Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VIII (NEW) EXAMINATION – WINTER 2017

Subject Code: 2181925 Date: 15/11/2017

Subject Name: Computational Fluid Dynamics(Department Elective III)

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.**

			MARKS
Q.1	**(a)**	Considering an example of a viscous flow over a flat surface, explain the concept of stretched (compressed) grid.	**03**
	(b)	Discuss the analogy between the steady state and unsteady state Laplace equation using proper physical interpretation.	**04**
	(c)	Discuss the philosophy of the pressure correction method along with the boundary conditions.	**07**
Q.2	**(a)**	Distinguish between Alternate-Direction-Implicit (ADI) technique and Crank-Nicolson scheme.	**03**
	(b)	What exactly the Cauchy condition in fluid dynamics represents?	**04**
	(c)	Derive the integral form of conservation of linear momentum equation for fixed and moving control volume.	**07**
		OR	
	(c)	Derive the governing equations for velocity boundary layer.	**07**
Q.3	**(a)**	Explain the statement : "most common finite-difference representations of derivatives are based on Taylor's series expansions"	**03**
	(b)	Difference between discretization error and round-off error.	**04**
	(c)	Using Taylor's series, derive the first order forward-difference and rearward-difference expressions for $\partial u/\partial y$.	**07**
		OR	
Q.3	**(a)**	What is the need for a staggered grid during the central differencing of the incompressible Navier-Stokes equations?	**03**
	(b)	Explain how to find a second-order-accurate finite-difference at the boundary using a polynomial approach.	**04**
	(c)	Discuss the MacCormack method with suitable example.	**07**
Q.4	**(a)**	Derive Reynolds Transport Theorem.	**03**
	(b)	Explain the Lax-Wendroff technique for solving marching problems.	**04**
	(c)	Discuss the instability issues related to QUICK scheme and its reformulation.	**07**
		OR	
Q.4	**(a)**	What id the physical significance of Crocco equation?	**03**
	(b)	Discuss the algebraic grid generation technique without clustering.	**04**
	(c)	With the help of flowchart, explain the SIMPLE algorithm. What is the need of staggered grid?	**07**

Q.5 **(a)** What are the four basic rules the FVM discretisation equation should obey to ensure the physical realism and overall balance. **03**

(b) Distinguish between stepwise profile and piecewise- linear profile assumptions for discretization. **04**

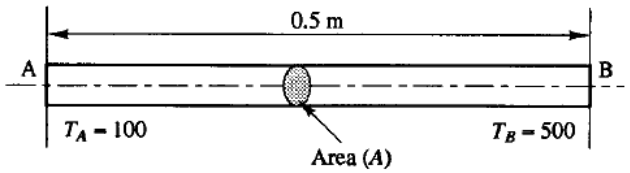
(c) Explain finite volume method for one-dimensional steady state diffusion problems. **07**

OR

Q.5 **(a)** Discuss in detail the advantages and disadvantages of FVM. **03**

(b) Explain: Conservativeness, Boundedness and Transportiveness. **04**

(c) Consider the problem of source- free heat conduction in an insulated rod whose ends are maintained at constant temperatures of 100°C and 500°C respectively. The one-dimensional problem sketched in figure is governed by $\frac{d}{dx}\left(k\frac{dT}{dx}\right)=0$ **07**



Calculate steady state temperature distribution in the rod. Thermal Conductivity equals 1000W/m K, cross section area is $10x10^{-3}$ m^2.