State the conditions you assume, if any insufficient.

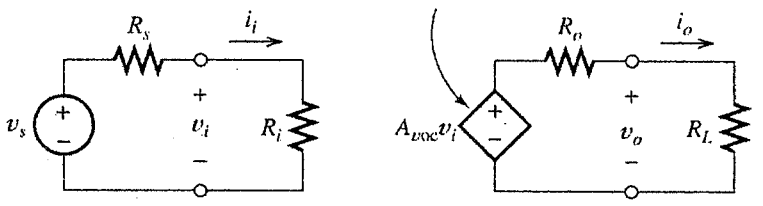
1. (20%) Please design a common-emitter BJT Amplifier with an emitter bypass capacitor, based on the following three constraints:

✓ Swing voltage of the output voltage must be between 22V and 24V (peak to peak)
✓ Voltage gain must be equal to 20.
✓ Power dissipation by resistors must be under 0.2 Watt

Your design must include the amplifier circuit, along with the bias circuit, as well as the values of all the resisters and capacitors, the DC power supplies, and the parameter (β) of the BJT.

2. (20%) Please provide a circuit design of current mirror using only MOSFET and DC power supplies. The output current of your current mirror circuit must be 1 mA. Please specify the parameters of your MOSFET.

3. (20%) Two amplifiers (each can be modeled as the following figure) were cascaded in the order A-B.



(a) (8%) Find the input impedance (R_i), output impedance (R_o), and open-circuit voltage gain of the cascade.
(b) (8%) Repeat (a) when the order is B-A.
(c) (4%) Which order is better? Why?

Amplifier	$A_{voc}= v_o/v_i$	R_i (Ohm)	R_o (Ohm)
A	100	1k	100
B	500	1M	1k

Problem 4 and 5 are on the next page.

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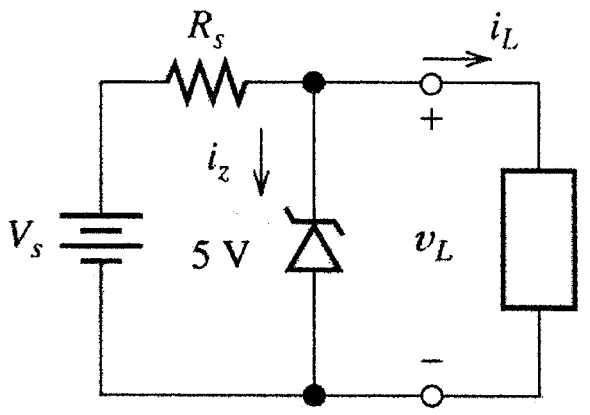
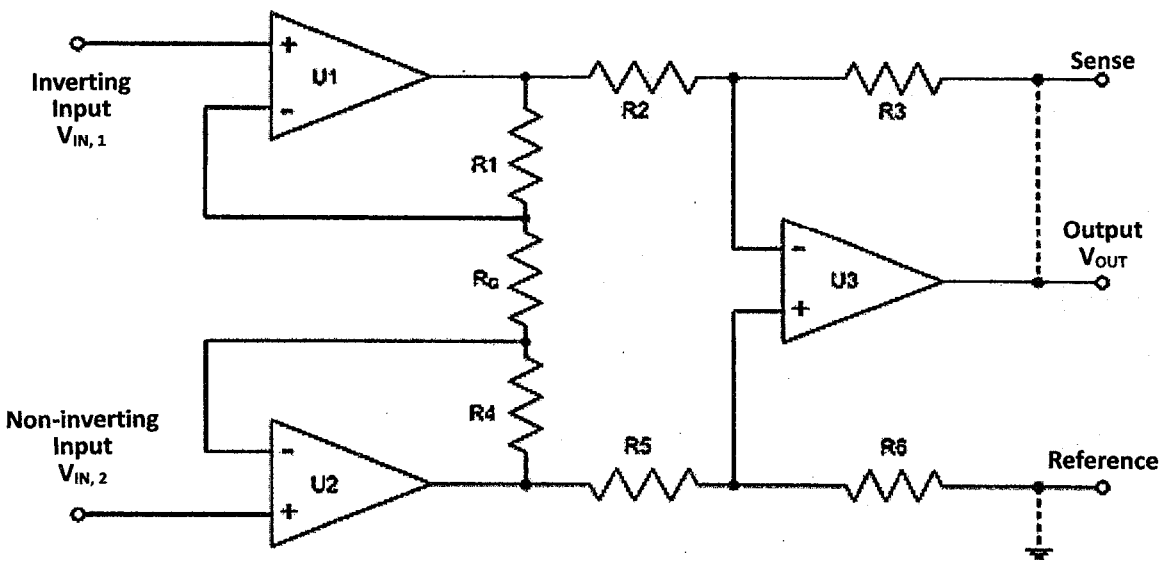
4. (16%) A Zener voltage regulator is shown below. The V_s varies from 7 to 10 V, and the i_L varies from 50 to 120 mA. Assume the Zener diode ideal.



(a) (10%) Determine the largest R_s for constant v_L.
(b) (6%) Following (a), determine the maximum power dissipation in R_s.

5. (24%) An instrumentation amplifier is shown below.



(a) (6%) What is the part with U1, R1, and R_G? What is the purpose of this part?
(b) (6%) What is the part with U3, R2, R3, R5, and R6? What is the purpose of this part?
(c) (12%) What is the mathematic relationship between $V_{IN,1}$, $V_{IN,2}$ and V_{OUT}?

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