Ex/ ME/T/414K/2019

B.E. MECHANICAL ENGG. EXAMINATION, 2019
(4th Year, 2nd Semester)
AERODYNAMICS

Time : 3 hours Full Marks: 100

[Group A]

1a. From dimensional analysis, find out the three most important dimensionless terms associated with aerodynamic studies.

b. Why and when does the concept of centre of pressure become inadequate?

c. Write short note on: Aerodynamic centre

d. Consider an aerofoil with chord length c and the running distance x measured along the chord. The leading edge is located at x/c=0 and the trailing edge at x/c=1. The pressure co - efficients of upper and lower sides are given respectively as,

$C_{p,u} = 1 - 250\ (x/c)^2$ for $0 \leq x/c \leq 0.4$

$C_{p,u} = -3.54 + 250\ (x/c)$ for $0.4 \leq x/c \leq 1.0$

$C_{p,l} = 1 - 0.89\ (x/c)^2$ for $0 \leq x/c \leq 1.0$

Calculate the lift co-efficient from the derived expression. 10+5+5+10

2a. Why are spiral staircases provided in tall chimneys?

b. Two high speed vehicles moving side by side in close proximity tend to attract one another - Justify. 5+5

3. Explain how velocity measurement of a supersonic airplane is done using pitot tube. 10

4a. Justify: In a 2D analysis of aerofoil with infinite span hypothesis, no induced drag can be generated.

b. Explain the nomenclature: NACA0012 and identify the type of the aerofoil. 5+5

[Group B]
[Answer any two]

5a. Explain the working principle of DRS for high velocity vehicles.

b. How does the co-efficient of lift for an aerofoil vary with the angle of attack. From the knowledge of the same, explain the working principles of Vertical and Horizontal Stabilizers associated to the longitudinal, lateral and directional control of an airplane. 5+15

6a. Write short note on: Absolute angle of attack.

b. Find out the contribution of wing and tail of an airplane flying in trimmed condition to the total pitching moment about its centre of gravity. 5+15

[Turn over

7. A wing - body model is tested in a subsonic wind tunnel. The lift is found to be zero at a geometric angle of attack $\alpha = -1.8°$. At $\alpha = 5°$, the lift co - efficient is measured as 0.6. Also at $\alpha = 2.10°$ and 7.88°, the moment coefficients about the centre of gravity are measured as - 0.014 and 0.07, respectively. The centre of gravity located at $0.3c$. The area and chord of the wing are 0.1 m^2 and 0.15 m respectively. A horizontal tail is attached to the model having an area of 0.02 m^2, tail setting angle 2.7°, tail lift slope 0.11 per degree. The tail's aerodynamic centre is 0.17 m behind the centre of gravity of the model. From experimental measurement, $\varepsilon = 0$ and $\delta\varepsilon/\delta\alpha = 0.32$ [notations have usual meanings]. Does this model have longitudinal static stability and balanced. 20