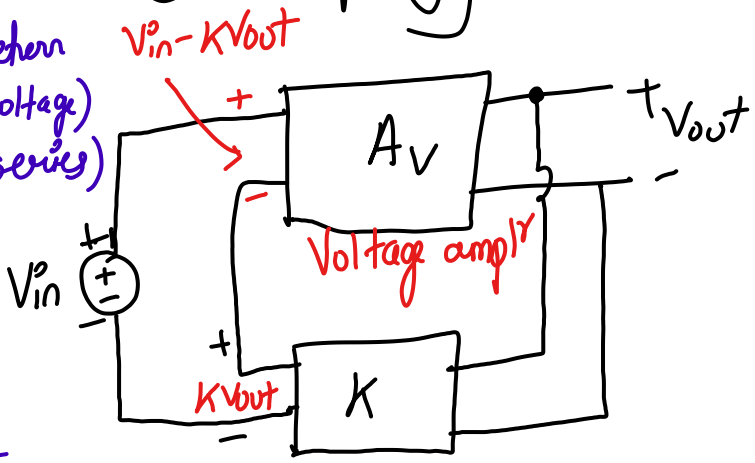
Voltage-series -ve flb topology

$\frac{V_{out}}{V_{in}} \rightarrow A_{vf}, R_{inf}, R_{outf}$

o/p → sensing (shunt)

I/p → series (voltage)

(Shunt-series)



A_{vf}: Voltage with -ve flb

$V_{out} = A_v(V_{in} - KV_{out})$

$V_{out} = A_v V_{in} - A_v K V_{out}$

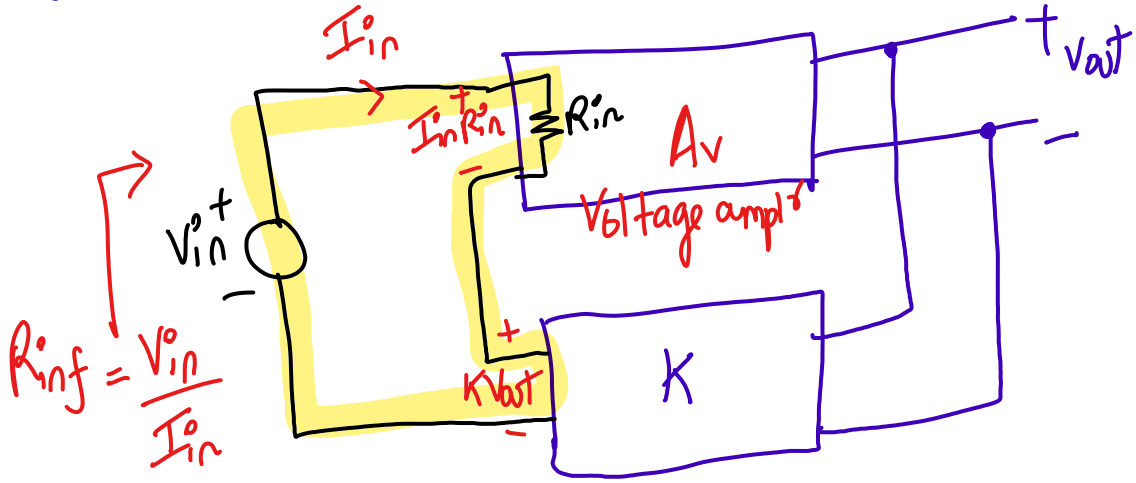
$V_{out}(1 + KA_v) = A_v V_{in}$

$$A_{vf} = \frac{V_{out}}{V_{in}} = \frac{A_v}{1 + KA_v}$$

A_v → open-loop gain

A_{vf} → (closed-loop gain)

② R_{inf} (closed loop i/p resistance)



