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Total No. of Questions : 09

B.Tech.(Aerospace Engg.) (2012 Onwards) (Sem.–6)

COMPUTATIONAL FLUID DYNAMICS

Subject Code : ASPE-309

M.Code : 72454

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

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

Q1 Answer briefly :

a) Parallel computing

b) Finite element method.

c) Serial Computing

d) Viscous flow

e) Flux variables

f) Time accurate solution

g) Stretched Grid

h) Boundary fitted Grid

i) Explicit solution

j) Contour plot

SECTION-B

2. Explain the physical significance of various terms in the Euler's equation (Momentum Equation) given below :

$$\frac{\partial(\rho u)}{\partial t} + \nabla.(\rho u \mathrm{V}) = -\frac{\partial p}{\partial x} + \rho f_x$$

$$\frac{\partial(\rho v)}{\partial t} + \nabla.(\rho v \mathrm{V}) = -\frac{\partial p}{\partial y} + \rho f_y$$

$$\frac{\partial(\rho w)}{\partial t} + \nabla.(\rho w \mathrm{V}) = -\frac{\partial p}{\partial z} + \rho f_z$$

3. Show that the Laplace's equation given below is an elliptic equation :

$$\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} = 0$$

4. Explain two of the computer graphic techniques used in cfd.

5. Explain Crank-Nicolson's method for Implicit solution techniques.

6. The generic form of the system of governing equations is given below. Explain space marching and time marching for the solution of these equations.

$$\frac{\partial \mathrm{U}}{\partial t} + \frac{\partial \mathrm{F}}{\partial x} + \frac{\partial \mathrm{G}}{\partial y} + \frac{\partial \mathrm{H}}{\partial z} = \mathrm{J}$$

SECTION-C

7. One dimensional heat conduction equation with constant thermal diffusivity is given below :

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

Obtain difference equation and explain explicit time marching approach for solution of the one dimensional heat conduction equation.

8. The Lax-Wendroff technique is explicit, finite-difference method particularly suited to marching solutions. Consider the Euler's Equation.

$$\frac{\partial \rho}{\partial t} = -\left(\rho\frac{\partial u}{\partial x} + u\frac{\partial \rho}{\partial x} + \rho\frac{\partial v}{\partial y} + v\frac{\partial \rho}{\partial y}\right)$$

$$\frac{\partial u}{\partial t} = -\left(u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + \frac{1}{\rho}\frac{\partial p}{\partial x}\right)$$

$$\frac{\partial v}{\partial t} = -\left(u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + \frac{1}{\rho}\frac{\partial p}{\partial y}\right)$$

$$\frac{\partial e}{\partial t} = -\left(u\frac{\partial e}{\partial x} + v\frac{\partial e}{\partial y} + \frac{p}{\rho}\frac{\partial u}{\partial x} + \frac{p}{\rho}\frac{\partial v}{\partial y}\right)$$

Set up a numerical solution of Euler's equation using Lax-Wendroff Technique.

9. Write short notes on the following :

a) Eigen value method for classifications of governing partial differential equations.

b) General transformation of the governing equations from physical space to computational space.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.