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10AE62

Sixth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Aircraft Performance

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting at least TWO full questions from each part.*
2. Assume any missing data and highlight it.

PART – A

1 a. State six parameters which influence the lift and drag of a body of given shape. **(06 Marks)**

b. The mass of an airplane is 10,000kg and its wing area is 35.59m^2. It is flying at sea level at a speed of 150m/sec. Estimate its lift coefficient and induced drag. Assume air density to be 1.225kg/m^3, e = 0.87 and wing aspect ratio to be 2.0. **(04 Marks)**

c. Define each of the following terms:
i) Centre of pressure
ii) Aerodynamic centre
iii) Parasite drag
iv) Interference drag
v) Draft polar. **(10 Marks)**

2 a. State the equation of motion for steady level flight. Assume that angle between engine thrust line and free stream direction can be neglected. **(02 Marks)**

b. Using the analytical approach and starting with $D = q_\infty \cdot S \cdot C_D$; derive an expression to find flight velocities for given valve of thrust required (T_R). **(10 Marks)**

c. Show that minimum power required occurs when the airplane is flying such that $C_L^{3/2}/CD$ is a maximum value. **(08 Marks)**

3 a. With the help of a force diagram, state the equations of motion for an aircraft in steady unaccelerated climbing flight and show that:
Rate of climb = Excess power / Aircraft weight
Note: thrust line is in direction of flight. **(10 Marks)**

b. Define absolute ceiling and service ceiling. **(04 Marks)**

c. For a jet propelled aircraft, derive an expression for maximum climb angle and the smallest equilibrium glide angle. **(06 Marks)**

4 a. State four fundamental parameters for aircraft performance. **(04 Marks)**

b. The drag polar for an aircraft is given as: $C_D = 0.015 + 0.08\,C_L^2$. Find the maximum valves of C_L/C_D; $C_L^{1/2}/CD$ and $C_L^{3/2}/CD$. **(09 Marks)**

c. Answer the following:
i) Define stalling angle of attack and when an aircraft is said to be stalled?
ii) Why conventional airplane is not flown in the stall region?
iii) Write an expression for stall velocity and what happens to stall velocity with increase in altitude. **(07 Marks)**

PART – B

5 a. Derive the Breguet range equation for a jet-propelled airplane. (10 Marks)
b. Derive the general equation for the endurance of an airplane. (06 Marks)
c. Estimate the maximum endurance for a jet-propelled airplane, for which $C_{DO} = 0.015$, $K = 0.08$, $C_t = 1.917 \times 10^{-4}\ S^{-1}$ and the ratio of initial to final weight is 1.6781. (04 Marks)

6 a. Explain the various phases of take-off of an airplane with neat sketch. (10 Marks)
b. Derive an expression to calculate distance while airborne to clear an obstacle. (10 Marks)

7 a. Explain the various phases of landing of an airplane, with neat sketch. (10 Marks)
b. Derive an expression to calculate approach distance during the landing of an airplane. (10 Marks)

8 a. With the help of a neat force diagram, derive an expression for "radius of turn" and for "rate of turn" for an aircraft in level turn. (10 Marks)
b. With the help of a neat force diagram, derive an expression for "radius of turn" during the pull-up as well as pull down maneuvers. (10 Marks)

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