

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE- SEMESTER-VII (NEW) EXAMINATION – WINTER 2020****Subject Code:2170106****Date:28/01/2021****Subject Name:Boundary Layer Theory****Time:10:30 AM TO 12:30 PM****Total Marks: 56****Instructions:**

1. Attempt any **FOUR** questions out of **EIGHT** questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

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|------------|--|-----------|
| <b>Q.1</b> | (a) Draw a path lines for laminar and turbulent flows.   | <b>03</b> |
|            | (b) Draw a profile transition from laminar to turbulent flow.  | <b>04</b> |
|            | (c) List out different types of wind tunnel and draw open type subsonic windtunnel   | <b>07</b> |
| <b>Q.2</b> | (a) Write characteristics of Laminar flow.   | <b>03</b> |
|            | (b) Write characteristics of Turbulent flow.   | <b>04</b> |
|            | (c) Derive Couette flow equation with neat sketch.   | <b>07</b> |
| <b>Q.3</b> | (a) Define Laminar Sublayer.   | <b>03</b> |
|            | (b) What is Boundary layer control?  | <b>04</b> |
|            | (c) Derive orr-sommer field equation.  | <b>07</b> |
| <b>Q.4</b> | (a) Define Displacement thickness with sketch.   | <b>03</b> |
|            | (b) Define momentum thickness and Energy thickness.  | <b>04</b> |
|            | (c) Derive an expression for the Darcy weisbach equation for turbulent boundary layer flow   | <b>07</b> |
| <b>Q.5</b> | (a) Explain flow over a flat plate for Turbulent flow.   | <b>03</b> |
|            | (b) Explain thermal boundary layer growth over the hot surface.  | <b>04</b> |
|            | (c) Draw an effect of viscosity on an airfoil in a moving fluid.   | <b>07</b> |
| <b>Q.6</b> | (a) Explain Reynolds analogy.  | <b>03</b> |
|            | (b) Determine the wall shearing stress in a pipe of diameter 100mm which carries water. The velocities at the pipe centre and 30mm from the pipe centre are 2 m/s and 1.5 m/s respectively. The flow in pipe is given as Turbulent | <b>04</b> |
|            | (c) Derive Momentum equations for boundary layer by von karman   | <b>07</b> |
| <b>Q.7</b> | (a) Define critical Reynolds number.   | <b>03</b> |
|            | (b) What is Prandtl mixing length theory?  | <b>04</b> |
|            | (c) Derive governing equation for Turbulent flow.  | <b>07</b> |
| <b>Q.8</b> | (a) Explain flow over a Cylinder for Laminar flow.   | <b>03</b> |

- (b) A thin plate is moving in still atmospheric air at a velocity of 5m/s. The length of the plate is 0.6 m and width 0.5m. **04**  
Calculate 1. The thickness of the B.L at the end of the Plate  
2. Drag force on one side of the plate  
Take Density of air as  $1.24 \text{ kg/m}^3$   
Kinematic viscosity 0.15 stokes
- (c) Derive velocity distribution for turbulent flow in smooth pipe. **07**