Department of Mechanical Engineering

National Institute of Technology Karnataka, Surathkal

Assignment I

ME317, Basics of Computational Fluid Dynamics

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1. Consider the one-dimensional steady-state heat conduction with heat generation in a rod. The governing equation is given by:

$$\frac{d^2T}{dx^2} + \frac{\dot{q}}{k} = 0$$

Take the length of the rod as 0.5m. The thermal conductivity k = 41 W/m k and the volumetric rate of heat generation q = 10^5 W/m^3. The left and the right sides are maintained at 0°C and 10 °C respectively. Divide in to 10 equal parts. Solve this problem by both TDMA and Gauss-Seidel method and compare the computational results.

2. A two dimensional long rod, square in cross section, has two vertical sides maintained at a temperature of 0 °C. The heat flux entering from the top wall is 10^5 W/m^2 and the bottom wall is kept insulated. If the length of each side is 0.5 m, determine the temperature distribution in the rod, employing $\Delta x = \Delta y = 0.001$m. Take k = 41 W/m K.

3. Consider Problem. 2, in order to reduce the computational domain and cost, assume a proper boundary condition in the given domain that leads to optimum computational domain and cost of the given problem and determine the temperature distribution. Compare the results with the results of Problem. 2.

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