Question Paper Code : 31026

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Fifth Semester

Aeronautical Engineering

AE 2301/AE 51/10122 AE 501 — FLIGHT DYNAMICS

(Regulation 2008/2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What is the significance of drag divergence Mach number?
2. Why SFC varies with velocity and altitudes?
3. What is the condition for minimum rate of sink and shallowest angle for powerless gliding flight?
4. Define absolute ceiling and service ceiling.
5. What is the need for aerodynamic balancing of a control surface?
6. What is neutral point? What is its significance?
7. What are adverse law effects and how it is controlled by rudder?
8. What are the advantages of sideslip?
9. What is meant by snaking?
10. What is autorotation?

PART B — ($5 \times 16 = 80$ marks)

11. (a) (i) Derive the condition for minimum drag and power required in straight and level flight. (8)

(ii) Explain briefly the different types of drag associated with an airplane. (8)

Or

(b) (i) An airplane W = 2,50,000N, S = 86.5 m^2, $C_D = 0.016+0.04\ C_L^2$. Calculate

(1) minimum thrust required for level flight at 5 Km altitude

(2) corresponding TAS at sea level. (8)

(ii) For an aircraft in straight and level flight at a speed 'm' times the minimum drag speed. Show that drag 'D' of the aircraft is $\frac{D\min}{2}\left[m^2+\frac{1}{m^2}\right]$ where D_{min} is the minimum drag. (8)

12. (a) (i) An airplane weighs 8000 Kg, wing area of 30 m^2 to execute a tightest turn, the aircraft operates very near to stall and assumes a turn rate of 0.0267 rad/sec. Maximum lift coefficient of the aircraft is 2. Determine

(1) Radius of turn

(2) Aircraft speed

(3) Load factor

(4) Bank angle. (8)

(ii) Calculate the maximum rate of climb of the given jet airplane at sea level and the angle of climb given W = 1,00,000 N,S = 50m^2 drag polar $C_D = 0.018 + 0.042\ C_L^2$ and F = 0.35 w. (8)

Or

(b) (i) Explain with a neat sketch V-n diagram with gust loads. (8)

(ii) Derive the Brequest Range and endurance equation for a jet propelled airplane. (8)

13. (a) A wing body model is tested in a subsonic wind tunnel $\alpha_{L=0} = -1.5^\circ$, at $\alpha = 5^\circ$, $C_L = 0.52$, at $\alpha = 1^\circ$ and $\alpha = 7.88^\circ$, C_{Mcg} are -0.01 and 0.05 respectively. The CG location is 0.35c, $i_w = 0$ and the tail volume ratio is 0.34. The tail setting angle is 2.7° and the tail lift curve slope is 0.1 per degree. $\varepsilon_0 = 0$, $\gamma_t = 0.98$ and $\frac{\partial \varepsilon}{\partial \alpha} = 0.35$ at $\alpha = 8^\circ$. Calculate C_{Mcg} for the aircraft. Find the neutral point location and static margin. (16)

Or

(b) (i) Discuss the power effect on longitudinal static stability of jet aircraft. (8)

(ii) Explain the contribution of the wing to longitudinal stability (8)

14. (a) (i) Write short notes on one engine inoperative condition and rudder lock. (8)

(ii) Write short notes on Aileron reversal and adverse yaw. (8)

Or

(b) (i) Explain coupling between rolling and yawing. (8)

(ii) Discuss briefly the basic requirements of the rudder. (8)

15. (a) Write short notes on

(i) Dutch Roll

(ii) Stability Derivatives

(iii) Weather cock effect. (16)

Or

(b) Explain

(i) Spiral and directional divergence.

(ii) Auto Rotation and spin recovery. (16)