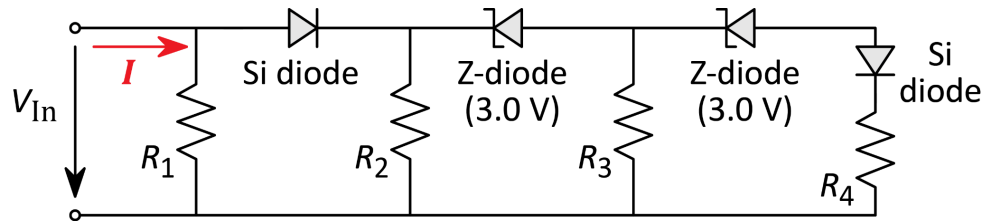
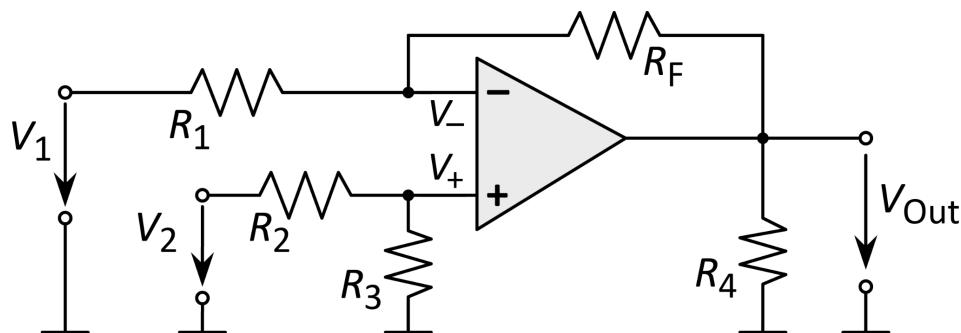


Exam-01 – OpAmps and Diodes

1. Consider the circuit shown below containing two Si diodes (threshold voltage = $V_{th} = 0.7$ V) and two Zener diodes (Zener voltage = 3.0 V). Assume that $R_1 = R_2 = R_3 = R_4 = 1$ k Ω .
 - (a) Calculate the total current I consumed by the circuit for the following DC input voltages: $V_{In} = 1.0$ V, 5.0 V, and 10.0 V.
 - (b) Assume the current through R_4 is 1.0 mA. Calculate the total current I consumed by the circuit.
 - (c) Sketch (qualitative sketch) the current-voltage characteristic (I -versus- V_{In}) of the circuit for input voltages ranging between 0 V and 10 V. Determine the voltages and currents at all significant points (kink points).



2. Consider the operational amplifier circuit shown below. Assume that the operational amplifier has ideal properties.
 - (a) Is an operational amplifier circuit, as the one shown below, a linear circuit? (Yes/No) Justify your answer.
 - (b) The circuit has two input voltages (stimuli) and one output voltage (effect). Following the superposition-principle procedure, calculate the effect of V_1 on V_{Out} .
 - (c) Following the superposition-principle procedure, calculate the effect of V_2 on V_{Out} .
 - (d) Give an equation that relates the output V_{Out} to the inputs V_1 and V_2 .
 - (e) Assuming $R_1 = R_2 = R_3 = R_F$, and defining the amplification as $A = V_{Out} / (V_2 - V_1)$, give the amplification of the circuit.
 - (f) Does R_4 enter the amplification A ? Justify your answer.
 - (g) If the operational amplifier would be a real (non-ideal) amplifier (with a non-zero output impedance), what would be the qualitative effect of R_4 ?



3. Are the following statements True or False? Justify your answer.
 - (a) Regularly charging a cell phone rechargeable battery at low currents (for example 1 A instead of 3 A) will prolong the lifetime of the battery.
 - (b) All silicon Zener diodes become conductive at 0.7 V for one of the two bias directions.
 - (c) In an operational amplifier circuit, the feedback branch (R_F) must always be connected to the inverting input terminal.