INSTITUTEOFAERONAUTICALENGINEERING
(Autonomous)
Dundigal, Hyderabad-500043

AERONAUTICAL ENGINEERING

TUTORIAL QUESTION BANK

Course Title	**AERODYNAMICS**				
Course Code	AAEB10				
Programme	B.Tech				
Semester	IV	AE			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Dr. P.K. Mohanta, Professor				
Course Faculty	Dr. Maruthupandyan K, Professor				

COURSE OBJECTIVES:

The course should enable the students to:	
I	Understand the basics of aerodynamics, aerofoil and wing characteristics
II	Calculate forces and moments acting on aero foils and wings under ideal flow conditions.
III	Design a propeller and determine aerodynamic interaction effects between different components of aircraft.

COURSE OUTCOMES (COs):

CO 1	Understand and develop basic concepts Potential flow
CO 2	Obtain a clear understanding of various aerofoils and related properties.
CO 3	Develop a clear understanding of the vortex and different vortex methods to analyze the aerofoil.
CO 4	Develop a Complete understanding of the flow over various parts of aircraft and its impact.
CO 5	Understand the various types of boundary layers and applications.

COURSE LEARNING OUTCOMES (CLOs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Potential flow, velocity potential, stream function, Laplace equation, flow singularities-Uniform flow, source, sink, doublet, Vortex, Non lifting and lifting flow over a cylinder Kutta-Joukowski theorem.	CLO 1	Describe the basic concepts of Potential flow and its properties.
		CLO 2	Properties of Laplace and Flow Singularities.
		CLO 3	Various potential flow properties and their combination.
		CLO 4	Basic concept of lifting theory due to flow over objects and Kutta-Joukowski theorem.
CO 2	Aerofoil nomenclature, aerodynamic characteristics, centre of pressure and aerodynamic centre; Wing of infinite aspect ratio, C_L-α-diagram for a wing of infinite aspect ratio, generation of lift, starting Vortex, Kutta's trailing edge condition; Thin aerofoil theory; Elements of panel method; High lift airfoils, High lift devices. .	CLO 5	Geometry of Airfoil and nomenclature.
		CLO 6	Impact of angle of attack on Lift coefficient
		CLO 7	Lift generation in infinite and finite wings and various vortex generation conditions
		CLO 8	Thin airfoil theory of symmetric and nonsymmetric conditions. High lift devices and panel methods.
CO 3	Vortex motions, vortex line, vortex tube, vortex sheet; Circulation; Kelvin and Helmhotz theorem; Biot-Savart's law, applications, Rankine's vortex; Flow past finite wings, vortex model of the wing and bound vortices; Induced drag; Prandtl's lifting line theory; Elliptic wing. Influence of taper and twist applied to wings, effect of sweep back wings; Delta wings, primary and secondary vortex; Elements of lifting surface theory. Source Panel Vortex panel and Vortex lattice methods.	CLO 9	Various Vortex properties and their applications
		CLO 10	Various wing geometry and its impact on aerodynamics properties
		CLO 11	Methods to augment the lift and various methods are used.
		CLO 12	Various Panel methods used
CO 4	Flow past non lifting bodies, method of singularities; Wing-body interference; Effect of propeller on wings and bodies and tail MODULE; Flow over airplane as a whole.	CLO 13	Flow over the lifting bodies and understand of various properties conditions
		CLO 14	Wing interfaces and its impact
		CLO 15	Propeller location and its impact on various aircraft parts.
		CLO 16	Net flow over the aeroplane body.
CO 5	Introduction to boundary layer, laminar and	CLO 17	Impact of viscosity and development of boundary layer

	turbulent boundary layer, transition, boundary layer on flat plate, displacement thickness, momentum thickness, energy thickness, effect of curvature, temperature boundary layer.	CLO 18	Various types of boundary layers and their properties.
		CLO 19	Various thickness properties of boundary layer
		CLO 20	Impact of boundary layer due to geometry and flow properties like temperature.

