Midterm Examination # 1

Electronic Circuits I - ECSE-330B

February 17th 2004, 8:35 AM – 9:55 AM

Professor Ramesh Abhari

Pertinent Information:

1) This is a closed-book examination, no notes permitted.

2) Answers should be written in pen.

3) This examination consists of 4 questions with total possible points of 36. Partial point distribution is indicated in brackets.

4) Only the Faculty Standard Calculator is permitted.

5) Show your work: answers without justification will not receive marks. State any assumption you find necessary to complete your answer.

Last Name	
First Name	
Student Number	

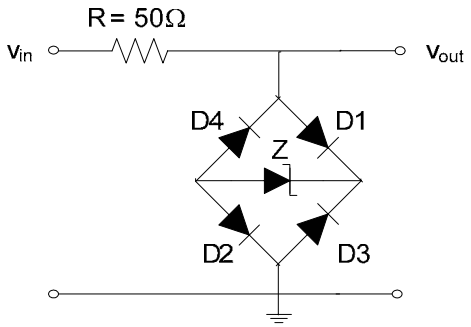
Question	Mark
1	/9
2	/9
3	/9
4	/9
Total	/36

Question #1 (9 pts)

In the circuit shown below, D1, D2, D3 and D4 are identical and are represented by constant voltage drop model (CVDM) $V_{D0} = 0.7$ Volt. Z is a Zener diode with the specified Zener voltage of 8V at 10mA and r_z=20 Ω and can be represented by a piecewise-linear model.

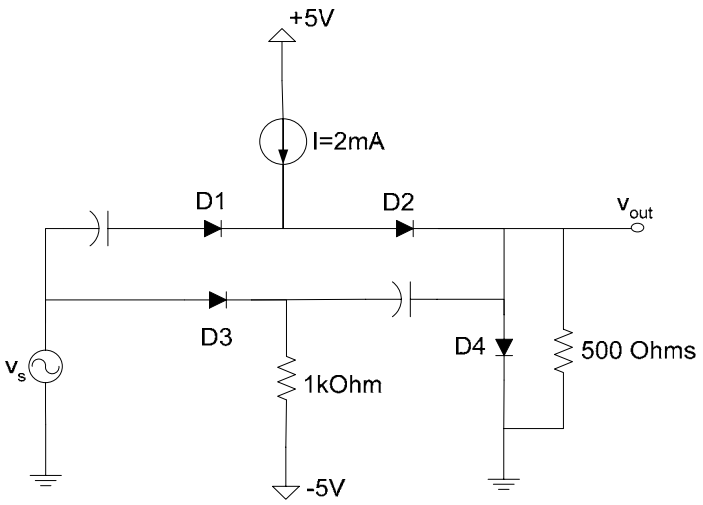
a) Find V_{Z0} in the piecewise-linear model for the Zener diode. (2 pts)

b) Sketch and clearly label the voltage transfer characteristic (VTC) of this circuit for $-20\ V < v_{in} < +20\ V$. (7 pts)



Question #2 (9 Points)

Consider the circuit below. All capacitors are "infinite". The source v_s is a signal source with no DC voltage (0V DC) and $v_s << nV_T$. Diodes are all identical (n=2).



a) Assume the constant voltage drop model. Determine the DC current flowing in each diode. (4 pts)

b) Determine the small signal gain v_{out}/v_s. (5 pts)

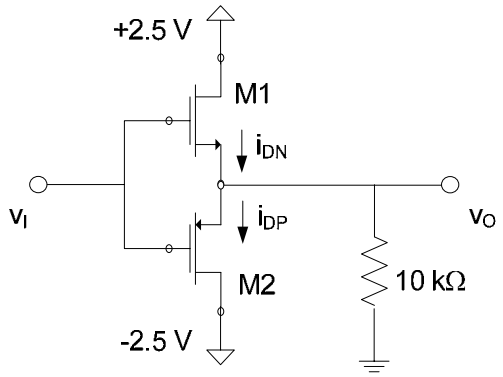
Question #3 (9 Points)

The NMOS and PMOS transistors in the circuit below are matched with ($\mathbf{k_n'W/L = k_p'W/L = 1mA/V^2}$) and $V_{tn}=-V_{tp}=1$ V, assuming $\boldsymbol{\lambda=0\ V^{-1}}$ for both devices find the drain currents i_{DN} and i_{DP} and the voltage v_O for:

a) $v_I = 0$ (4 pts)

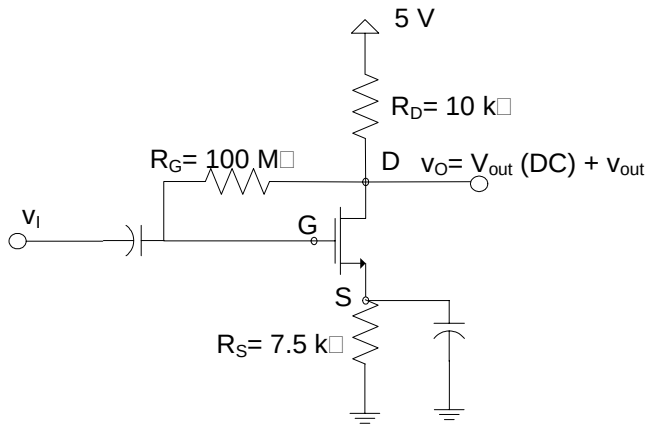
b) $v_I = 2.5$ V (5 pts)

For each case, explain the assumption you make for the mode of operation of M1 and M2.



Question #4 (9 Points)

a) In the following MOSFET circuit, $\lambda=0.05V^{-1}$ and $V_{tn}=1$ V and all the capacitors are infinite. Draw the small-signal model. (3 pts)



b) Assume V_S = 1.5 V and Vout (DC)= 3V. What is the voltage gain of the circuit in part (a)? (2 pts)

c) In the following circuit $|\lambda|=0.05V^{-1}$, Vref = 3V and V_{tp}=-1 V. I_{ref} is equal to the I_{DS} found for the circuit shown in part (a). Draw the small-signal model of the circuit below and calculate the drain-source resistance. (4 pts)