

CBCS SCHEME

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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 $\left(\frac{C_M}{C_L}\right)$ 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 : $C_{m\delta_e} = -V_H \eta C_{L_{\alpha}} \tau$. (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)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

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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