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18AE71

Seventh Semester B.E. Degree Examination, June/July 2023
Aircraft Stability and Control

Time: 3 hrs.

Max. Marks: 100

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Explain Longitudinal Static Stability and its criteria to achieve it. **(10 Marks)**

   b. Derive an expression for wing contribution $\left[\dfrac{dC_m}{dC_L}\right]_w$ for the longitudinal static stability of an airplane and discuss the significance of C.G. position with respect to the wing aerodynamic center. **(10 Marks)**

OR

2 a. Define Stick – Fixed neutral point and static margin. Derive an expression for stick fixed neutral point and discuss the effect of C.G shift on pitching moment. **(10 Marks)**

   b. Derive the expression for elevator control power. **(10 Marks)**

Module-2

3 a. With a help of diagram and expression, explain the control surface floating characteristics and aerodynamic center. **(10 Marks)**

   b. Derive the estimation of hinge moment parameters in stick – free conditions. **(10 Marks)**

OR

4 a. Derive the equation for stick – free neutral point. And also show the difference between stick – free and stick fixed neutral point. **(10 Marks)**

   b. Derive Stick force gradient in an unaccelerated flight conditions. **(10 Marks)**

Module-3

5 a. Briefly explain the requirements for direction control and obtain the expression for rudder control effectiveness. **(10 Marks)**

   b. Obtain an expression for lateral control power. **(10 Marks)**

OR

6 a. Explain the effect of wing sweep, flaps and power on dihedral effect. **(10 Marks)**

   b. Obtain the relation for Aileron Control Forces. **(10 Marks)**

Module-4

7 a. Derive the equation for motion of a rigid body. **(10 Marks)**

   b. 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 condition. **(10 Marks)**

OR

8 a. Derive the derivatives due to change in forward speed. **(10 Marks)**

   b. Derive the derivatives due to time rate of change of angle of attack. **(10 Marks)**

Module-5

9 a. What is Dynamic Stability? Explain the types of its modes with a neat sketch. (10 Marks)

   b. Write short note on Cooper – Harper Scale. (10 Marks)

OR

10 a. Explain Dutch Roll and Spiral Instability with relevant sketches. (10 Marks)

   b. Explain the terms :
     i)   Auto – rotation   ii) Spin   iii) Wing Rock. (10 Marks)

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