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ME 120 FINAL EXAMINATION – SECTION C

Fall 2015

Computer Portion: Allowed materials include computer, pen or pencil.

1. Excel Problem (25 points)

A research group has been working on an electric motor. They would like to know its efficiency. In order to graph the efficiency, they have been measuring the current inputted to the motor at different torques (T). The torque can be viewed as the turning force of the motor. Their result is shown in the table below:

Torque (oz.in)	Current (mA)
0.05	260
0.1	300
0.2	380
0.3	460
0.4	540
0.5	620
0.6	700

(a) (3 point) Copy the data of the table onto an Excel sheet. Knowing that the voltage supply was set to 9V, add a column where you compute the power input (in W) for each current value.

(b) (3 points) The research group has observed that the angular velocity of the motor was linearly proportional to torque, following the relationship:

$$\omega_{rpm} = -18\,454 * T + 11709$$

where T is the torque in oz.in and ω_{rpm} is the angular velocity in rpm (revolutions per minute). Add a column where you compute the angular velocity in rpm.

(c) (3 points) The power output of the motor can be expressed (in W) as:

$$P_{output} = T * \omega_{rpm} * 0.000739$$

where T is the torque in oz.in and ω_{rpm} is the angular velocity in rpm. Add a column where you compute the power output.

(d) (3 points) Add a column where you compute the efficiency (in %) of the motor.

(e) (3 points) Create a plot of the efficiency as a function of torque.

(f) (5 points) On the same graph, create a least squares curve fit that, in your judgment, does a good job of approximating the data. Make the fit equation and the R^2 value visible on the plot. Explain your reasoning for your choice of curve fit. (you can write in a cell under the graph)

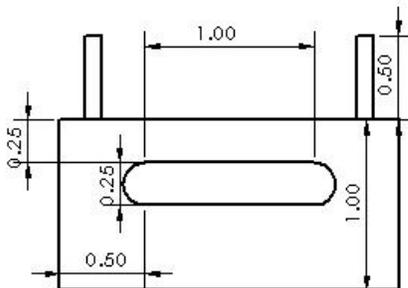
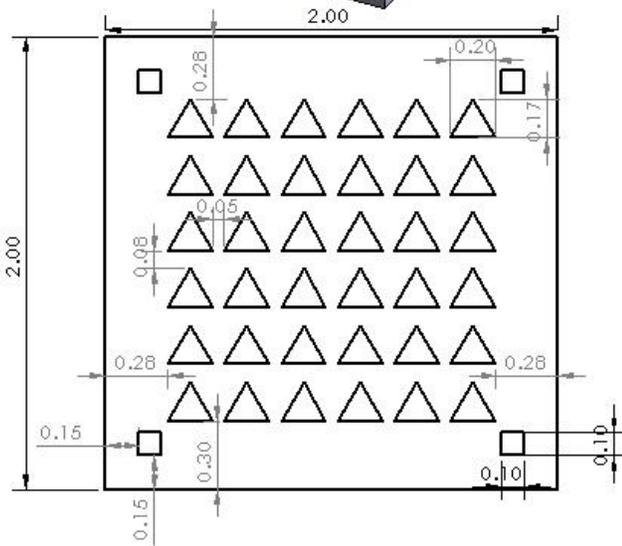
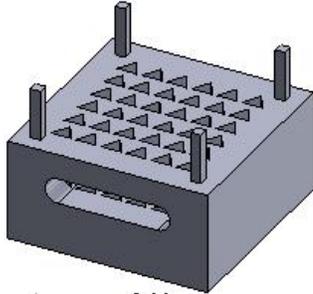
(g) (4 points) What is the maximum efficiency, and at what torque?

(h) (1 point) Save your excel sheet following the naming convention:

LastName_FirstInitial.xlsx (example: doe_j.xlsx) via the D2L dropbox called "Excel FINAL".

2. SolidWorks Problem (25 points)

Make a Solidworks model of the part pictured below. When you are finished, save the model following the naming convention: LastName_ FirstInitial.SLDPRT (example: doe_j.SLDPRT) via the D2L dropbox called "SolidWorks FINAL".



Rubric:

You will be tested on accuracy of dimensions, shape, and placement of all the subparts, following the rubric below:

- (2 points) File saved in the D2L dropbox
- (3 point) Base block
- (5 points) Four (4) corner legs
- (7 points) Rounded-end Slot
- (8 points) Triangular holes (in linear pattern)