Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2018

Subject Code: 2170106 **Date: 03/12/2018**

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.**

Q.1	(a)	1.Define Laminar boundary layer 2. Define Boundary Layer thickness 3.Write an equation for Reynolds number	03
	(b)	Draw and explain Velocity profile and Temperature profile for Flat plate.	04
	(c)	Derive an expression for the Darcy weisbach equation for turbulent boundary layer flow.	07
Q.2	(a)	Explain Reynolds expression for turbulent shear stress.	03
	(b)	Define smooth and rough boundaries with sketches.	04
	(c)	Derive velocity defect equations for turbulent flow in pipe.	07
		OR	
	(c)	Derive orr-sommer field equation.	07
Q.3	(a)	Define Momentum thickness and energy thickness with equations.	03
	(b)	Pipe line carrying water has average height if irregularities projecting from the surface of the boundary of the pipe as 0.15 mm. what type of boundary is it? The shear stress developed is 4.9 N/m^2. The kinematic viscosity of water is 0.01 stokes.	04
	(c)	Derive Blasius exact solution for laminar boundary layer flows.	07
		OR	
Q.3	(a)	Explain wind tunnel turbulence.	03
	(b)	Explain critical Reynolds number.	04
	(c)	Write a short note on Relaminarization.	07
Q.4	(a)	Explain Colburn analogy.	03
	(b)	Discuss flow over a cylinder with neat sketch.	04
	(c)	Derive an equation for Couette flow.	07
		OR	
Q.4	(a)	Explain Reynolds analogy.	03
	(b)	Draw thermal boundary layer growth and thermal profile over the hot surface.	04
	(c)	A rough pipe is of diameter 8 cm. the velocity at a point 3 cm from wall is 30% more than the velocity at a point 1 cm from pipe wall. Determine the average height of the roughness.	07
Q.5	(a)	List out Different kinds of boundary layer control.	03
	(b)	Explain boundary layer on a flat plate	04

(c) Air at 20^0C and at a pressure of 1 bar is flowing over a flat plate at a velocity of 3m/s. If the plate is 280mm wide and at 56^0C, calculate the following quantities at x=280mm 07

1.Average friction coefficient
2.Shearing stress due to friction
3.Thickness of thermal boundary layer
4.Local convective heat transfer coefficient
5.Average convective heat transfer coefficient

Take, Density of air is 1.1374kg/m^3, K=0.02732 W/m^0C, C_p=1.005kJ/kgK, Kinematic viscosity=16.768*$10^{-6}$$m^2$/s, Pr=0.7

OR

Q.5 (a) Discuss causes of boundary layer separation. 03

(b) Air at 20^0C and at a pressure of 1 bar is flowing over a flat plate at a velocity of 3m/s. If the plate is 280mm wide and at 56^0C, calculate the following quantities at x=280mm 04

1. Boundary layer thickness
2. Local friction coefficient

Take, Kinematic viscosity=16.768*$10^{-6}$$m^2$/s,

(c) Derive Momentum equations for boundary layer by von- karman. 07

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