

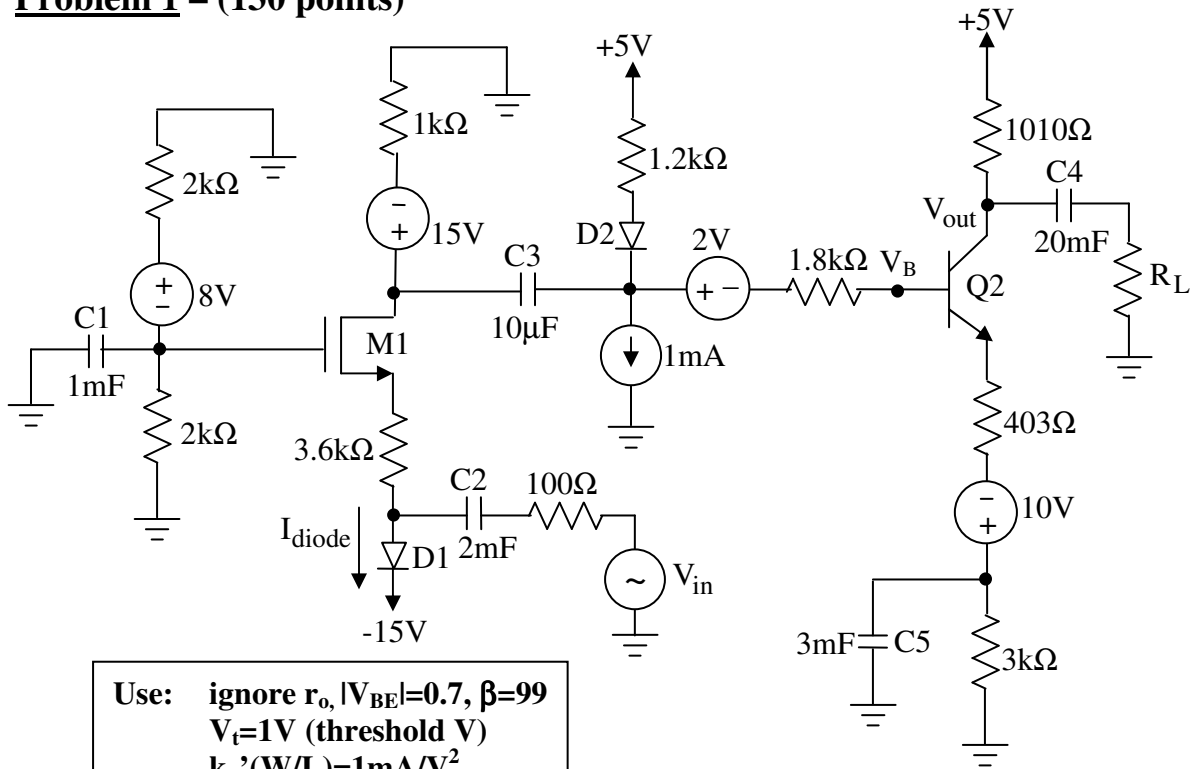
ECE2280
FINAL EXAM

This is a **CLOSED** book exam. You may have three sheets (8 ½ by 11) front and back. You may also use a calculator.

NAME: _____

Spring 2008

Problem 1 – (130 points)



Use: ignore r_o , $|V_{BE}|=0.7$, $\beta=99$
 $V_t=1V$ (threshold V)
 $k_n'(W/L)=1mA/V^2$
 $\lambda=0$
 $V_{D0}=0.8V$
 $n=2$
 $V_T=25mV$ (Thermal V)
 $V_{in} = 5+0.001\sin(20t)$

For DC analysis, assume that the capacitors act as an open.

(a) **Solve** for the DC values:

