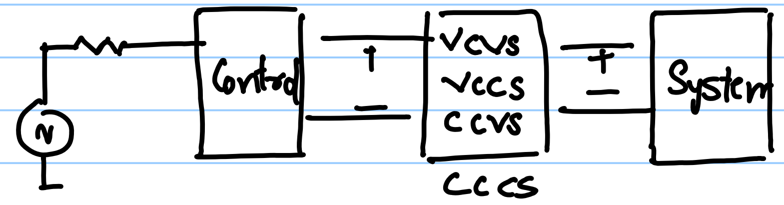
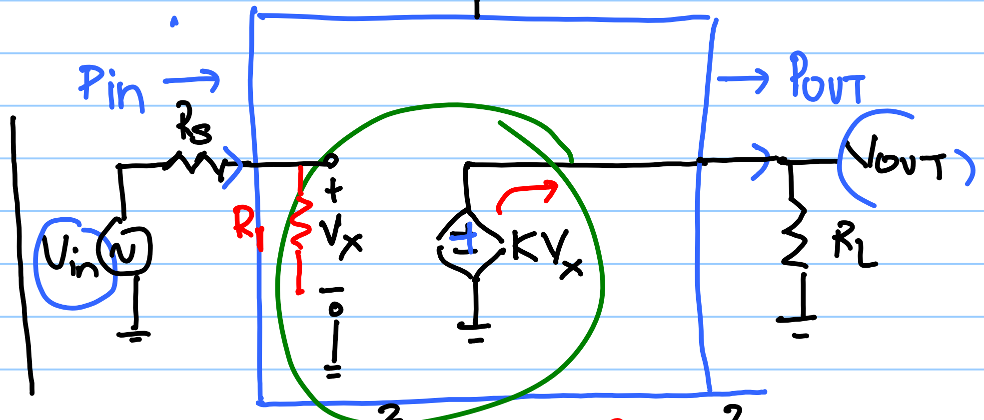
Note Title 17-01-2020

Lecture #2

Controlled Sources





$P_{in} = P_{OUT}$

$(P_{in} = 0) < (P_{out} = \infty)$

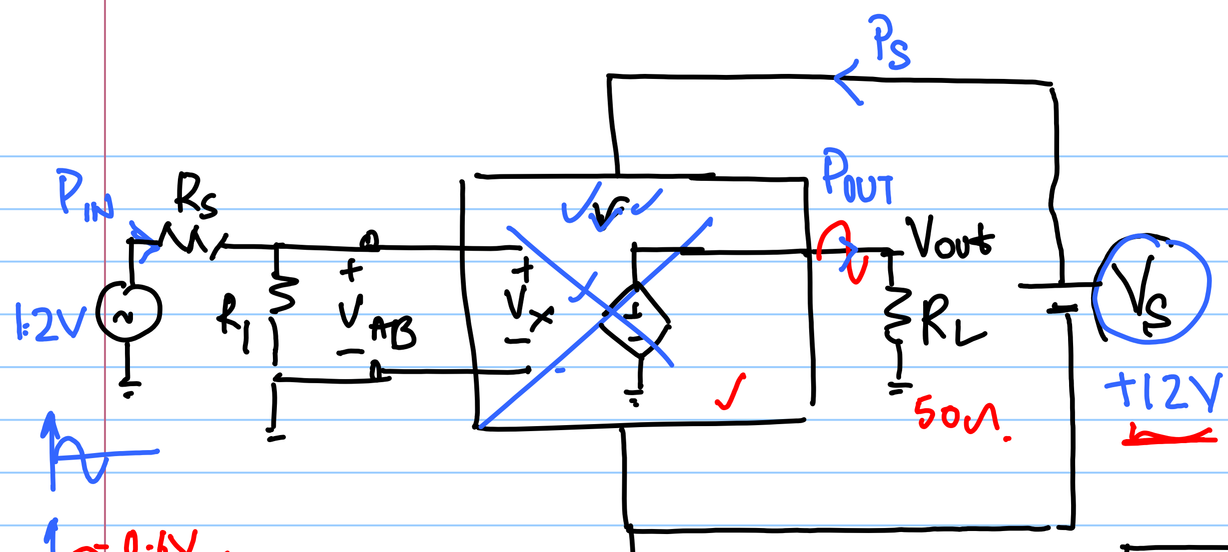
$$P_{OUT} = \frac{V_{OUT}^2}{R_L} = \frac{(K V_x)^2}{R_L}$$

