BACHELOR OF MECHANICAL ENGG. (EVENING) EXAMINATION, 2019
(4^{th} Year, 2^{nd} Semester)
AERODYNAMICS

Time : 3 hours Full Marks: 100

Answer any four [4] questions

1a. Derive the expression for the lift co-efficient in connection to the pressure co - efficients of the upper and lower surface of an aerofoil and the chord length.
b. 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. 15+10

2. 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. 7+18

3a. Explain the working principle of DRS for high velocity vehicles.
b. Two high speed vehicles moving side by side in close proximity tend to attract one another - Justify.
c. Explain the two necessary criteria of stability of an airplane in trimmed motion. 7+6+12

4a. Write short notes on: 5 x 5
i) Centre of Pressure
ii) Aerodynamic Centre
iii) Starting Vortex
iv) Canard configuration
v) Induced drag

5. A wing - body model is tested in a subsonic wind tunnel. The lift is found to be zero at a geometric angle of attack α = - 1.8° . At α = 5°, the lift co - efficient is measured as 0.6. Also at α = 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. 25