Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– VII (New) EXAMINATION – WINTER 2019

Subject Code: 2170106 **Date: 30/11/2019**

Subject Name: Boundary Layer Theory

Time: 10:30 AM TO 01:00 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)**	Define laminar flow and turbulent flow for flow over an object and flow through the object.	**03**
	(b)	What is the characteristic of a viscous flow? When hydrodynamic and thermal boundary layers formed over the surface of a body?	**04**
	(c)	Derive Von Karmann momentum integral equation.	**07**
Q.2	**(a)**	Derive the expression for shear stress, local skin friction and average skin friction coefficient based on Blassius solution.	**03**
	(b)	Explain the methods to control boundary layer separation over the surface.	**04**
	(c)	Based on Blassius solution prove that stretching factor 5 defines boundary layer region along the length of a plate.	**07**
		OR	
	(c)	Derive the expressions for momentum thickness, energy thickness and displacement thickness.	**07**
Q.3	**(a)**	How rough pipes and smooth pipes are classified based on roughness?	**03**
	(b)	Find displacement thickness and momentum thickness for the velocity distribution in the boundary layer given by, $\frac{u}{U_\infty} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$	**04**
	(c)	Derive an expression for the Darcy weisbach equation for loss of head due to friction in pipes.	**07**
		OR	
Q.3	**(a)**	Explain the characteristics of turbulent flow.	**03**
	(b)	What is the need to control growth of boundary layer over the body?	**04**
	(c)	Discuss the methods of boundary layer control. Give the reasons those lead boundary layer separation?	**07**
Q.4	**(a)**	Draw velocity profile for a fully developed flow?	**03**
	(b)	Derive Orr-Sommerfield equation.	**04**
	(c)	Derive the energy equation for thermal boundary layer over the flat surface.	**07**
		OR	
Q.4	**(a)**	Derive Reynolds analogy.	**03**
	(b)	Derive Reynolds stress for turbulent flow.	**04**
	(c)	Derive the expression for total drag offered by turbulent boundary layer over the flat surface.	**07**
Q.5	**(a)**	What are the factors affecting transition?	**03**
	(b)	Discuss in brief laminar airfoils.	**04**

	(c)	Give the approximate solution of thermal boundary layer over a flat surface.	**07**

OR

Q.5	**(a)**	Write the expression for local convective heat transfer coefficient and average heat transfer coefficient.	**03**
	(b)	Explain with neat sketch Prandtl mixing length theory for turbulent shear stress.	**04**
	(c)	Derive velocity defect equation for turbulent flow.	**07**

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