Register Number:……..

KUMARAGURU college of technology
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B.E/B.TECH DEGREE EXAMINATIONS: APRIL /MAY 2024

(Regulation 2018)

Fourth Semester

AERONAUTICAL ENGINEERING

U18AEI4201: Low Speed Aerodynamics

COURSE OUTCOMES

CO1: Apply conservation laws to solve incompressible flow regime.

CO2: Solve the problems on potential flows.

CO3: Apply Joukowski transformation to fluid flow problems.

CO4: Explain airfoil and wing characteristics.

CO5: Apply propeller theory to predict blade performance.

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

Answer all the Questions:-

PART A (10 x 2 = 20 Marks)

(Answer not more than 40 words)

1.	Determine the condition that the velocity components u= ax+dy and v= cx+dy will satisfy the equation of continuity.	CO1	[K_2]
2.	For the velocity field $u = y/(x^2 + y^{2)}$ and $v = - x/(x^2 + y^2)$, write the equation of streamline passing through the point (0, 5).	CO1	[K_2]
3.	Define: D'Alembert Paradox and Magnus effect.	CO2	[K_2]
4.	The lift on a spinning circular cylinder in a free stream velocity of 30 m/s and at standard sea level conditions is 6 N/m of span. Calculate the circulation around the cylinder.	CO2	[K_2]
5.	Explain Cauchy-Riemann equation.	CO3	[K_2]
6.	Define conformal transformation.	CO3	[K_2]
7.	State Kutta condition.	CO4	[K_2]
8.	Define Helmholtz theorems.	CO4	[K_2]
9.	Define pitch of a propeller.	CO5	[K_2]
10.	What are propeller coefficients?	CO5	[K_2]

Answer any FIVE Questions:-
PART B (5 x 4 = 20 Marks)
(Answer not more than 80 words)

11.	State continuity equation and irrotationality in terms of stream function.		CO1	[K_3]
12.	Consider the lifting flow over a circular cylinder with a diameter of 0.5 m. The free stream velocity is 25 m/s, and the maximum velocity on the surface of the cylinder is 75 m/s. The free stream conditions are those for a standard altitude of 3 km (ρ= 0.90926 kg/m^3). Calculate the lift per unit span on the cylinder.		CO2	[K_4]
13.	Explain Karman-Trefftz profiles.		CO3	[K_2]
14.	Describe the airfoil characteristics and its nomenclature with neat sketches.		CO4	[K_2]
15.	Differentiate between: (i) Wash in and wash out, (ii) Centre of pressure and Aerodynamic center, (iii) Geometric twist and Aerodynamic twist, (iv) Downwash and induced drag.		CO4	[K_2]
16.	Explain the blade element theory.		CO5	[K_3]

Answer any FIVE Questions:-
PART C (5 x 12 = 60 Marks)
(Answer not more than 300 words)

17.	a)	Explain Aerodynamic forces and moments.	6	CO1	[K_3]
	b)	What are the significance of aerodynamic heating and briefly explain aerodynamic aspects of slender body and blunt body with relevant diagrams.	6	CO1	[K_3]
18.		List out the body forces and surface forces. Derive the general x-momentum equation for an unsteady 3-D inviscid flow in partial differential form using a control volume approach.	12	CO2	[K_3]
19.		Consider the non-lifting flow over a circular cylinder. Derive an expression for the pressure coefficient at an arbitrary point (r, θ) in this flow, and show that it reduces to $Cp=1-4\sin^2\theta$ on the surface of the cylinder.	12	CO2	[K_4]
20.		Obtain an expression for the thickness ratio of the symmetrical airfoil section transformed from a circle of radius 'b' by means of the formula $W = Z + a^2 / Z$.	12	CO3	[K_4]

21.	a)	Consider a thin flat plate at 5 degree angle of attack. Calculate (a) the lift coefficient, (b) the moment coefficient about the leading edge, (c) moment coefficient about the quarter chord point, and (d) moment coefficient about the trailing edge.	6	CO4	[K_4]
	b)	For the NACA 2412 airfoil, the lift coefficient and moment coefficient about the quarter-chord at -6° angle of attack are -0.39 and -0.045, respectively. At 4° angle of attack, these coefficients are 0.65 and -0.037, respectively. Calculate the location of the aerodynamic center.	6	CO4	[K_4]
22.	a)	Derive the Froude's efficiency of propulsive system from momentum theory.	8	CO5	[K_3]
	b)	Briefly describe the performance of fixed and variable pitch propeller.	4	CO5	[K_3]

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