TUTORIAL QUESTION BANK

MODULE -I				
INTRODUCTORY TOPICS FOR AERODYNAMICS				
Part - A(Short Answer Questions)				
S.NO	**QUESTIONS**	**Blooms Taxonomy Level**	**Course Outcomes**	**Course Learning Outcomes**
1	Define Potential flow?	Understand	CO 1	AAEB10.01
2	What are the characteristics of potential flow?	Understand	CO 1	AAEB10.01
3	Define velocity potential?	Understand	CO 1	AAEB10.01
4	Write the relation between velocity components and velocity potential.	Understand	CO 1	AAEB10.01
4	Define stream function?	Remember	CO 1	AAEB10.01
5	Write the relation between velocity components and stream function.	Understand	CO 1	AAEB10.01
6	What is Laplace equation, and discuss its importance?	Understand	CO 1	AAEB10.01
7	Define streamline, equipotential line.	Remember	CO 1	AAEB10.01
8	What do you understand by flow singularities?	Remember	CO 1	AAEB10.02
9	What do you understand by uniform flow?	Understand	CO 1	AAEB10.02
10	What do you understand by source flow? Explain with neat diagram.	Remember	CO 1	AAEB10.02
11	What do you understand by sink flow? Explain with neat diagram.	Remember	CO 1	AAEB10.03
12	What do you understand by half body? Explain with neat diagram.	Understand	CO 1	AAEB10.03
13	Define doublet and explain with neat sketch.	Remember	CO 1	AAEB10.03
14	What do you mean by Rankine oval? Explain with diagram.	Remember	CO 1	AAEB10.04
15	What is Vortex flow?	Understand	CO 1	AAEB10.03

16	Non lifting and lifting flow over a cylinder.	Understand	CO 1	AAEB10.04
17	Draw the diagram of irrotational flow over the airfoil.	Understand	CO 1	AAEB10.04
18	What are the two characteristics are important in potential flow?	Understand	CO 1	AAEB10.04
19	What do you understand by Kutta-Joukowski theorem?	Remember	CO 1	AAEB10.04
20	What do you understand by Magnus effect?	Understand	CO 1	AAEB10.04
Part - B (Long Answer Questions)				
1	Write short note on potential flow and its properties with neat diagrams.	Remember	CO 1	AAEB10.01
2	What is meant by velocity potential function? State and prove its properties.	Understand	CO 1	AAEB10.01
3	Write short notes about velocity potential with neat diagram.	Remember	CO 1	AAEB10.02
4	What is the sign conventions of velocity potential and stream function? Explain with neat diagram.	Understand	CO 1	AAEB10.01
5	Write short notes about stream function with neat diagram.	Understand	CO 1	AAEB10.01
6	Prove that velocity potential and stream functions are orthogonal.	Understand	CO 1	AAEB10.01
7	Derive the Laplace equation. And prove that $\nabla 2\varphi = 0$.	Understand	CO 1	AAEB10.02
8	What are characteristics of streamline and equipotential line	Understand	CO 1	AAEB10.02
9	Explain the flow singularities with suitable diagram.	Understand	CO 1	AAEB10.02
10	Draw the diagram and explain the difference between rotational and irrotational flow.	Understand	CO 1	AAEB10.02
11	Derive expressions for stream function and velocity potential for the source in uniform flow. Draw the neat diagram.	Remember	CO 1	AAEB10.03
12	Derive expressions for stream function and velocity potential for the source and sink in uniform flow. Draw the neat diagram.	Remember	CO 1	AAEB10.04
13	Derive expressions for stream function and velocity potential for the Rankine oval with neat diagram.	Understand	CO 1	AAEB10.04
14	Derive expressions for stream function and velocity potential for the doublet with neat diagram.	Understand	CO 1	AAEB10.04
15	Find the stagnation points of half body. Explain with neat diagram.	Remember	CO 1	AAEB10.04
16	Derive expressions for stream function and velocity potential for the vortex flow with neat diagram.	Remember	CO 1	AAEB10.04
17	Non lifting and lifting flow over a cylinder	Understand	CO 1	AAEB10.03
18	Explain the magnus effect and draw the streamline diagram over a circular cylinder.	Understand	CO 1	AAEB10.03
19	Explain the magnus effect and draw the streamline diagram	Remember	CO 1	AAEB10.03

