Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI • EXAMINATION – WINTER 2013

Subject Code: 160105 **Date: 04-12-2013**

Subject Name: Computational Fluid Dynamics II

Time: 02:30 pm to 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)**	With a neat sketch explain the flow though shock tube and relate the shock tube problem to the Godunov approach.	**07**
	(b)	Explain in detail the 1st order and 2nd order upwind schemes.	**07**
Q.2	**(a)**	Explain the need of beam warming approach and apply the same on multidimensional problem.	**07**
	(b)	Draw the flow chart for TAUXY function subprogram for a supersonic viscous flow over a flat plate at zero incidence.	**07**
		OR	
	(b)	Explain the calculation of step sizes in space and time, initial and boundary conditions in regard to the numerical solution of supersonic viscid flow over a horizontal plate.	**07**
Q.3	**(a)**	Discuss in detail flux difference splitting.	**07**
	(b)	From the generic form for the subsonic supersonic flow though C-D nozzle, derive the flux terms and source terms as a function of U_1, U2 and U_3.	**07**
		OR	
Q.3	**(a)**	Explain the concept of shock capturing and setup a problem for the flow though C-D nozzle with a shock in the divergent section.	**07**
	(b)	Get the roots of one dimensional, unsteady inviscid flow using the methods of Jacobians.	**07**
Q.4	**(a)**	Explain the main transformation and inverse transformation of partial differential equations.	**07**
	(b)	Consider the case of unsteady flow in two spatial dimensions, with no source terms. Transforms the generic form of governing equations of such flow in strong conservation from in the transformed (□□□□ plane.	**07**
		OR	
Q.4	**(a)**	Differentiate the compression waves and expansion waves. With neat sketch derive the expression for the Prandtl-Mayer function for the supersonic flow expanded through the corner.	**07**
	(b)	Derive the basic governing equations in non-dimensional form for the 1-D flow though C-D nozzle.	**07**
Q.5	**(a)**	Explain the concept of Abbett's boundary conditions and calculation of downstream marching step size for the steady, supersonic, expanding flow through a corner.	**07**
	(b)	Explain high resolution scheme in general.	**07**
		OR	
Q.5	**(a)**	Apply the Mac-cormark Technique to the generic form for 2-D, unsteady flow without heat generation and body forces, to get the new value of U for the time step $t+\Delta t$	**07**

(b) Consider a supersonic expanding flow through a corner of 17°. The properties at upstream the expansion wave are Mach 2.2, static pressure and static temperature are 1bar and 298K respectively. Get the stagnation and static properties at the downstream the expansion wave. **07**

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