

ECE627

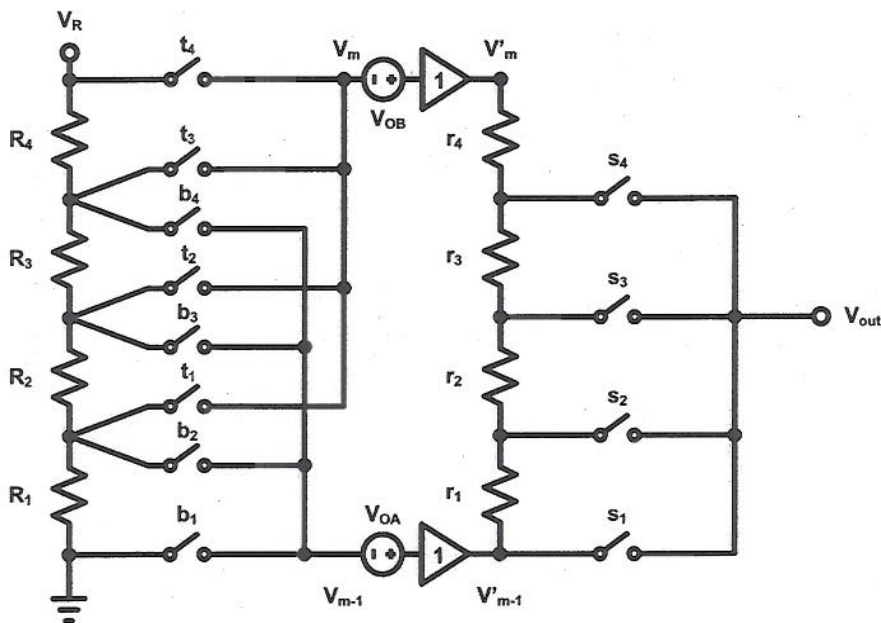
Spring 2010

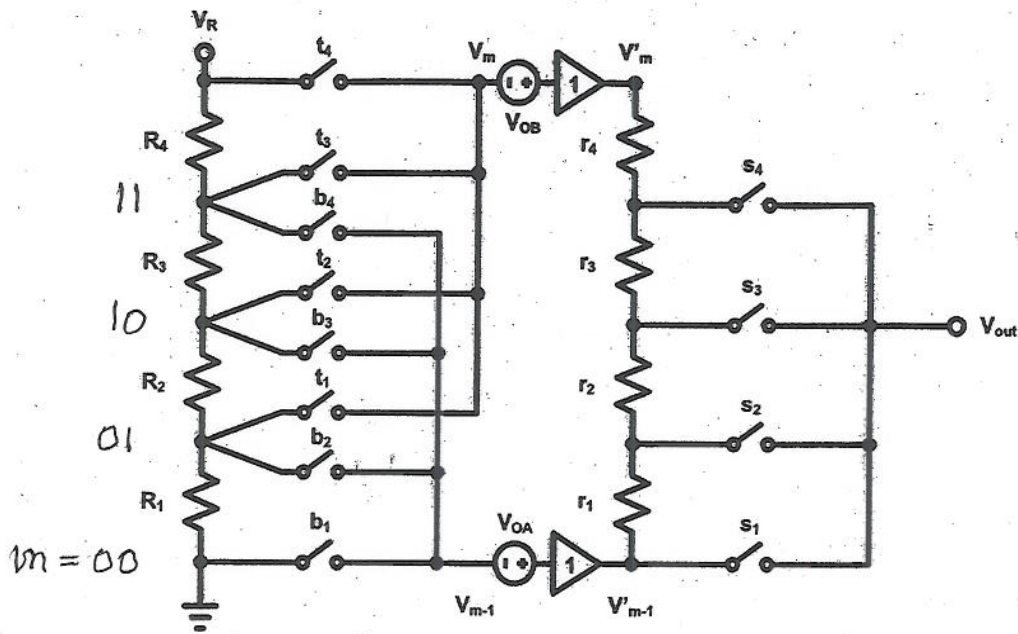
Midterm Examination

May 14, 2010, 3 - 3:50 pm

A 4-bit segmented DAC is shown below. The two MSBs control the switches which connect the two buffers to adjacent taps on the resistor string containing the resistors R_m . The LSBs select one of the tap voltages of the r_l string as the output voltage. Assume $V_R = 5$ V, and buffer offset voltages $V_{OA} = 0.2$ V, $V_{OB} = 0.5$ V. All resistors are equal to 1 kilohm.