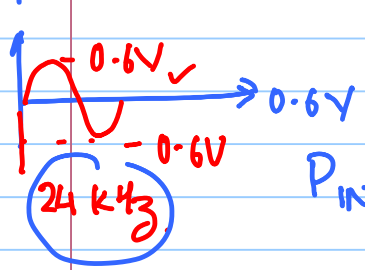
$$P_{IN} = \frac{V_{in}^2}{R_1 + R_s}$$

$$\text{Power Gain} = \frac{P_{OUT}}{P_{in}} > 1$$

$$= \frac{K^2}{R_L} \times \left(\frac{R_1}{R_1 + R_s}\right)^2 V_{in}^2 \quad \frac{(R_1 + R_s)}{V_{in}^2}$$

$\propto K^2$



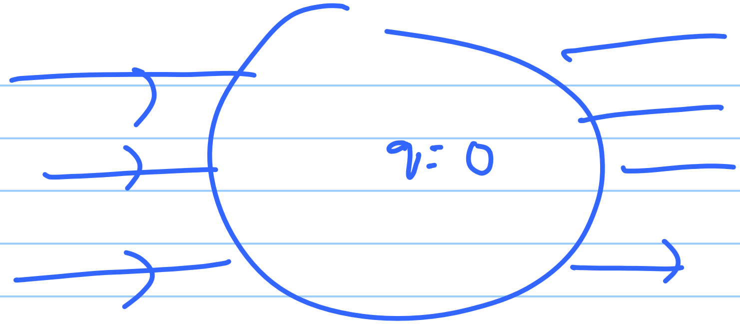


$P_{IN} + P_S$ > P_{OUT}

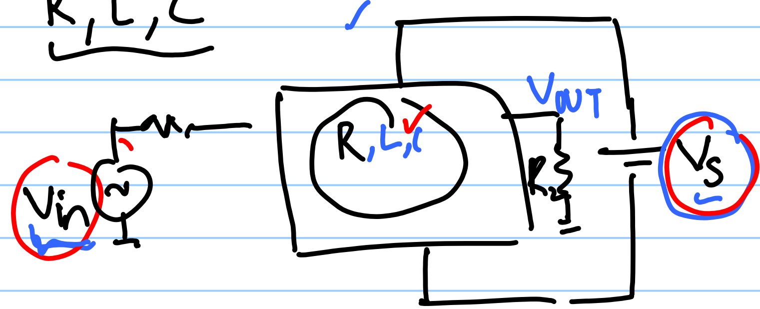
$P_{OUT} < P_{IN} + P_S$

$x(t) = A \sin(\omega_0 t)$

$\omega_0 = 2\pi \times 24kHz$.

