18AE42

Model Question Paper-1 with effect from 2019-20 (CBCS Scheme)

USN | | | | | | | | | |

Fourth Semester B.E. Degree Examination

Aerodynamics - I

TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.

		Module -1	
Q.01	a	Derive energy equation using control volume approach.	8
	b	Describe the relationship between stream function and velocity potential equation.	4
	c	Derive an equation for vorticity, ξ	8
		OR	
Q.02	a	In a two dimensional incompressible flow the fluid velocity components are given by $V_x = x - 4y, V_y = -y - 4x$. Show that the flow satisfy the continuity equation and obtain the expression for stream function, if the flow is potential obtain also the expression for velocity potential.	8
	b	In the ideal flow around a half body, the free stream velocity is 0.5 m/s and the strength of the source is 2 m^2/s. Predict the fluid velocity and its direction at a point, r = 1.0 and $\theta = 120^0$.	8
	c	With a neat sketch explain the concept of circulation	4
		Module-2	
Q. 03	a	With a neat sketch illustrate the typical aerodynamic characteristics at low speeds.	6
	b	Calculate the velocity of bullet fire in standard air if the mach angle is 30^0. Take R = 287.14 J/kg k and k = 1.4 for air. Assume temperature as 15^0 C.	4
	c	Outline the Types of drag-Definitions with suitable examples	10
		OR	
Q.04	a	Explain the following modified NACA four and five digit series 1 series: NACA 16-123 6 series: NACA 61_2-315 7 series: NACA 712A315	6
	b	Consider two different points on the surface of an airplane wing flying at 80 m/s. The pressure coefficient and flow velocity at point 1 are -1.5 and 110 m/s, respectively. The pressure coefficient at point 2 is -0.8. Assuming incompressible flow, calculate the flow velocity at point 2.	6
	c	A light airplane weight 10000 N, its wing span measures 12 m, its chord measures 1.8 m, and a payload of 2000 N is anticipated. Predict (a) the take-off speed if an AOA of 8^0 is desired, (b) the stall speed of the conventional airfoil (c) the power required by the airfoil during cruise at 50 m/s. Assume $C_l = 1$ @ 8^0 AOA and $C_{lmax} = 1.72$.	8
		Module-3	
Q. 05	a	Briefly explain the following elementary flows with neat sketches and write Ψ and ϕ for each of them (a) Uniform flow (b) Source and sink flow	8
	b	Derive pressure coefficient using non-lifting flow over a circular cylinder, find the location on the surface of cylinder where the surface pressure equals the free stream pressure.	8
	c	Write a short note on D'Alembert's paradox	4
		OR	

Q. 06	a	With a neat sketch explain the kelvin's circulation theorem and the starting vortex.	4
	b	Derive an expression for lift curve slope for a symmetric airfoil using classical thin airfoil theory.	8
	c	Derive an expression for lift curve slope for a symmetric airfoil using classical thin airfoil theory.	8
		Module-4	
Q. 07	a	Derive the expression for the induced angle of attack and induced drag coefficient using elliptical lift distribution.	8
	b	Derive the expression for the induced angle of attack and induced drag coefficient using general lift distribution.	8
	c	Discuss lifting surface theory and vortex lattice method for wing	4
		OR	
Q. 08	a	Derive an expression for lift coefficient and induced drag coefficient in terms of circulation strength $\Gamma(y)$ for a finite wing through Prandtl's classical lifting line theory.	10
	b	Derive the expression for the velocity induced by infinite vortex filament using the Biot-savart law.	5
	c	Derive the Vortex filament: Infinite and semi-infinite vortex filament expressions for incompressible flow.	5
		Module-5	
Q. 09	a	Explain the following with a neat sketches A. Drag-divergence Mach number and sound barrier B. Transonic area rule	8
	b	Discuss the advantages and disadvantages of high lift devices	6
	c	Explain the difference between thick and thin airfoils	6
		OR	
Q. 10	a	Write a short note on Source panel & vortex latice method.	6
	b	Outline the leading-edge and trailing edge slats aerodynamic characteristics	6
	c	Outline the Subsonic and Supersonic leading edges with relevant sketches	8