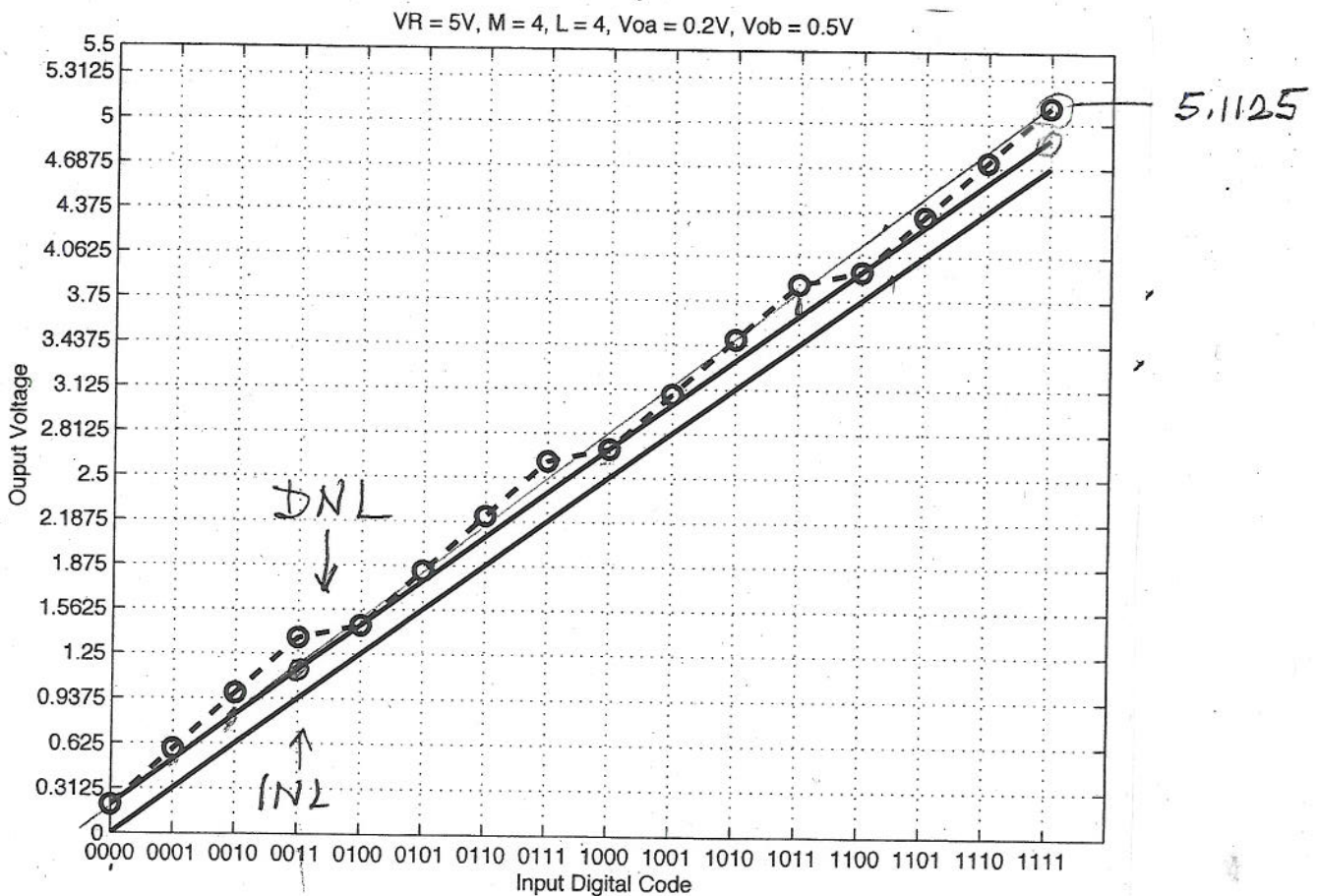
- Find the equation for the output V_{out} as a function of m (the value of the MSB word), and of l (the value of the LSB word).
- Plot the input-output characteristics of the DAC.
- What is the offset error? What is the gain error?
- Find the INL and DNL. You may neglect the gain error in these calculations.





a.
$$V_{out} = V_{m-1}' + \frac{L}{4} (V_m' - V_{m-1}') = \frac{5}{4} m + \frac{1.55}{4} L + 0.2 \text{ (V)}$$

b.



c. Offset error = 0.2 V, gain error = 5.1125 - 0.2 -

d.
$$INL = \frac{1.55}{4} \cdot 3 - 5 \cdot \frac{3}{16} = 0.225 \text{ V} \quad (15/16) \cdot 5 = -0.225 \text{ V}$$

$$DNL = \left(\frac{5}{4} - \frac{1.55}{3} \right) - \frac{5}{16} = -0.225 \text{ V} = -0.72 \text{ LSB}$$