Register Number: ……

B.E DEGREE EXAMINATIONS: NOV/DEC 2010

Sixth Semester

AERONAUTICAL ENGINEERING

U07AR604: Aircraft Stability and Control

Time: Three Hours **Maximum Marks: 100**

Answer ALL Questions:-

PART A (10 x 1 = 10 Marks)

1. Up and down movement of the aircraft is called _____

   A) Yawing B) Heaving C)Surging D)Rolling

2. Aileron deflection is positive, when_____

   A) Port side aileron goes down B) Star board side aileron goes down

   C) Star board side aileron goes up D) Both ailerons go up

3. If the CG lies forward of the aerodynamic centre, the lift increment produces _____

   A) Nose up pitching moment B) No change in pitching moment

   C) change in yawing moment D) Nose down pitching moment

4. For static longitudinal stability, static margin value must be_____

   A) zero B) negative C) positive D) infinity

5. Dorsal fin making the aircraft, _____

   A) Laterally stable B) Laterally unstable

   C) Laterally stable and directionally stable D) Laterally unstable and directionally stable

6. Aileron reversal is a _____

   A) static aero elastic phenomenon B) dynamic aero elastic Phenomenon

   C) structural dynamics Phenomenon D) flight mechanics Phenomenon

7. The condition for static directional stability is _____

   A) $\frac{dN}{d\psi} = 0$ B) $\frac{dN}{d\psi} > 0$ C) $\frac{dN}{d\psi} < 0$ D) $\frac{dN}{d\psi} < 0$ and $C_{N\beta} > 0$

8. In directional stability, the propeller effect is destabilizing for _____

   A) Pusher propeller B) Tractor propeller C) Both D) Pod engines

9. Directional divergence can occur when the airplane does not posses _____

   A) Longitudinal stability B) Lateral stability C) Directional stability D) Keel effect

10. For long period Phugoid oscillation time required to halften the amplitude is_____

A) big B) zero C) small D) infinite

PART B (10 x 2 = 20 Marks)

11. Distinguish between static and dynamic stability.
12. Define degrees of freedom. How much required for aircraft?
13. Write the conditions for longitudinal static stability.
14. Define neutral point and static margin.
15. Define adverse yaw.
16. What is meant by cross-coupling effect?
17. What is meant by weather cocking effect?
18. Give the name of various components of airplane towards static directional stability.
19. Define Routh's discriminant.
20. What is snaking mode?

PART C (5 x 14 = 70 Marks)

21. a) Explain the various types of stability with neat sketch.

(OR)

b) (i) What are the characteristics of the airplane control surfaces? (4)

(ii) Briefly explain about the aircraft control surfaces. (10)

22. a) What is aerodynamic balancing? Explain with neat sketch.

(OR)

b) Using the following data find out the expression for elevator angle for longitudinal trim of aircraft.

Wing loading = 25 Kg/m^2.

CG is 0.08 chord behind aerodynamic centre of wing.

$Cm_0 = -0.04$.

Tail volume ratio =0.5.

The lift coefficient of the wing is given by $C_L = 0.075\alpha°$ measured from the no lift incidence.

The lift coefficient of tail plane is isolated from the wing is given by $C_{LT} = 0.06\ \alpha_T° + 0.03\eta°$.

The tail plane is set at –3° to the no lift position of the wing.

The rate of change of the downwash angle with wing incidence at the tail plane is 0.4.

23. a) Based on strip theory derive an expression for aileron control power.

(OR)

b) Explain (i) What is the effect of dihedral on static lateral stability? (7)

(ii) Write short notes on aileron reversal. (7)

24. a) Explain in detail the various requirements of Rudder.

(OR)

b) (i) Rudder lock. (4)

(ii) Discuss the contribution of various components of airplane towards static directional stability. (10)

25. a) Explain (i) Dutch Roll. (7)

(ii) Spin. (7)

(OR)

b) Explain (i) Equation of motion (7)

(ii) Phugoid oscillation (7)

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