→ $V_{out} = A_v I_{in} R_{in}$

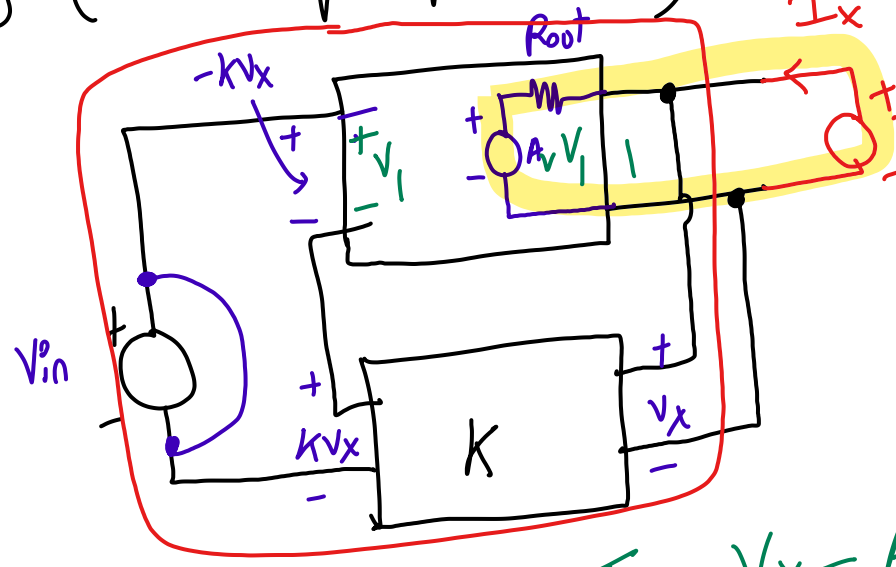
→ KVL at I/p side, $V_{in} - I_{in}R_{in} - KV_{out} = 0$

$V_{in} = I_{in}R_{in} + K A_v I_{in} R_{in}$

$$R_{inf} = \frac{V_{in}}{I_{in}} = R_{in}(1 + KA_v)$$

→ R_{in} - I/p resistance of open loop amplr

3) R_{outf} (Closed-loop o/p resistance)



$$R_{outf}=\frac{V_x}{I_x}$$

$$\rightarrow A_vV_1=-A_vKV_x \rightarrow I_x=\frac{V_x-A_vV_1}{R_{out}}$$

$$\rightarrow I_x=\frac{V_x+A_vKV_x}{R_{out}}$$

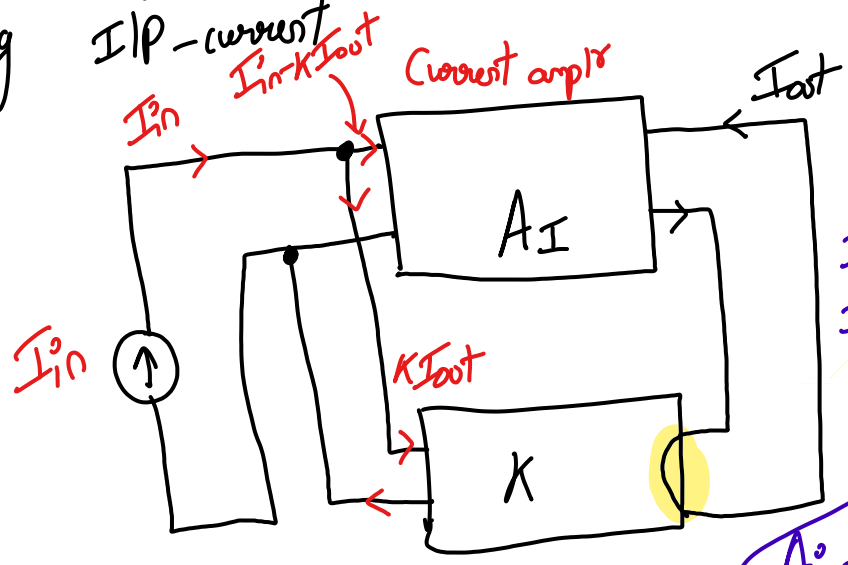
$$R_{out}I_x=V_x(1+KA_v)$$

$$R_{outf}=\frac{V_x}{I_x}=\frac{R_{out}}{(1+KA_v)}$$

Current-shunt -ve f/b amplifier:

o/p - sensing (series)

