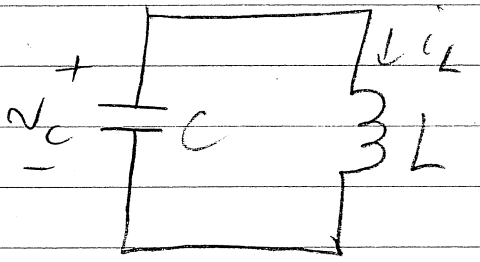
NEGATIVE RESISTANCE

- CAN CREATE NEGATIVE RESISTANCE USING FEEDBACK

- WHY ?? => USEFUL FOR OSCILLATORS AND LATCHES

OSCILLATORS

IF IDEAL C & L (NO RESISTANCES)

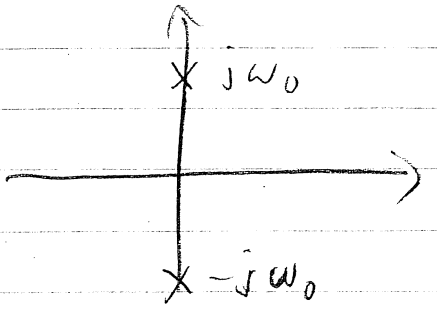


THEN IF INITIAL v_c (OR i_L)

WILL OSCILLATE AT

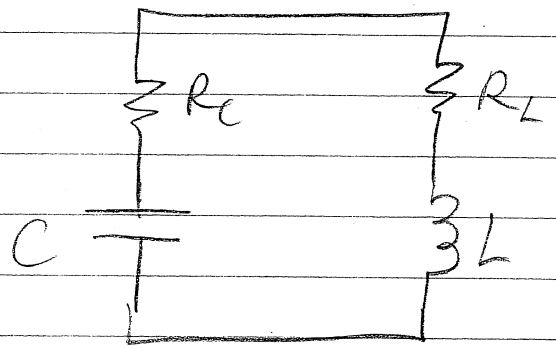
$$\omega_0 = \frac{1}{\sqrt{LC}}$$

POLES AT $\pm j\omega_0$



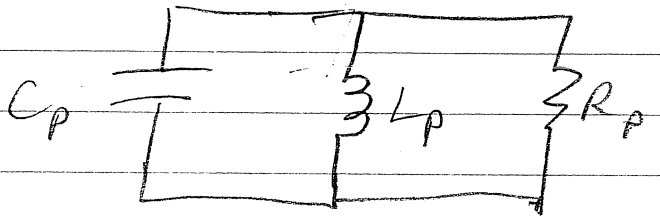
NR2

HOWEVER, IN PRACTICE INDUCTOR HAS SERIES R_L & CAPACITOR HAS SERIES, R_C



R_C & R_L CAUSE DAMPING & POLES IN LEFT HALF PLANE

CAN MODEL ABOVE AS PARALLEL CIRCUIT AT NARROWBAND FREQ NEAR OSC FREQ

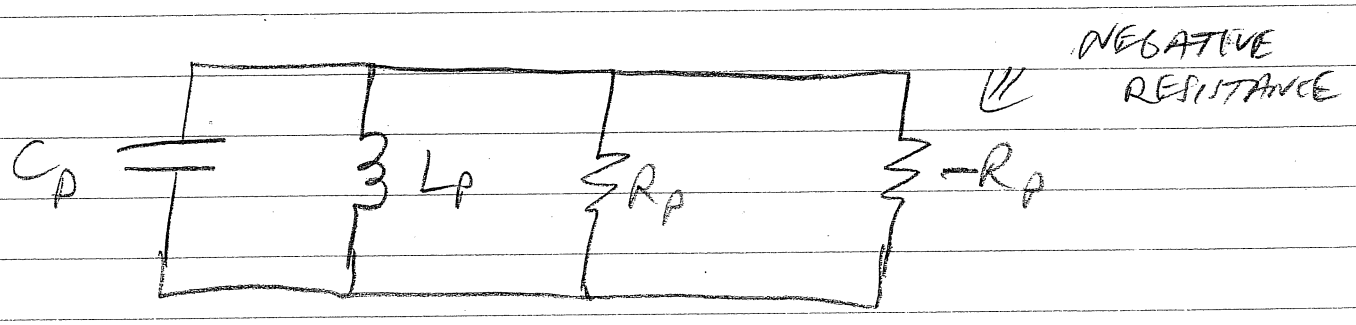


(NOTE $C_p \neq C$
$L_p \neq L$
$R_p \neq R_C + R_L$)

