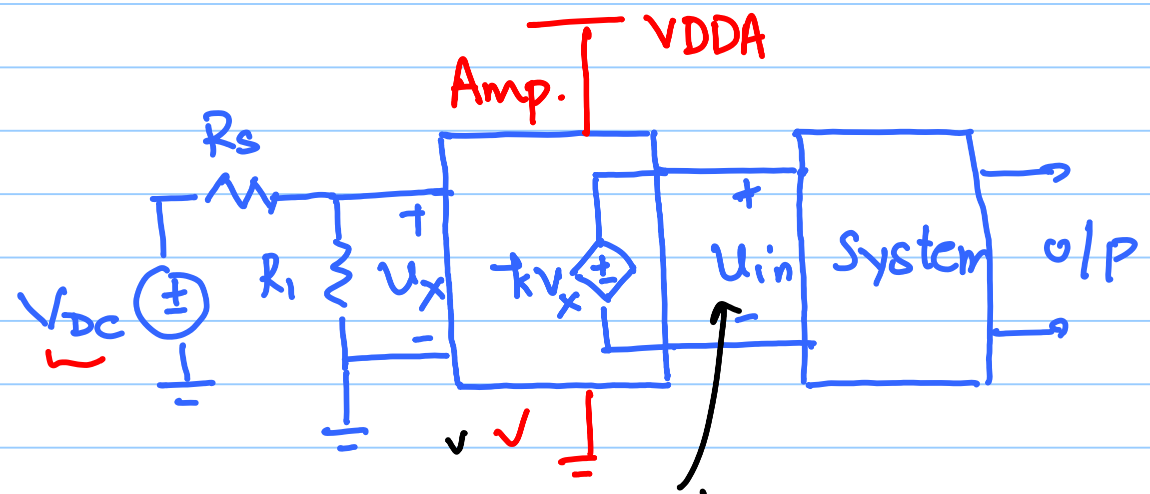
Lecture # 03



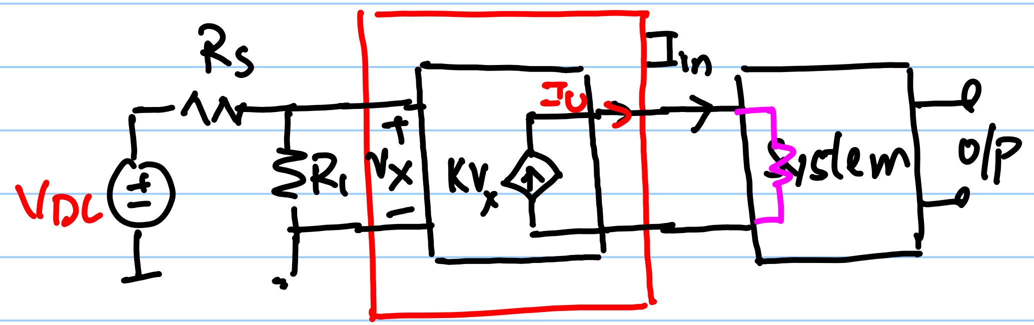
as large as required by sys.

$$V_x = \frac{R_1}{R_1+R_s} V_{DC}$$

$$V_{in} = kV_x \leq V_{DC}$$

$$> V_{DC}$$

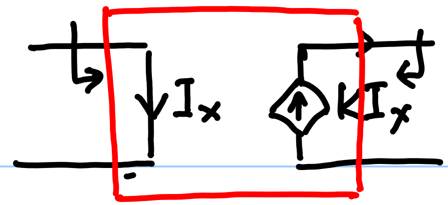
VCVS: Voltage Controlled Voltage Source.



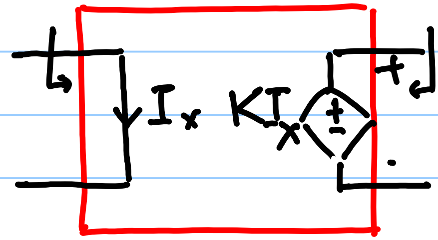
VCCS: Voltage Controlled Current Source

$$I_o = kV_x = k \cdot \frac{R_1}{R_1+R_s} V_{DC}$$

Current Controlled Current Source (CCCS)

