

ENED 1090: Engineering Models I
Homework Assignment #2

Due: Week of September 16th at the beginning of your Recitation Section

Instructions:

1. Before you begin editing this document, you must save this document to your laptop or you will end up losing all of your work. If you opened this document directly from Blackboard, click on the Enable Editing button then choose File → Save As and save the document to your laptop. You should set up a folder on your laptop for ENED1090 where you keep all of your homework assignments and lab reports.
2. **Show your work! Make sure you include MATLAB commands.**
3. It is fine to work with other students, but what you turn in must be your own work - not something copied from someone else.
4. Submit an electronic copy of your work to your *individual section* of Blackboard – go to the Assignments Folder and look for Homework #2. **Reminder: once you hit submit, be patient and wait – attachments take a while to upload. Hitting submit multiple times will result in multiple submissions.**

Problem 1: Plotting Functions (Suggestion: Create a script file for this)

Use the subplot command to break the MATLAB figure window into a 2x2 grid of sub-windows. Then plot the following functions using MATLAB commands (**not Plot Tools**) for the formatting. Be sure to make good choices for the values on the x-axis. In all four plots, don't mark the individual data points.

(a) Top Left Sub-window: $y = t^2 - 4t + 3$ (solid red line - grid)

MATLAB Commands:

- a. EDU>> ta=0:0.001:4;
- b. EDU>> ya=ta.^2-4*ta+3;
- c. EDU>> subplot(2,2,1); plot(ta,ya,'r-'); grid

(b) Top Right Sub-window: $y = \cos(4t)$ (dashed black line)

MATLAB Commands:

- a. EDU>> tb=0:0.001:6;
- b. EDU>> yb=cos(4*tb);
- c. EDU>> subplot(2,2,2); plot(tb,yb,'k--'); grid

(c) Bottom Left Sub-window: $y = e^{0.12t}$ (dashed magenta line – grid)

MATLAB Commands:

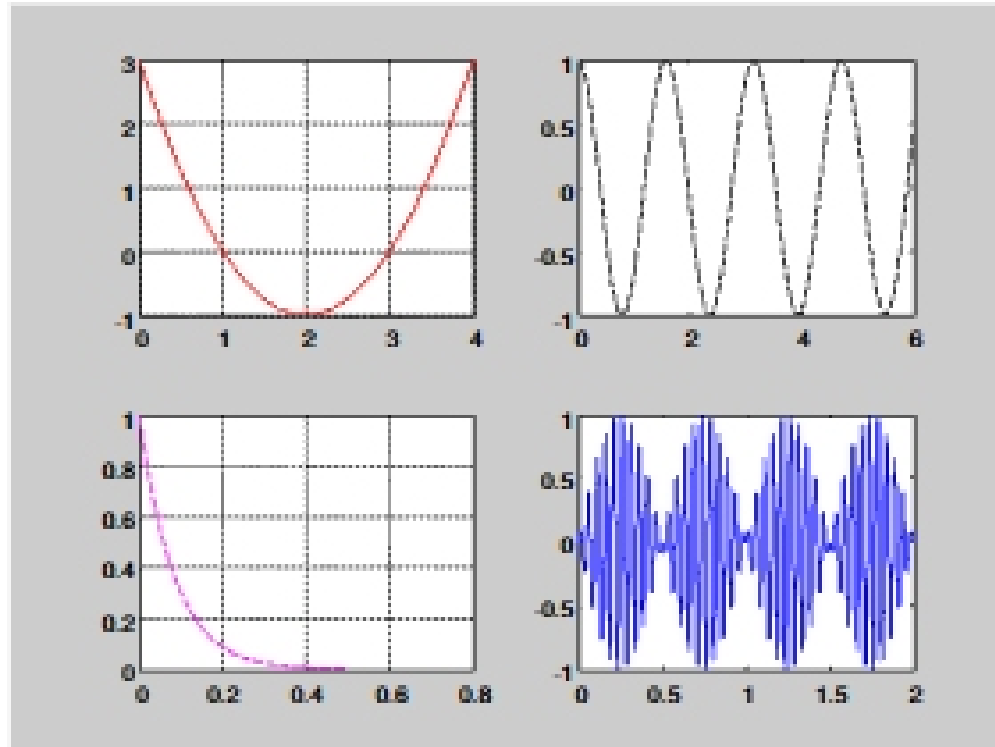
- a. EDU>> tc = 0:0.001:0.5;
- b. EDU>> yc = exp(-12*tc);
- c. EDU>> subplot(2,2,3); plot(tc,yc,'m--'); grid

