

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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