MEEN 644 – Numerical Heat Transfer and Fluid Flow

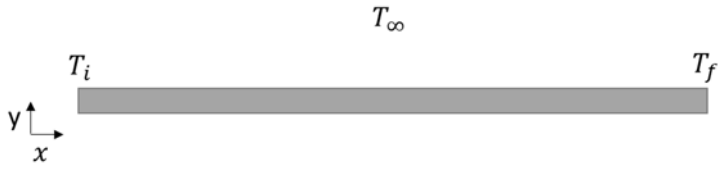
Spring 2020

HOMEWORK #5

Name _____

Instructor: N. K. Anand

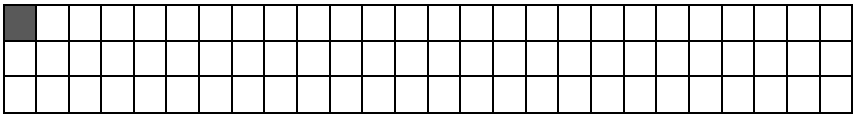
Due Date: April, 9, 2020 Maximum Points: 100



Consider a flow of liquid Lead in a 2D channel with length of 2 m and height of 0.05 m. The temperature at the entrance of the channel is held at (T_i) at 1,000 °C and the temperature at the exit (T_f) is held at exit at 700 °C. The surface of the channel is exposed to ambient temperature (T_∞) at 27 °C and convective heat transfer coefficient (h) is 2,000 W/m^2 °C. Density (ρ), specific heat capacity (c_p), thermal conductivity (k) of Lead is 10,000 kg/m^3, 140 J/kg °C, 21 W/m °C, respectively. Assume flow has constant velocity of 0.2 m/s in x direction.

Write a finite volume code to predict temperature distribution along the length of the channel and Nusselt number along the interior of the channel using power law. Use 100 uniformly sized CVs in stream-wise direction and 41 uniformly sized CVs in cross-stream direction. Plot and discuss your results. Include your code on the report.

- Write down linearized equation for control volume at northwest corner surrounded by inlet and wall – 30 **Points**



- Build code **– 30 Points**
- Plot temperature at center, wall and average along the channel. **– 10 points**
- Plot Nusselt number along the interior wall of the channel. Its value might be higher than you thought. **– 10 points**
- Plot contour graph for temperature **– 10 points**
- Short discussion **– 10 points**