



# CBCS SCHEME

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15AE832

## Eighth Semester B.E. Degree Examination, Jan./Feb. 2021 Boundary Layer Theory

Time: 3 hrs.

Max. Marks: 80

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

### Module-1

- 1 a. Develop viscous flow phenomenon over an aerofoil and prescribe necessary boundary condition of the flow. (08 Marks)
- b. Describe mathematical characterization of governing equations of viscous flow. (08 Marks)

OR

- 2 a. Explain how boundary layer thickness varies with the direction of a 2D steady flow situation and derive displacement and momentum thickness for a boundary layer formed over a flat plate. (10 Marks)
- b. Elaborate 'Scale Analysis and Boundary layer approximation'. (06 Marks)

### Module-2

- 3 a. Describe both Couette flow and Poiseuille steady flow through duct and derive necessary velocity profile in each case. (10 Marks)
- b. Develop boundary layer equation for a laminar flow over a flat plate. (06 Marks)

OR

- 4 a. Explain unsteady duct flow between plates with bottom injection and top suction. (08 Marks)
- b. What is plane stagnation flow? Give its differential equation free of parameters. (08 Marks)

### Module-3

- 5 a. Derive Von Karman momentum integral equation and highlight its significance in laminar boundary layer. (10 Marks)
- b. What is shape factor and how is it connected with boundary layer thickness? (06 Marks)

OR

- 6 Outline:
  - a. Thermal Boundary layer
  - b. Boundary layer approximation of laminar flow
  - c. Momentum and Energy thickness
  - d. Applications of Navier-Stokes equation. (16 Marks)

### Module-4

- 7 a. How is Prandtl's boundary layer equation significant in boundary layer theory and prove that  $U \left( \frac{dU}{dX} \right) = - \left( \frac{1}{\rho} \right) \left( \frac{dP_o}{dX} \right)$  (08 Marks)
- b. Brief on dimensionless variables importance in Boundary layer theory. (08 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

- 8 a. What is the basis of Reynold's Analogy and how its useful to understand the essence of relationship between and momentum exchange? (08 Marks)
- b. Mention the importance of Reynold's Averaging and parameters affecting the transition to turbulence. (08 Marks)

**Module-5**

- 9 a. Explain free turbulence in jets, wakes and mixing layers. (08 Marks)
- b. Describe Time averaging and fluctuations in incompressible turbulent flow. (08 Marks)

OR

- 10 a. Elaborate on how turbulence measurement is done in a hot wire anemometer. (08 Marks)
- b. What are the methods for flow visualization used? Explain Schlieren method for flow visualization. (08 Marks)

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