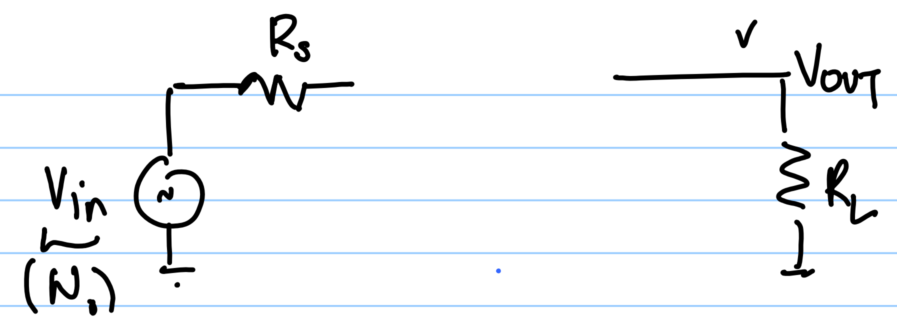


R, L, C



$V_{OUT} = aV_{in} + b.V_s$ ✓ ×

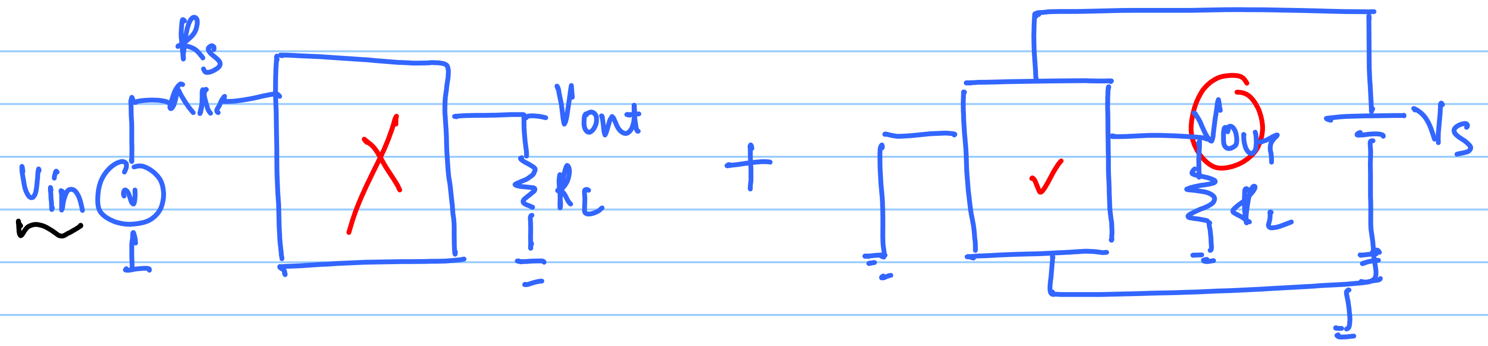
$V_{OUT} = K.V_{in}$



$$\frac{V_{OUT}}{V_{in}} = K > 1$$

$$V_{out} = \frac{R_L}{R_s + R'} V_{in}$$

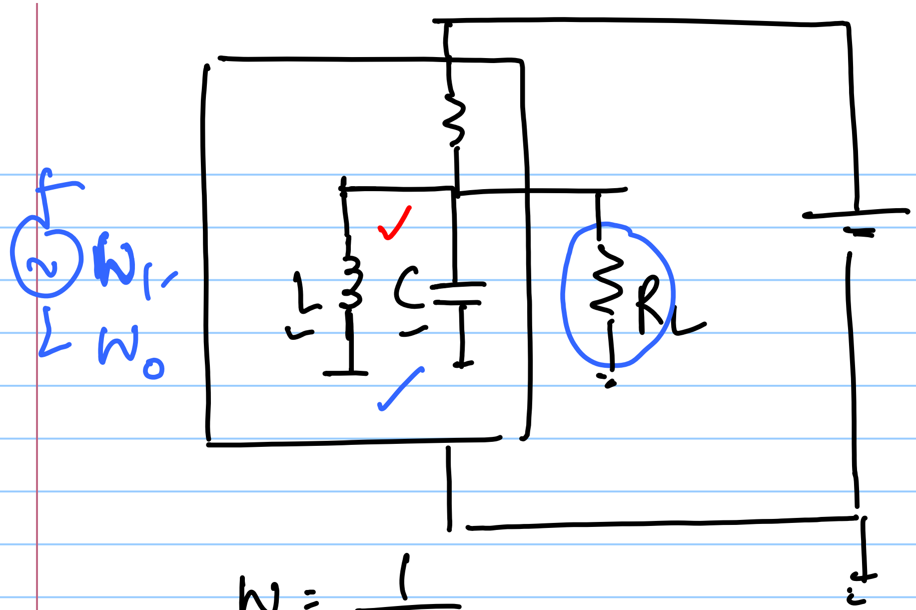
$$V_{out} = aV_{in} + b.V_s$$ ✓



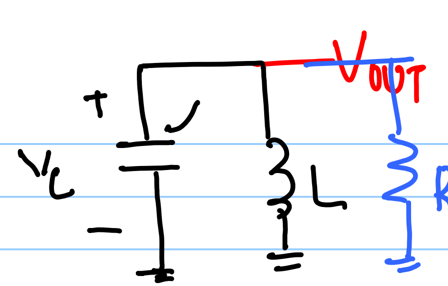
$$V_{OUT} = a_0 (\alpha V_{in} + \beta V_s) + a_1 (\alpha V_{in} + \beta V_s)^2 + a_2 (\alpha V_{in} + \beta V_s)^3 + \cdots$$

