AMITY UNIVERSITY
UTTAR PRADESH

Course Title: BOUNDARY LAYER THEORY **Credit Units: 03**

L	T	P/S	SW/ FW	TOTAL CREDIT UNITS
3	-	-	-	3

Course Code: AERO407

Course Level: UG

Course Objectives

This course will provide knowledge of basic concepts of momentum and thermal boundary layers, formulation of equations and solutions given by different investigators in case of flat surface and axi-symmetric bodies. The study involves the analysis and understanding of empirical results for laminar boundary layer, transition and turbulent boundary layer.

Pre-requisites: Aerodynamics - I & II

Course Contents/Syllabus:

	Weightage (%)
Module I : Review of Basic Concepts and Formulation of Equation **Descriptors/Topics *:*** Boundary layer thickness, Momentum thickness, Energy thickness, Shape Factor, separation equations of Motion and energy equation for compressible viscous fluid-derivation and discussion, boundary layer equation and their general properties.	**25**
Module II : Exact Solution and Approximate Methods **Descriptors/Topics :** Flat plate at zero incidence, Flows with pressure gradient, Von Karman and Polhausen Methods.	**15**
Module III : Axially Symmetrical Body **Descriptors/Topics :** Rotation near ground, Circular jet, Boundary layer on a body of revolution, flow in the entrance section of pipe.	**10**
Module IV : Thermal Boundary Layer **Descriptors/Topics :** Heat transfer from heated surface. Incompressible and compressible laminar flow over a flat plate, Plate thermometer problem.	**10**

Module V : Transition **Descriptors/Topics:** Pipe flow and flow over a flat plate, Critical Reynolds number, Turbulent spots, Principles of theory of stability of Laminar flows, Sommer-field equation, factors affecting transition, Laminar airfoils.	**5**
Module VI : Boundary Layer Control **Descriptors/Topics :**. Methods of control, Fundamental equations and exact solution for a flat plate with uniform suction, Compressible Boundary Layers with suction, Approximate solution for a flat plate with uniform suction, Compressible Boundary Layers with suction Approximate solutions, Theoretical and Experimental Results.	**10**
Module VII : Turbulent Boundary Layer **Descriptors/Topics :** Fundamentals of Turbulent flow, Mean motion and fluctuations, Reynolds stresses, wind tunnel Turbulence, Prandtls mixing Length theory, Von Karman's similarity Hypothesis, Velocity distribution laws.	**15**
Module VIII : Turbulent flow through Pipe **Descriptors/Topics :** Experimental results through smooth pipes, Relation between laws of friction and velocity distribution, Universal Resistance law for smooth pipe at large Reynolds number, Rough pipe and equivalent roughness.	**10**

Student Learning Outcomes:

- Describe and formulate momentum & thermal boundary layers equations in respect of flat surface and axi-symmetric bodies.
- Analyze empirical results obtained for laminar, transition and turbulent boundary layers.

Pedagogy for Course Delivery: Session Plan / course-material uploading, Class-room teaching associated with assignments, presentations**,** quiz, viva-voce and evaluation.

Assessment/ Examination Scheme:

Theory L/T (%)	Lab/Practical/Studio (%)	Total
100	**NA**	**100**

Theory Assessment (L&T):

Continuous Assessment/Internal Assessment - 30					End Term Examination
Components (Drop down)	**A**	**CT**	**S/V/Q**	**HA**	**70**
Weightage (%)	5	10	8	7	70

Text & References:

- Schlichting H., "Boundary Layer Theory" :
- Houghton and Boswell, "Further Aerodynamics for Engineering Students".

Any other Study Material:

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