	over a circular cylinder. And illustrate few practical example of magnus effect.			
20	Explain Kutta-Joukowski theorem.	Understand	CO 1	AAEB10.03
Part - C (Analytical Questions)				
1	Determine the flow field governed by the stream function (units: m^2/s) defined by the expression: $\Psi = 6x + 12y$	Understand	CO 1	AAEB10.01
2	Derive the stream function and potential function for uniform flow. Draw suitable diagram for explanation.	Understand	CO 1	AAEB10.01
3	What you understand by stream function and velocity potential? Explain with neat diagram and their sign convention.	Remember	CO 1	AAEB10.01
4	Derive the Laplace equation and provide your concluding remarks.	Understand	CO 1	AAEB10.04
5	Derive the equation of Rankine oval and illustrate resulting velocity potential and stream function.	Remember	CO 1	AAEB10.04
6	Consider the velocity field given by $u = y/(x^2 + y^2)$ and $v = -x/(x^2 + y^2)$. Calculate the equation of the streamline passing through the point (0, 5). Calculate the vorticity.	Understand	CO 1	AAEB10.04
7	Derive Kutta - Joukowski theorem and prove that lift is directly proportional to circulation.	Understand	CO 1	AAEB10.04
8	Explain in detail how combination of a uniform flow and doublet flow produces non- lifting flow over a cylinder.	Remember	CO 1	AAEB10.04
9	Derive the stream function and potential function for vortex flow. Explain with suitable diagram.	Understand	CO 1	AAEB10.01
10	Explain in detail how combination of uniform flow, doublet flow and vortex flow produces lifting flow over a cylinder.	Understand	CO 1	AAEB10.01
MODULE -II				
THIN AEROFOIL THEORY				
Part – A (Short Answer Questions)				
1	What do you understand by airfoil nomenclature?	Understand	CO 2	AAEB10.05
2	Illustrate the various parts of airfoil with suitable diagram.	Remember	CO 2	AAEB10.05
3	What do you understand by aerodynamic characteristics of an airfoil?	Understand	CO 2	AAEB10.06
4	Define centre of pressure.	Remember	CO 2	AAEB10.06
5	Define aerodynamic centre.	Remember	CO 2	AAEB10.05
6	What do you understand by is NACA Series airfoil?	Remember	CO 2	AAEB10.05
7	What is Wing of infinite aspect ratio?	Understand	CO 2	AAEB10.05
8	What Is aspect ratio?	Understand	CO 2	AAEB10.05

