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Homework #8  
(Due 12/10/04)

EECS140  
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1. Consider the circuit shown in Figure 1..

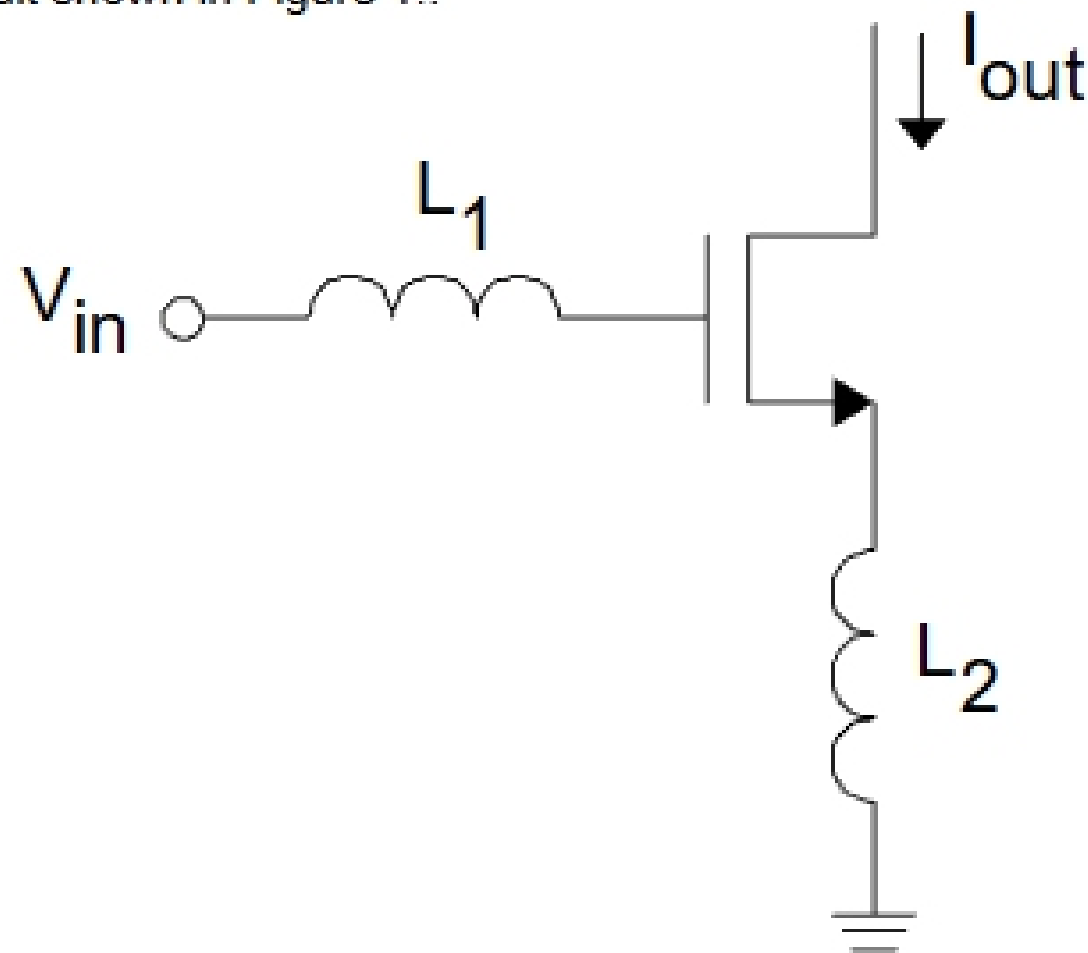


Figure 1

For the transistor above, consider only its  $g_m$  and  $C_{GS}$ . (i.e.  $r_o \rightarrow \text{infinity}$ ,  $C_{GD} = 0$ , etc)

- Determine the size of  $L_1$  and  $L_2$  such that the input impedance is purely real and exactly 50ohms at an operating frequency of 5GHz.  $g_m = 10\text{mS}$ ,  $C_{GS} = 80\text{fF}$
- Calculate the  $G_M$  of this circuit for the parameters given and  $L_1$ ,  $L_2$  as determined from part (a)