(d) Bottom Right Sub-window: $y = \sin(2\pi t) * \sin(2\pi(20t))$ (solid blue line – use t = 0 to 2 secs)

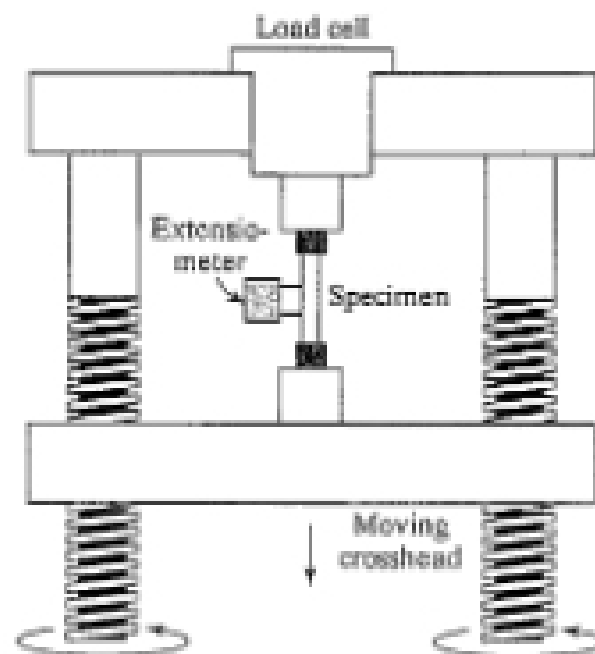
MATLAB Commands:

- a. EDU>> td = 0:0.001:2;
- b. EDU>> yd = sin(2*pi*td).*sin(2*pi*20*td);
- c. EDU>> subplot(2,2,4); plot(td,yd);

Final Plot:



Problem 2: Tensile Testing (Suggestion: Create a script file for this)
(Modified from William Callister, Materials Science and Engineering, An Introduction, 5th ed.)



A tensile testing machine, like the one shown in the diagram above, is used to apply an increasing force to a material and measure the resulting strain in order to characterize how the material behaves as it deforms.

Applied Force	Length after force is applied	Applied Stress, σ	Resulting Strain, ϵ
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(lbf)	(in)	(lbf/in ²)	(in/in)
0	2	0	0
1650	2.003	13130.3	0.0015
3400	2.006	27056.3	0.0032
5200	2.009	41380.3	0.0045
6850	2.012	54510.6	0.0060
7750	2.015	61672.5	0.0075
8150	2.03	64855.6	0.0150
8500	2.06	67640.9	0.0400
8750	2.09	69630.3	0.0450
9000	2.12	71619.7	0.0600

- (a) Calculate the *Applied Stress*: $\sigma = F/A$ and enter the results into the table. F is the applied force (lbf) and A is the cross-sectional area of the material (in²). Assume the material is a cylindrical rod with a diameter of 0.4 in.
- (b) Calculate the resulting *Strain*: $\epsilon = (\text{Length} - \text{OriginalLength})/\text{OriginalLength}$. The original length of the rod is 2 inches (i.e., the length with no applied force). Enter the results in the table.
- (c) In MATLAB, plot strain on the x-axis and stress on the y-axis. Connect the data points with a solid black line and mark the data points as circles. Label the x and y axis appropriately making sure to include units. Paste all of your MATLAB commands to create the plot in the space below. Leave your plot open for the next part of the problem.

MATLAB Commands:

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1 - force = [ 0 1650 3400 5200 6850 7750 8150 8500 8750 9000];
2 - L = [2 2.003 2.006 2.009 2.012 2.015 2.03 2.06 2.09 2.12];
3 - % Compute Stress
4 - stress = force/(pi*0.2^2); % Area = pi*r^2
5 - disp('stress = '); disp(stress);
6 - % Compute Strain
7 - strain = (L-2)/2;
8 - disp('strain = '); disp(strain);
9 - plot(strain, stress, 'k-o');
10 - xlabel('Strain (in/in)'); ylabel('Stress (lbf/in^2)');
11 - title('Stress vs. Strain')
12

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- (d) The point at which the curve begins to flatten is called the yield point or yield stress. If the applied stress is below the yield point, the material will return to its original length when the force is removed. If the applied stress exceeds the yield point, the material has been deformed and will not return to the original shape. Add a text arrow to mark the yield point. To do this, choose Insert in your figure window and select Text Arrow. Place the arrow then type the text (yield point).