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Question Paper Code : 90071

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Fifth Semester

Aeronautical Engineering

AE 8501 — FLIGHT DYNAMICS

(Common to : Aerospace Engineering)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What do you meant by induced drag and how to minimize it?
2. Sketch the typical power required versus flight speed of an airplane in steady, level flight.
3. The minimum ROD corresponds to minimum drag condition. True or False? Justify.
4. State the significance of V-n diagram.
5. What is the physical meaning of elevator angle per 'g'?
6. What is the need for aerodynamic balancing?
7. Define rudder lock.
8. Differentiate angle of yaw and sideslip.
9. Define spiral divergence.
10. Sketch the typical phugoid motion of an airplane.

PART B — (5 × 13 = 65 marks)

11. (a) Derive an expression for velocity of an airplane in steady, level flight in terms of design parameters and hence obtain the expression for maximum cruise velocity.

Or

(b) Derive the expression for minimum power required for an airplane in steady, level flight. Discuss the condition for minimum power required and hence arrive the expression for velocity corresponding to it.

12. (a) Derive the expression for maximum ROC of a jet airplane in terms of design parameters, assuming shallow climb angle.

Or

(b) Derive the expressions for velocity and load factor pertaining to maximum turn rate of an airplane.

13. (a) Derive the contribution of horizontal tail to static longitudinal stick fixed stability of a conventional airplane, if the tail is at a positive setting angle with respect to fuselage centreline.

Or

(b) Derive an expression for free elevator factor of a conventional airplane and hence obtain the expression for stick free neutral point.

14. (a) What do you meant by aileron reversal? Derive an expression for aileron reversal speed. Discuss the possible ways to avoid this phenomenon.

Or

(b) Derive the contribution of wing dihedral to dihedral effect of an airplane.

15. (a) What is Routh's criterion? Discuss its importance in dynamic stability analysis of airplane with an example.

Or

(b) Explain in detail about autorotation and spin along with their recovery procedures with neat sketches.

PART C — (1 × 15 = 15 marks)

16. (a) The wing and horizontal tail of an airplane are geometrically similar. The tail area is one-third of the wing area and the tail arm is equal to the semi-span of the wing. For this airplane C_L=1.2, a=0.08 per deg, span=6 times Mean Aerodynamic Chord (MAC), moment about aerodynamic center is zero, downwash angle=0.35 times angle of attack. Determine the maximum distance that the C.G can be located behind the wing aerodynamic center so that the wing-tail combination remains statically stable Also find the angle of incidence of the tail to trim for a 5% static margin.

Or

(b) An Airplane has wing loading of 2850 N/m², wing span of 27m and maximum C_L of 1.75. Lift curve slope of the vertical tail is 0.082 per degree. Tail volume ratio is 0.2. $(\delta C_n/\delta\beta)$ =0.015 per degree. Assume that one degree of rudder deflection changes the vertical tail incidence by 0.3 degree. The maximum rudder deflection is restricted 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 20% higher than the stall velocity and tail efficiency as 100%.