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**Seventh Semester B.E. Degree Examination, June/July 2016**  
**Aircraft Stability and Control**

Time: 3 hrs.

Max. Marks: 100

**Note: Answer FIVE full questions, selecting  
at least TWO questions from each part.**

**PART – A**

- 1 a. Describe the moment of an aircraft with co-ordinate system forming expression for Aerodynamic forces and moments. (10 Marks)
- b. Consider a model of wing-body shape mounted in a wind tunnel. The flow conditions in the test section are standard sea level properties with a velocity of 100m/s. The wing area and chord are  $1.5\text{m}^2$  and 0.45m, respectively using the wind tunnel force and moment measuring balance, the moment about the CG when the lift is zero found to be -12.4Nm. When the model is pitched to another angle of attack, the lift and moment about the CG are measured to be 3675N and 20.67Nm, respectively. Calculate the value of the moment coefficient about the aerodynamic center and the location of the aerodynamic center. (10 Marks)
- 2 a. Derive the expression for elevator power. (07 Marks)
- b. Calculate the Rearward shift of the limiting forward C.G location for the following case, where  $\Delta\delta_{\text{cg-o}} = -12^\circ$ ,  $C_{m\delta} = -0.015$  and  $C_{L\text{max}} = 2.0$ . (05 Marks)
- c. Explain how severely the allowable CG range is Restricted in practice with neat diagram. (08 Marks)
- 3 a. Derive the equation for stick Free Neutral point. (10 Marks)
- b. Derive stick force equation. (10 Marks)
- 4 a. List and explain the flight condition that introduces yawing moments that must be overcome with the Rudder control. (10 Marks)
- b. What is the function of dorsal fin? Explain with example, the effect of dorsal fin on pedal force versus sideslip characteristics. (10 Marks)

**PART – B**

- 5 a. Explain Dihedral effect. (05 Marks)
- b. Explain the effect of wing sweep, Flaps and power on Dihedral effect with neat diagram. (10 Marks)
- c. What are the advantages and disadvantages of frise aileron? (05 Marks)
- 6 a. Starting with x-force equation, use the small disturbance theory to determine the linearized force equation. Assume a steady level flight for the Reference flight conditions. (10 Marks)
- b. Derive the equation for motion of a Rigid body. (10 Marks)
- 7 a. Show that the coefficient  $C_{mu}$  depends on the mach number but also is affected by elastic properties of air frame. (10 Marks)
- b. Obtain derivatives due to the pitching velocity. (10 Marks)
- 8 a. Determine whether the characteristic equation given below have stable or unstable roots.
  - i)  $2\lambda^3 + 4\lambda^2 + 4\lambda + 12 = 0$
  - ii)  $A\lambda^4 + B\lambda^3 + C\lambda^2 + D\lambda + E = 0$ , where A, B, C, D and E are the functions of the longitudinal stability derivatives. (06 Marks)
- b. Explain cooper – Harper scale. (07 Marks)
- c. Briefly explain Phugoid response and short period response with neat diagram. (07 Marks)