Homework #2

ME 2256/MEMS 1256 - Applications of Computational Heat and Mass Transfer

Assigned March 9$^{\text{th}}$, 2020
Due March 30$^{\text{th}}$, 2021

Problem #1

1. Consider heat conduction within a rod that has a length of 40 [cm] whose ends at x=0 and x=L are kept at 0 °C for all t>0. Complete the following:
   (a) Find the solution for (x,t), supposing α^2=1, with the initial condition $T(x,0)$=x for 0<x<40.
   (b) Plot $T(x,t)$ versus x for t=5, 10, 15, 20, 40, 80, 160 and 240 seconds.
   (c) For each value of t used in (b), estimate the value at which $T(x,t)$ is greatest and plot said values against time.
   (d) Plot $T(x,t)$ versus x and t on a three-dimensional surface plot.
   (e) How long does it take for the rod to cool to 1 °C? This can be done mathematically or graphically.

   Complete this using the FVM method for 10, 20, 40, 80 and 160 control volumes, plotting the L2 norm of the error (analytic solution provided). Do this for each of the three schemes (explicit, implicit and Crank-Nicholson). For the implicit and Crank-Nicholson method, determine the maximum timestep for stability. Now, repeat the problem in ANSYS Fluent, using the same grid sizes, and pulling the solutions at the same times, and compare the solution to your code.