9	Draw the CL-α- diagram for a wing of infinite aspect ratio and explain?	Understand	CO 2	AAEB10.06
10	Define aerofoil.	Remember	CO 2	AAEB10.06
11	Explain how the lift is generated with suitable diagram.	Understand	CO 2	AAEB10.05
12	Explain the starting Vortex.	Remember	CO 2	AAEB10.06
13	What do you understand by Kutta's trailing edge condition?	Understand	CO 2	AAEB10.06
14	What do you understand by horse shoe vortex?	Understand	CO 2	AAEB10.06
15	Define thin airfoil theory.	Understand	CO 2	AAEB10.06
16	Draw the high lift devices used in airfoil.	Understand	CO 2	AAEB10.06
17	What is panel method?	Remember	CO 2	AAEB10.06
18	Draw the various types of aerofoil.	Remember	CO 2	AAEB10.06
19	What are high lift airfoils?	Understand	CO 2	AAEB10.06
20	What do you mean by high lift devices?	Remember	CO 2	AAEB10.06
Part - B (Long Answer Questions)				
1	How NACA aerofoil nomenclature is done? Explain with 4 series and 5 series aerofoil?	Understand	CO 2	AAEB10.05
2	Draw neat skech of airfoil and explain its nomenclature.	Understand	CO 2	AAEB10.05
3	Describe the stalling of an airfoil and the related aerodynamic phenomena.	Understand	CO 2	AAEB10.05
4	Prove that the local jump in tangential velocity across a vortex sheet is equal to the local sheet strength.	Remember	CO 2	AAEB10.06
5	Explain the centre of pressure and aerodynamic centre.	Understand	CO 2	AAEB10.06
6	Explain with sketch the thin aerofoil theory and prove that lift coefficient is directly proportional to angle of attack.	Understand	CO 2	AAEB10.06
7	What do you understand by Wing of infinite aspect ratio?	Understand	CO 2	AAEB10.05
8	Explain in detail about how lift is generated by airfoil.	Remember	CO 2	AAEB10.06
9	Draw the C_L-α- diagram for a wing of infinite aspect ratio and explain the important features.	Understand	CO 2	AAEB10.06
10	What is the difference between aerodynamic characteristics of flow over wing of finite aspect ratio and infinte aspect ratio.	Understand	CO 2	AAEB10.06
11	Discuss about the starting Vortex with neat diagram.	Remember	CO 2	AAEB10.06
12	Explain why lift coefficient for airfoil is more than wing having same airfoil in detail.	Understand	CO 2	AAEB10.06
13	Explain Kutta condition and its significance for the case of steady flow over an airfoil.	Understand	CO 2	AAEB10.06
14	Describe the stalling of an airfoil and the related	Remember	CO 2	AAEB10.05

	aerodynamic phenomena that result in the process of stall.			
15	Write the assumptions and characteristics of Thin aerofoil theory.	Remember	CO 2	AAEB10.05
16	Distinguish between a free vortex and a forced vortex.	Understand	CO 2	AAEB10.05
17	Explain the Elements of panel method.	Understand	CO 2	AAEB10.06
18	Write done the steps and methods of panel method.	Remember	CO 2	AAEB10.06
19	Describe high-lift devices and why they are needed.	Remember	CO 2	AAEB10.05
20	Explain in detail about high lift airfoils.	Understand	CO 2	AAEB10.06
Part - C (Analytical Questions)				
1	Draw a aerofoil, and narrate the nomenclature used for NACA series aerofoil.	Understand	CO 2	AAEB10.05
2	What do you understand by aerodynamic characteristics of aerofoils at various angle of attach? Suggest few ideas to improve the stall condition.	Understand	CO 2	AAEB10.05
3	Why the centre of pressure is behind the aerodynamic centre?	Understand	CO 2	AAEB10.06
4	Discuss about the wing aspect ratio and induced drag.	Understand	CO 2	AAEB10.06
5	Draw the C_L-α- diagram for a wing of infinite aspect ratio and describe about wing of infinite aspect ratio.	Understand	CO 2	AAEB10.06
6	Describe the generation of lift and starting Vortex.	Understand	CO 2	AAEB10.06
7	State Kutta's trailing edge condition and derive the trailing edge condition?	Understand	CO 2	AAEB10.06
8	What do you understand by thin aerofoil theory? Explain as a representation of vortex sheet.	Understand	CO 2	AAEB10.06
9	Explain about elements of panel method and discretization of aerofoil contour into straight line segments.	Understand	CO 2	AAEB10.06
10	Write details about the High lift airfoils and High lift devices with neat sketches.	Remember	CO 2	AAEB10.06
MODULE –III				
FINITE WING THEORY				
Part – A (Short Answer Questions)				
1	What do you Vortex motions, vortex line, vortex tube, vortex sheet?	Remember	CO 3	AAEB10.07
2	What do you understand by Circulation?	Understand	CO 3	AAEB10.07
3	State Kelvin and Helmhotz theorem.	Remember	CO 3	AAEB10.08
4	Write Biot-Savart's law and its applications.	Understand	CO 3	AAEB10.08
5	What do you understand by Rankine's vortex?	Remember	CO 3	AAEB10.07