- i. I_{diode}
- ii. V_B
- iii. V_{out}

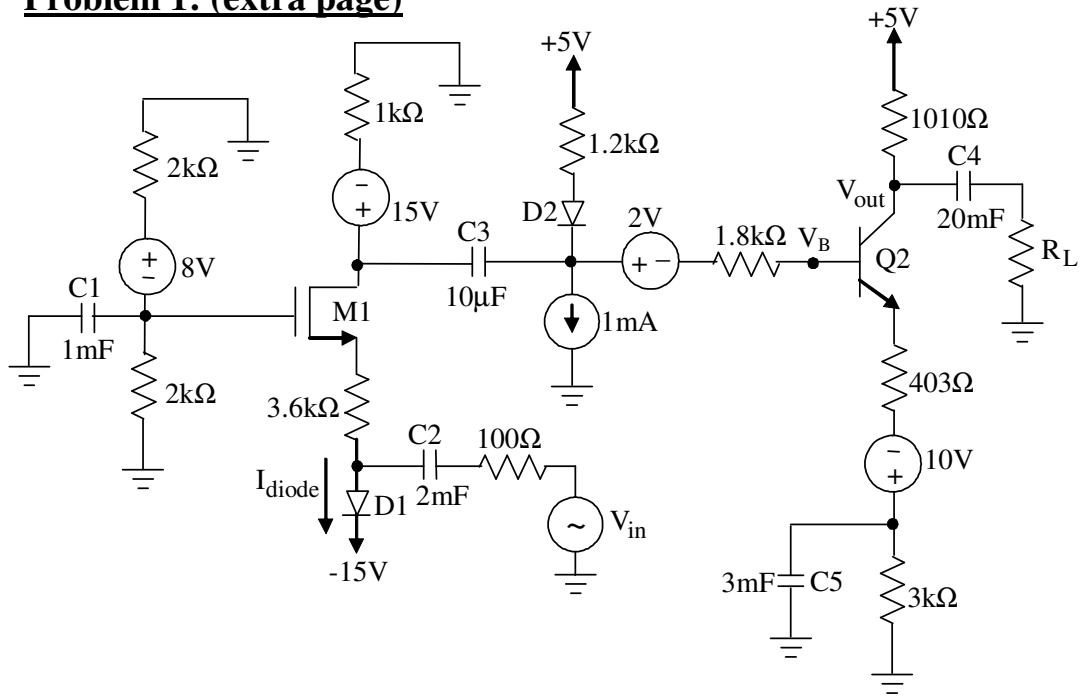
(b) **Verify** that the MosFet transistor, M1 is saturated. **Verify** that the BJT transistor, Q2 is active.

(c) Create a rough **sketch** of the total waveform seen at V_{out} given V_{in} stated above, if $V_{out}/V_{in}=-500V/V$. Make sure to label all relevant y-axis values (maximum, minimum, etc.).

(d) **Draw** the AC small-signal equivalent circuit (use hybrid- π or model T). Make sure that everything is labeled in terms of the transistor number. (e.g. g_{m1} , $v_{\pi2}$, etc.). **Include r_o** for all transistors.

(e) Use the AC parameters, $r_{d1}=10\Omega$, $g_{m1}=1mA/V$, $r_{d2}=1,140\Omega$, $r_{\pi2}=2k\Omega$ (not their actual values). Assume that C1, C4, and C5 contribute pole values less than $1rad/sec$. **Calculate** the pole contributions of C2 and C3 in (rad/sec). At what frequency (rad/sec) does this circuit begin to amplify the input at a constant value?

Problem 1: (extra page)



Problem 2 – (70 points)

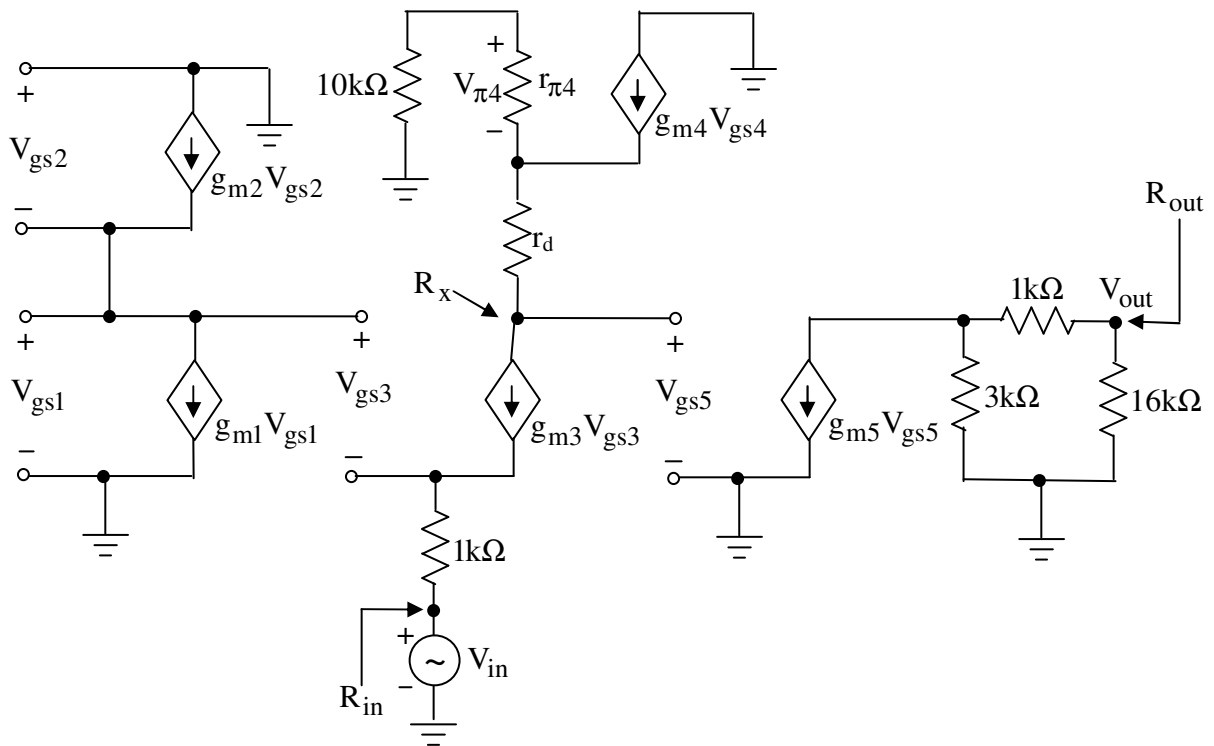
Use: ignore r_o and λ , $|V_{BE}|=0.7$, $\beta=49$, $n=4$, V_T (Thermal V)= 25mV , V_t (threshold V)= 1V , $k_n'(W/L)=10\text{mA/V}^2$
 $V_{in} = 0.02\sin(20t)$

