DEPARTMENT OF MECHANICAL ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

ME415: Computational Fluid Dynamics & Heat Transfer
Assignment # 4: Curvilinear Grid Generation and Heat-Conduction for Complex Geometry
 Weightage: 10%   **Instructor**: Prof. Atul Sharma

Date Posted: 25th October (Tuesday)   Due Date: 5th Nov. (Saturday, Early Morning 2 AM)

ONLINE SUBMISSION THROUGH MOODLE ONLY (No late submission allowed): Create a single zipped file consisting on (a) filled-in answer sheet of this doc file converted into a pdf file and (b) all the computer programs. The name of the zipped file should be rollnumber_A4

1) Curvilinear Grid Generation using Elliptic PDE Method:

 Consider a square plate of dimension 10 units with a circular hole of 2 units. Develop a computer program to generate an elliptic PDE method based curvilinear grid generation and generate different types of grid: (a) O, (b) C and (c) H type grid. Take the number of grid points (vertices of CVs) for grid generation as shown in Slide No. 11.9, 11.11 and 11.12; and plot similar figures for the 2D grid (3 figures).

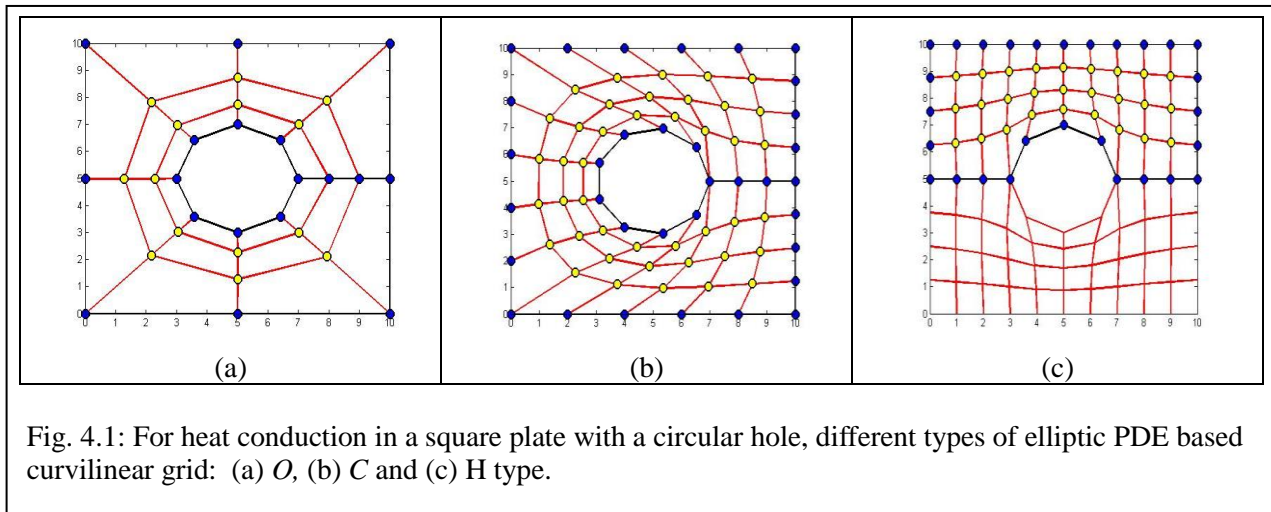## 2) Unsteady Heat Conduction in a Square Plate with Circular Hole:

Consider the O-type grid - generated in the previous problem – for 2-D heat conduction in a square plate (density: 7750 kg/m3, specific-heat: 500 J/Kg K & thermal-conductivity: 16.2 W/m-K) with a circular hole. Using the grid, develop a code with flux based methodology for an explicit method. Run the code for a non-dimensional boundary condition for temperature as unity in the hole and zero at the outer square boundary, plot the steady state temperature distribution in the plate. Also, compute the total heat transfer from the hole and outer square boundary. Take convergence criteria as 0.000001. The computational as well as physical domain for this problem; and implementation of BC is shown below.
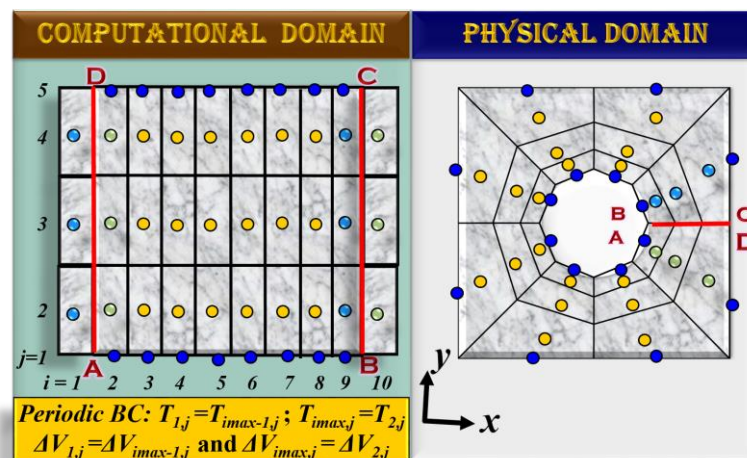
Answer Sheet

Problem # 1: Curvilinear Grid Generation

a) Plot the (a) O, (b) C and (c) H type grid. (3 figures).

