Midterm Quiz: Electronics 323
October 14, 2010

Formula sheet provided. Total 46 points. Individual values follow each question.

1. (a) In the context of our class what is a "system"? Give two of the benefits of using electronic systems. (3)
   (b) Give two examples of light sensors and very briefly describe the physical process involved. (4)
   (c) Give two examples of light "actuators". (2)
   (d) Explain how something as simple as a button a keyboard can be considered a "sensor". What is being "sensed" and what is the new physical quantity produced by the sensor? (3)

2. (a) Draw the equivalent circuit of an amplifier with $A_V = 20$, $R_i = 10$ kΩ, $R_o = 75$ Ω with appropriate labels. (2)
   (b) Now add a source with $V_s = 0.050$ V and $R_s = 1.0$ kΩ and a load with $R_L = 450$ Ω. (2)
   (c) Determine the voltage gain of the entire circuit. Also give the gain in decibels using the usual formula based on the voltage. (I will give partial credit for this question even if you don't know how to draw the equivalent circuit.) (5)
   (d) A_V as given is sometimes referred to as the "ideal" gain. Explain under what circumstances you would see that ideal behaviour. (3)

3. See the diagram of the low-pass filter below. Assume the frequency is $f = (2\pi RC)^{-1}$. Calculate the decibel gain (or attenuation in this case) and phase change in V_{out} at this frequency. (You don't need to derive the general formula; just substitute in the value of ω.) Give a plot of gain and phase versus the log of the frequency (don't need to derive this; just use knowledge from class, lab, and possibly the formula sheet). (8)

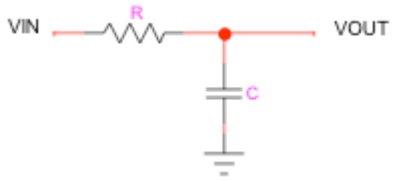

Figure 1: Low-pass filter

4. (a) Draw the generic feedback diagram showing the user input, subtractor, forward path, output, and feedback path. Show that the effective gain of this arrangement is $A/(1 + AB)$. (5)
   (b) What is the condition on AB for relative stability as A varies? What is the condition on AB for oscillations? Are these cases of positive or negative feedback? (3)
   (c) How does negative feedback affect the bandwidth of an amplifer? (2)

5. What are the 741 and 311 chips? Very briefly, how does their functionality differ? (4)