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BAS-017

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B.TECH. IN AEROSPACE ENGINEERING (BTAE)

Term-End Examination

June, 2012

BAS-017 : FLIGHT MECHANICS

Time : 3 Hours *Maximum Marks : 70*

Note : *(1) Answer **any five** questions.*

(2) Use of non programmable calculator is permitted.

1. Validate the following statements with brief explanations.

(a) Two aircrafts turn through 360 degrees in the same time, but radius of turn of one aircraft is twice that of the other aircraft. So both the aircrafts have the same angle of bank. **2**

(b) The forward CG limit of an aircraft is decided by stability considerations. **2**

(c) Measurement of elevator angle for trim versus co-efficient of lift C_L is carried out during the flight test at various CG positions to estimate stick-fixed neutral point. **2**

(d) The stick-fixed manoeuvre point lies forward of stick-fixed neutral point. **2**

(e) For elevator hinge moment coefficient $C_H = b_1\alpha + b_2\eta + b_3\beta$, the coefficient b_1 is always positive, so also b_2 and b_3. 2

(f) For a given aircraft, the angle of glide is determined solely by its lift-drag ratio and is independent of its weight. 2

(g) To fly in a steep turn it is necessary to fly fast because the stalling speed is high. 2

2. (a) Explain the purpose of aerodynamic balancing of a control surface. 7

(b) Explain the purpose of mass balancing of a control surface. 7

3. (a) The following data is given for an aircraft : 7

(i)	aircraft speed	100 m/s
(ii)	wing area	1.5 m^2
(iii)	chord	0.15 m
(iv)	Moment with respect to CG when the lift is zero	- 12.4 N/m

The aircraft experienced a lift of 3675 N and moment 20.67 N-m when pitched at a different angle of attack.

Calculate the value of moment coefficient about the aerodynamic center and location of aerodynamic center from leading edge. Assume sea-level conditions.

(b) A horizontal tail without elevator is added to the above aircraft. The distance from airplane's center of gravity to the tail's aerodynamic center is 1.0 m. The area of tail is 0.4 m^2, and the tail setting angle is 2°. The lift slope of the tail is 0-12/degree, $\epsilon_o = 0$, an $\frac{\partial \epsilon}{\partial \alpha} = 0.42$. If the absolute angle of attack is 5° and the lift at this angle of attack is 4134 N, calculate the moment of aircraft about center of gravity. Does the aircraft possess longitudinal static stability? 7

4. (a) Explain with figures how the neutral point for Stick Fixed flight of aircraft is determined. 7

(b) What is weather cock stability ? What is the purpose of vertical tail ? 7

5. (a) What is directional stability in an aircraft ? How is it achieved ? Explain with a graph the required condition for achieving directional stability in an aircraft. 7

(b) Discuss the factors to be considered while designing a rudder for an aircraft. 7

6. (a) What is adverse yaw and asymmetric flight ? 5

(b) What is the effect of dihedral and swept back wings on roll stability ? 5

(c) What is aerodynamic and mass balancing and how is it achieved in an aircraft ? 4

7. (a) Explain the concept of longitudinal stability for wing and tail combination in an aircraft. 7

(b) Explain with $C_m - \alpha$ graph, the following terms for an aircraft. 7

(i) stable

(ii) unstable

(iii) neutrally stable

8. Explain in detail the concepts of stick fixed and stick free longitudinal stability. 14