CBCS SCHEME

USN | | | | | | | | | | |

18AE/AS42

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Aerodynamics - I

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Using control volume approach derive the energy equation in Partial differential form for steady, Inviscid and adiabatic flow. **(12 Marks)**

b. Write about types of flow and draw sketches wherever applicable. **(08 Marks)**

OR

2 a. For 2D potential flow, velocity potential is given as, $\phi = X(2y-1)$. Find the velocity at point P(4, 5). Also find the expression of stream function ψ and value of stream function at point P. **(10 Marks)**

b. Obtain the expression for speed of sound in a calorically perfect gas as a function of temperature only. **(10 Marks)**

Module-2

3 a. Obtain the expression for co-effiicient of Lift. Drag and moment from surface pressure distribution over the airfoil with neat sketch. **(15 Marks)**

b. Draw the airfoil characteristic curve for symmetric and cambered airfoil and explain. **(05 Marks)**

OR

4 a. Draw and explain about airfoil nomenclature. Also explain about NACA 4 series 5 series and 6 series airfoils. **(08 Marks)**

b. Explain about centre of pressure and aerodynamic centre. **(06 Marks)**

c. Write about types of drag in aircraft. **(06 Marks)**

Module-3

5 a. Explain how to generate lift using cylinder and prove it by obtaining lift equation. **(16 Marks)**

b. Consider the lifting flow over a circular cylinder with a diameter 0.5 m. The free stream velocity is 25 m/s and circulation is 39.27 m^2/s. Density of air at this condition is 0.90926 kg/m^3. Calculate lift per unit span on the cylinder. **(04 Marks)**

OR

6 a. Obtain the relation for location of centre of pressure for a cambered airfoil using classical thin airfoil theory. **(14 Marks)**

b. Write about :

(i) Kutta condition.

(ii) Vortex Filament and Vortex sheet. **(06 Marks)**

Module-4

7 a. Write about Biot-Savart law and obtain the expression for Induced velocity for an Infinite, Straight Vortex filament. (08 Marks)

b. Obtain the fundamental equation of Prandtl's lifting line theory and obtain the solution for $\Gamma = \Gamma(y_0)$. (12 Marks)

OR

8 a. Prove that Induced Drag co-efficient is inversely proportional to the aspect ratio of the wing for Elliptical distribution and write about effect of Aspect ratio. (12 Marks)

b. Write about lift and Drag characteristics of complete aircraft. (08 Marks)

Module-5

9 a. Define critical Mach number and obtain the expression for critical pressure co-efficient as a function of critical Mach number. (12 Marks)

b. Explain about swept back wing and it's advantages in using in supersonic aircrafts with neat sketch. (08 Marks)

OR

10 Explain about,

a. Transonic area rule.

b. Ground effects.

c. Drag-divergence Mach number.

d. Hight lift devices. (20 Marks)

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