Code No: NR322101 **NR**

III B.Tech II Semester Supplementary Examinations, Apr/May 2006
AERODYNAMICS-II
(Aeronautical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Describe the need of controls in airplane when we know that static and dynamic stabilities are associated with an airplane. Is the stability a part of the airplane design and operation? Does the pilot apply control in this respect? Please illustrate. [16]

2. Establish from the basic equation of moments $C_{mc.g}$ developed for an airplane with wing-aft-tail combination that elevator is the longitudinal control for such configuration. Now define the terms elevator effectiveness and elevator power. Hence show that a plot of elevator angle δ_e v/s C_L leads to the expression $\delta_e = \delta_{e0} + \frac{d\delta_e}{dC_L} C_L$ [16]

3. Explain with sketches /plots the occurrence of hinge moments on the horizontal tail from the pressure distribution due to angle of attack α and the deflections δ_e and δ_t from elevator and tab. Hence define the terms 'floating tendency and restoring tendency'. Describe ways and means to alleviate or control these hinge moments. [16]

4. $F_s = K\frac{1}{2}\rho V^2 (A + C_{h\delta t}\delta_t) - K\frac{W}{S}\frac{C_{h\delta}}{C_{m\delta}}\left[\frac{dC_m}{dC_L}\right]_{free}$, provides stick force variation with flight velocity. Exploit this relation for in-flight measurement of stick free neutral point.Describe the procedure and the instrumentation. [16]

5. Establish that $C_{l'\beta} = -\frac{2\Gamma}{57.3}\frac{dC_L}{d\beta}\frac{\overline{y}}{b}\frac{S_\Gamma}{S}$ holds for an airplane with dihedral when a right side-slip produces left rolling moments (with standard notations) . [16]

6. Develop the criterion for static directional stability of an airplane. Describe the contribution of wing,fuselage, power unit and the empennage to the stability of airplane.Is the analysis of directional stability similar to that of longitudinal stability.Make use of a yawing airplane in a sketch and illustrate your answer. [16]

7. Define the term longitudinal dynamic stability of airplane. Explain if an airplane when possessing static longitudinal stability will as well be dynamically stable. Make use of the stability quartic equation and sketches accompanied by plots illustrating typical modes of motion in support of your answer. [16]

8. The characteristic equation of lateral dynamic stability is ; $A\lambda^4 + B\lambda^3 + C\lambda^2 + D\lambda + E = 0$, where A = 1, B = 10 , C = 14 , D = 50 and E = 0.05 .Extract the roots of this equation by an approximate technique and comment on the stability of the modes of airplane motion. Work out the details of the motions of airplane. [16]

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