Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER– II(Old course) • EXAMINATION (Remedial) – WINTER- 2015

Subject Code: 1721005 **Date: 11/12/2015**

Subject Name: Computational Fluid Dynamics

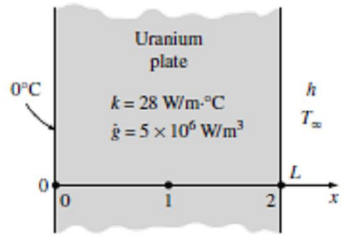
Time:2:30 pm to 5:00 pm **Total Marks: 70**

Instructions:

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

Q.1	**(a)**	Derive integral form of momentum conservation equation along xdirection.	**07**
	(b)	State and explain various types of errors that occur during CFD simulation.	**07**
Q.2	**(a)**	How computational fluid dynamics techniques are different than traditional methods? What are its advantages?	**07**
	(b)	Explain classification of quasilinear partial differential equations. What is its importance associated with CFD?	**07**
		OR	
	(b)	Explain explicit and implicit finite difference scheme.	**07**
Q.3	**(a)**	Explain in detail NavierStokes equation and its important forms.	**07**
	(b)	Discuss use of hyperbolic PDE in CFD for (i) steady inviscid supersonic flow, and (ii) unsteady inviscid flow.	**07**
		OR	
Q.3	**(a)**	What are Neumann and Dirichlet boundary conditions? Explain various types of boundary conditions.	**07**
	(b)	Define vorticity and stream function. Write the differential form of vorticity ï stream function equation. Derive integral form of the vorticity stream function equation from differential form.	**07**

Q.4 **(a)** Consider a large uranium plate of thickness L=4 cm and thermal conductivity k=28 W/m°C in which heat is generated uniformly at a constant rate of g=5 x 10^6W/m^3.One side of the plate is maintained at 0° C by iced water while the other side is subjected to convection to an environment at T_D =30° C with a heat transfer coefficient of h=45 W/m^2 °C , as shown in figure. Considering a total of three equally spaced nodes in the medium , two at the boundaries and one at the middle , estimate the exposed surface temperature of the plate under steady condition using the finite difference approach. **07**



(b) Write notes on central difference scheme of finite volume method. **07**

OR

Q.4 **(a)** Explain potential flow. What are assumptions to be made while writing potential flow equation? Discuss the merits and demerits of solving potential flow problem numerically. **07**

Q.4 **(b)** Discretize the 1D unsteady heat conduction equation in an explicit finite difference scheme and discuss its stability. **07**

Q.5 **(a)** Discuss the advantages and limitations of finite difference method and finite element method. **07**

(b) Explain the process of discretization of conservation equations used in CFD **07**

OR

Q.5 **(a)** Give brief introduction of MAC (Marker & Cell) method to solve the unsteady Navier-Stokes equations. **07**

(b) Write one dimensional scalar transport equation and explain advection, diffusion and source. **07**

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