6	Write short notes on Flow past on finite wings.	Understand	CO 3	AAEB10.07
7	Write about vortex model of the wing and bound vortices.	Remember	CO 3	AAEB10.08
8	What do you understand by Induced drag?	Remember	CO 3	AAEB10.07
9	What is Prandtl's lifting line theory?	Remember	CO 3	AAEB10.07
10	What is Elliptic wing?	Understand	CO 3	AAEB10.08
11	Write the Influence of taper by applied to wings.	Understand	CO 3	AAEB10.08
12	Write short notes on Influence of twist applied to wings.	Understand	CO 3	AAEB10.08
13	What are the effects of sweep back wings?	Understand	CO 3	AAEB10.08
14	Draw neat sketch of Delta wings?	Remember	CO 3	AAEB10.07
15	What is primary and secondary vortex?	Understand	CO 3	AAEB10.07
16	What is Elements of lifting surface theory?	Understand	CO 3	AAEB10.07
17	What is Source Panel method?	Understand	CO 3	AAEB10.07
18	What is Vortex panel?	Understand	CO 3	AAEB10.08
19	What is Vortex lattice method?	Understand	CO 3	AAEB10.08
20	What are the limitations of lifting line theory?	Understand	CO 3	AAEB10.08
Part – B (Long Answer Questions)				
1	Write short notes on vortex motions, vortex line, vortex tube, vortex sheet with neat diagrams.	Understand	CO 3	AAEB10.08
2	What is effect of circulation on the flow around an aerofoil at an angle of incidence?	Understand	CO 3	AAEB10.08
3	Write short notes on Kelvin and Helmhotz theorem.	Remember	CO 3	AAEB10.08
4	State biot-Savart law and explain its usefulness in aerodynamics.	Understand	CO 3	AAEB10.08
5	What is Rankine's oval? Explain with suitable diagram.	Understand	CO 3	AAEB10.08
6	Write the Flow past finite wings and explain the creation of wing tip vertices.	Understand	CO 3	AAEB10.08
7	Write about creation of horse shoe vortex with suitable diagram.	Understand	CO 3	AAEB10.07
8	What is Induced drag, explain with suitable diagram.	Understand	CO 3	AAEB10.08
9	Write about Prandtl's lifting line theory and explain.	Understand	CO 3	AAEB10.08
10	What is Elliptic wing loading? Explain with suitable diagram.	Understand	CO 3	AAEB10.08
11	What are the Influence of taper applied to wings? Explain	Understand	CO 3	AAEB10.07