NR3

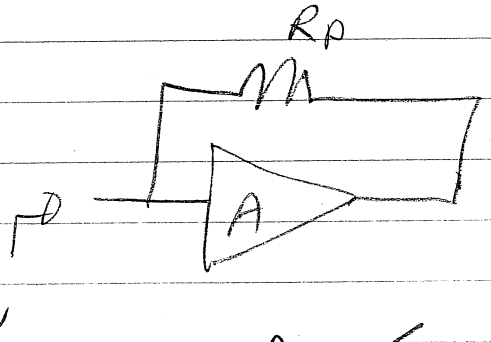
SO TO CREATE AN OSCILLATOR

NEED NEGATIVE RESISTANCE



(MAKE $|-R_p| > R_p$ SO OSCILLATION GROWS THEN LET NON-LINEARITIES KEEP OSCILLATION AMPLITUDE STABLE)

USING MILLER EFFECT



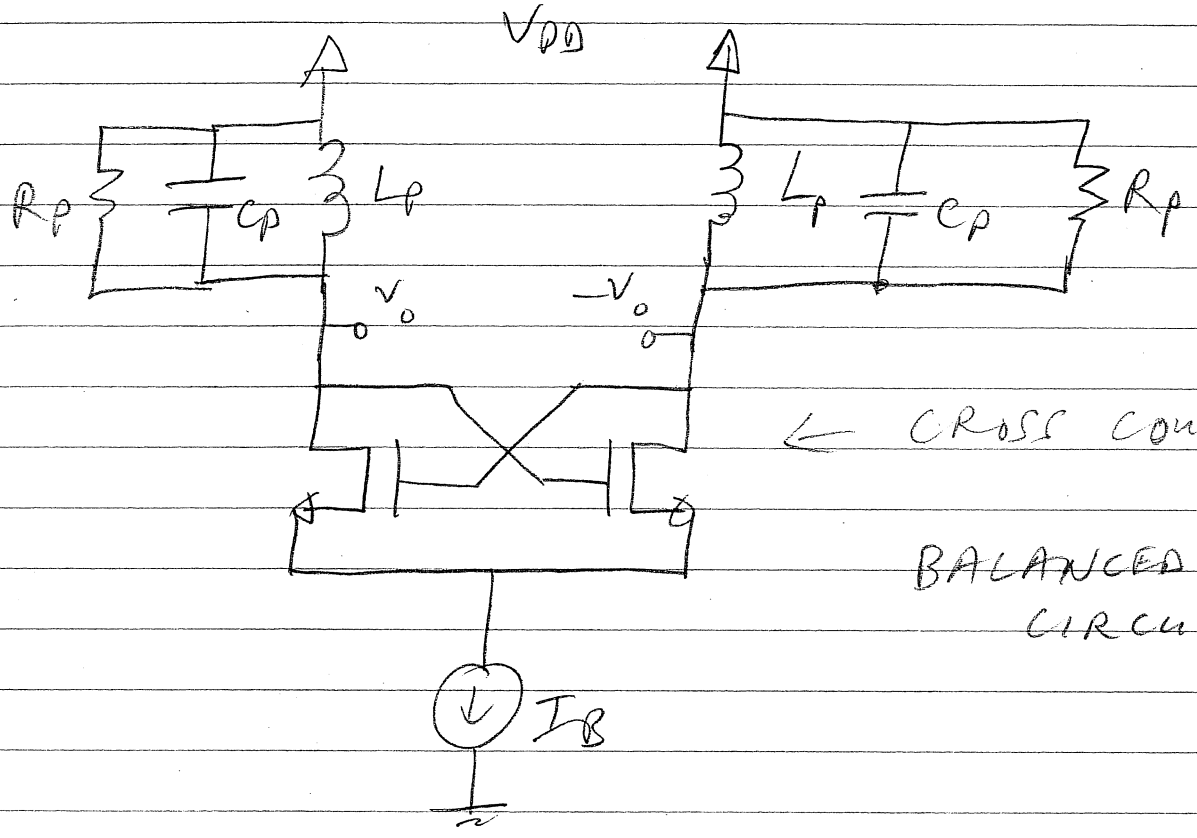
$$R_{IN} = R_p/(1-A) \quad \text{IF} \quad A = -2$$

