

Assignment 5
Finite difference method for one-dimensional PDE (Explicit methods)
Due and Viva on: 1 Oct, 2025, 2:30 pm

One end of a one-dimensional copper bar of width 1.0 m (thermal conductivity of the slab is 400 W/m-K, the specific heat is 385 J/kg.K, density is 8000 kg/m³). The bar is initially ($t=0$) at a uniform temperature of 25 °C. At $t > 0$, the surface temperatures of the left ($x = 0$) and right ($x = L$) faces are suddenly increased to 400 °C, and maintained at this temperature thereafter. There are no sources within the wall.

- a. Plot the variation in temperature with time at midpoint of the bar from 0 to 900 s, using the following schemes.
 - 1) Fully explicit method: FTCS
 - 2) Fully implicit method: BTCS
 - 3) Du-Fort Frenkel Scheme.

Use separate figure for each scheme. Consider $\Delta x = 0.1$ $\Delta t = 1$ s.

- b. Determine the time at which the middle length temperature reaches 200 °C using FTCS.