Code No: NR412101 **NR**

IV B.Tech I Semester Supplementary Examinations, April/May 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. Explain the terms static stability and dynamic stability of an airplane. Establish that an airplane must possess static stability even if it is not dynamically stable. What happens if it does not possess static stability? Explain these stability requirements with examples taken from a transport airplane and a fighter plane like F-16.

2. The geometrical and aerodynamic characteristics of a glider are given as follows; Wing AR=8(NACA23012, a_0= 0.104,α_{0L}= −1.2) , Hor. Tail AR=4(NACA 0009.a_0 = 0.110), Tail volume ratio $\overline{V} = 0.6$, rate of change of down wash $\frac{d\delta}{d\alpha} = 0.5$, tail efficiency $\eta_1 = 0.9$, aerodynamic centre at 0.24c, $\left(\frac{dC_m}{dC_L}\right)_{Fus}$=0.0.8 , Elevator area ratio Se/St=0.35. Calculate the Stick fixed neutral point.
Derive the required equation before you make use of the same.

3. Define the terms AERODYNAMIC BALANCING. Describe its role in the static longitudinal stability of an airplane. What are different means to achieve aerodynamic balancing? Explain the use of horn balance in this respect.

4. Show that for unaccelerated flight of airplane, with standard notations that the control force is given by; $F_s = K\frac{1}{2}\rho V^2(A + C_{h\delta t}\delta_t) - K\frac{W}{S}\frac{C_{h\delta}}{C_{m\delta}}\left[\frac{dC_m}{dC_L}\right]_{free}$. Further establish the value of stick force gradient $\frac{dF_s}{dV}$.

5. Make use of the knowledge of Airplane stability and control to sketch airplane configurations with wing and tail such that

   (a) $C_{i\beta}$= 0

   (b) $C_{i\beta}$> 0

   (c) $C_{i\beta}$< 0

   PROVIDE explanation in each case.

6. Consider the pedal force gradient given by $\frac{dPF}{d\psi} = -\frac{GqS_r\overline{c}_r\eta_\nu C_{h\delta r}}{C_{n\delta r}}(C_{n\psi})_{Free}$.
Hence describe the phenomenon of Rudder Lock. Explain the effect of addition of a dorsal fin. Make use of sketches and plots.

7. Consider an airplane in cruising flight at an altitude. It meets an upgust for about 20seconds. Make use of sketches and plots to illustrate the after-gust behavior of the airplanes motion in support of your answer. Consider all possible options and explain the aerodynamics involved.

8. The oscillatory mode from the lateral-directional stability quartic is given by $\lambda^2 + B\lambda + C = 0$, where B=2.97 and C=38.36. Obtain the characteristics of the oscillation and its simple analysis in terms of stability derivatives.

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