I/p - current



$$\# A_{If}=\frac{I_{out}}{I_{in}}$$

$$I_{out}=A_I(I_{in}-KI_{out})$$

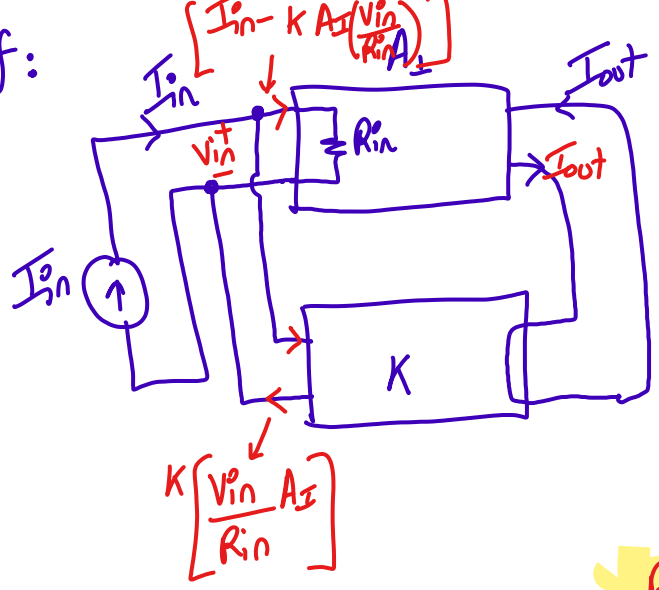
$$I_{out}=A_II_{in}-A_IKI_{out}$$

$$I_{out}(1+KA_I)=A_II_{in}$$

$$\frac{I_{out}}{I_{in}}=\frac{A_I}{1+KA_I}$$

$$A_{if}=\frac{A_i}{1+KA_i}$$

② R_{inf}:



$$I_{out} = A_I\left(\frac{V_{in}}{R_{in}}\right)$$

$$R_{inf} = \frac{V_{in}}{I_{in}}$$

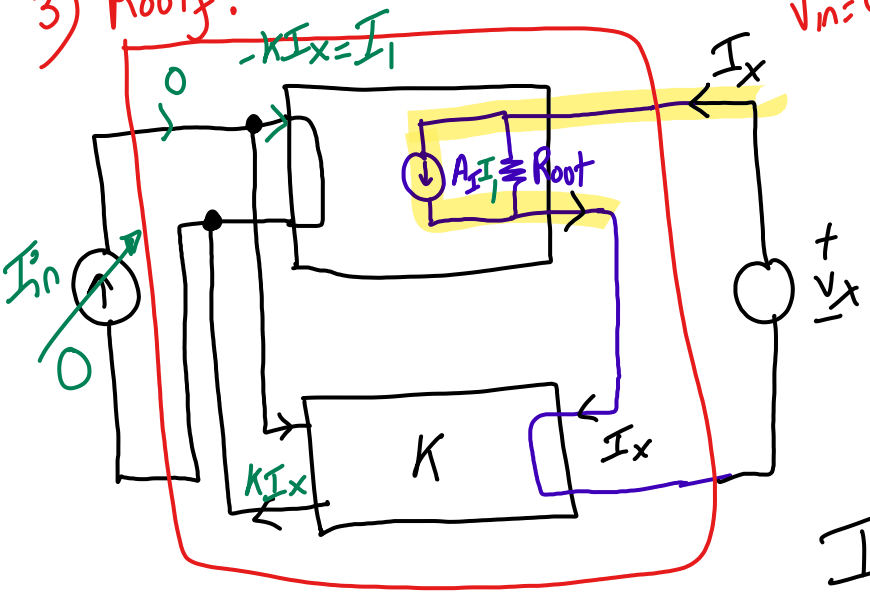
$$V_{in} = R_{in}\left[I_{in} - K A_I\left(\frac{V_{in}}{R_{in}}\right)\right]$$

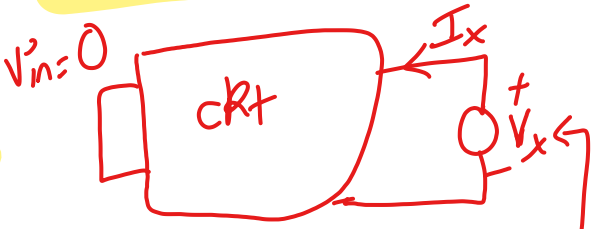
$$I_{in}R_{in} = V_{in}\left(1 + K A_I\right)$$

$$\frac{V_{in}}{I_{in}} = \frac{R_{in}}{1 + K A_I}$$

$$\boxed{R_{inf} = \frac{R_{in}}{1 + K A_I}}$$

③ R_{outf}:





$$R_{outf} = \frac{V_x}{I_x}$$

$$\boxed{I_1 = -K I_x}$$

$$A_I I_1 = -K I_x A_I$$

$$I_x = \frac{V_x}{R_{out}} + \left(A_I I_1\right)$$

$$I_x = \frac{V_x}{R_{out}} - K I_x A_I$$

$$\frac{V_x}{R_{out}} = I_x + K I_x A_I = I_x\left(1 + K A_I\right)$$

$$\boxed{R_{outf} = \frac{V_x}{I_x} = R_{out}\left(1 + K A_I\right)}$$