Seat No.: _____ Enrolment No.______

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-II Remedial Examination December 2010

Subject code: 721005 **Subject Name: Computational Fluid Dynamics**

Date: 22 /12 /2010 **Time: 02.30 pm – 05.00 pm**

Total Marks: 60

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Explain in detail – Essentials of Computational Fluid Dynamics. **06**

(b) Discuss general steps of solution using CFD. **06**

Q.2 **(a)** What is importance of integral form of governing flow equations over differential form equations? **06**

(b) Describe types of PDE with example and its characteristics. Also describe three basic types of boundary condition for the PDE. **06**

OR

(b) What is importance of boundary conditions in solution of fluid dynamics problems? **06**

Q.3 **(a)** From first principle derive general Navier-Stokes equation for incompressible flow without heat transfer. **06**

(b) Explain Crammer's rule for classification of partial differential equations. **06**

OR

Q.3 **(a)** Define vorticity and stream function. Write complete set of vorticity-stream function equation to obtain numerical solution. **06**

(b) Derive vorticity-stream function equation from Navier-Stokes equation. Also write assumption made to obtain the equation. **06**

Q.4 **(a)** Derive forward, backward, central difference formulae for the function f(x) using Taylor's series. **06**

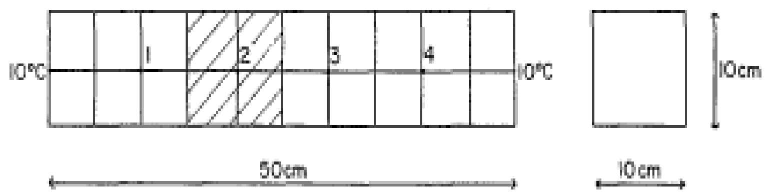
(b) Show that the following equation is an elliptic form equation. **06**

$$\frac{\partial^2\phi}{\partial x^2}+\frac{\partial^2\phi}{\partial y^2}=0$$

OR

Q.4 **(a)** Explain the SMAC Algorithm to solve Navier-Stokes equation. **06**

(b) Find out temperature distribution inside the square cross section (10×10 cm^2, length 50 cm) lagged metal bar with thermal conductivity k = 50 W/m-K & inside heat generation rate H = 4×10^4 W/m^3. Consider across every cross section of the bar, the condition remains constant with respect to time & both ends of the bar are maintained at constant temperature of 10 ºC as shown in figure below . **06**



Q.5 **(a)** Using polynomial approach, derive one sided finite difference expression for a function $u(y) = a+by+cy^2$. **06**

(b) Discuss k-ε model for turbulent flow modeling. **06**

OR

Q.5 **(a)** Discuss shear stress associated with turbulent flow. **06**

(b) Explain Blausius' approximation in relation with velocity distribution in turbulent flow. **06**

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