ME 352 Problem Set 1 due 2 October 2007

Quick Questions

1. **(15 points)** Use MATLAB to evaluate the following formulas. Show the results of executing the formulas in a MATLAB session. For each formula *use variables, not numerical values* for the constants given at the start of the problem statement. Pure numbers in the formulas can be entered directly.

   Example:

   Given $m = 3$ gm, $v = 30$ m/s, compute the kinetic energy $\mathrm{KE} = \frac{1}{2}mv^2$

   Solution

```
>> m = 3e-3;
>> v = 30;
>> KE = 0.5*m*v^2
KE =
    1.3500
```

   Formulas:

   a. Evaluate δ for $n = 1, 74, 204, 355$.

$$\delta = 23.45 \sin\left(360 \frac{284 + n}{365}\right)$$

   b. Evaluate h/E for $\mathrm{Fr} = 1, 1.25, 2.5, 5, 7.23$.

$$\frac{h}{E} = \frac{\left[\sqrt{1 + 8\,\mathrm{Fr}^2} - 3\right]^3}{8\left[\sqrt{1 + 8\,\mathrm{Fr}^2} - 1\right]\left[\mathrm{Fr}^2 + 2\right]}$$

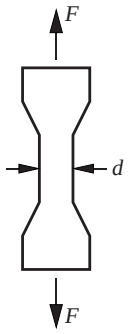
   c. Given $A = 17.27$ and $B = 237.7\,^\circ\mathrm{C}$, the following formula can be used to compute the dew point temperature T_d as a function of the dry bulb temperature T and relative humidity RH in percent.

$$T_d = \frac{B\left[\ln\left(\frac{\mathrm{RH}}{100}\right) + \frac{AT}{B+T}\right]}{A - \ln\left(\frac{\mathrm{RH}}{100}\right) - \frac{AT}{B+T}}$$

   Evaluate T_d for $T = 25, 30, 35\,^\circ\mathrm{C}$ at $\mathrm{RH} = 70$ and $\mathrm{RH} = 90$.

Comprehensive Questions

2. **(20 points)** The `AltensileTest.dat` file contains three columns of numbers recorded during a tensile test for a sample of aluminum. The first column is the time of the reading in seconds, the second column is the strain of the sample (inch/inch), and the third column is the load F (lb_f). The measured diameter of the sample is $d = 0.254\,\text{inch}$. Recall that Young's modulus is defined as the ratio of stress to strain for the linear elastic region of the material behavior.



$$E = \frac{\text{stress}}{\text{strain}}$$

The measured data can be compared to the properties of Aluminum 2024-T4 which has a Young's modulus of $E = 10.6 \times 10^6\,\text{psi}$ and a yield strength of $\sigma_y = 47 \times 10^3\,\text{psi}$.

Write a `tensileTest` function that performs the following tasks.

a. Read the data from `AltensileTest.dat`.

b. Compute the stress at each point during the test from the measured F values.

c. Plot stress versus strain using small dots ($\cdot$) for each data point. In other words, do not connect the points with line segments.

d. Add the yield stress point for Aluminum 2024-T4 to the curve as a solid, red, horizontal line.

e. Draw a dashed line indicating the Young's Modulus for Aluminum 2024-T4.

f. Label the x axis "Strain (in/in)" and the y axis "Stress (psi)".

g. Modify the `tensileTest` function so that `sigmaMax`, the maximum stress for the data set, and `tmax`, the time of the last recorded measurement are computed. Return both `sigmaMax` and `tmax` as outputs from the function. *Do not* print `sigmaMax` and `tmax` from within the function.

Here is a shell of the tensile test program. An electronic copy of `tensileTest.m` can be downloaded from `web.cecs.pdx.edu/~gerry/class/ME352/homework`. The final version of your plot should look like that at the bottom of the page.

```
function tensileTest
% tensileTest  Load and plot tensile test data.
%              ME 352 Problem Set #1, Fall 2003

% --- Load data from file into matrix D.  Copy to working vectors
D = load('AltensileTest.dat');
t = D(:,1);           %  time  (s)
strain = D(:,2);      %  strain (in/in)
force = D(:,3);       %  load  (lbf)

% --- Known material properties
E = 10.6e6;         %  Young's modulus (psi) and
sigYield = 47e3;    %  yield strength (psi) for 2024-T4 Aluminum

% --- Compute stress
%  >> Your code goes here <<

% --- Plot the measured data along with the straight line corresponding to the
%     published Young's modulus and yield strength for 2024-T4 Aluminum
%  >> Your code goes here <<
```

On your solution sheet *be sure* to include the following

- A short description of the problem (one or two sentences).
- The listing of your code.
- A sample MATLAB session showing the result of running your code. Be sure to assign `sigmaMax` and `tmax` to variables in the command line so that both values are printed *after* the function is completed.
- The plot created by your code.

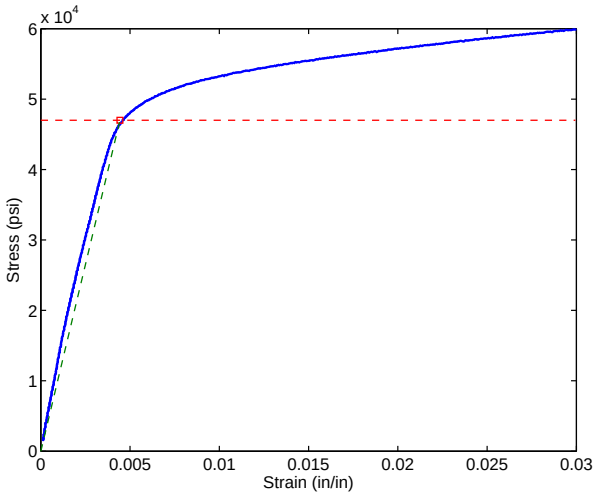


Figure 2.1 Plot from the solution to problem 2.