CBCS SCHEME

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

21AE/AS42

Fourth Semester B.E. Degree Examination, June/July 2024
Aerodynamics

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Derive the related expressions for non-lifting flow over the cylinder and draw its pressure coefficient distribution. **(12 Marks)**

b. Explain the following :
i) D-Alembert's Paradox
ii) Kutta – Jackowski theorem
iii) Magnus effect. **(08 Marks)**

OR

2 a. Explain the following :
i) Kelvin circulation theorem
ii) Vortex sheet
iii) Kutta condition. **(08 Marks)**

b. Find lift slope and coefficient of moment at quarter chord point of cambered air foil using thin airfoil theory. **(12 Marks)**

Module-2

3 a. Draw neat sketch and derive the Prandtl's lifting line theory for the finite wing and find its aerodynamic variables. **(12 Marks)**

b. Write short notes on Subsonic open and closed type wind tunnels. **(08 Marks)**

OR

4 a. Consider a finite wing with an aspect ratio of 8 and 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°. Assume that $\delta = \tau = 0.055$. **(08 Marks)**

b. Explain the following :
i) Flow visualization techniques in wind tunnel
ii) Downwash and induced drag
iii) Manometer and pitot tube. **(12 Marks)**

Module-3

5 a. Derive the expression for the simplified horse shoe vertex model. **(08 Marks)**

b. Explain the following :
i) Formation of flight
ii) Ground effects
iii) Swept wing concepts. **(12 Marks)**

OR

6 a. Elaborate the trailling edge related high-lift. Devices with neat sketches. **(10 Marks)**

b. Explain the following :
i) Transonic area reuse
ii) Drag – divergence mach number. **(10 Marks)**

Module-4

7 a. Derive the expression for stagnation temperature, stagnation pressure and stagnation density. **(10 Marks)**

b. Obtain the expression for effect of mach number on compressibility. **(10 Marks)**

OR

8 a. Draw C-d nozzle and explain the flow through a C-d nozzle for various back pressure with neat sketch. **(10 Marks)**

b. Air flowing in Q duct has Q velocity of 600m/s, pressure 1.0 bar and temperature 290k. Taking $\gamma = 1.5$ and $R = 2.67$J/kg-k. Determine :

i) Stagnation pressure and temperature

ii) Velocity of sound in the dynamic and stagnation conditions

iii) Stagnation pressure assuming constant density. **(10 Marks)**

Module-5

9 a. Derive the Prandtl relation for normal shock wave and obtain the expression for pressure ratio, temperature ratio, density ratio in terms of upstream mach number. **(10 Marks)**

b. The state of gas ($\gamma = 1.3$, $R = 0.479$ kJ/kg-k) upstream of a normal shock wave is given by the following data :

$M_1 = 2.4$, $P_1 = 2$ bar, $T_1 = 265$k

Calculate the mach number, pressure, temperature and velocity of the gas downstream of the shock (Use property ratio formula). **(10 Marks)**

OR

10 a. Draw and explain the flow properties of oblique shock wave and obtain the relation for shock angle, flow deflection angle in terms of upstream mach number. **(10 Marks)**

b. Explain the following :

i) Detached shocks

ii) Mach reflection. **(10 Marks)**

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