

**EXAM 1 – COMPUTER PORTION**

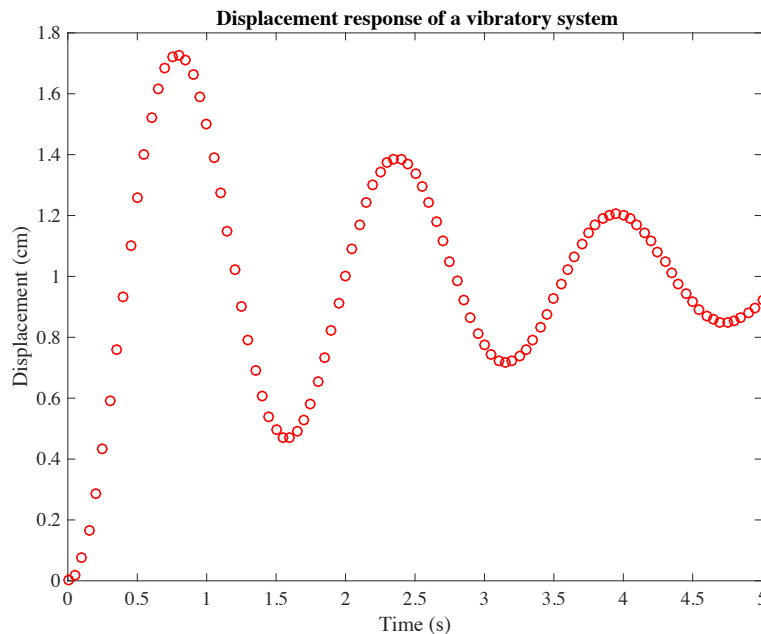
Put all of your code in one script and name it `lastname_firstname.m` (all lower case). Include your name, section number, and CM number in the header section of your code. **There should be no output other than what is requested.**

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**Problem (50 pts)**

For this exam problem, we will work with the Excel file `oscillation.xls` posted on the course website. The file contains displacement data for the oscillatory response of a system. Time (in seconds) is recorded in the first column, and the second column contains the system's displacement in cm.

- a) (15 points) Download the Excel file from the course website. Load the contents of the file into MATLAB. **Do not** hard code the dimensions of the loaded array. Plot the displacement data over time using **red circles**. Add good axis labels and a title. When finished, your figure should look like the one shown below.



- b) (15 points) Add code to your script to automatically compute the number of peaks present in the oscillatory displacement data. (From the figure above, there are clearly 3 peaks.) Print your result to the **Command Window** using the following words:

There are XX peaks in the data.

Here, `XX` is your result, which must be printed using the specified format and a variable. (That is, **do not** just look at the result and type it into the `fprintf` statement.)

(over)

- c) (20 points) We will now fit a model to the data. The trend of the displacement data may be approximated by the following function:

$$x_{\text{model}}(t) = 1 - e^{-at} \sin(4t + 1.5) ,$$

where  $x_{\text{model}}$  is the model displacement in cm,  $t$  is time in seconds, and  $a$  is a damping parameter. Add code to your script to determine the value of  $a$  that generates a model displacement curve for which the error,  $x_{\text{model}} - x_{\text{data}}$ , **in absolute value** is never more than 0.04 cm. Limit your search to  $a$  values ranging from 0.1 to 0.8 in steps of 0.05. When evaluating the model displacement function, use the same times at which the data were collected.

Once you have found the optimal  $a$  value, generate a vector of the best-fit model displacement. In a **new figure** (i.e., **do not** overwrite your first graph), plot the displacement data over time using **red circles** and the model displacement curve over time using a **solid black line** on the same axes for comparison. Make sure you include good axis labels, a title, and a legend.

When you are finished, put your script (`lastname_firstname.m`) in the Moodle assignment dropbox.

**NOTE:** All programming must stop 5 minutes before the end of the period. You will have 5 minutes after that to post your file to Moodle if you need that time.