U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

October 2024 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 23AS4PCLSA **Max Marks: 100**
Course: Low Speed Aerodynamics

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	Explain lifting flow over a circular cylinder from fundamental flows of potential theory. Deduce the (i) Stream function (ii) Velocity components (iii) Locate the stagnation points (iv) Pressure coefficient	*CO1*	*PO1*	**10**
	b)	(i) Define vorticity and circulation. Define the physical significance of vorticity and circulation and derive the mathematical relationship between them. (ii) Consider the lifting flow over a circular cylinder. The lift coefficient is 5. Calculate the peak (negative) pressure coefficient.	*CO1*	*PO2*	**10**
		UNIT - II			
2	a)	Define aerodynamic center and center of pressure and estimate the location of center of pressure for a symmetric airfoil based on the assumptions of thin airfoil theory.	*CO2*	*PO1*	**10**
	b)	Consider a thin flat plate at an angle of attack of 5^0. Calculate the following (i) Lift coefficient (ii) Moment coefficient about the leading edge (iii) Moment coefficient about the quarter-chord point	*CO2*	*PO2*	**10**
		OR			
3	a)	(i) Define Kelvin circulation theorem. Explain in detail the formation of starting vortex with neat sketches. (ii) Consider an NACA 2412 airfoil with a chord of 0.64 m in an airstream at standard sea level conditions. The freestream velocity is 70 m/s. The lift per unit span is	*CO2*	*PO2*	**10**

			1254 N/m. Calculate the drag per unit span and strength of the steady-state starting vortex.			
		b)	(i) Differentiate between symmetric and unsymmetric airfoil. Explain the variation of coefficient of lift with angle of attack for both symmetric and unsymmetric airfoil. (ii) What are high lift airfoils. Explain various types of high lift airfoils with neat sketches that are used to enhance the lift characteristics.	*CO2*	*PO1*	**10**
			UNIT - III			
	4	a)	(i) What is the best spanwise lift distribution for a wing? and how do you arrive at such a conclusion. (ii) Consider an elliptical wing with an aspect ratio of 8. Calculate the lift and induced drag coefficients for the wing when its induced angle of attack is given as 5^0	*CO2*	*PO2*	**10**
		b)	(i) Briefly describe the algorithm used for source panel method and vortex lattice method. (ii) Write down the salient features of Helmholtz Theorem	*CO2*	*PO1*	**10**
			UNIT - IV			
	5	a)	Under what conditions does flow over circle in z plane (z=x+iy) becomes flow over unsymmetric airfoil in ζ plane (ζ=ξ+iη) when Joukowski transformation ($f(z) = z + \frac{c^2}{z}$) is applied. Assume the radius of circle is r.	*CO2*	*PO2*	**10**
		b)	Using method of singularities derive an expression for flow happening in kitchen sink and calculate the following i. Velocity potential and stream function ii. Velocity components iii. Stagnation points iv. Sketch stream lines and equi-potential lines	*CO2*	*PO1*	**10**
			UNIT - V			
	6	a)	Differentiate between inviscid and viscous flows and explain flow separation on an airfoil in detail with neat sketches.	*CO3*	*PO1*	**10**
		b)	Define boundary layer thickness. Derive an expression for displacement thickness and momentum thickness.	*CO3*	*PO1*	**10**
			OR			
	7	a)	Write the boundary layer equations and prove that the pressure gradient across the boundary layer remains constant	*CO3*	*PO1*	**10**
		b)	What are the characteristics of boundary layer? Sketch velocity and temperature profiles across the boundary layer.	*CO3*	*PO1*	**10**

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