USN ☐☐☐☐☐☐☐☐☐☐   **18AE71**

Seventh Semester B.E. Degree Examination, July/August 2022
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. **(06 Marks)**
   b. Using a neat sketch, describe the forces and moments acting on an Airplane. **(04 Marks)**
   c. Derive an expression for Tail contribution $\left(\dfrac{C_M}{C_L}\right)$ for the static longitudinal stability of an Airplane tail and discuss the downwash at the tail. **(10 Marks)**

OR

2 a. Define Stick Fixed Neutral point and Static Margin. **(04 Marks)**
   b. Derive an expression for Stick – Fixed Neutral point and discuss the effect of CG shift on pitching moment. **(10 Marks)**
   c. Derive the expression for Elevator control power : $C_{m\delta_e} = -V_H \eta \ C_{L_{\alpha t}} \ \tau$. **(06 Marks)**

Module-2

3 a. Briefly discuss Elevator hinge moment parameters and trim tab with suitable sketches and equations. **(10 Marks)**
   b. Obtain the expression for neutral point for stick free condition with necessary graphs. **(10 Marks)**

OR

4 a. Write short notes on Aerodynamic balancing and its types. **(10 Marks)**
   b. Explain Stick Force Gradient conditions in unaccelerated flight in detail. **(10 Marks)**

Module-3

5 a. Briefly explain the requirements of directional control and obtain the expression for rudder control effectiveness $C_{n\delta_r}$. **(10 Marks)**
   b. Enumerate about "Rudder Lock" and "Dorsal Fin". **(06 Marks)**
   c. Discuss about Static directional stability for Stick – Free conditions. **(04 Marks)**

OR

6 a. Explain Dihedral Effect. **(06 Marks)**
   b. Discuss the effect of Wing sweep , Flaps and power on dihedral effect, with neat sketches. **(10 Marks)**
   c. What is meant by "Adverse Yaw Effect" and "Aileron Reversal" in Static Lateral Stability? **(04 Marks)**

Module-4

7 a. Derive Rigid Body equation of Motion. **(12 Marks)**
   b. Briefly explain Gravitational and Thrust forces acting on the Airplane. **(08 Marks)**

OR

8 a. Starting with X – Force equation, use the Small Disturbance theory to determine the linearised force equation. Assume a steady level flight for the reference flight conditions.

(10 Marks)

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

Module-5

9 a. Explain Routh's criteria and determine whether the characteristic equations given below have stable or unstable roots :

    i) $\lambda^3 + 6\lambda^2 + 12\lambda + 8 = 0$ ii) $2\lambda^3 + 4\lambda^2 + 4\lambda + 12 = 0.$ **(10 Marks)**

    b. Discuss the following :

    i) Cooper – Harper Scale   ii) Effect of wind shear.   **(10 Marks)**

OR

10 a. Explain the dynamic lateral stability considering rudder Free case with expressions.

(10 Marks)

    b. Discuss the following :

    i) Dutch roll and Spiral instability.

    ii) Auto rotation and Spin.   **(10 Marks)**

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