	each case with suitable diagrams.			
12	What is the Influence of twist applied to wings? Explain.	Understand	CO 3	AAEB10.08
13	What are the effect of sweep back wings?	Understand	CO 3	AAEB10.07
14	What do you understand by Delta wings?	Understand	CO 3	AAEB10.08
15	How primary and secondary vortex are generated? Explain with suitable diagram.	Understand	CO 3	AAEB10.08
16	Elements of lifting surface theory.	Understand	CO 3	AAEB10.08
17	With suitable sketch discus the Source Panel methods.	Understand	CO 3	AAEB10.08
18	What is Vortex panel, explain its application to thin aerofoil theory?	Understand	CO 3	AAEB10.08
19	What is Vortex lattice methods? Explain with Suitable Diagram.	Understand	CO 3	AAEB10.08
20	What do you understand by Elliptic wing loading?	Understand	CO 3	AAEB10.08
Part - C (Analytical Questions)				
1	What do you understand by Vortex motions, vortex line, vortex tube and vortex sheet.	Understand	CO 3	AAEB10.08
2	Draw the neat diagram of Rakine's vortex and explain.	Understand	CO 3	AAEB10.07
3	vortex model of the wing and bound vortices;.	Understand	CO 3	AAEB10.08
4	Compute the induced drag, assuming that the speed corresponding to a C_L of 1.2 is 96 km/h (26.5 m/s), and that the air density is 1.225 kg/m^3.	Applying	CO 3	AAEB10.08
5	Explain the Prandtl's lifting line theory with neat sketch.	Understand	CO 3	AAEB10.08
6	Derive the expression for induced velocity induced by an infinite long vortex filament at any arbitrary point located at a distance 'r' from the vortex filament.	Understand	CO 3	AAEB10.08
7	Explain the influence of taper applied to wings.	Understand	CO 3	AAEB10.07
8	What are the effects of sweep back wings?	Understand	CO 3	AAEB10.08
9	What do you understand by primary and secondary vortex?	Understand	CO 3	AAEB10.08
10	Explain the Numerical Implementation of Source Panel Method.	Understand	CO 3	AAEB10.08
MODULE -IV				
FLOW PAST NON-LIFTING BODIES AND INTERFERENCE EFFECTS				
Part – A (Short Answer Questions)				
1	What is the meaning of Flow past non lifting bodies?	Remember	CO 4	AAEB10.09

2	What is difference between bluff body and non lifting body.	Remember	CO 4	AAEB10.09
3	What do you understand by flow singularity?	Understand	CO 4	AAEB10.09
4	Is there any difference between Flow singularity and Zero flow?	Understand	CO 4	AAEB10.09
5	Give the example of flow singularity.	Remember	CO 4	AAEB10.09
6	What is wing-body interference?	Understand	CO 4	AAEB10.09
7	What are the affected parameters due to wing-body interference?	Understand	CO 4	AAEB10.09
8	What is difference between induced drag and parasite drag?	Remember	CO 4	AAEB10.09
9	What are the Effect of propeller on wings unit?	Remember	CO 4	AAEB10.09
10	How the propeller effects can be minimized?	Understand	CO 4	AAEB10.10
11	Draw the various mounting location of propetter.	Remember	CO 4	AAEB10.11
12	Draw the flow Effect of propeller on bodies unit.	Understand	CO 4	AAEB10.10
13	What are the Effect of propeller on tail unit?	Remember	CO 4	AAEB10.10
14	What do you understand by pitch of an aircraft?	Remember	CO 4	AAEB10.10
15	Write short notes on variable pitch of propeller.	Remember	CO 4	AAEB10.10
16	Write the interference effect due various parts over airplane as a whole aircraft.	Understand	CO 4	AAEB10.10
17	Define upwash and write short notes on it.	Understand	CO 4	AAEB10.10
18	Write short notes on downwash.	Understand	CO 4	AAEB10.10
Part – B (Long Answer Questions)				
1	With diagram explain the Flow past non lifting bodies.	Understand	CO 4	AAEB10.10
2	What is Lifting flow about circular cylinder, explain?	Understand	CO 4	AAEB10.10
3	Derive the coefficient of pressure over the circular cylinder.	Remember	CO 4	AAEB10.09
4	What does singularity mean in a vortex flow?	Understand	CO 4	AAEB10.10
5	What are the effects due to wing-body interference?	Understand	CO 4	AAEB10.09

