U.S.N.										

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

Autonomous Institute Affiliated to VTU

October 2023 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 19AE4DCBAD **Max Marks: 100**
Course: Basic 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

1	a)	With a neat sketch explain the kelvin's circulation theorem and the starting vortex.	**6**
	b)	Show that the pressure coefficient on the surface of a circular cylinder of radius R in a uniform stream (U_∞), without a circulation, has the form $Cp = 1 - (4\sin^2\theta)$	**10**
	c)	Consider the lifting flow over a circular cylinder. The lift coefficient is 4π. Calculate the peak (negative) pressure coefficient.	**4**

UNIT - II

2	a)	Derive $C_l=2\pi\alpha$, where α is angle of attack for a symmetric airfoil using thin airfoil theory.	**8**
	b)	Consider an NACA 0012 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 1254 N/m. Calculate the angle of attack assuming the thin airfoil theory.	**6**
	c)	With a neat sketch of Wing planform geometry explain (i) Wing span (ii) Wing area (iii) Aspect ratio	**6**

OR

3	a)	Using thin airfoil theory for symmetric airfoil, show that center of pressure and aerodynamic pressure coincide with each other.	**10**
	b)	Consider an airfoil at 12^0 angle of attack. The normal and axial force coefficients are 1.2 and 0.03 respectively. Calculate the lift and drag coefficients.	**6**
	c)	With neat sketches, describe nomenclature of an airfoil. Considering NACA 4 digit series 0012, write down significance of each digit.	**4**

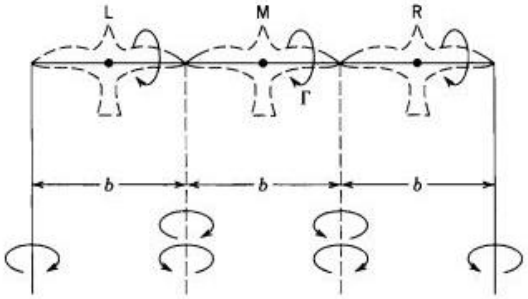
UNIT - III

4	a)	Using blade element theory derive the expression for efficiency of the propeller in terms of axial inflow factor and rotational inflow factor.	**10**
	b)	Discuss various performance parameters, which can be used to design a propeller .	**5**

	c)	Draw the blade section of the propeller. Show the geometric as well as the local flow details of this blade section.	**5**

UNIT - IV

Derive the expression for the induced downwash at the mid-bird's C.G. (shown in the below figure) if three birds represented by horse-shoe vortex model are flying side by side. The wing span of each bird is 'b', the strength of horse-shoe vortex is 'Γ', and the bound vortices of all the birds are in the same line. Neglect the distance between the birds.

5	a)		**10**
	b)	What is method of singularities? Explain it with an example.	**5**
	c)	Define: downwash and induced drag.	**5**

UNIT - V

6	a)	Briefly explain the following elementary flows with neat sketches and write the stream function and velocity potential for each of them: (i) uniform flows, (ii) source and sink flows, (iii) doublet flow, (iv) vortex flow	**12**
	b)	Explain the following with a neat sketches A. Drag-divergence Mach number and sound barrier B. Transonic area rule	**8**

OR

7	a)	Define source sheet. Explain the procedure or algorithm used to calculate the coefficient of pressure at the control point over the surface of any arbitrary shaped body using source panel method.	**10**
	b)	An airplane weighs 150 kN has flaps. The maximum lift coefficient at subsonic speed is 1.15. Calculate stalling speed at sea level. The area of wing of the airplane is 18 m^2 (ρ_{SL} = 1.23 kg/m^3).	**6**
	c)	Discuss the effects of propeller on the tail plane of an aircraft.	**4**

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