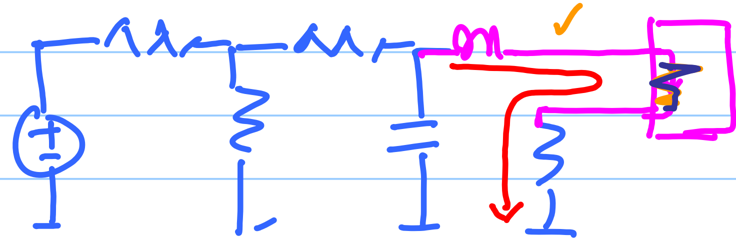


Current Controlled Voltage Source (CCVS)



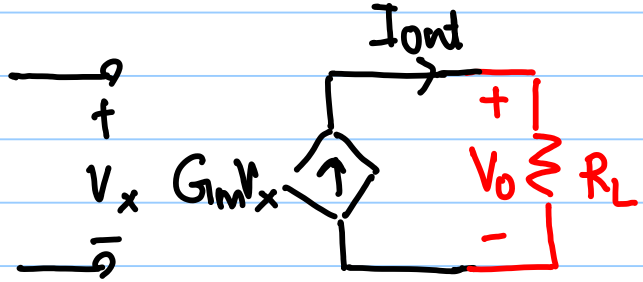
Voltage source @ o/p $\Rightarrow Z_{out} = 0$

Current source @ o/p $\Rightarrow Z_{out} = \infty$



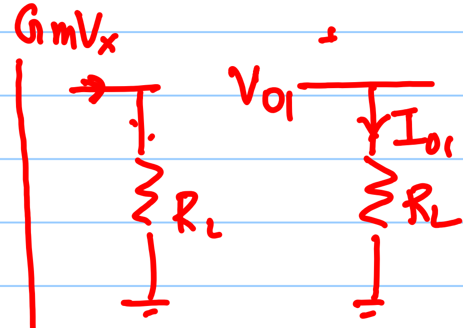
Voltage sensing @ i/p $\Rightarrow Z_{in} = \infty$

