Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER V • EXAMINATION – WINTER - 2012

Subject code: 150104 Date: 16-01-2013

Subject Name: Computational Fluid Dynamics – I

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)** Explain the finite difference for second order mixed derivatives. **07**

(b) Solve **07**

$\frac{d}{dx}(K\frac{dT}{dx}) + q = 0$ with T(0)=100, T(L)=200, K=0.5 w/m/k, L=2 cm ,q=1000 Kw/mt^3. Compute using Finite Volume method using five nodes and taking cross section area as constant.

Q.2 **(a)** Explain the explicit approach for the one dimensional heat conduction equation. **07**

(b) Describe Lax method for nonlinear hyperbolic equation. **07**

OR

(b) Explain Euler's Forward time and backward space approximations also state Midpoint Leapfrog method. **07**

Q.3 **(a)** Describe the finite volume method for the convection diffusion equation. **07**

(b) Explain in brief the concept of requirement of CFD. **07**

OR

Q.3 **(a)** Explain the aspects of descritization. **07**

(b) Explain the finite volume method for the steady state equation. **07**

Q.4 **(a)** Explain the eigen value method for determining the classification of partial differential equation. (with example) **07**

(b) Define substantial derivative and partial derivative also describe the relation between the two. **07**

OR

Q.4 **(a)** Explain the general mathematical behavior of a hyperbolic equation and describe how it can be solved using CFD. **07**

Q.4 **(b)** Derive momentum equation for a viscous and unsteady flow. **07**

Q.5 **(a)** Explain the case of supersonic flow over a blunt nosed body as an example of ill posed problem and describe how this ill posed problem was converted to a well posed problem. **07**

(b) Explain the various models of flow used in CFD. Also write the velocity boundary conditions on the surface of the inviscid flow. **07**

OR

Q.5 **(a)** Derive the difference equation for one dimensional heat conduction equation. **07**

(b) Consider the viscous flow of air over a flat plate. Variation in velocity with respect to y is given as: $u=1582(1-e^{-y/L})$. Where L= 1 unit and $\mu=3.37\times10^{-7}$slug/(ft.s). y is from 0 to 0.3 in the steps of 0.1. Find the percentage error in shear stress, involved in 1st ordered and 2nd ordered difference compared to exact solution. **07**

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