

**IV B.Tech I Semester Supplementary Examinations, November 2005**  
**FLIGHT DYNAMICS**  
**(Aeronautical Engineering)**

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions  
 All Questions carry equal marks

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1. (a) What do you understand by degree of freedom of a system . Show degree of freedom in case of an airplane with the help of sketch? [5]
- (b) Give example of each stable and unstable aircraft. Why they are designed stable and unstable respectively? [6]
- (c) What is maneuver margin and what is its significance ? [5]
2. (a) How do you measure stick free neutral point from flight testing program? Discuss the instrumentation involved. [10]
- (b) An airplane has a static margin of - 0.16 while balanced at c.g. location of 0.28C. [6]
  - i. Estimate the location of the neutral point.
  - ii. Suggest a few methods to push the neutral point aft. [6]
3. (a) Show that a shielded horn balance is inferior to an unshielded horn balance with an example each.
- (b) Why do ailerons tend to loose their effectiveness at high speeds. Explain Frise aileron. [8+8]
4. Explain the following with sketches wherever needed
  - (a) Elevator power
  - (b) Static and dynamic stability
  - (c) Hinge moment
  - (d) Forward and Aft C.g. limits [4x4=16]
5. (a) What is meant by longitudinal Dynamic stability of an airplane? What are the possible time responses of a system when it is disturbed from equilibrium
- (b) What are rotory cross derivatives ? Give a few examples.
- (c) Why does excessive dihedral effect leads to Dutch Roll ? [6+5+5]
6. (a) What is Autorotation in Roll ? Under what condition will an airplane experience this? [3+3]
- (b) Explain the contribution of tail towards the stability of an aircraft by deriving the following relationship

$$\left(\frac{dc_m}{dG}\right)_{Tail} = -\frac{a_t}{a_w} \bar{V}_{\eta t} \left(1 - \frac{d\varepsilon}{d\alpha}\right). \quad [10]$$

7. Show that the slope of the stick force versus speed is given by

$$\frac{dF_s}{dV} = K\rho V (A + Ch_{\delta t}\delta t)$$

where  $K = -GS_e C_e \eta_t$

$$A = C_{ho} + C_{h\alpha}(\alpha_0 - i_w + i_t) + C_{h\delta}\delta_{eo}$$

Define the various terms involved also.

[16]

8. Write short notes on any FOUR the following

- (a) Routh's Discriminant
- (b) One engine inoperative condition
- (c) Weathercock stability
- (d) Phugoid oscillations
- (e) Variable incidence tailplane

[4x4=16]

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