Current sensing @ i/p $\Rightarrow Z_{in} = 0$



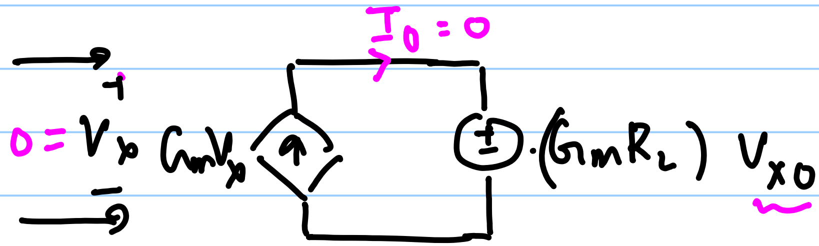
$V_o = G_m V_x \cdot R_L$

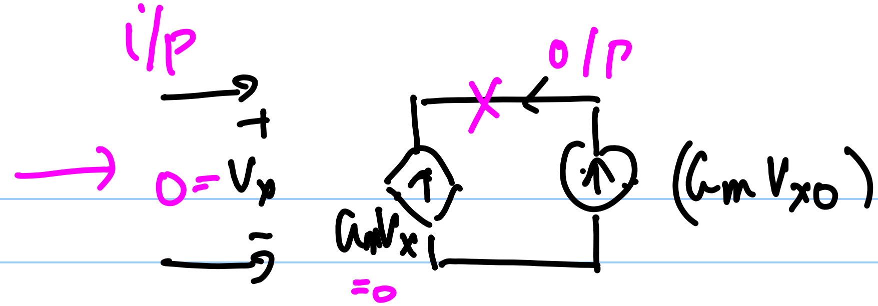
$= (G_m R_L)\, V_x$

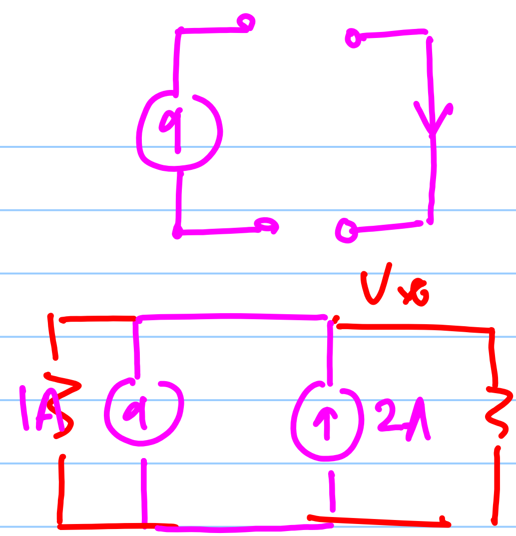


$\underline{V_{o1}} = \underline{(G_m R_L) V_x}$

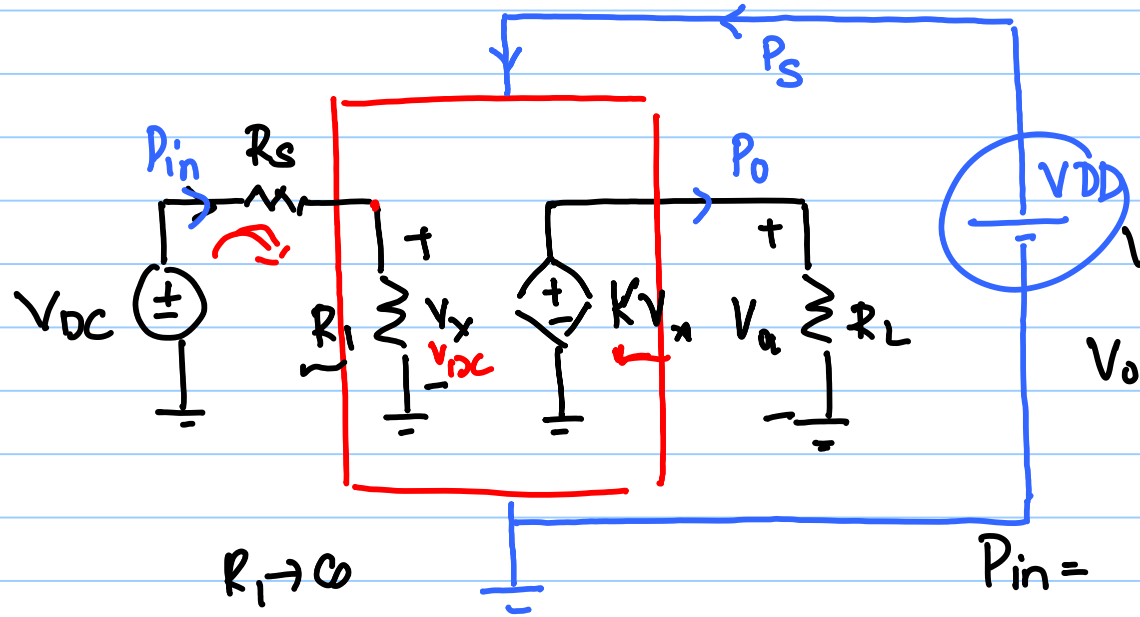
$I_{o1} = \underline{G_m V_x}$







Unilateral controlled sources.



$V_o = K V_x$

$$V_o = K \frac{R_1}{R_1 + R_s} V_{DC}$$

$$P_{in} = \frac{V_{DC}^2}{R_1 + R_s}$$

$$P_{out} = \frac{K^2 V_x^2}{R_L} = \frac{K^2 V_{DC}^2}{R_L} \frac{R_1^2}{(R_1+R_s)^2}$$

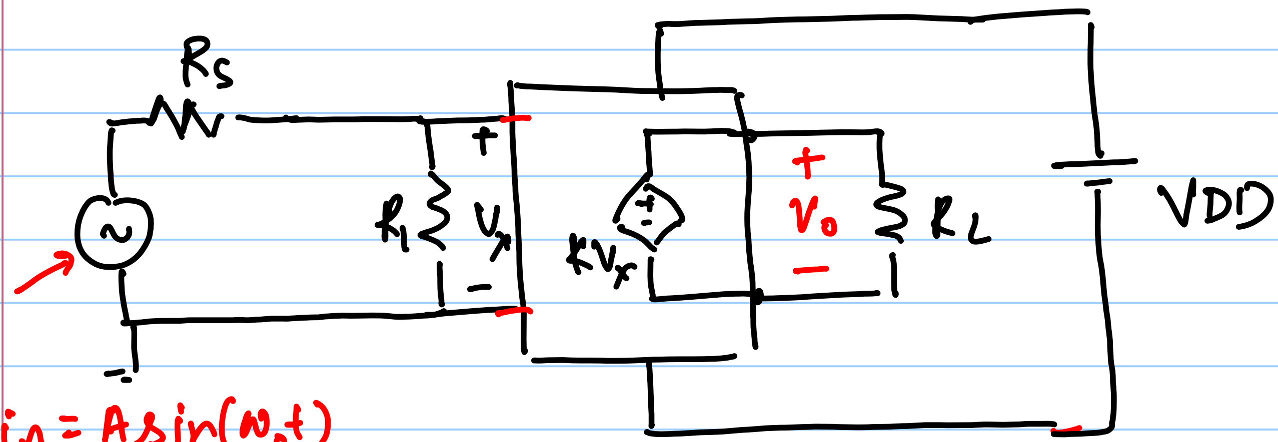
$$\frac{P_{out}}{P_{in}} = \frac{K^2 R_1^2 / R_L (R_1+R_s)^{\cancel{2}}}{1/(R_1+\cancel{R_s})} = \frac{K^2 R_1^2}{R_L (R_1+R_s)}$$