6	Explain the tail wing setting is done based on main wing setting.	Understand	CO 4	AAEB10.09
7	What are the effect of propeller on wings unit, discuss?	Understand	CO 4	AAEB10.11
8	Discuss about downwash effect due to induced flow?	Understand	CO 4	AAEB10.09
9	How the induced drag and parasite drag are generated, explain with neat diagram?	Understand	CO 4	AAEB10.09
10	What are the Effect of propeller on bodies unit?	Understand	CO 4	AAEB10.10
11	What are the Effect of propeller on tail unit?	Understand	CO 4	AAEB10.10
12	Explain the effect of propeller on control surfaces.	Understand	CO 4	AAEB10.10
13	What are various wing configurations of aeroplane?	Understand	CO 4	AAEB10.09
Part - C (Analytical Questions)				
1	Draw the neat diagram Flow past on non-lifting cylinder, and derive the expression of Pressure coefficient.	Understand	CO 4	AAEB10.09
2	What is singularity explain with diagram? Derive the stagnation point of Rankine oval.	Understand	CO 4	AAEB10.10
3	Derive the expression for downwash using Prandtl lifting line theory.	Understand	CO 4	AAEB10.10
4	What are the Effect of propeller on wings unit, explain?	Understand	CO 4	AAEB10.10
5	What are the Effect of propeller on bodies unit, explain	Understand	CO 4	AAEB10.10
6	What are the Effect of propeller on tail unit, and its impact on tail setting?	Understand	CO 4	AAEB10.10
7	What is down wash? How does it effect the aerodynamics characteristics of a finite wing?	Understand	CO 4	AAEB10.10
8	Explain the flow past over lifting bodies with suitable diagram.	Understand	CO 4	AAEB10.09
9	Write about the propeller placement geometry in aircraft.	Understand	CO 4	AAEB10.10
10	Write the working principle of propeller. Explain the reason of propeller twist is more near root than tip.	Understand	CO 4	AAEB10.09
	MODULE-V			
	BOUNDARY LAYERTHEORY			

Part – A (Short Answer Questions)				
1	How can we determine whether the flow is laminar or turbulent?	Remember	CO 5	AAEB10.12
2	How the converts a laminar flow into a turbulent flow?	Remember	CO 5	AAEB10.12
3	Explain adverse pressure gradient?	Understand	CO 5	AAEB10.12
4	Explain the boundary layer growth along a flat surface.	Remember	CO 5	AAEB10.14
5	Draw and explain the velocity profile in the turbulent boundary layer.	Understand	CO 5	AAEB10.13
6	Draw and explain the velocity profile in the Transition boundary layer,	Remember	CO 5	AAEB10.14
7	Write a short note on favourable pressure gradient.	Remember	CO 5	AAEB10.14
8	What do you understand by boundary layer on flat plate?	Understand	CO 5	AAEB10.13
9	Define Reynolds number.	Understand	CO 5	AAEB10.15
10	What is displacement thickness?	Remember	CO 5	AAEB10.15
11	What are the properties of viscus flow?	Remember	CO 5	AAEB10.14
12	What is momentum thickness?	Understand	CO 5	AAEB10.15
13	What is thermal thickness?	Understand	CO 5	AAEB10.14
14	What is energy thickness?	Remember	CO 5	AAEB10.15
15	What do you understand by the stalling angle of an aerofoil, and how it can be postponed?	Remember	CO 5	AAEB10.15
16	What is the effect of curvature on boundary layer?	Understand	CO 5	AAEB10.14
17	What is the role of slots and flaps on boundary layer control?	Remember	CO 5	AAEB10.14
18	How separation can be postponed by slots and slats, explain?	Understand	CO 5	AAEB10.14
19	What is temperature boundary layer?	Understand	CO 5	AAEB10.14
20	What is couette flow?	Understand	CO 5	AAEB10.14
Part – B (Long Answer Questions)				
1	Describe the process of transition in the development of a	Remember	CO 5	AAEB10.12

