H.T.No. | | | | | | | | | | |

Code No: ME1541 **GEC-R14**

IV B. Tech I Semester Regular Examinations, November 2017

COMPUTATIONAL FLUID DYNAMICS

(Mechanical Engineering)

Time: 3 Hours **Max. Marks: 60**

Note: All Questions from **PART-A** are to be answered at one place.
Answer any **FOUR** questions from **PART-B.** All Questions carry equal Marks.

PART-A

6 × 2 = 12M

1. What is "Newtonian flow"? How does it help in analysis of fluid flow problems?
2. List out different methods of solving simultaneous algebraic equations by iterative techniques.
3. For a second order PDE
   $A\frac{\partial^2\emptyset}{\partial x^2} + B\frac{\partial^2\emptyset}{\partial x\partial y} + c\frac{\partial^2\emptyset}{\partial y^2} + d\frac{\partial\emptyset}{\partial x} + e\frac{\partial\emptyset}{\partial y} + f\emptyset = 0$, what is the condition for the equation to be parabolic.
4. Write the differences between linear and non-linear partial differential equations.
5. Consider $u(x,y,t)$ as function defined in (x,y) plane. Write the transformations for the derivatives $\frac{\partial u}{\partial x}$ and $\frac{\partial u}{\partial y}$ into (ξ,η) plane.
6. What are the reasons for adapting ADI approach in dealing with multi-dimensional problems?

PART-B

4 × 12 = 48M

1. a) What are the two approaches for deriving the governing equations of motion in fluid mechanics? Differentiate them. (4M)

   b) What conservation law leads to the continuity equation? Derive the governing equation in differential form. (8M)

2. a) Describe Gauss Elimination method. (6M)

   b) Find the inverse of the matrix $A = \begin{bmatrix} 3 & 2 & 1 \\ 2 & 3 & 2 \\ 1 & 2 & 2 \end{bmatrix}$ (6M)

3. a) Consider a one dimensional unsteady state equation is given by $\frac{\partial T}{\partial t} = \alpha\frac{\partial^2 T}{\partial x^2}$. Show that this is a parabolic equation. (6M)

   b) Show that second - order wave equation $\frac{\partial^2 u}{\partial t^2} = c^2\frac{\partial^2 u}{\partial x^2}$ is a hyperbolic equation. (6M)

4. For the following equation:

$$\frac{\partial T}{\partial t} = \alpha \frac{\partial^2 T}{\partial x^2}$$

   i) Obtain discretized form of finite difference.

   ii) Using explicit method, write algebraic equations for 3 x 3 grid. (12M)

5. Explain the grid generation techniques based on PDE and summarize the advantages of the elliptic grid generation method. (12M)

6. Illustrate Crank- Niclosan technique by taking one dimensional unsteady state heat conduction equation. (12M)

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