2. Consider the circuit in figure 2

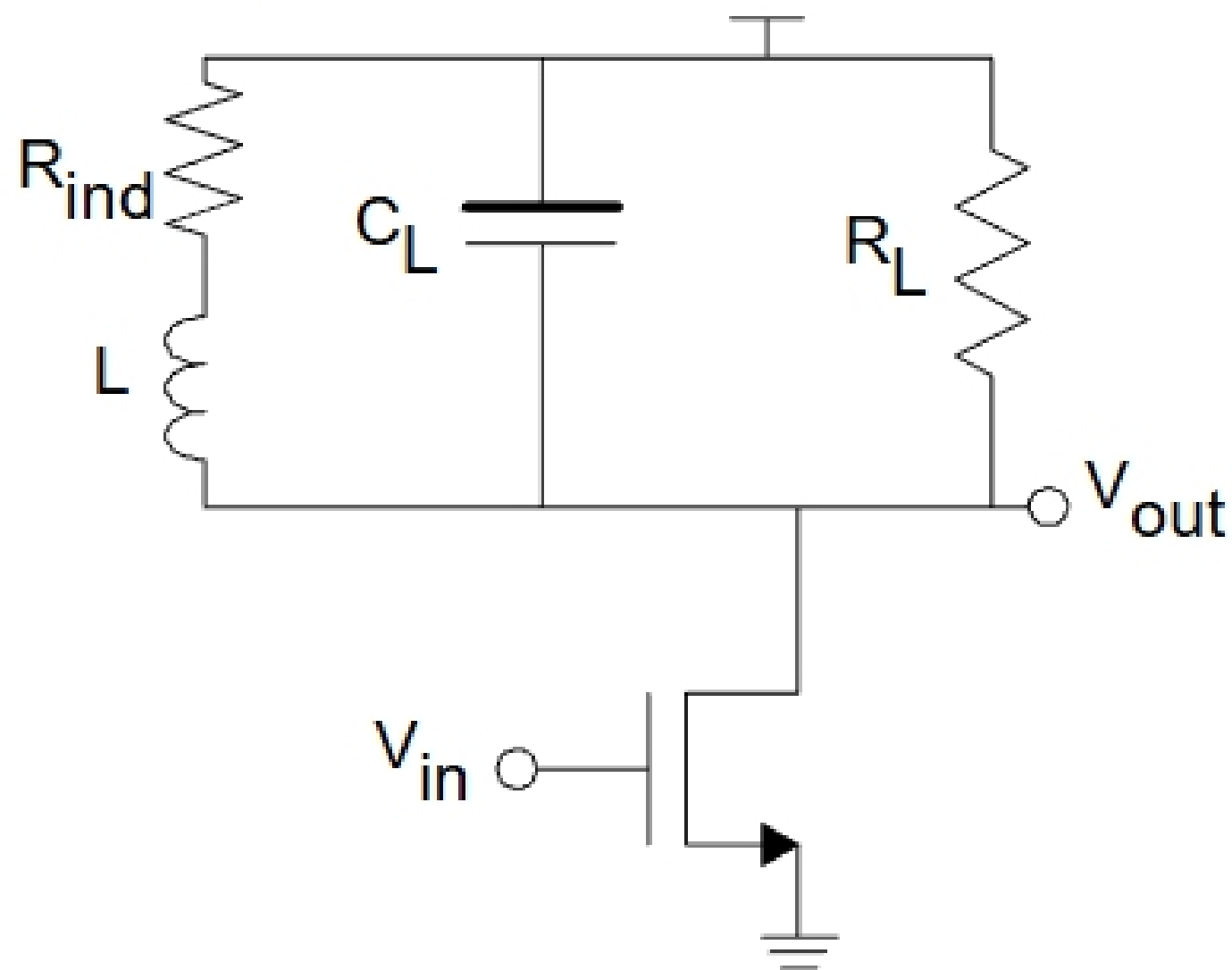


Figure 2

- a) At an operating frequency of  $\omega_0$ , we seek to use an inductor to cancel out the capacitance at the output,  $C_L$ . Determine the size of the inductor,  $L$ , that is required in terms of  $C_L$ ,  $\omega_0$ ,  $Q_{ind}$ , and  $R_L$ . Note that the inductor has a finite  $Q$  ( $=Q_{ind}$ ), so that the relationship between  $R_{ind}$  and  $L$  is:

$$R_{ind} = \frac{\omega \cdot L}{Q_{ind}}$$

- b) Calculate the expression for the gain at  $\omega = \omega_0$  of the circuit with and without the inductor present.

- c) Re-do parts (a) and (b) for the following device parameters:

$$\begin{aligned} g_m &= 10\text{mS} \\ R_L &= 1\text{kohm} \\ C_L &= 1\text{pF} \\ \omega_0 &= 2\pi \cdot 5\text{GHz} = 31.41 \text{ Grad/s} \\ Q_{IND} &= 10 (@ 5\text{GHz}) \end{aligned}$$

- d) Verify the gain calculations from part (b) in spice with the parameters from part (c)