

Open book open notes but not open computers; 100 points total (75 minutes);
 Your signature insures that the work submitted is solely your own. Good luck

1. (35 points, 20 min; NMOS bias & gain)

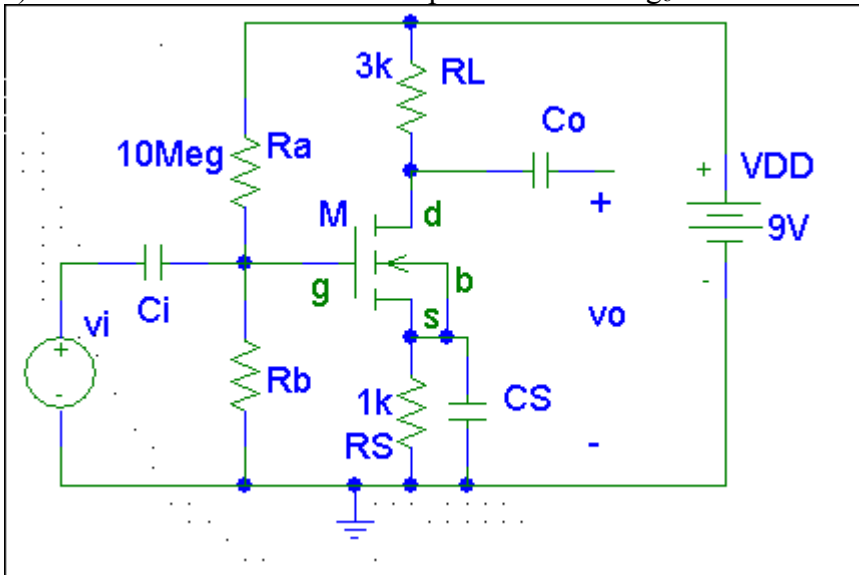
The following NMOS circuit is biased for $I_D=1\text{mA}$ using the battery of voltage $V_{DD}=9\text{V}$. Assume the transistor is described by

$$I_D=k(v_{GS}-V_{TO})^2(1+\lambda v_{DS})$$

with

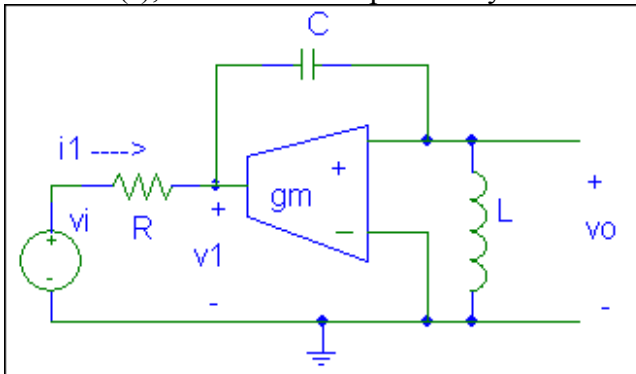
$$k=10^{-3}, V_{TO}=1 \text{ and } \lambda=0 \text{ [in parts b \& c] or } \lambda=0.2 \text{ [in parts d \& e]; } g_o=\lambda I_D$$

- Determine V_{DS} (for either λ).
- When $\lambda=0$, determine V_{GS} and with it R_b .
- and when R_S is suitably bypassed by C_S , give the small signal voltage gain.
- When $\lambda=0.2$ determine V_{GS} and the new R_b .
- When $\lambda=0.2$ determine the output conductance g_o and the new voltage gain.



2. (30 points, 20 min; Voltage Gain)

For the following small signal OTA circuit find the open circuit voltage gain, $v_o/v_i(s)$, and discuss the possibility of this forming an oscillator.



3. (35 points, 20 min; diode & load line)

A tunnel diode is described by its current i_d versus voltage v_d by the equation

$$i_d = 0.1v_d(v_d^2 - 10.5v_d + 30)$$

for which the derivative is $di_d/dv_d = 0.3((v_d - 2)(v_d - 5))$. It has a load characterized by $y = m.v_d + Y_0$

These curves are plotted below along with detail near the intersect points.

- Determine m and Y_0 for the load line (given that it passes through the local minimum of i_d at $v_d = 5$)
- Give the current and voltage values at the three intersect points.
- Determine the small signal conductance at the three intersect points.

