M. Tech.-III (Mechanical CAD/CAM) (CBCS – 2015 Course) :
SUMMER - 2019
SUBJECT: ELECTIVE-I: COMPUTATIONAL FLUID DYNAMICS

Day: Friday
Date: 17/05/2019
Time: 11.00 AM TO 02.00 PM
Max Marks: 60

S-2019-3519

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) Answer to both the sections should be written in **SAME** Answer book.

SECTION-I

Q.1 **a)** Differentiate between **(05)**
i) Uniform and Non-uniform fluid flows
ii) Laminar and turbulent fluid flows
Give suitable examples of each type of fluid flow.

b) When a fluid flows over a curved surface, what is role of a pressure gradient $\left(\frac{\partial p}{\partial x}\right)$ in the direction of a flow in causing separation of a flow? **(05)**

OR

Q.2 **a)** What is the effect of Mach number or propagation of disturbances in case of a compressible fluid? **(05)**

b) Derive a differential form of generalized transport equation. State meaning of each term. **(05)**

Q.3 **a)** What do you understand by geometric modelling? How is it performed? **(05)**

b) What are dependent and independent CAD errors? **(05)**

OR

Q.4 **a)** What do you understand by CAD repairing? **(05)**

b) What do you understand by water tight geometry? Why is it important to create water tight geometry? **(05)**

Q.5 Derive an expression for Navier-Stoke's equation in Cartesian coordinates. State the assumptions made and also explain physical significance of the Navier-Stoke's equation. **(10)**

OR

Q.6 Derive an expression for energy equation in Cartesian coordinates. State the assumptions made and also explain physical significance of the energy equation. **(10)**

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SECTION-II

Q.7 **a)** From Taylor's series expansion, find out the finite difference expression for the mixed derivative $\frac{\partial^2 \phi}{\partial x \partial y}$ and the order of truncation error. **(05)**

b) How are implicit and explicit schemes used in analysis of one dimensional unsteady heat conduction problems? **(05)**

OR

Q.8 Consider a problem of one dimensional steady heat conduction in an insulated rod whose ends are maintained at constant temperatures of 100 °C and 500 °C respectively as shown in Figure 1. **(10)**

The governing equation is: $\frac{d}{dx}\left(k\frac{dT}{dx}\right) = 0$

Develop the matrix of equation for the unknown node temperatures using finite volume analysis.

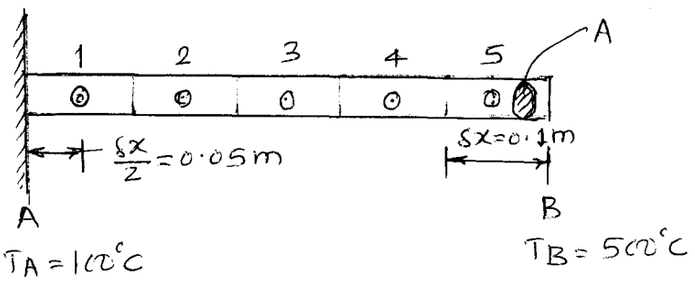

FIGURE 1

Q.9 **a)** How is surface mesh generation conducted in CFD? **(05)**

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

OR

Q.10 **a)** What are mesh smoothing algorithms? **(05)**

b) What do you understand by grid clustering? **(05)**

Q.11 Derive governing equations for algebraic stress equation model. What are the advantages and limitations of this model? **(10)**

OR

Q.12 Why is it important to model multiphase flows? Explain Eulerian and Lagrangian approaches for modeling of multi-phase flows. What are the advantages and limitations of these approaches? **(10)**

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