Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII EXAMINATION – WINTER 2015

Subject Code: 170106 **Date:04/12/2015**

Subject Name: Viscous Flow and Boundary Layer Theory

Time: 10:30am to 1:00pm **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)**	With velocity profiles explain flow over a cylinder.	**07**
	(b)	Derive the equation of Couette flow.	**07**
Q.2	**(a)**	Derive Orr-Summerfeild equation.	**07**
	(b)	Derive energy equation for flow over the plate at zero incidences.	**07**
		OR	
	(b)	Explain exact solution for thermal boundary layer. If necessary justify your answer with suitable mathematical derivation.	**07**
Q.3	**(a)**	Derive the expressions for Nusselt number and heat transfer coefficient for the flow over the flat plate.	**07**
	(b)	Write a short note on relaminarization.	**07**
		OR	
Q.3	**(a)**	Explain Prandtl's mixing length theory.	**07**
	(b)	Write a short note on boundary layer separation and the methods to control it.	**07**
Q.4	**(a)**	Derive momentum equation for turbulent flow in terms of Reynolds stresses.	**07**
	(b)	Define viscosity and shear stress? Explain Newton's law of viscosity to handle the viscous flows. What is Reynolds number? How the flow over the objects and through the objects classified based on Re?	**07**
		OR	
Q.4	**(a)**	Explain in detail the growth of hydrodynamic boundary layer and the thermal boundary layer when the viscous cold fluid is past over the hot flat surface.	**07**
	(b)	Derive the expressions for Reynolds analogy and Colburn analogy.	**07**
Q.5	**(a)**	Consider a cubic velocity profile and derive the expression for the momentum thickness, wall shear stress, coefficient of friction and drag over the body from momentum integral equation.	**07**
	(b)	Derive the continuity equation and momentum equation for the hydrodynamic boundary layer.	**07**
		OR	
Q.5	**(a)**	With appropriate sketches explain the fully developed flow in pipes.	**07**
	(b)	Define boundary layer thickness, momentum thickness and energy thickness, and derive expression for the energy thickness for laminar flow over a flat plate.	**07**

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