

B. MECHANICAL ENGINEERING (PART TIME) FOURTH YEAR SECOND SEMESTER EXAM 2017 (Old)

ELECTIVE - II [AERODYNAMICS]

Time : 3 hours

Full Marks: 100

Answer all the questions

1a. Explain the working principles of primary control surfaces associated to the longitudinal, lateral and directional control of an airplane.

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 - efficient of upper and lower sides are given respectively as,

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

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

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

Calculate the lift co-efficient.

15+10

2. Explain with neat figures the two necessary criteria for Longitudinal Static Stability of an airplane. Find out the mathematical expression for the contribution of tail to the co - efficient of the total pitching moment about the centre of gravity of an airplane.

10+15

3. A wing - body model is tested in a subsonic wind tunnel. The lift is found to be zero at a geometric angle of attack $\alpha = -1.8^\circ$. At $\alpha = 5^\circ$, the lift co - efficient is measured as 0.6. Also at $\alpha = 2.10^\circ$ 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, $\epsilon = 0$ and $\delta\epsilon/\delta\alpha = 0.32$ [notations have usual meanings]. Does this model have longitudinal static stability and balanced.

25

4a. What is the significance of the nomenclature NACA2412?

b. What do you mean by 'Aerodynamic Centre' and 'Centre of Pressure'? Briefly discuss the significance of them.

c. What is 'absolute angle of attack'?

d. Explain why tail with a negative lift is preferred for an airplane. When the reverse is true?

7+6+6+6