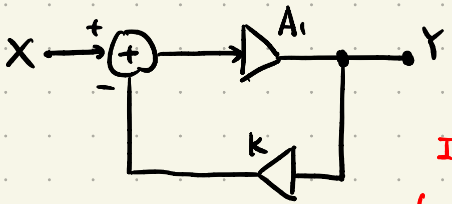
Lec 29

- Application Examples of Feedback
- Summary of feedback Concepts
- Properties of Negative Feedback

Review of Lec 28



$$\frac{Y}{X} = \frac{A_1}{1+kA_1}$$ Loop Gain

If loop gain >> 1 ⇒ closed-loop gain $\approx \frac{1}{k}$

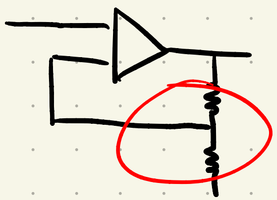
(relatively indep. of A_1)

• Summary of Feedback Concepts

① We sacrifice the open-loop gain to benefit from negative feedback.

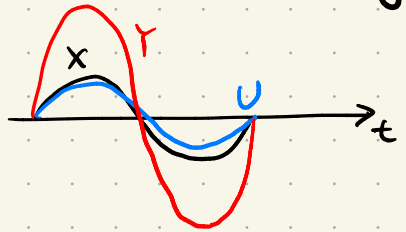
② The feedback signal is a good copy of the input signal.

③ $Y = \frac{U}{k}$ is a good copy of X but with a scaling factor. eg: if $k=0.1$ $Y = 10U$

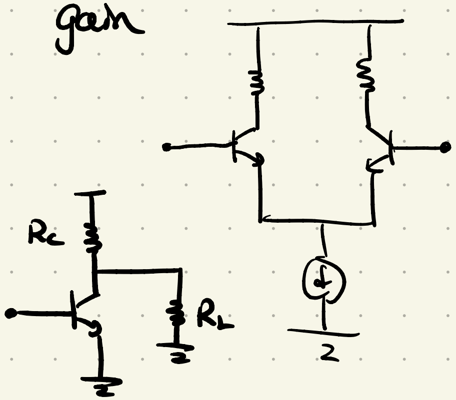


K (indep. of freq.)

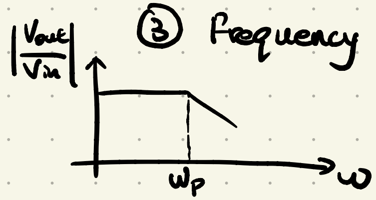
⇒ The loop wants to make Y a good copy of X



④ If $kA_1 \gg 1$ ⇒ factors that cause A_1 to vary have less effect on the closed-loop gain

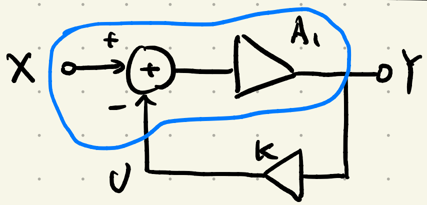


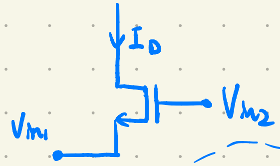
factor: ① Temperature
② Supply Voltage
③ Frequency



④ Load Imp.

Example

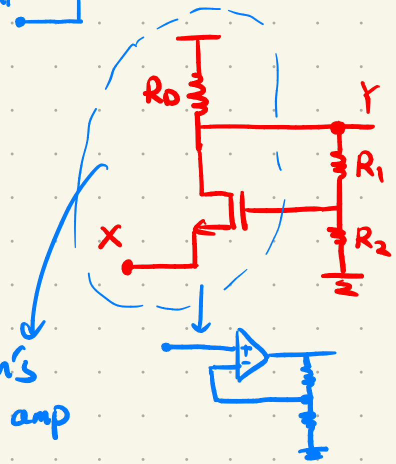




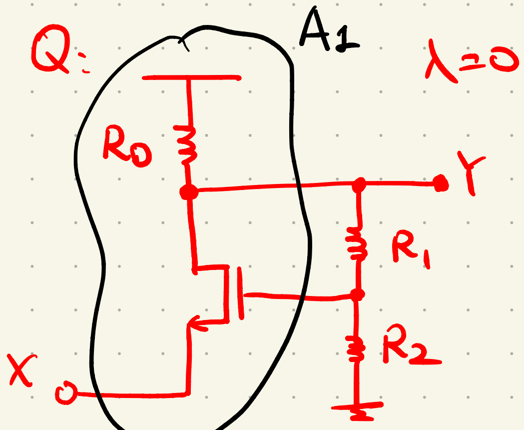
$$I_D = \frac{1}{2}\mu_n C_{ox}\frac{W}{L}(V_{in2}-V_{in1}-V_{TH})^2$$

For small signal operation:

$$I_D = g_m V_{GS} = g_m(V_{in2}-V_{in1})$$



Poor Man's Op amp



$\frac{Y}{X} = ?$ $R_1 + R_2$ is very large

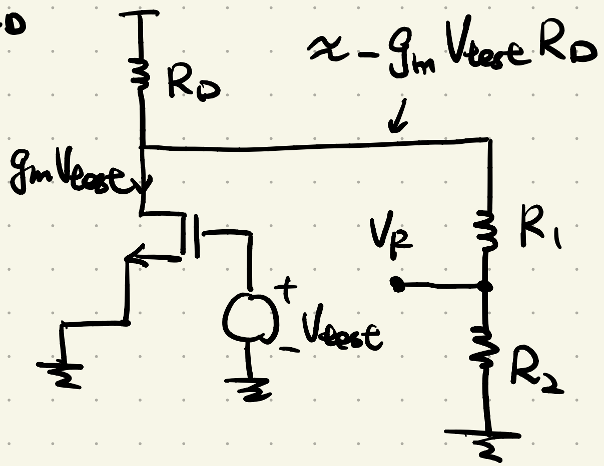
$$= \frac{A_1}{1 + KA_1} \qquad A_1 = g_m R_D$$

$$K = \frac{U}{Y} = \frac{R_2}{R_1 + R_2}$$

$$\frac{Y}{X} = \frac{g_m R_D}{1 + \frac{R_2}{R_1 + R_2} g_m R_D}$$

Loop Gain:

$$= -\frac{V_F}{V_{test}} = \frac{g_m R_D R_2}{R_1 + R_2}$$



$$V_F = -g_m V_{test} R_D \frac{R_2}{R_1 + R_2}$$

Properties of Negative Feedback

$$\frac{Y}{X} = \frac{A_1}{1 + KA_1} \approx \frac{1}{K} \quad \text{if } KA_1 \gg 1$$

① Gain Desensitization: $\frac{Y}{X}$ is less sensitive to temp. supply. --- than A_1 is

② Bandwidth Extension: Greater BW for the closed loop system

③ Modification of Input and Output. Impedances

④ Higher Linearity