Computational Fluid Dynamics (AE/ME 339)
MAEEM Dept.

Home Work Problem hw06b

An infinitely long bar of thermal diffusivity α has a square cross section of side 2a. It is initially at a uniform temperature θ_0 and then suddenly has its x = $\pm a$ surfaces raised to a non-dimensional temperature θ_1, and the y = $\pm a$ surfaces raised to non-dimensional temperature θ_2. The following definitions apply:

$$\theta = \frac{T - T_0}{T_1 - T_0}, \qquad \xi = x / a, \qquad \eta = y / a, \qquad \tau = \frac{\alpha t}{a^2} \tag{1}$$

These surface temperatures are held constant at those values subsequently. The governing equations in non-dimensional form is given by

$$\frac{\partial \theta}{\partial \tau} = \frac{\partial^2 \theta}{\partial \xi^2} + \frac{\partial^2 \theta}{\partial \eta^2} \tag{2}$$

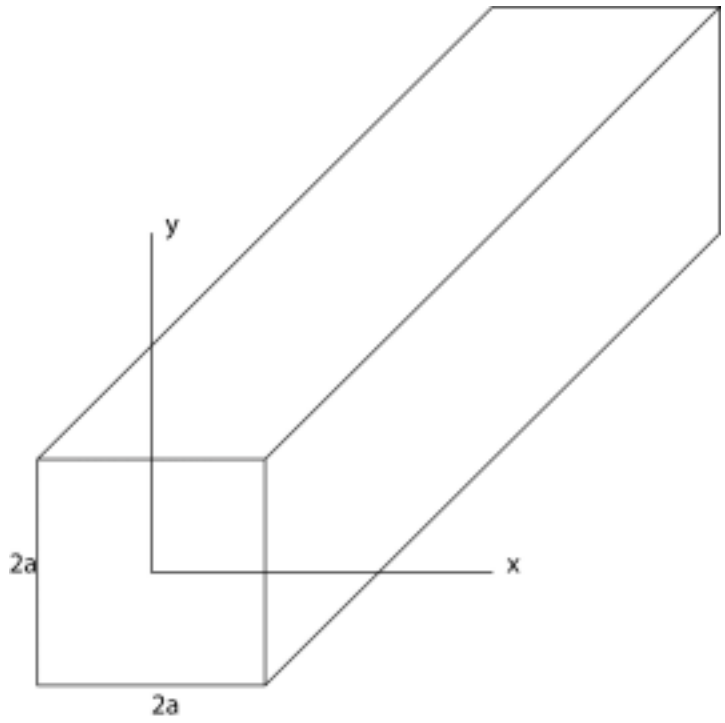
1. Obtain numerical solutions for the following data: $\theta_0 = 0$, $\theta_1 = 1.0$, $\theta_2 = 0.8$.

2. Plot the dimensionless temperature distribution along a line AB parallel to x axis for which $\eta = 0.5$ at the following time levels.

i) $\tau = 0.05$
ii) $\tau = 0.1$
iii) $\tau = 0.15$

Include printed output for temperature distribution in the planes of symmetry for $\tau = 0.15$.

3. Present your results and discuss the solution. Your submission should include a brief description of the problem, program listing, the solution technique, convergence, and accuracy.


y
x
2a
2a