M. Tech.-III (Mechanical CAD/CAM) (CBCS – 2015 Course) : WINTER - 2018

SUBJECT: ELECTIVE-I: COMPUTATIONAL FLUID DYNAMICS

Day: Tuesday | Time: 11.00 AM TO 02.00 PM
Date: 04/12/2018 | **W-2018-3254** | Max Marks: 60

N.B.:

1) Solve Q.1 or Q.2, Q.3 or Q.4 and Q.5 or Q.6 from **Section-I** and Q.7 or Q.8, Q.9 or Q.10 and Q.11 or Q.12 from **Section-II**
2) Figures to the right indicate **FULL** marks
3) Assume suitable **DATA** wherever necessary
4) Both the section should be written in **SEPARATE** answers books.

SECTION-I

Q.1 **a)** What is Reynolds Transport Theorem? How is it useful in analysis of fluid flow problems? **(05)**

b) How propagation of disturbance occurs in case of compressible fluid at different Mach numbers? **(05)**

OR

Q.2 **a)** With the help of a neat sketch, explain the distribution of pressure around an airfoil section when it is submerged in a flowing fluid. **(05)**

b) What do you understand by laminar and turbulent fluid flows? How turbulence makes difference in analysis of fluid flows? **(05)**

Q.3 **a)** What is the meaning of CAD repairing? How is it performed? **(05)**

b) What is solid modeling? How is it different from surface modeling? **(05)**

OR

Q.4 How is parametric representation of curves and surfaces performed? With the help of neat sketches and/or mathematical relationships, explain these concepts in detail. **(10)**

Q.5 What is CFD? What are advantages of CFD? How does a CFD code/ a commercial CFD software work? What are fields of application of CFD? **(10)**

OR

Q.6 What are the different governing equations used in CFD? State their physical significance. Also state meaning of each term in each equation. **(10)**

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SECTION-II

Q.7 Consider the function $\phi(x, y) = e^x + e^y$. Consider the point $(x, y) = (1, 1)$. **(10)**
Then, i) Calculate exact values of $\frac{\partial \phi}{\partial x}$ and $\frac{\partial \phi}{\partial y}$ at this point.

ii) Use first order forward differences, with $\Delta x = \Delta y = 0.1$ unit, to calculate approximate values of $\frac{\partial \phi}{\partial x}$ and $\frac{\partial \phi}{\partial y}$ at point (1, 1)

iii) Use first order backward differences, with $\Delta x = \Delta y = 0.1$ unit, to calculate approximate values of $\frac{\partial \phi}{\partial x}$ and $\frac{\partial \phi}{\partial y}$ at point (1, 1)

iv) Use second order central differences, with $\Delta x = \Delta y = 0.1$ unit, to calculate approximate values of $\frac{\partial \phi}{\partial x}$ and $\frac{\partial \phi}{\partial y}$ at point (1, 1)

Also calculate percentage difference in results in part ii), iii) and iv) as compared with exact values calculated in part i).
Give your comments on the overall results.

OR

Q.8 Consider two dimensional steady state heat conduction in a region subjected to the boundary conditions shown in Figure 1. The material has thermal conductivity k = 60 W/m-°C. By using finite difference mesh at $\Delta x = \Delta y =$ 0.3 cm, develop the matrix equation for the unknown node temperatures. **(10)**

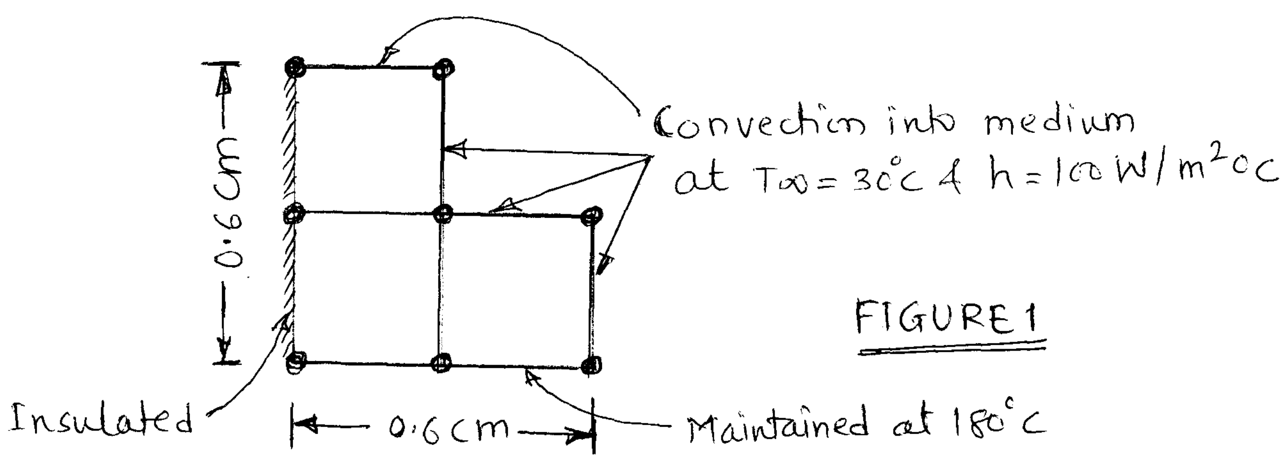

FIGURE 1

Q.9 **a)** What is need for adaptive and moving grids? **(05)**

b) What is use of mesh smoothing algorithms? **(05)**

OR

Q.10 **a)** How is quality check for volume mesh conducted? **(05)**

b) What are the different types of grid elements? **(05)**
State their advantages and applications.

Q.11 Derive governing equations for two equation model. **(10)**
What are the boundary conditions used while deriving this model?
What are the advantages and disadvantages of this model?

OR

Q.12 What is the importance of modeling of multiphase flows? **(10)**
What are the different approaches used for modeling of multiphase flows?
Explain any one of the approaches with its advantages and disadvantages.

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