Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V • EXAMINATION – WINTER • 2014

Subject Code: 150104 Date: 01-12-2014

Subject Name: Computational Fluid Dynamics - I

Time: 10.30 am - 01.00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Using polynomial approach, derive **07**

$$\frac{\partial u}{\partial y} = \frac{-3u_1 + 4u_2 - u_3}{2\Delta y} + O(\Delta y)^2$$

(b) Explain grid generation. Discuss the different types of grids. **07**

Q.2 **(a)** What is discretization? Explain the need for discretization. Explain FDM, FEM and FVM. **07**

(b) Implementing Taylors series expansion derive the first order forward and backward difference formulation, also describe the second order central second difference. **07**

OR

(b) State the advantages and disadvantages of explicit and implicit approaches. **07**

Q.3 **(a)** State the disadvantages of Lax-Wendroff Technique and explain Mac Cormark technique. **07**

(b) Explain the relaxation techniques. **07**

OR

Q.3 **(a)** Discuss the requirement of computational fluid dynamics in engineering. **07**

(b) Explain the concept of adaptive grid and compressed grids. **07**

Q.4 **(a)** Explain the mathematical behavior of governing flow equation with the example of supersonic flow over the blunt nose. **07**

(b) Derive the complete momentum equation for 3-D unsteady, viscous flow through infinitesimally small moving fluid element. **07**

OR

Q.4 **(a)** Write a short note on shock fitting method and shock capturing method to handle the shocks in flow field. **07**

(b) Consider irrotational 2-D inviscid steady flow of a compressible gas. Flow field is slightly perturbed get the roots of such system equations and give your comments on the obtained roots. **07**

Q.5 **(a)** Derive the momentum equation for 1-D subsonic-supersonic flow through convergent divergent nozzle in a non-conservation and conservation forms. **07**

(b) Explain in detail the stepwise procedure to solve the fluid flow problem using CFD solvers. Also list the common boundary conditions applied to the flow field. **07**

OR

Q.5 **(a)** Explain in detail the boundary conditions and initial conditions applied to subsonic-supersonic isentropic nozzle flow. **07**

(b) Derive the continuity equation for the subsonic – supersonic isentropic nozzle flow and from that derive the dimensionless form of continuity form for the same system. **07**

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