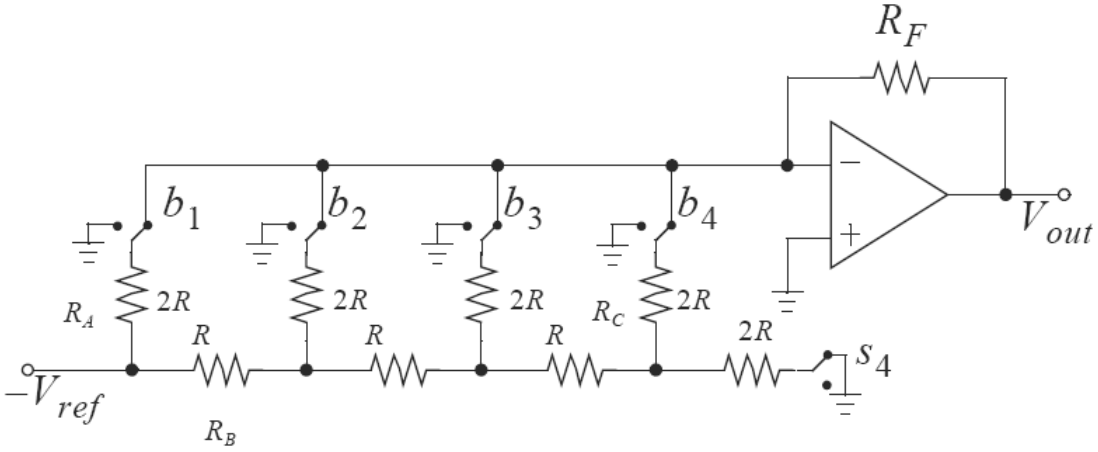
ELEC 501 Analog Integrated Circuit Design
Assignment #2
Nominal Due: Wednesday April 1, 2026 at 11:59pm

1. In the following R-2R-based DAC,



a) What is the output error (in LSBs) when R_A=2.01R? What is the output error when R_C=2.01R? Based on your result, the precision of which resistor (R_A or R_C) is more important?

b) Assume that all switches in the above circuit are MOSFETs and are scaled such that their on resistance is much smaller than R, however, they each have an 80mV voltage drop across them (their drain to source) when on. What would the effect of this non-ideality on the accuracy of the converter?

2. A 12-bit binary-weighted DAC produces a glitch voltage of 0.4V when its MSB is changed. What would be this glitch voltage if a thermometer-code approach is used for the top 4 bits, whereas binary-weighting is used for the remaining 8 bits.

3. Assuming the input capacitance of a differential stage (and/or comparator) is the same in either a flash or folding/interpolating ADC, what reduction of input capacitance over a flash converter would be achieved if an 8-bit folding/interpolating ADC having 4 folding blocks, each with a folding rate of 8 is used? If a straight interpolating ADC is to have the same reduction in input capacitance (as compared to an 8-bit flash ADC), how many resistors are required between each two consecutive input comparators.

4. Find an expression for the number of latches in an N-bit folding A/D converter whether the folding rate is FR=2^m (m is an positive integer number).

5. Explain whether or not:
a) an 8-bit ADC can have a worst-case DNL of 1.2LSB
b) a 12-bit ADC can have -0.5LSB<DNL<+0.5LSB and -0.2LSB<INL<+0.2LSB

6. You are to realize a third-order MASH by cascading three first-order stages as shown in the following block diagram. The second and third stages accept as their inputs the quantization errors of the previous stages, namely, e1(n) and e2(n). Assuming all of the discrete-time integrators in the first-order modulator are ideal, find the digital filters H_1, H_2, and H_3 so that the overall MASH output, y, includes only the input signal u (or the delayed version of it) and the third-order shaped quantization noise.