Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE- V$^{th}$ SEMESTER–EXAMINATION – MAY/JUNE - 2012**

**Subject code: 150104 Date: 05/06/2012**

**Subject Name: Computational Fluid Dynamics I**

**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 is CFD? List out advantages of CFD over the wind tunnels. Give a brief on applications of CFD. **07**

**(b)** With a neat sketch explain the flow field over a supersonic blunt nosed body. Also discuss the mathematical behavior of different zones of such case. **07**

**Q.2** **(a)** List out the fundamental physical principles of fluid flow. With a neat sketch explain the models of fluid flow and derive the continuity equation for the model of an infinitesimally small element fixed in space. **07**

**(b)** Give the physical boundary conditions for the viscid and inviscid flows. Also write down the generic form for two dimensional viscid flows without heat generation. **07**

**OR**

**(b)** Explain the general methods of determining the classification of PDEs. **07**

**Q.3** **(a)** Explain the domain and boundaries for the solution of hyperbolic equations for 2-D and 3-D steady flows. **07**

**(b)** Write a short note on shock fitting and shock capturing methods. **07**

**OR**

**Q.3** **(a)** Derive the momentum equation for the unsteady 1-D flow through nozzle. **07**

**(b)** Replace all the terms of momentum equation using the non dimensional terms and apply the predictor step to the same to get the expression for $V_i^{t+\Delta t}$. where $V_i^{t+\Delta t}$ is the value of velocity for the new time step $t+\Delta t$ at the same grid point i. **07**

**Q.4** **(a)** Write a short note on adaptive grids and compressed grids. **07**

**(b)** Using Taylor's series derive first order and second order forward difference, rear ward difference and central difference expressions for $\frac{\partial u}{\partial y}$. **07**

**OR**

**Q.4** **(a)** Write a short note on one sided finite difference alternative approach. **07**

**(b)** Write a note on Lax Wendroff Method for nonlinear equation. Also state its stability requirements. **07**

**Q.5** **(a)** Describe Mac Cormack multi-step method **07**

**(b)** Explain the Rich Mayer method for the numerical approach to solve fluid flow equations. **07**

**OR**

**Q.5** **(a)** Describe the implicit approach for 1-D heat conduction equation **07**

**(b)** Derive the finite volume method for convection diffusion equation. **07**

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