

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**

$$\frac{d}{dx} \left(K \frac{dT}{dx} \right) + q = 0 \quad \text{with } T(0)=100, T(L)=200, K=0.5 \text{ w/m/k, } L=2 \text{ cm, } q=1000$$

Kw/mt³. 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 discretization. **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 $\mu=3.37 \times 10^{-7}$ 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**