DC Values:

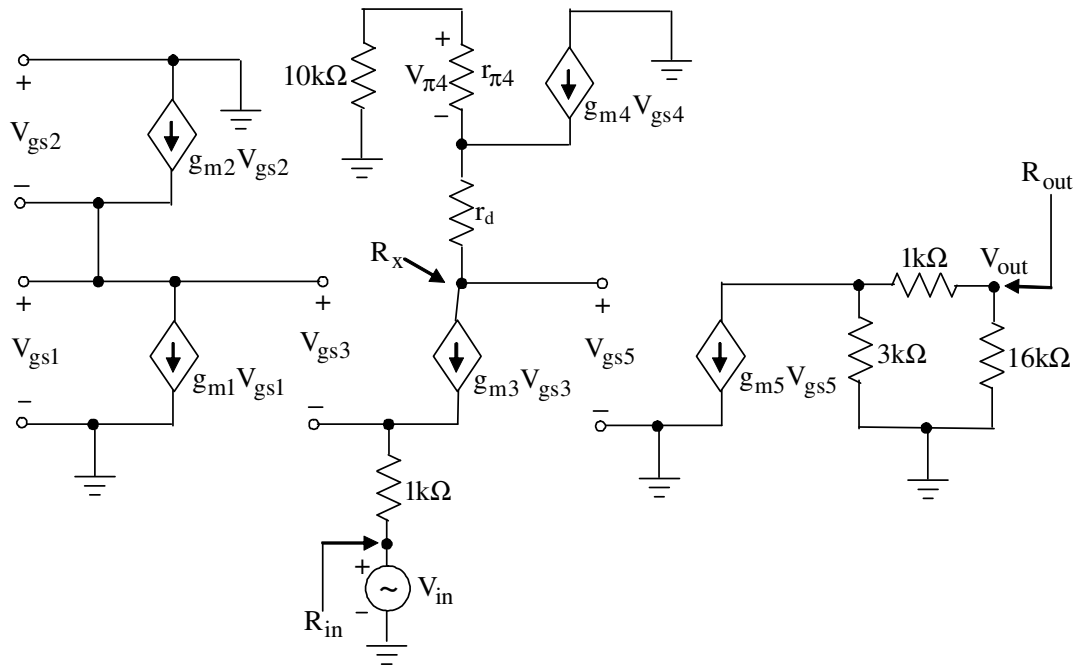
$$I_{E4}=I_{DIODE}=100\mu\text{A}, I_{D3}= I_{D5}=20\text{mA}$$

For the following hybrid- π equivalent circuit below, find the following values:

- r_d (diode parameter), $r_{\pi4}$ and g_{m4} (BJT), g_{m3} and g_{m5} (MOSFet).
- R_x
- R_{in} (input resistance –ignore only the input source, V_{in} ; include **all** resistors seen above V_{in})
- R_{out} (output resistance-include **all** resistors at node {**no load is connected**})
- midband gain, $\frac{V_{out}}{V_{in}}$
- Explain why or why not this is a good amplifier for voltage amplification.



Problem 2: (extra page)



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Name _____

Scores:

Prob 1 _____ of a possible 130pts

Prob 2 _____ of a possible 70pts

Total _____ of a possible 200 pts