Hall Ticket No | | | | | | | | | | | Question Paper Code:AAEC08

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal-500043, Hyderabad

B.Tech IV SEMESTER END EXAMINATIONS (REGULAR) - JULY 2022

Regulation:UG20

AERODYNAMICS

Time: 3 Hours **(AERONAUTICAL ENGINEERING)** **Max Marks: 70**

Answer ALL questions in Module I and II

Answer ONE out of two questions in Modules III, IV and V

(NOTE: Provision is given to answer TWO questions from among one of the Modules III / IV / V

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

MODULE – I

1. (a) A uniform flow has a velocity V, show that this flow is physically possible incompressible flow and that it is irrotational. [BL: Apply| CO: 1|Marks: 7]

   (b) The lift on a spinning circular cylinder in a freestream with a velocity of 30 m/s and at standard sea level conditions is 6 N/m of span. Calculate the circulation around the cylinder. [BL: Apply| CO: 1|Marks: 7]

MODULE – II

2. (a) Illustrate the effect of trailing edge deflection of a high lift devices on the aerodynamic coefficients and flow pattern. [BL: Understand| CO: 2|Marks: 7]

   (b) An NACA 2412 airfoil has a chord of 0.64 m in an airstream at standard sea level conditions. The free stream velocity is 80 m/s. The lift per unit span is 1264 N/m. Calculate the strength of the steady-state starting vortex. [BL: Apply| CO: 2|Marks: 7]

MODULE – III

3. (a) Discuss in detail about the flow past finite wings and explain how are the wing tip vortices created. [BL: Understand| CO: 3|Marks: 7]

   (b) Consider a finite wing with an aspect ratio of 10 and a taper ratio of 0.8. The airfoil section is thin and symmetric. Calculate the lift and induced drag coefficients for the wing when it is at an angle of attack of 5 degree . Assume that $\delta = \tau = 0.055$. [BL: Apply| CO: 3|Marks: 7]

4. (a) Develop the expression for velocity induced by an infinite long vortex filament at any arbitrary point located at a distance 'r' from the vortex filament. [BL: Apply| CO: 4|Marks: 7]

   (b) The measured lift slope for the NACA 23012 airfoil is 0.1080 $degree^{-1}$, and α_L=0 = -1.3 degree. Consider a finite wing using this airfoil, with AR = 8 and taper ratio = 0.8. Assume that $\delta = \tau = 0.055$. Calculate the lift and induced drag coefficients for this wing at a geometric angle of attack = 6 degree. [BL: Apply| CO: 4|Marks: 7]

MODULE – IV

5. (a) Illustrate the position of circle for tranformation of circle into flat plate, ellipse, circular arc, symmetrical and cambered airfoil in Kutta- Joukowski transformation.

[BL: Understand| CO: 5|Marks: 7]

(b) A particle moves in the xy-plane such that its position (x, y) as a function of time t is given by: [z= i+2t/t-i]. Solve the velocity and acceleration of the particle in terms of t.

[BL: Apply| CO: 5|Marks: 7]

6. (a) Discuss about the effect of propeller slip stream and flow from wing on the tail unit of aircraft.

[BL: Understand| CO: 5|Marks: 7]

(b) Explain the Kutta-Joukowski transformation. Solve the transformation of the uniform flow parallel to the y-axis, in the z-plane, using the transformation function $\zeta = z^2$.

[BL: Apply| CO: 5|Marks: 7]

MODULE – V

7. (a) Illustrate transition boundary layer with neat diagram. Demonstrate various methods utilized to control boundary layer separation. [BL: Understand| CO: 6|Marks: 7]

(b) The wing on a Piper Cherokee general aviation aircraft is rectangular, with a span of 9.75 m and a chord of 1.6 m. The aircraft is flying at cruising speed (63 m/s) at sea level. Assume that the skin friction drag on the wing can be approximated by the drag on a flat plate of the same dimensions. Calculate the boundary-layer thickness at the trailing edge for completely laminar flow. The standard sea level value of viscosity coefficient for air is $\mu = 1.7894 \times 10^{-5}$ kg/(m-s)

[BL: Apply| CO: 6|Marks: 7]

8. (a) Summarize the steps invloved in calculating accurately the boundary-layer properties.

[BL: Understand| CO: 6|Marks: 7]

(b) Consider a flow with the conditions p_∞=1.01×10^5 N/m^2, T_∞= 288K, p_∞=1.22kg/m^3 and μ_∞=1.7894×10^{-5}kg/(m)(s) over a flat plate with a chord length of 2m and 20m width kept at zero angle of attack. Assume the wall temperature is the adiabatic wall temperature T_{aw}. Calculate the friction drag on the plate assuming a turbulent boundary layer for a free stream velocity of 100 m/s. Given R=287J/KgK, C_f/C_{fw}=0.85. [BL: Apply| CO: 6|Marks: 7]

– ○ ○ ◯ ○ ○ –