UNIVERSITY OF CALIFORNIA
Department of Electrical Engineering and Computer Sciences
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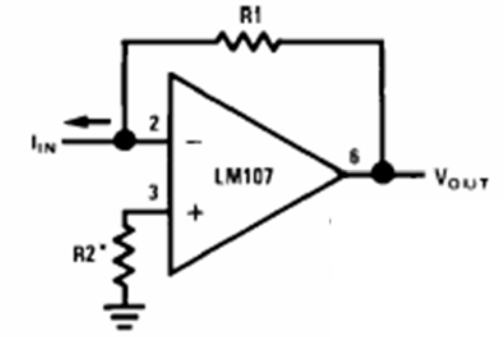
Prof. Subramanian

Test 2

FOR ALL QUESTIONS, ASSUME OP-AMPS ARE IDEAL UNLESS OTHERWISE STATED

1) Consider the circuit below.

   a) Derive an equation for the output voltage as a function of the input current.

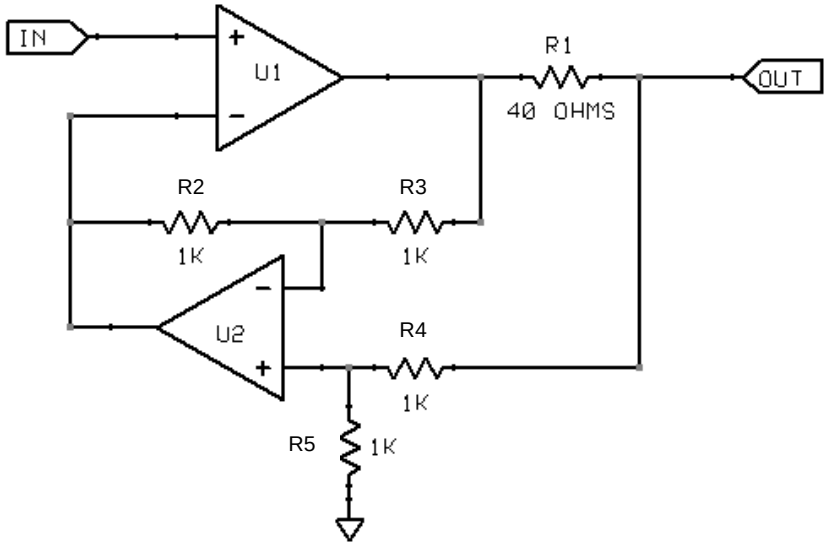


   b) Suppose R2 was replaced by a short circuit, would your answer above change? Give reasons as appropriate.

   c) Now, suppose the input of the op-amp is no longer ideal, and in fact, there is an input resistance R_{in} between the non-inverting and inverting inputs. Derive an equation for V_{out} as a function of I_{in} in this case.

d) R_{in} is typically not a well-controlled parameter in operation amplifiers. What value would you pick for R_2 above to ensure that variations in R_{in} do not significantly impact the circuit performance? Give reasons as appropriate.

2) Consider the circuit below.



a) Derive equations for V_{out}

b) Suppose a load resistor R_L is connected from the output to ground. Derive an equation for I_{out}, i.e., the current through R_L.

3) Consider Operational Amplifiers as used in modern circuits

   a) Why do we use high-gain op-amps and then use negative feedback to reduce the gain? Why not just use an op-amp with the desired gain?

   b) Suppose I designed a voltage amplifier with a gain of 100, and used a V_{DD} and V_{SS} of +15V and -15V respectively. What is the maximum input signal sinusoid amplitude that could be used without clipping?

   c) Why do clipped waveforms sound distorted to the human ear? Given a mathematical justification (no need to write any equations; just explain the concept).

   d) For the amplifier in part (b), what is the gain in dB?

4) For the following circuit, derive V_{out} / V_{in} as a function of "a". "R" is a fixed value of resistance.