	boundary layer and its effects on flow over airfoil.			
2	Write short notes about Skin friction and boundary layer.	Understand	CO 5	AAEB10.12
3	What is Boundary layer and why this concept is necessary?	Understand	CO 5	AAEB10.14
4	What is Turbulent boundary layer and how it is different from Laminar boundary layer?	Understand	CO 5	AAEB10.13
5	Define Reynolds number and explain the importance of it.	Understand	CO 5	AAEB10.14
6	What do you understand by Transition boundary layer? Explain the importance.	Understand	CO 5	AAEB10.15
7	Derive the equation of momentum thickness, and describe its significance.	Understand	CO 5	AAEB10.13
8	Describe the development stages of boundary layer on flat plate with neat sketch.	Understand	CO 5	AAEB10.14
9	Define Momentum thickness and Displacement thickness in boundary layer flows.	Understand	CO 5	AAEB10.14
10	Derive the equation of displacement thickness and discuss its importance.	Remember	CO 5	AAEB10.14
11	Derive the equation of displacement thickness, and describe its significance.	Understand	CO 5	AAEB10.14
12	Derive the equations of momentum thickness, and describe its importance.	Understand	CO 5	AAEB10.14
13	Derive the Blasius' equation for incompressible flow over a flat plate.	Understand	CO 5	AAEB10.15
14	What do you understand by energy thickness? Derive the required equation.	Understand	CO 5	AAEB10.15
15	Derive the equation of energy thickness, and describe its significance.	Understand	CO 5	AAEB10.14
16	What are the various methods used to measure boundary layer	Understand	CO 5	AAEB10.13
17	What is difference between flow separation and wake?	Understand	CO 5	AAEB10.14
18	Why the rough golf ball travels more distance than smooth ball.	Understand	CO 5	AAEB10.13
19	Describe the temperature boundary layer, how it is different than boundary layer thickness.	Understand	CO 5	
20	What are the various techniques used to control boundary layer. Explain with neat sketches.	Understand	CO 5	AAEB10.14
Part – C (Analytical Questions)				
1	A cylinder 0 mm diameter and 200 mm long is placed in a stream of fluid flowing at 0.5 m/s. the axis of the cylinder is normal to the direction of flow. The density of the fluid is 800	Analyzing	CO 5	AAEB10.12

	kg/m3. The drag force is measured and found to be 30N. Calculate the drag coefficient.			
2	In a fluid the velocity measured at a distance of 5 mm from the boundary is 1.125 m/s. The fluid has absolute viscosity 0.048 Pa s and relative density 0.913. What is the velocity gradient and shear stress at the boundary assuming a linear velocity distribution? Determine its kinetic viscosity.	Applying	CO 5	AAEB10.12
3	Describe temperature boundary layer. Give an example of a high-lift device which uses boundary layer control.	Remember	CO 5	
4	Describe the process of transition in the development of a boundary layer and its effects on flow over airfoil.	Understand	CO 5	AAEB10.13
5	What do you understand by boundary development on flat plate, describe the properties with neat diagram?	Understand	CO 5	
6	Derive the equations of displacement thickness, momentum thickness and energy thickness with their significance.	Understand	CO 5	AAEB10.15
7	Prove the laminar boundary layer thickness on a flat plate at a distance x from the leading edge is proportional to $x/\sqrt{(Rn)}$	Understand	CO 5	AAEB10.15
8	For the displacement thickness, the momentum thickness, and energy thickness for the velocity distribution in the boundary layer.	Understand	CO 5	AAEB10.15
9	Describe the effect of curvature on boundary layer development and flow separation with neat sketches.	Understand	CO 5	AAEB10.15
10	Consider a flat plate at zero angle of attack in an airflow at standard sea level conditions ($p\infty = 1.01 \times 105$ N/m^2 and T_∞ = 288 K). The chord length of the plate (distance from the leading edge to the trailing edge) is 2 m. The planform area of the plate is 40 m^2. At standard sea level conditions, $\mu\infty = 1.7894 \times 10^{-5}$ kg/(m)(s). Assume the wall temperature is the adiabatic wall temperature Taw. Calculate the friction drag on the plate assuming a turbulent boundary layer for a freestream velocity of 100 m/s,	Applying	CO 5	AAEB10.15

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