

Computational Fluid Dynamics and Heat Transfer (ME 415), Autumn 2014

Assignment 1: Heat Conduction - I (10% Weight)

Due Date: 18th September 2015

Please submit a report on the assignment in the following manner:

- 1. Please write the algorithm (i.e. steps followed)*
- 2. Provide grid details and the implemented boundary conditions*
- 3. Results (Plots/ data values at specific grid point(s))*
- 4. Please do not use any in-built function, otherwise marks will be deducted*
- 5. Please submit the code in softcopy ((if a generalized code is used, please mention for what problem which part of the code is used). Submission of results and documentation are in hardcopy.*

DO NOT COPY FROM OTHERS. IF FOUND MARKS WILL NOT BE GIVEN.

Problems:

Note: Use TDMA for solving the following questions. Please develop TDMA which can be used in all problems.

1. In a large 5 cm thick brass plate of $k = 111 \text{ W/m.K}$, heat is generated uniformly at a rate of $2 \times 10^4 \text{ W/m}^3$. One side of the plate is insulated while the other side is exposed to an environment at 25°C with a heat transfer coefficient of $44 \text{ W/m}^2\text{K}$. Using Finite Volume Method (FVM) and Finite Difference Method (FDM), find the followings:
 - a. Find the temperature distribution of the wall for grid sizes of $\Delta x = 0.01, 0.001$ and 0.0001 .
 - b. Compare the results with the analytical solution.
 - c. Estimate the overall energy balance for these grid sizes $\Delta x = 0.01, 0.001$ and 0.0001 .

(15+35)
2. A large industrial furnace is supported on a column of clay bricks which is of length $L = 1.5 \text{ m}$ in x -direction by $H = 3 \text{ m}$ in y -direction. The installation during the steady- state process is such that the column is subjected to following boundary conditions: (i) $y = 0, T = 300^\circ\text{C}$, (ii) $x = 0, T = 30^\circ\text{C}$, (iii) $y = H, T = 400^\circ\text{C}$ and (iv) $x = L, T = 30^\circ\text{C}$. Choose a uniform grid size of 0.05 m in both directions. Use FVM for this problem.
 - a. Plot the temperature contours as the output. Please provide values of some isotherms.

(15+35)

Total: 100 (Formulation (hardcopy) + Code)