B.E. Eighth Semester (Aeronautical Engineering) (C.B.S.)

Elective - III : Computational Fluid Dynamics (CFD)

P. Pages : 2 **KNT/KW/16/7655**

Time : Three Hours * 0 3 4 4 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Illustrate your answers whenever necessary with the help of neat sketches.
11. Use of non programmable calculator is permitted.

1. a) Describe 2 Applications of CFD in Environmental Industry. **7**

b) What are the various models of flow? Explain **6**

OR

2. a) Derive the continuity equation in cylindrical coordinates. **10**

b) Write the non – Conservation form of Continuity Equation. **3**

3. a) Energy equation is **6**

$$\rho\left(\frac{\partial h}{\partial t}+\frac{u\partial h}{\partial x}+\frac{v\partial h}{\partial y}+\frac{w\partial h}{\partial z}\right)=\left(\frac{\partial p}{\partial t}+\frac{u\partial p}{\partial x}+\frac{u\partial p}{\partial y}+\frac{w\partial p}{\partial z}\right)+S_h$$
$$+\phi+\frac{\partial}{\partial x}\left(\frac{u\partial T}{\partial x}\right)+\frac{\partial}{\partial y}\left(\frac{u\partial T}{\partial y}\right)+\frac{\partial}{\partial z}\left(\frac{u\partial T}{\partial z}\right)$$

P = Pressure, T = Temperature
ρ = Density
ϕ = Viscous dissipation
Simplify Equation for –
- No Radiation
- No Internal Energy
- No Viscous Dissipation
- 2 Dimensional
- Steady Flow

b) What is Eulerian and Lagrangian formulations? **7**

OR

4. a) Explain FDM, FUM and FEM with their pro's and cons. **7**

b) Write conservation form of momentum equation for 3D flow. **6**

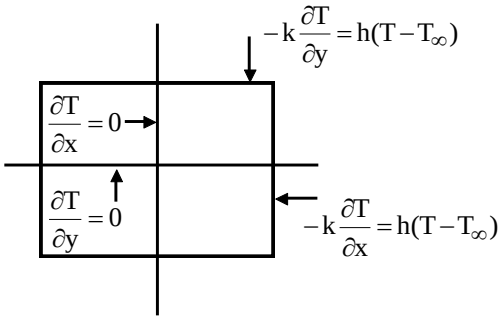
5. Drive 2nd order accurate finite difference formulations for forward difference and central difference using Taylor series expansion. **14**
eg:

$$f(x) = f(a) + f'(a)\frac{(x-a)}{1!} + f''(a)\frac{(x-a)^2}{2!} + ------$$

OR

6. Consider square Block initially heated at temperature T_w. Dimension of one side is 'L' infinitely long in Z – Direction. Thermal diffusivity is α. **14**

i) Write non – dimensional governing equation.
ii) Write initial condition and boundary condition.
iii) Identify solution domain



7. Present algorithm for Runge – Kutta method to ODE and outline procedure for adaptive stepping. **14**

OR

8. Solve using Runge Kutta 4th order. **14**

$$\frac{dy}{dx} = 3e^{-x} - 0.4y \; ; \; y(0) = 5$$

Find y(3) as h = 1.5

9. Explain 'Simple' algorithm and 'Simpler'. **13**

OR

10. a) Explain staggered grid. **7**

b) What is pressure correction scheme? **6**

11. Explain Mac–Cormack method for continuity equation and explain how will you discritize it. **13**

OR

12. What are shooting methods? Derive general formulation for it. **13**

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