ME370 **Homework 2** Due LSN8 at Start of Class (50 points)

<u>Requirements:</u> Use MATLAB to calculate the values. Use comments to enter your name, date and assignment identification, i.e. HW2, at the top of the file.
Remember: Clear all variables and do not hard-code variable values (use actual variable names). *Suppress all unnecessary output.*

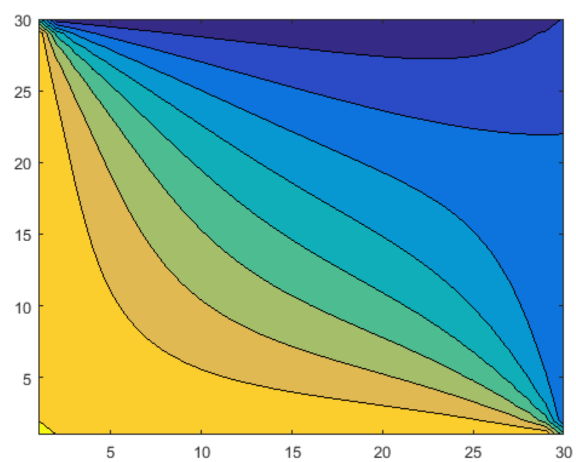
<u>Deliverables</u>: <u>Publish code and results to .pdf, along with Excel file for problem 2.</u> Add a digitally signed cover sheet to the MATLAB submission, and upload a concatenated .pdf to BlackBoard. ***The concatenated .pdf should include both the function file and the main m-file.***
To publish to .pdf: Get your program running first. In the editor, click the Publish Tab above, use drop down menu to Edit Publishing Options to configure to .pdf, and then click "Publish".

1. The left and bottom sides of a square piece of metal are heated to 200 [ºC], the top is maintained at 25 [ºC] , and the right side at 60 [ºC]. The temperature of the exterior four corners are the average of the two sides making the corner. Divide the square into a grid of 30 x 30 elements. The temperature of each of the 28 x 28 interior elements are the average of their four neighbors.

$$T(i,j) = \frac{T(i+1,j)+T(i-1,j)+T(i,j+1)+T(i,j-1)}{4}$$

   a. Plot the temperature on a 2D *contourf* plot. Should look like the left plot below (rotated is OK). No labels are needed.

      Hint: Set an initial value of 25 [ºC] for the 28 x 28 interior elements (boundary conditions!). Compute the temperature T(i,j) of each interior element, best using two 'for' loops: one for rows i = 2:29 and one for columns j = 2:29. Do this many times (i.e. another loop), until the plot doesn't change and a steady state result is achieved. The plots below are with a loop run 250 times.



(Cool animation: after each time the temperatures are calculated inside the double loop, plot results using *contourf(T)* followed by *getframe*. You don't need to turn this in, but should check it out.)

2. [Gilat Chapter 5, problem 27 (pg. 169)] According to Planck's law of black-body radiation, the spectral energy density R as a function of wavelength λ [m] and temperature T [K] is given by:

$$R = \frac{2\pi c^2 h}{\lambda^5} \frac{1}{e^{hc/\lambda kT} - 1}$$

where $c = 3 \times 10^8 [\mathrm{m/s}]$ is the speed of light, $h = 6.626 \times 10^{-34} [\mathrm{J-s}]$ is the Planck constant, and $k = 1.38 \times 10^{-23} [\mathrm{J/K}]$ is Boltzmann constant. Make the below figure that contains plots for R as a function of λ for $0.1 \leq \lambda \leq 3[\mu\mathrm{m}]$ for three temperatures $T = 3{,}000[\mathrm{K}], T = 4{,}000[\mathrm{K}]$, and $T = 5{,}000[\mathrm{K}]$. Make your figure match the example below, to include axis values, axis labels, legend placement, line styles, and line colors: