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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