(a)   (b)   (c)

Fig. 4.1: For heat conduction in a square plate with a circular hole, different types of elliptic PDE based curvilinear grid: (a) *O,* (b) *C* and (c) H type.

Problem # 2: Unsteady Heat Conduction in a Square Plate with Circular Hole:
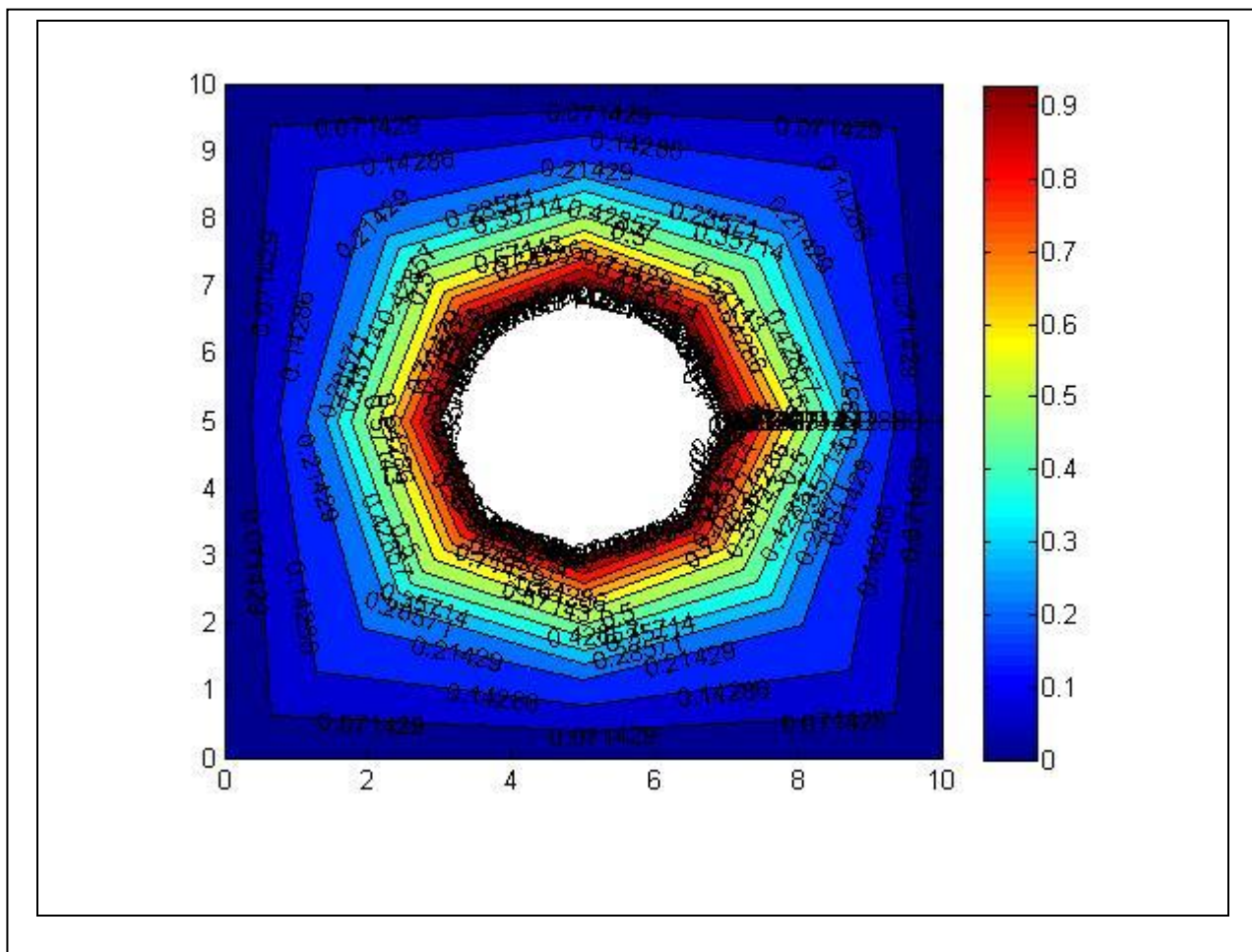
Table 4.1: Heat transfer from hole and outer boundary of square plate.

Boundary	Q
Inner: Hole	99.8381
Outer: Plate	96.7669