Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E SEM-V Examination-Nov/Dec.-2011

Subject code: 150104 **Date: 29/11/2011**

Subject Name: Computational Fluid Dynamics-1

Time: 02.30 pm-05.00 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)** What do you understand by computational fluid dynamics? What are the different applications of CFD now days in various industries? **07**

(b) Derive the continuity equation **07**

Q.2 **(a)** Derive the momentum equation used in computational fluid dynamics **07**

(b) Write a short note on Physical boundary conditions for viscid and inviscid fluid flow **07**

OR

(b) Derive expression for substantial derivatives **07**

Q.3 **(a)** Explain the different methods to classify quasi-linear PDE. Explain Eigen value method in detail **07**

(b) Write a short note on Hyperbolic equations used to solve steady inviscid supersonic flows. **07**

OR

Q.3 **(a)** Explain in brief finite difference, finite element and finite volume method to descretize the computational domain. **07**

(b) Explain and list the differences between implicit and explicit methods **07**

Q.4 **(a)** What you understand by the stability and convergence of solution? **07**

(b) What are various errors encounter in discritization techniques? How these errors effect the solution of the problem? **07**

OR

Q.4 **(a)** Explain the characteristic lines and its concept. Also explain in brief about the method of characteristics used to solve flow through nozzle **07**

(b) Explain various types of grid. Also explain structured and unstructured grid with their advantages and disadvantages **07**

Q.5 **(a)** Explain different types of solutions of discritization equation **07**

(b) How do we classify the following differential equation? **07**

$$\left(1-M_\infty^2\right)\frac{\partial u'}{\partial x}+\frac{\partial v'}{\partial y}=0 \quad ; \quad \frac{\partial u'}{\partial y}-\frac{\partial v'}{\partial x}=0$$

Where *u'* and *v'* are small perturbation velocities, measured relative to the free stream velocity i.e. $u=V_\infty=+u'$ and $v=v'$. M_∞ is the free stream Mach number and can be subsonic or supersonic.

OR

Q.5 **(a)** Explain Lax Wendfroff method **07**

(b) Explain Maccormark's technique to solve partial differential equation **07**

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