

Assignment 07: Finite Difference Temperature Profile in Excel
[10 Points]

*Last Updated 4/13/2009
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Due: Monday, April 20, 2009 @ 2pm

This assignment is to be submitted electronically in class on a jump drive.

**In the spreadsheet, put all required calculations under one tab,
and put the brass plate solution under a second tab.**

In class on 4/13/2009, the formula to calculate the temperature of each element in a heated flat plate via finite difference was derived.

Use MS Excel to reproduce the temperature profile on a 1 m^2 flat brass plate with the boundary conditions indicated below. The plate must be broken into at least 100 elements in the X direction and in the Y direction (10,000 nodes total). The temperature of the individual node element at (50, 50) must be within $\pm 0.1 \text{ }^\circ\text{C}$ of the analytical solution to achieve convergence. The plate must visually demonstrate a temperature profile indicated by variation in cell color from blue (cold) to red (hot).

The following grading rubric will be applied.

- A. The finite difference equation is correctly executed using an MS Excel spreadsheet [1 point]
- B. The solution is made up of at least 100 X-axis and 100 Y-axis mesh lines yielding at least 10,000 total nodes. [1 point]
- C. Convergence is demonstrated by comparing the temperature of the individual node element at (50, 50) to the analytical solution. To get full credit, report the expected analytical temperature value at the plate's center [1 point], report the temperature by finite difference at node (50, 50) [1 point], and show that these values agree to within $\pm 0.1 \text{ }^\circ\text{C}$ [1 point].
- D. Color contour is used to adequately differentiate color contrasts between hot and cold cells [1 point].
- E. Each node is formatted to be exactly the same height and width so the simulated brass piece appears on the screen as a perfect square (see figure below in notes section) [1 point].
- F. The brass plate is correctly oriented (i.e., $200 \text{ }^\circ\text{C}$ top, $600 \text{ }^\circ\text{C}$ bottom, $50 \text{ }^\circ\text{C}$ left, $100 \text{ }^\circ\text{C}$ right) [1 point].
- G. 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.
2. The final result should appear somewhat like the figure on the adjoining page.

