KUMARAGURU
college of technology
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B.E DEGREE EXAMINATIONS: MAY 2017

(Regulation 2015)

Fourth Semester

AERONAUTICAL ENGINEERING

U15AET401 :Aerodynamics I

COURSE OUTCOMES

CO1:   Predict the behavior of airflow over bodies with particular emphasis on aerofoil sections in the incompressible flow regime.

CO2:   Apply Joukowski transformation to fluid flow problems.

CO3:   Apply airfoil theory to predict airfoil performance.

CO4:   Analyze and optimize wing performance.

CO5:   Apply propeller theory to predict blade performance.

CO6:   Apply the concepts of aerodynamics to the design of aerospace systems.

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1.   Matching type item with multiple choice code   CO1   [K_1]

List I	List II
(A). Reynolds No.	(i). occurs when fluid rotates as a solid about an axis.
(B). Forced vortex	(ii). line integral around a closed curve of the velocity field.
(C). Circulation	(iii). are instantaneously tangent to the velocity vector of the flow
(D). Streamline	(iv). the ratio between the inertial force and viscous force

	A	B	C	D
a)	(i)	(iii)	(ii)	(iv)
b)	(iii)	(ii)	(i)	(iv)
c)	(iv)	(i)	(ii)	(iii)
d)	(i)	(iii)	(iv)	(ii)

2. The normal stress is the same in all directions at a point in a fluid, when the fluid is   CO1 [K₂]

a) non-viscous.   (c) incompressible.

c) both (a) and (b).   (d) having no motion of one fluid layer relative to the other.

3. The pitot static tube measures the _____ pressure.   CO1 [K₂]

a) static   (c) total

c) difference in static & dynamic   (d) all (a), (b) and (c)

4. For irrotational flow past circular cylinder, the non-dimensional pressure distribution over the surface of the cylinder is given by   CO2 [K₃]

a) $1 - 4 \sin^2 \theta$ (c) $1 - 4 \cos \theta$

c) $1 - 4 \sin \theta \cos \theta$ (d) $1 - 4 \cos^2 \theta$

5. The transformation of the uniform flow parallel to the y-axis in the z-plane results in ……….. using the transformation function $\zeta = z^2$ in the ζ-plane.   CO2 [K₃]

a) strainght line   (c) hyperbola

c) parabola   (d) ellipse

6. Acording to Thin airfoil theory, the lift curve slope is equal to…….. (in terms of radians)   CO3 [K₂]

a) 2π (c) 2α

c) $2\pi\alpha$ (d) $2\pi(1-\alpha)$

7. Assertion (A): The propulsive efficiency of the propeller is high   CO5 [K₂]

Reason (R): The propeller affects large mass of air

a) Both A and R are Individually true and R is the correct explanation of A   b) Both A and R are Individually true but R is not the correct explanation of A

c) A is true but R is false   d) A is false but R is true

8. The circulation about the aerofoil with a vortex lying over the aerofoil, due to the boundary layer at the surface, is called the   CO4 [K₃]

a) starting vortex   (c) free vortex

c) bound vortex   (d) point vortex

9. What causes convective acceleration in fluid flow?   CO1 [K₂]

a) Steep slope in flow   (c) Unsteady nature of flow

c) Non-uniformity of flow   (d) Turbulence in flow

10. Which of the following denotes the effect of compressibility in fluid flow? — CO5 [K₁]

    a) Weber number   (c) Mach number

    c) Euler number   (d) Reynolds number

PART B (10 x 2 = 20 Marks)
(Answer not more than 40 words)

11.	What do you mean by vorticity?	CO1	[K₁]
12.	Draw a pressure distribution over a cambered airfoil kept at an angle of attack of 5 deg.	CO1	[K₂]
13.	How the doublet is obtained from the elementary flows?	CO2	[K₂]
14.	State D'Alembert Paradox.	CO2	[K₁]
15.	What did you understand from the Cauchy-Reimann equation?	CO3	[K₃]
16.	What is Karman-Trefftz profiles?	CO3	[K₁]
17.	State Kutta condition.	CO4	[K₁]
18.	What do you mean by downwash?	CO4	[K₂]
19.	What are the advantages of controllable pitch propeller when compared to fixed pitch propeller?	CO5	[K₃]
20.	When will you say a flow as a compressible?	CO5	[K₂]

Answer any FIVE Questions:-
PART C (5 x 14 = 70 Marks)
(Answer not more than 300 words)

Q.No. 21 is Compulsory

21. Obtain the expression for the performance parameters of the propeller using Froude momentum theory. — CO5 [K₃]

22. (i). Differentiate Lagrangian approach from Eulerian approach. What do you mean (6) — CO1 [K₄]
by substantial derivative?

(ii). Derive the differential form of the x-momentum equation from the basic (8)
principle.

23. (i). Obtain the expression to find the stagnation point for the flow over a cylinder by (7) CO1 [K$_3$] combining elementary potential flows.

    (ii). Obtain the expression for the pressure coefficient and show its variation along (7) the location of the cylinder.

24. Using Joukowski's transformation, transform the circular cylinder into a symmetrical CO2 [K$_4$] airfoil with mathematical derivations.

25. (i). Illustrate Bio-Savart's law and Helmholtz 1st and 2nd theorem with neat sketch. (7) CO3 [K$_2$]

    (ii). Obtain the expression for the Bernoulli's equation from the Euler's equation. (7) [K$_3$] State the assumptions involved in obtaining the same

26. (i). What do you mean by Magnus effect? How will you prove the Magnus effect by (8) CO1 [K$_4$] combining elementary flows through mathematical derivation?

    (ii). State Blasius theorem and explain briefly. (6) CO2 [K$_2$]

27. (i). With neat sketch, illustrate the Horse Shoe Vortex. (6) CO4 [K$_2$]

    (ii). Illustrate methods involved in determining different design parameters of NACA (8) CO4 4 digit, and 6 digit airfoils using Airfoil nomenclature

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