INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad-500 043

AERONAUTICAL ENGINEERING

ASSIGNMENT

Course Name	:	**AERODYNAMICS I**
Course Code	:	**A42102**
Class	:	II B. Tech II Semester
Branch	:	Aeronautical Engineering
Year	:	2016 – 2017
Course Coordinator	:	Dr. A.BARAI, Professor
Course Faculty	:	Dr. A.BARAI, Professor

OBJECTIVES

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited.

In line with this, Faculty of Institute of Aeronautical Engineering, Hyderabad has taken a lead in incorporating philosophy of outcome based education in the process of problem solving and career development. So, all students of the institute should understand the depth and approach of course to be taught through this question bank, which will enhance learner's learning process.

ASSIGNMENT-I

S. No	Question	Blooms Taxonomy Level	Course Outcome
	UNIT-I **REVIEW OF FLUID MECHANICS**		
1	Explain how lift generated.	Knowledge	1
2	State Continuity Equation and also derive the equation in partial differential form.	Comprehension	1
3	State Buckingham pi theorem.	Analysis	3
4	Consider the supersonic flow over a 5° half-angle wedge at zero angle of attack.The freestream Mach number ahead of the wedge is 2.0, and the freestream pressure and density are 1.01 x 105 N/m2 and 1.23 kg/m3, respectively (this corresponds to standard sea level conditions). The pressures on the upper and lower surfaces of the wedge are constant with distance 5 and equal to each other, namely, P_u= P_l= 1.31 X 10^5 N/m2.The pressure exerted on the base of the wedge is equal to P∞. The shear stress varies over both the upper and lower surfaces as $\tau_w = 431\ s^{-0.2}$. The chord length, c, of the wedge is 2 m. Calculate the drag coefficient for the wedge.	Evaluation	2
5	State momentumequation and also derive the equation in partial differential form.	Comprehension	1

S. No	Question	Blooms Taxonomy Level	Course Outcome
UNIT – II **INVISCID INCOMPRESSIBLE FLOWS**			
1	Derive the stream function and velocity potential for source and sink pair.	Knowledge	4
2	Explain the KuttaJoukowsky theorem and Kelvin circulation theorem.	Knowledge	4
3	Explain in detail how combination of uniform flow, doublet flow and vortex flow produces lifting flow over a cylinder.	Analysis	1
4	Prove that the velocity potential and the free stream for a uniform flow satisfy Laplace's equation.	Analysis	1
5	D'alembert's paradox is between theoretical drag and real life drag. What does this paradox describes specifically?	Knowledge	3
UNIT – III **VISCOUS FLOW AND BOUNDARY LAYER**			
1	Derive skin friction drag by integration of tangential and pressure drag by integration of normal stresses respectively.	Knowledge	6
2	Discuss in detail the flow separation phenomena.	Analysis	5
3	Discuss in detail laminar, transition and turbulent flows.	Analysis	9
4	Explain the boundary layer growth along a flat surface.	Analysis	8
5	Discuss the patching of inviscid external flow and viscous boundary layer flow.	Comprehension	5

ASSIGNMENT-II

UNIT – III **VISCOUS FLOW AND BOUNDARY LAYER**			
1	Derive the Blasius solution for flat plate problem.	Knowledge	5
2	Explain in detail momentum thickness and displacement thickness	Analysis	8
3	Some engineers wish to obtain a good estimate of the drag and boundary-layer thickness at the trailing edge of a miniature wing. The chord and span of the wing are 6mm and 30mm respectively. A typical flight speed is 5m/s in air (kinematic viscosity = 15 x 10^{-6} m^2/s, density = 1.2 kg/m^3). They decide to make a superscale model with chord and span of 150 mm and 750 mm respectively. Measurements on the model in a water channel flowing at 0.5m/s (kinematic viscosity = 1x$10^{-6}$$m^2/s$, density = l000 kg/m^3) gave a drag of 0.19N and a boundary-layer thickness of 3 mm. Estimate the corresponding values for the prototype.	Analysis	5
4	Consider Mach 4 flow at standard sea level conditions over a flat plate of chord 5 in. Assuming all laminar flow and adiabatic wall conditions, calculate the skin friction drag on the plate per unit span.	Analysis	9
5	Write down the effects of transition on aerofoils.	Knowledge	9
UNIT – IV **INVISCID FLOW OVER WINGS & PANEL METHODS**			
1	Consider a vortex filament of strength Γ in the shape of a closed circular loop of radius R. Obtain an expression for the velocity induced at the center of the loop in terms of Γ and R	Knowledge	13
2	Explain starting, bound and trailing vortices of wings.	Analysis	11
3	Explain in detail Prandtl's lifting line theory.	Analysis	10
4	Explain the source and vortex panel methods.	Analysis	10
5	State the vortex filament statement of Helmholtz's vortex theorem	Knowledge	9

S. No	Question	Blooms Taxonomy Level	Course Outcome
UNIT – V **APPLIED AERODYNAMICS ANDINTRODUCTION TO PROPELLERS**			
1	Explain in detail how sweep, winglets and flaps are used for lift augmentation.	Knowledge	12
2	Define the following terms: a) Critical Mach number b) Drag divergence c) Torque coefficient d) Efficiency	Analysis	12
3	Explain actuator disk theory due to Rankine & Froude power & thrust coefficients.	Analysis	12
4	Explain the concept of slip-stream with only axial velocity.	Analysis	12
5	a) Explain the effect of sweep in lift augmentation. b) Explain in detail advance ratio and torque coefficient.	Knowledge	12

Prepared by: Dr. A.BARAI, Professor

HOD, AERONAUTICAL ENGINEERING