USN

17AE73

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. Derive an expression for wing contribution $\left[\dfrac{d_{C_M}}{d_{C_L}}\right]_W$ for the longitudinal static stability of an airplane and discuss the significance of C.G. position with respect to aerodynamic centre. **(10 Marks)**

   b. Explain the terms of equilibrium conditions, static stability, longitudinal static stability and stability criteria with relevant equations and graphs. **(10 Marks)**

OR

2 a. Define stick fixed neutral points. Write down the expression for stick fixed neutral point and discuss the effect of C.G. shift on pitching moment. **(06 Marks)**

   b. Briefly explain about longitudinal control. **(08 Marks)**

   c. Define elevator power and how does elevator power affects the longitudinal stability. **(06 Marks)**

Module-2

3 a. Explain Hinge moment parameters. **(06 Marks)**

   b. Explain about Trim tabs. **(06 Marks)**

   c. Derive the equation for stick free neutral points. **(08 Marks)**

OR

4 a. Define static directional stability of an airplane and the criteria with the relevant sketches and expressions. **(06 Marks)**

   b. Explain about adverse Yaw and Spin recovery. **(08 Marks)**

   c. Explain about "Rudder Lock" and "Dorsal Pin". **(06 Marks)**

Module-3

5 a. Explain dihedral effect. **(08 Marks)**

   b. Explain the effect of wing sweep, flaps and power on dihedral effect with neat diagram. **(12 Marks)**

OR

6 a. Obtain a relationship to rate of roll for a given stick force varies inversely with the density of the air and with the velocity, V and also inversely with the span to the fourth power. **(10 Marks)**

   b. Define longitudinal dynamic stability of airplane and plot the types of mode of motion and discuss about phugoid and short period motion. **(10 Marks)**

Module-4

7 a. Derive Rigid body equations of motion. **(14 Marks)**

   b. Briefly explain gravitational and thrust forces. **(06 Marks)**

OR

8   a.   Derive the derivatives due to the pitching velocity.   **(10 Marks)**

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

Module-5

9   a.   Explain Routh's criterion and determine whether the characteristics equations given below have stable or unstable roots.

$$\lambda^3 + 6\lambda^2 + 12\lambda + 8 = 0$$

$$2\lambda^3 + 4\lambda^2 + 4\lambda + 12 = 0$$
                                                                               (10 Marks)

     b.   Explain dutch roll and spiral instability with relevant sketches.   **(10 Marks)**

OR

10   Write short notes on the following:

     a.   Flying qualities

     b.   Cooper-Harper scale

     c.   Wind shear

     d.   Auto-rotation and spin   **(20 Marks)**

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