$$\frac{P_{out}}{P_{in}} = \frac{K^2}{\frac{R_L}{R_1}\left(1+\frac{R_S}{R_1}\right)} > 1$$

$P_S + P_{in} \geq P_{out}$

VDDA, AVDD, DVDD

Analog, Digital



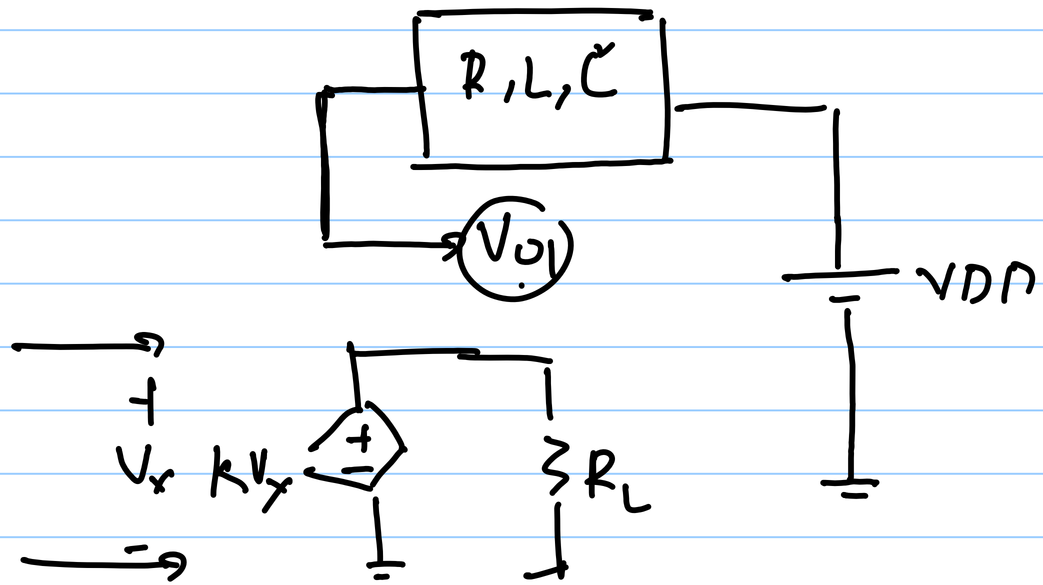
$V_{in} = A\sin(\omega_0 t)$

$$V_0 = KV_x = K\frac{R_1}{R_1+R_S}\left(A\sin(\omega_0 t)\right)$$

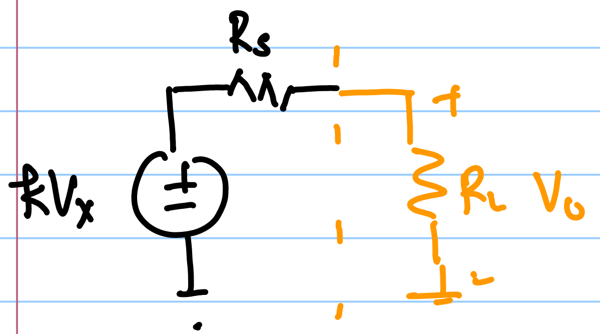
$$V_0 = K\frac{R_1}{R_1+R_S}A\sin(\omega_0 t)$$

- Power gain from i/p to o/p irrespective of i/p amp. & frequency
- Power is drawn from supply VDD and delivered to o/p.

$$A\sin(\omega_{in}t) \longrightarrow \boxed{\text{linear}} \longrightarrow \alpha \cdot A\sin(\omega_{in}t + \phi)$$



$\Rightarrow$ Non-linear system to deliver power at o/p with $\frac{P_{out}}{P_{in}} > 1$



$$V_o = \frac{R_L}{R_L + R_s}(kV_x)$$