NTK/KW/15/7460

Faculty of Engineering and Technology

Fifth Semester B.E. (Aeronautical Engg.)
(C.B.S.) Examination

AERODYNAMICS—II

Time : Three Hours] [Maximum Marks : 80

INSTRUCTIONS TO CANDIDATES

(1) All questions carry marks as indicated.

(2) Solve **SIX** questions as follows :

Question No. **1 OR** Question No. **2**

Question No. **3 OR** Question No. **4**

Question No. **5 OR** Question No. **6**

Question No. **7 OR** Question No. **8**

Question No. **9 OR** Question No. **10**

Question No. **11 OR** Question No. **12**

(3) Due credit will be given to neatness and adequate dimensions.

(4) Assume suitable data wherever necessary.

(5) Diagrams and Chemical equations should be given wherever necessary.

(6) Illustrate your answers wherever necessary with the help of neat sketches.

(7) Use of non-programmable calculator is permitted.

(8) Take Sea-level air density as 1.2256 kg/m^3.

4. (a) Consider a wing with elliptic lift distribution. Find the expressions for the downwash and the induced angle of attack, for this wing, in terms of circulation at the centre of wing and wing span. 7

(b) Calculate the lift coefficient, induced angle of attack and induced drag coefficient for a elliptic wing of AR = 7, wing area = 10 m^2, Speed = 50 m/s and Lift = 25 N. 7

5. (a) Prove the following equation, $a = \frac{a_0}{1 + \frac{a_0}{\pi AR}}$,

where symbols carry their usual meanings. 6

(b) With neat sketches, explain the working of winglets and strakes. What is their importance ? 7

OR

6. (a) What are the bodies of revolution ? Explain the aerodynamics of flow past the slender bodies of revolution. 6

(b) The lift curve slope for certain airfoil is 0.108/degree and $\alpha_{L=0} = -1.3°$. Consider a finite wing using this airfoil with AR = 8, taper ratio = 0.8, assume $\delta = \tau$. Calculate lift and induced drag coefficients for this wing at $\alpha = 7°$. 7

7. (a) With suitable sketches and plots, explain supersonic area rule. 7

(b) A supersonic flow with M = 1.5, P = 1 atm and T = 288 K in upstream flow, is expanded around a sharp corner, through a deflection angle of 15°. Calculate M_2, P, T, P_o, T_o in downstream direction and also the angles of forward and rearward Mach lines with respect to the upstream flow. 7

OR

8. (a) Explain the following terms, with sketches :

(i) Critical Mach No.

(ii) Drag Divergence Mach No.

(iii) Critical pressure coefficient. 6

(b) Prove that, the linearized supersonic pressure coefficient, is directly proportional to the local surface inclination with respect to the free-stream direction. 8

9. (a) With a neat sketch, explain the working of intermittent operation wind tunnel. 8

(b) Sketch the shock tube and explain its working. 5

OR

1. (a) Prove that, the velocity induced by a straight semi-infinite vortex of strength 'Γ' at a distance 'h' from it, is given by $\Gamma/4\ \pi h$. 7

   (b) Explain Momentum theory of wing for lift, down-wash and induced drag. Draw suitable sketches. 6

OR

2. (a) Using suitable sketches, justify the statement : "Induced drag is also called as Lift dependent drag". 4

   (b) Why induced drag is experienced by a finite wing and not by an airfoil ? 3

   (c) A finite wing of area 10 m^2 flying in air at sea level at 50 m/s. The geometric and effective angle of attack are 10° and 8° respectively. Lift coefficient of wing is 1.5. Find induced angle of attack, lift, induced drag and downwash produced by a wing. 6

3. (a) Derive the governing integro-differential equation of Prandtl's classical lifting line Theory. 9

   (b) Explain the following terms :

   (i) Free vortex

   (ii) Bound vortex

   (iii) Horse shoe vortex.

   How wing is replaced by Horse-shoe vortex ? 5

OR

10. Write short notes on the following :

   (a) Interference effects in wind tunnels 5

   (b) Wind tunnel Balances 4

   (c) Hypersonic wind tunnel characteristics. 4

11. (a) Explain with neat sketch, the Schlieren system of flow visualisation in wind tunnels. 8

   (b) Explain the working of hot wire anemometer. 5

OR

12. Write short notes on following :

   (a) Measurement of Roll angle 4

   (b) Free Flight Testing 4

   (c) Measurement of dynamic pressure. 5