



**B.E DEGREE EXAMINATIONS : APRIL/ MAY 2016**

(Regulation 2013)

Sixth Semester

**AERONAUTICAL ENGINEERING**

U13AET603 : Aircraft Stability and Control

**Time: Three Hours**

**Maximum Marks: 100**

**Answer all the Questions:-**

**PART A (10 x 1 = 10 Marks)**

1. If an aircraft returns to a position of equilibrium it is said to be
  - a) positively stable
  - b) neutrally stable
  - c) negatively stable
  - d) Both a) and b)
2. If you have an aircraft that is more laterally stable than directionally stable it will tend to\_\_\_\_\_.
3. An aileron control surface is provided with an inset hinge.
  - a) to prevent flutter
  - b) to prevent adverse aileron yaw
  - c) to provide aerodynamic balance
  - d) to increase the stick force
4. \_\_\_\_\_ provides the greatest positive contribution to the static longitudinal stability in an aeroplane.
5. Dihedral of the wing
  - a) is the only way to increase the static lateral stability
  - b) increases the static lateral stability
  - c) is only positive for aeroplanes with high mounted wings
  - d) decreases the static lateral stability
6. The effect of a swept wing is to give \_\_\_\_\_
7. Which phenomenon is counteracted with differential aileron deflection
  - a) Turn co-ordination
  - b) Aileron reversal
  - c) Sensitivity for spiral dive
  - d) Adverse yaw
8. The primary function of the fin is to give \_\_\_\_\_
9. Dynamic longitudinal stability requires
  - a) an effective elevator
  - b) a small CG range
  - c) positive static longitudinal stability
  - d) a variable incidence (trimming) tailplane
10. Dutch roll is a combination of \_\_\_\_\_

**PART B (10 x 2 = 20 Marks)**  
**(Answer not more than 40 words)**

11. What do you mean by inherently stable airplane?
12. State two requirements of aircraft control surfaces.
13. What are the two major effects of the running propeller that contribute to the Longitudinal stability?
14. What determines the longitudinal stability of an airplane?
15. What is control reversal?
16. List out the type of motions resulting from coupled effects.
17. What is meant by weathercocking effect?
18. What is rudder lock?
19. Define routh's discriminant?
20. An airplane has  $w/s = 4000 \text{ N/m}^2$ , is flying at sea level at 400 kmph. The characteristic equation for dynamic stability is  $\lambda^2 + 0.5\lambda + 3 = 0$ . Find the period of oscillation and time to halve the amplitude.

**PART C (5 x 14 = 70 Marks)**  
**(Answer not more than 400 words)**

**Q.No. 21 is Compulsory**

21. Write short notes on the following: Degrees of freedom of a system, Need for stability in an airplane and Basic equations of equilibrium.
  
22. (a) (i) Derive an expression for the wing contribution to the pitching moment of an aircraft about centre of gravity. (8)  
(ii) A wing body model is tested in a subsonic wind tunnel. The lift is found to be zero at a geometric  $\alpha = -1.5^\circ$ . At  $\alpha = 5^\circ$ , the  $C_L$  is measured as 0.52. Also at  $\alpha = 1^\circ$  and  $7.88^\circ$ , the  $C_{Mcg}$  are measured as -0.01 and 0.05 respectively. The c.g is located at 0.35 C. calculate the location of Aerodynamic Center and the value of  $C_{Mac, wb}$ . (6)
  
- (OR)
- (b) Discuss the power effects on longitudinal static stability for both jet and propeller driven airplanes.
  
23. (a) (i) Explain the effect of dihedral on static lateral stability with neat sketch. (7)  
(ii) Discuss briefly the contribution of various components of the airplane on static directional stability. (7)

(OR)

- (b) Based on strip theory derive an expression for aileron control power.

24. (a) Explain in detail the various types of aerodynamic balancing of a control surface with neat sketches.

**(OR)**

(b) (i) Describe briefly the basic requirements of the rudder and One engine (7) inoperative condition.

(ii) Briefly explain the contribution of fuselage and vertical tail on static lateral (7) stability.

25. (a) Write short notes on the following: Dutch roll, Spiral divergence, Autorotation and Spin.

**(OR)**

(b) Discuss the following:

(i) Phugoid motion. (7)

(ii) Stability derivatives in longitudinal dynamics. (7)

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