

ECE 2C Circuits, Devices and Systems

Midterm Sample#1

Instructor: Prof. C. Patrick Yue

Name: _____

- **You have 1 hour and 15 minutes to complete this exam.**
- **Closed book, one 8.5"x11" equation sheet both side allowed.**
- **Calculators are allowed.**
- **Please turn off and put away your mobile phone**
- **Be sure to include the proper units in your answers.**
- **State all of your assumptions in your solutions in order to receive partial credits for incorrect answers.**
- **To receive credit, there must be sufficient evidence of your reasoning. Correct answers without correct reasoning or clear calculation steps will not receive full credits.**

Problem 1 _____ / 20 (Two-port parameters)

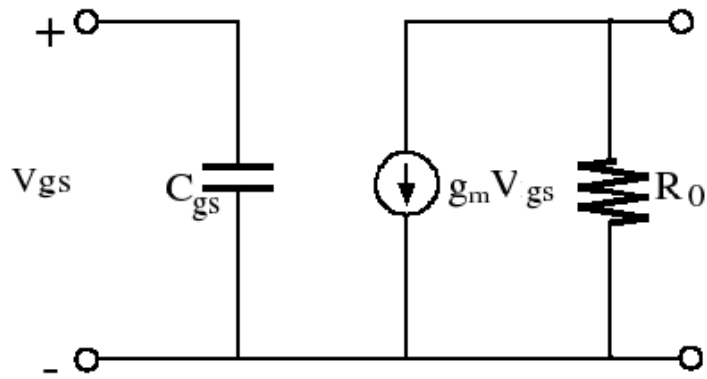
Problem 2 _____ / 20 (DC analysis of MOSFET circuit)

Problem 3 _____ / 60 (Frequency response of MOSFET amplifier)

Total _____ / 100

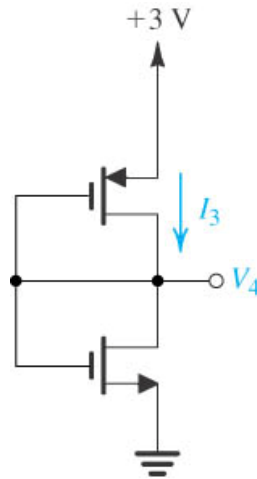
Problem 1 (Total 20 pt.)

Find [h] and [y] parameters for the following two-port network.



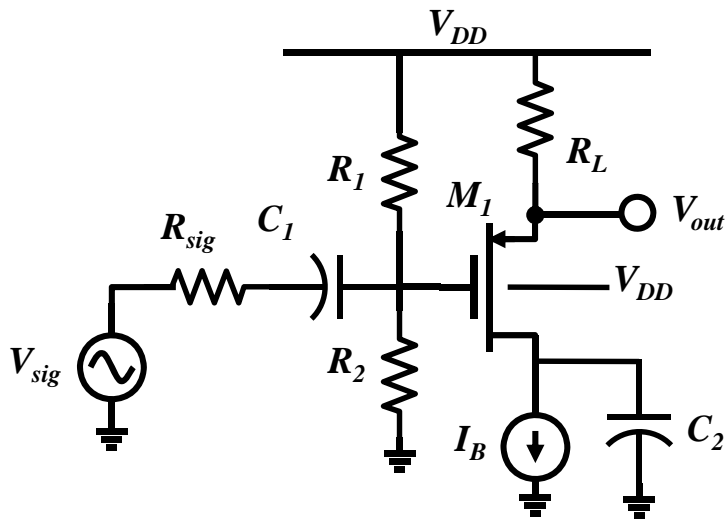
Problem 2 (20 pt.)

Solve for I_3 and V_4 for $\mu_n C_{ox} = 100 \mu\text{A}/\text{V}^2$, $\mu_p C_{ox} = 40 \mu\text{A}/\text{V}^2$, $V_{tn} = 1\text{V}$, $V_{tp} = -1\text{V}$, $\lambda_n = \lambda_p = 0$, $L_n = L_p = 10 \mu\text{m}$, $W_n = 30 \mu\text{m}$, and $W_p = 75 \mu\text{m}$.



(b)

Problem 3 (60 pt.)



- (a) What would you call this circuit? (5 pt.)
- (b) Find the expression for the frequency response of the circuit:
- the midband gain v_{out}/v_{sig} (15 pt.)
 - estimate the lower -3dB corner frequency (ω_l) of the gain expression $v_{out}/v_{sig}(s)$ (15 pt.)
 - estimate the upper -3dB corner frequency (ω_h) of the gain expression $v_{out}/v_{sig}(s)$ (15 pt.)

You need to include the effect of r_o and g_{mb} in your calculation because $\lambda \neq 0$ and $\gamma \neq 0$. For the small-signal transistor model, you only need to consider C_{gs} , i.e. C_{gd} and C_j can be neglected. You need to consider the effect of C_1 and C_2 in your analysis.

- (c) Sketch the Bode plot of $v_{out}/v_{sig}(s)$ based on your answer to part (b). (10 pt.)