$$a_0 (\sin(\omega_0 t) + 12) + a_1 (\sin(\omega_0 t) + 12)^2 + \cdots$$

$\rightarrow 2 \cdot 12 \cdot \sin(\omega_0 t)$

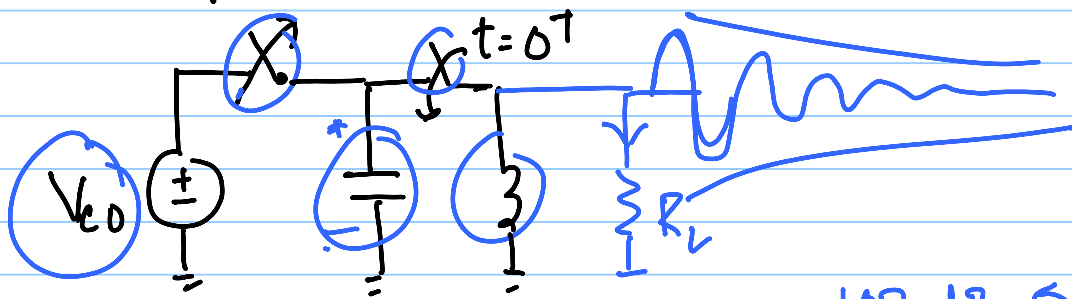


$w = \frac{1}{\sqrt{LC}}$



$\omega_0 = \frac{1}{\sqrt{LC}}$

$t=0, V_c(0) = V_{c0}$

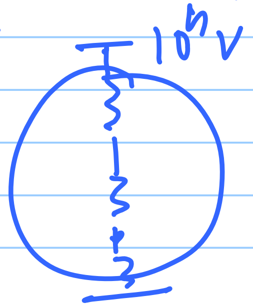


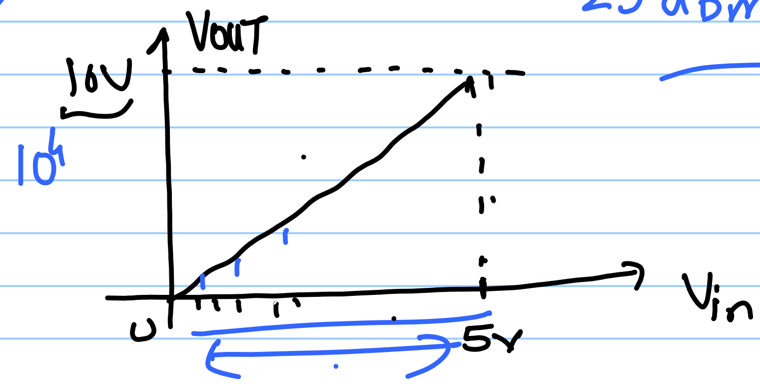
$V_{out} = f(V_s, V_{in})$

$-102\ dBm = 10\log_{10}\left(\frac{V^2}{4\times50}\right)$

$-25\ dBm$

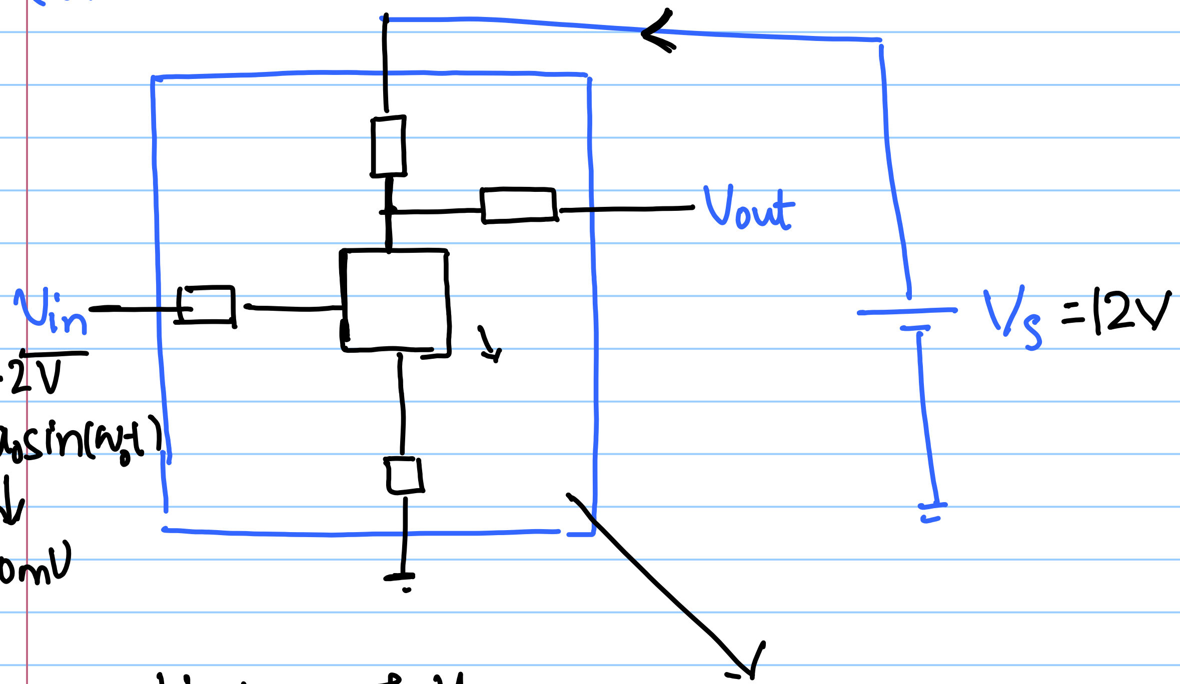
- Power derived from supply by a non-linear system
- input-to-output control has to be linear.





✓ (M) MOSFET :

✓ (B) BJT :



$1.2V + a_0 \sin(\omega_0 t)$
↓
$10mV$

$V_{out} = f(V_{in}, V_s)$ ✓
↓
non-linear.

$V_{out} = k V_{in} =$
limited.

$\Delta V_{out} = 100 \cdot \Delta V_{in}$ ✓

$V_{out} = k V_{in}$

VCCS, VCVS, – .