$$R_{IN} = -R_p$$

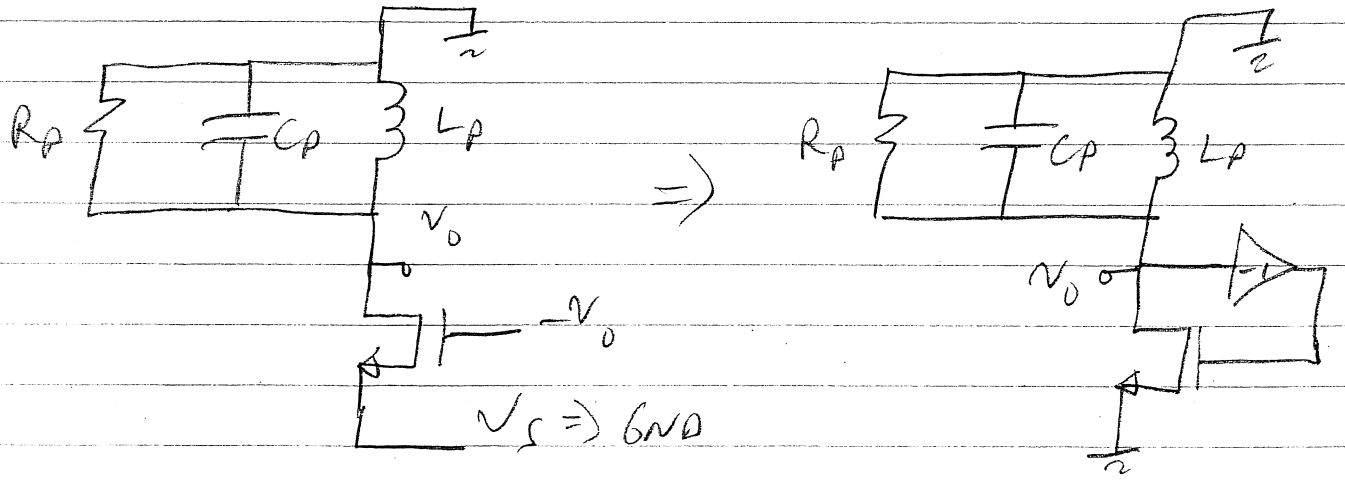
NR4

MORE COMMON APPROACH

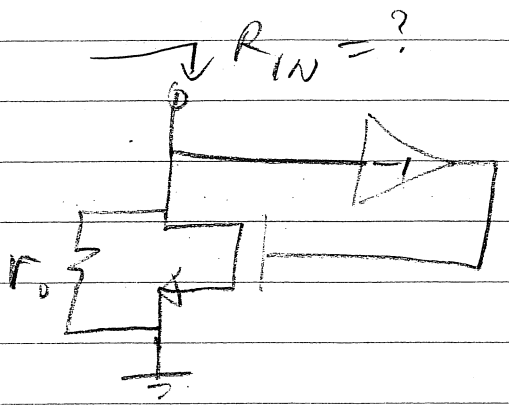
CROSS COUPLED TRANSISTORS



HALF CIRCUIT



NR5



NOTE -ve SIGN

$$R_{P0} = r_o \qquad L_S = 0 \qquad L_0 = -g_m r_o$$

$$R_{IN} = R_{P0}\left[\frac{1+L_S}{1+L_0}\right]$$

$$R_{IN} = \frac{r_o}{1-g_m r_o} = r_o \,||\, -\frac{1}{g_m}$$

$$\boxed{R_{IN} = r_o \,||\, -\frac{1}{g_m}} \quad \text{SET} \quad R_{IN} = -R_P$$