Assignment_7

November 16, 2024

#Assignment 7 Due EOD Thursday 21 November. Discussion will be held on Monday Nov. 25 lab time.

#Q1. The Blasius equation is a Boundary Value Problem that appears in fluid mechanics as a laminar flow boundary layer and is written:

$$y''' + yy'' = 0 \quad y(0) = y'(0) = 0, y'(\infty) = 2$$

##a) Express this 3rd order ODE as a system of first order ODEs. {answer}

0.1 b) Solve this equation using the shooting method. Plot the solution y.

{Method, implementation, answer}

#Q2

The temperature in an annunlar pipe is given by:

$$\frac{\partial T}{\partial t} = \alpha \left[\frac{\partial^2 T}{\partial r^2} + \frac{1}{r} \frac{\partial T}{\partial r} \right]$$

The pipe is initially submerged in a perfect heat bath at $ 200^0C$ reaching uniform temperature.

At $t = 0$, a fluid with high thermal mass at 0^0C is passed along the inside.

You are tasked with determining the steady state temperature profile.

0.2 a) Write out (don't code it yet) an appropriate timestepping scheme. Explain your choice.

{Answer, Explaination}

##b) Code your scheme and determine when you will reach steady state to within 1% {method, time stepper implementaiton, steady state check, answer}

$$\| \frac{T(t) - T(t = \infty)}{T(t = \infty)} \|_2 = 0.1$$