Assignment 10

(Problem 5 is optional. Bonus credit will be given to those who try and succeed)

1. **For students with odd roll Nos**: Perform the consistency and von Neumann stability analysis for MacCormack scheme used to solve linear Burgers equation. Plot the range of values D and C for stability of MacCormack Scheme.

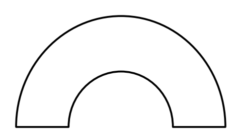
   For students with even roll nos: Perform the consistency and von Neumann stability analysis for Lax Wendroff scheme used to solve Convection equation and Leonard's third order upwind scheme used to solve linear Burgers equation. Plot the range of values D and C for stability of Leonard's Scheme.

2. For a lid driven cavity problem discussed in class, obtain the solution using the stream function-vorticity method. The parameters for the problem may be taken as follows.

   The cavity size = 0.1 m X 0.1 m
   The lid velocity = 0.1 m/s
   kinematic viscosity = 10 **(-4) m**2/s

   You may solve it using suitable finite difference method for the transport equation and the Poisson equation. Make sure that you do not violate the stability condition for the time step as well as the cell Reynolds number problem. Carry forward as many time steps as is necessary to achieve steady state. If the density of the fluid is 1 kg/m**3, compute the drag force on the lid.

3. Generate a body fitted Laplacian grid (NXN) for the semi ring shown in the figure. You may take the two arcs for ξ = 0 and 1, and the two edges for η = 0 and 1. The inner and outer radius of the ring can be taken as 1 cm and 5 cm respectively. Note when working in non-dimensional equations you would work for r going from 0 to 1 where $r^* = \frac{r - r_i}{r_o - r_i}$. Plot the grids and visualise the same. If you find surprises, see what you can do to improve it.



4. Obtain an analytical solution for steady state temperature variation as a function of r, if the heat transfer mode is by conduction, and the inner and outer walls are at 30 °C and 100 °C respectively. Express this variation in the non-dimensional form between T^* and r^*, where $T^* = \frac{T - T_i}{T_o - T_i}$. Now proceed to solve this problem with body fitted grid as described in the class and verify the solution obtained with the analytical solution.

5. Consider the same driven cavity problem as in Problem 2. Solve the same with MAC algorithm and compare the results

Happy Programming and Best Wishes for computations in your future career.
Note that you will have no one to help there. Hence learn to be independent.