Reg. No. :

Question Paper Code : 91064

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019
Fifth Semester
Aeronautical Engineering
AE 6501 – FLIGHT DYNAMICS
(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Draw the typical power required and power available curves of a propeller-driven airplane.
2. Define stall velocity of an airplane and write the expression for the same.
3. Sketch the force balance of an airplane in a level turn.
4. What do you mean by corner speed ? State its significance.
5. Define stick fixed maneuver point.
6. Sketch the typical variation of stick force versus flight velocity.
7. What do you mean by rudder lock ? How would you prevent it ?
8. What is the effect of wing location with respect to fuselage on the lateral stability of an airplane ?
9. Define Dutch roll motion of an airplane.
10. Differentiate elevation angle and pitch angle.

PART – B **(5×13=65 Marks)**

11. a) Explain with suitable graphs the variation of thrust and SFC with flight velocity and altitude of a turbojet engine.

(OR)

b) Show that the velocity at minimum power condition is 0.76 times the velocity at minimum drag condition.

12. a) A glider has weight of 5000 N, wing area of 25 m^2, $C_{DO} = 0.012$, AR = 16 and e = 0.87. Determine the following :

i) The minimum glide angle, minimum Rate Of Descent (ROD) and corresponding speeds under sea level. **(6)**

ii) The greatest duration of flight and the greatest distance that can be covered when gliding from a height of 300 m. Neglect the changes in density during glide. **(7)**

(OR)

b) A jet aircraft has maximum speed of 800 km/hr at sea level. The weight of the aircraft is 160000 N and wing area is 50 m^2. The drag polar is given by $C_D = 0.02 + 0.04C_L^2$. Assume shallow climb angle. Determine the following :

i) The climb angle and Rate Of Climb (ROC) when flying at 75% of maximum aerodynamic efficiency. **(7)**

ii) Maximum ROC and the corresponding velocity. **(6)**

13. a) The wing of an airplane is at a positive incidence and the tail is at a negative incidence with respect to the fuselage centerline. Derive the expression for pitching moment of this combination.

(OR)

b) What do you mean by elevator angle per 'g' ? Derive an expression for elevator angle required to trim the airplane in a pull-up maneuver.

14. a) i) Derive the contribution of wing dihedral angle towards the lateral stability. **(7)**

ii) Derive an expression for rudder control power. **(6)**

(OR)

b) i) Derive an expression for the contribution of vertical tail towards the lateral stability of an airplane. **(7)**

ii) Explain the importance of rudder during one engine failure condition encountered by a multi-engine airplane. **(6)**

15. a) Explain in detail about any four stability derivatives involved in longitudinal motion of an airplane.

(OR)

b) Explain in detail about directional divergence and spiral divergence with suitable sketches.

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PART – C (1×15=15 Marks)

16. a) An airplane has W/S = 2800 N/m², b = 25 m, maximum C_L is 1.7. Lift curve slope of the vertical tail is 0.08 per degree. Tail volume ratio is 0.25. The derivative of yawing moment co-efficient with sideslip = 0.015 per degree. Assume that one degree of Rudder deflection changes the vertical tail angle of attack by 0.3 degree.

The maximum rudder deflection is limited to ± 25 degree. Determine the maximum crosswind speed that can be permitted for take-off at sea level. Assume that the lift-off velocity is 1.2 times the stall velocity.

(OR)

b) An airplane is flying straight and level at sea level at a speed of 91 m/s. The pilot causes the airplane to enter a horizontal circle of 868 m radius while maintaining the same angle of attack, the engine thrust being altered as necessary. Without altering either the angle of attack or the engine thrust, the pilot then brings the airplane out of the turn and allows it to climb. Estimate the ROC if at that angle of attack the L/D ratio is 9.