EC201 : ANALOG CIRCUITS
QUIZ 1 — Maximum Marks 20 — TIME - 1 Hour

Please explicitly state all assumptions you make. In your own interest, do not skip steps while working the problems . *NO CREDIT WILL BE GIVEN FOR ANSWERS WITHOUT CLEAR EXPLANATIONS AS TO HOW YOU CAME TO THE SOLUTION. THE INSTRUCTORS JUDGMENT WILL BE FINAL IN THIS REGARD.*

1 Problem 1 (10 Marks)

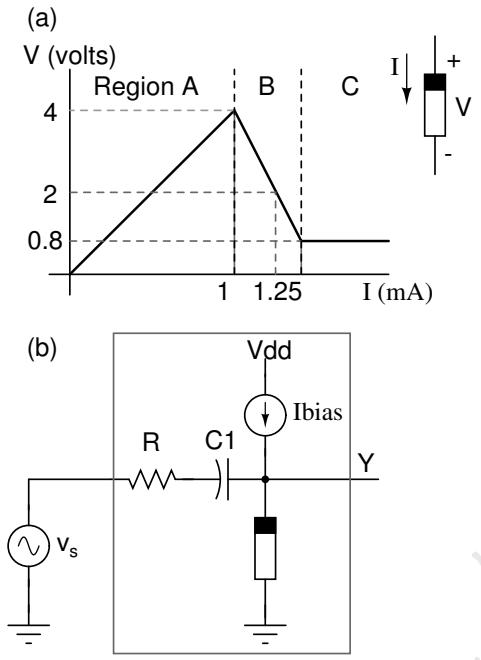


Figure 1: Problem 1

A new semiconductor device, the wormister, has taken the world by storm. The V-I characterstic of the device, which is piecewise linear, is shown in Fig. 1(a). As a circuit expert, you are given the job of using the device to obtain incremental gain. You come up with the arrangement shown in Fig. 1(b), where R is a linear resistor and $C1$ is an infinite capacitor. Y is the output node and we denote the **incremental** voltage at Y as v_Y. v_s is the sinusoidal input signal. R is a linear resistor.

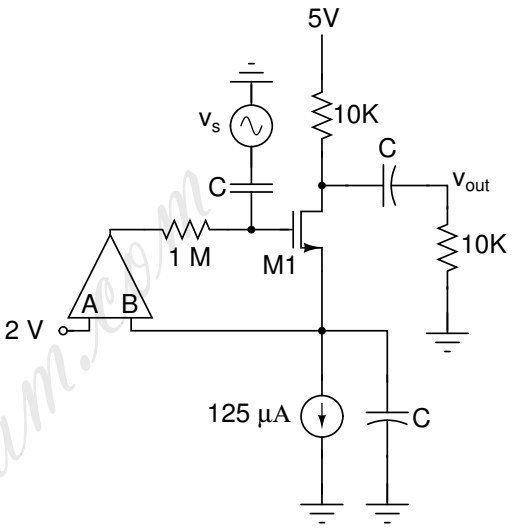
1. In what region of the device characterstic will you bias the device, so that you can obtain an incremental gain ? Why ? (2 Marks)

2. Determine the value of R so that the incremental gain is -4. (2 Marks)

3. For the value of R determined in part 2 above, find the value of Ibias that maximizes the amplitude of the input sinusoid one can use while avoiding distortion at the output. (4 Marks)

4. Under the conditions of parts 2 & 3 above, determine the incremental y-parameters of the two port (in the box) shown in Fig. 1(b). (2 Marks)

2 Problem 2 (10 Marks)



M1 : V_T=0.7 V, (W/L) = 10, k=100 µA/V^2

Figure 2: Problem 2

For M1 in Fig. 2, assume that $\lambda = 0$. All other device parameters are indicated in the diagram.

1. Determine the signs on the opamp for negative feedback operation. (2 Marks)

2. Determine the quiescent voltage at the gate and drain of M1. (2 Marks)

3. What is the incremental gain $\frac{v_{out}}{v_s}$? (2 Marks)

4. What is the amplitude of the largest input sinewave for which the output does not clip? (4 Marks)