EAS 199A **Homework 4** **Due 24, 25 October 2011**

Problems 1 through 3 should use the Direct Solution Format. Problem 4 should use the Engineering Solution Format.

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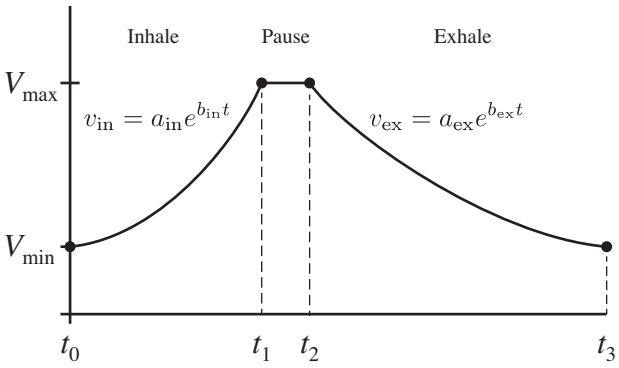
1. Read the Soldering notes from the class web site (linked from Lecture 08), and complete the Soldering Quiz on the last page of this assignment. The soldering quiz can also be downloaded from the class web site.

   Turn in the soldering quiz, with your signature, as a separate sheet of paper.

2. Select values of V_{min}, V_{max}, t_1, t_2, and t_3 to define a model of the breathing LED. Refer to the plot at the right and the class notes. The values of V_{min} and V_{max} should come from experiments with an LED circuit and PWM output from an Arduino. Values of t_1, t_2, and t_3 should come from observations of your own breathing patterns.



   a. What are your values of V_{min}, V_{max}, t_1, t_2, and t_3?

   b. For the value of V_{min}, V_{max}, t_1, t_2, and t_3 obtained in the preceding step, what are the coefficients of the two exponential functions for the inhale and exhale phases of the breathing cycle?

   c. Use Excel to make a plot of the breathing cycle. Your plot should look like the one in the problem statement above.

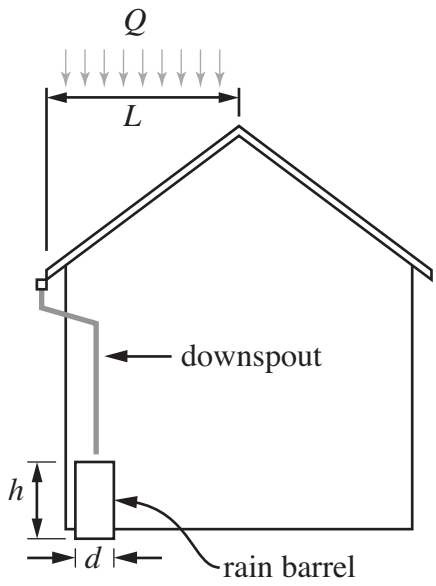
3. Build the breadboard circuit, and write an Arduino sketch to implement the breathing LED described in the class notes. Use the parameters obtained in your solution to the preceding problem.

   Note that working code for a linear variation in PWM output is available from links on `http://web.cecs.pdx.edu/~gerry/class/EAS199A/topics/`

   Copy your code to a word-processing document (e.g. MS Word). Add a brief description (say two to three sentences) and put a title and problem number on the document. In other words, *do not* simply print the code and attach it to your assignment sheet. Have your program and circuit running at the start of the next class (Monday, 26 October or Tuesday 27 October 2011).

(Continued on next page.)

4. **Background**: You have been asked to create information for the City of Portland's program to promote the use of rain barrels to manage rainwater from downspouts. The program's goal is to reduce the flow of water into the storm sewers by temporarily storing runoff in a rain barrel, which then is emptied more slowing into your yard.



Assume that the plan area of one side of a roof is square with length L on each side. Let the rainfall be Q inches per hour. The volume of water flowing from the roof in time Δt is

$$V_w = 2QL^2\Delta t\,. \qquad (1)$$

where the factor of 2 is needed because there are two sides to the roof. Assuming that the rain barrel is a cylinder with diameter d and height h, the volume of the barrel is

$$V_b = \frac{\pi}{4}d^2h \qquad (2)$$

By setting $V_w = V_b$, we can determine the time it takes to fill the rain barrel.

$$V_w = V_b \quad \Rightarrow \quad 2QL^2\Delta t = \frac{\pi}{4}d^2h \quad \Rightarrow \quad \Delta t = f(Q,L,d,h)\,. \qquad (3)$$

Assignment: Perform the algebra necessary to obtain the formula for $\Delta t = f(Q,L,d,h)$ listed above. Use Excel create the table below where the empty cells are the values of Δt for the given Q and d. Define cell names for L = 20 ft and h = 30 inches, which are held constant. On a single set of axes, make a plot of Δt versus Q for the three curves (one for each d). Make sure your spreadsheet has a header with the class name, your name, the course and the due date.

	d =	d =	d =
Q (inch/hr)	28	32	34
0.5			
1			
1.5			
2			
2.5			

EAS 199A: Soldering Safety Quiz Name: _____

View the Soldering Safety presentation on the course web site and complete the "safety quiz" below. When you are sure you understand all of the information in the presentation, sign the bottom of the quiz. Do not include this quiz with your homework. Submit it in a separate stack at the next class period. Do not fold this quiz.

(T F) Soldering involves melting metal and high temperatures that may result in injury.
(T F) Soldering could start a fire.
(T F) You do not need to wear safety glasses when soldering.
(T F) I can be burned by touching the tip of a soldering iron even after it is unplugged.
(T F) The tip of the soldering iron is typically supported by a small stand (see slide 10). Touching this stand can also cause burns.

I promise to adhere by the guidelines presented in the Soldering Safety presentation and act responsibly when using equipment that could be hazardous to others and me.

Signature: _____ Date: _____