

**ANNA UNIVERSITY - 2007**  
**B.E/B.TECH MODEL EXAMINATION**  
**AIRCRAFT STABILITY AND CONTROL**  
**(AERONAUTICAL ENGINEERING)**

TIME-3HOUR  
MARK-100

ANSWER ALL QUESTIONS

**PART - A (10 X 2 = 20 MARKS)**

1. Define static stability and dynamic stability.
2. What do you mean by degree of freedom.
3. What is meant by aileron reversal?
4. What is snaking. Sketch the snaking motion of an aircraft.
5. Difference between stick fixed and stick free.
6. What is meant by 'Weather Cock Stability'.
7. What are the condition for longitudinal static stability.
8. How is dihedral useful for lateral stability.
9. What is porpoising mode?
10. What is meant by phugoid oscillation? Explain.

**PART - B (5 X 16 = 80 MARKS)**

- 11 (a) Explain the significance of Routh's discriminant.
- (b) Drive an expression for the tail contribution to the pitching moment of an aircraft if  $i$  is the wing setting angle and  $i_t$  is the tail setting angle.
- 12 (a) A wing body model is tested in a subsonic wind tunnel.  $aL=0 = -1.50$ , at  $\alpha = 5^\circ$ ,  $CL$  is 0.52. At  $\alpha = 10^\circ$  and  $7.880$  CMcg are  $-0.01$  and  $0.05$  respectively. The c.g location is  $0.35c$ .  $i_w = 0$  and tail volume ratio is  $0.34$ . The tail setting is  $2.70$  and the tail lift curve slope is  $0.1$  per degree.  $e_0 = 0$  and  $\partial e/\partial \alpha = 0.35$ . At  $\alpha = 8^\circ$ , calculated CMcg for the aircraft.

( OR )

- (b) i. Discuss in detail the power effects on longitudinal static stability.
- ii For the problem in 12, find the neutral point location and also static margin.
- 13(a) Write short notes on

- i. Variable incidence tail plane
- ii. Adverse Yaw

( OR )

- (b) i. What is the coupling between rolling and yawing moments, explain with suitable examples.
- ii. What is the effect of running propeller on directional stability
- 14 (a) Explain the following Phenomenon

- i. Dutch Roll
- ii. Spiral instability
- iii. Spin

( OR )

(b) Write short notes on

- i. Stability derivatives in longitudinal dynamic stability
- ii. Stability quartic
- iii. Spoils in lateral control

15 (a) An airplane  $W/s = 3000 \text{ N/m}^2$ ,  $V = 450 \text{ kmph}$  flying at 6 km attitude has the characteristic equation in longitudinal mode of the form  $(\lambda^2 + \lambda + 6)(3\lambda^2 + \lambda + 1) = 0$ . Find the period and time to dump and comment whether oscillation can be ignored.

( OR )

(b) Write short notes on

- i. Tail volume ratio
- ii. Controls of aircraft
- iii. Rudder requirement in directional control