Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2170106 Date: 09/05/2017

Subject Name: Boundary Layer Theory(Department Elective - II)

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.**

Q.1 **(a)** Attempt all **07**

1. Define Laminar boundary layer
2. Write an equation for Reynolds number
3. Define Boundary Layer thickness
4. Draw a temperature profile for flat plate
5. Draw a velocity profile for flat plate
6. Define momentum thickness
7. Difference between viscous and Inviscid flow

(b) Derive an expression for the Darcy weisbach equation for turbulent boundary layer flow. **07**

Q.2 **(a)** Air flows at 20m/s past a smooth rectangular flat plate 0.3m wide and 3m long. Assuming that the turbulence level in the oncoming stream is low and that transition occurs at R_e=5, 00,000, calculate ratio of total drag when the flow is parallel to the length of the plate to the value when the flow is parallel to the width. Take kinematic viscosity of air is 0.15 stoke, Density of air is 1.24kg/m^3 **07**

(b) Explain with neat sketch prandtl mixing length theory for turbulent shear stress. **07**

OR

(b) Explain boundary layer with pressure gradient and explain effect of adverse pressure gradient on boundary layer. **07**

Q.3 **(a)** Derive Reynolds stresses equation for turbulent flow. **07**

(b) A smooth pipe of diameter 80mm and 800m long carries water at the rate of 0.480 m^3/minute. Calculate the loss of head, wall shearing stress, centre line velocity, velocity and shear stress at 30mm from the pipe wall. Also calculate the thickness of laminar sub layer. Take kinematic viscosity of water as 0.015stokes. take value of co-efficient of friction f from the relation given as $f=0.0791/(R^e)^{1/4}$, where R_e=Reynolds number **07**

OR

Q.3 **(a)** 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**

(b) Derive velocity defect equation for turbulent flow. **07**

Q.4 **(a)** Derive orr-sommer field equation **07**

(b) Derive Von karman momentum equation for boundary layer flow. **07**

OR

Q.4 **(a)** Define thermal boundary layer. Draw and explain thermal boundary layer formed during flow of cool fluid over a warm plate and warm fluid over a cool plate. **07**

(b) Air at 20^0C and at a pressure of 1 bar is flowing over a flat plate at a velocity of **07**

3m/s. If the plate is 280mm wide and at 56^0C, calculate the following quantities at x=280mm,

1. Boundary layer thickness
2. Local friction coefficient
3. Average friction coefficient
4. Shearing stress due to friction
5. Thickness of thermal boundary layer
6. Local convective heat transfer coefficient
7. 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

Q.5	**(a)**	Derive Blasius exact solution for laminar boundary layer flows.	**07**
	(b)	Write a short note on Relaminarization.	**07**
		OR	
Q.5	**(a)**	Derive the equation for Couette flow.	**07**
	(b)	Explain characteristics of turbulent flow	**07**

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