

**Assignment 08: Exact Solution Approximation
to Flat Plate Temperature Profile**
[10 Points]

*Last Updated 4/19/2009
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Due: Monday, April 27, 2009 @ 2pm

This assignment is to be submitted in hard copy format in class.

In class on 4/15/2009, the separation of variables method was demonstrated to solve La Place's equation for the spatial temperature profile on a flat plate where a single side is elevated in temperature. For this homework assignment, expand the given method to find the exact spatial temperature profile solution for a plate heated to 200 °C on the top, 600 °C on the bottom, 50 °C on the left, 100 °C on the right. These temperature boundaries are identical to the conditions given in MEEN 2250 Assignment 07 where students were asked to solve this same problem using a finite difference approach.

Having found the exact solution for the spatial temperature profile, students will note the expression includes an infinite series. Therefore, an exact analytical value cannot be realized; it can only be approximated numerically by summing up a large number of terms. The solution becomes increasingly accurate as more terms are added to the summation.

Write a code in MATLAB to carry out the summation of terms for the exact flat plate temperature profile solution. Construct the code to sum the first 1,000 terms in the infinite series. Use MATLAB to make a color contour plot of the solution (this plot should look very similar to the finite difference color contour plot created for MEN 2250 Assignment 07).

The following grading rubric will be applied.

- A. Show by hand the mathematical procedure starting with the La Place equation and boundary conditions to yield an exact analytical flat plate temperature profile. [2 points]
- B. The exact analytical solution is given correctly. [1 point]
- C. A MATLAB code is given that approximates the exact analytical solution by summing the first 1,000 terms on the infinite series [2 points].
- D. A color contour plot, generated in MATLAB, shows the approximate flat plate temperature profile by adequately differentiating color contrasts between hot (red) and cold (blue) [2 point].
- E. The brass plate is correctly oriented on the contour plot (i.e., 200 °C top, 600 °C bottom, 50 °C left, 100 °C right) [1 point].
- F. Solution for entire brass plate appears to be correct. Qualitatively, it is hot where it is supposed to be and cool where it is supposed to be [2 point].

Notes:

1. You **may not** collaborate with anyone else on this assignment. Please work independently. Copying, plagiarism, and other forms of academic dishonesty will result in academic sanctions.