

CBCS SCHEME

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15AE73

Seventh Semester B.E. Degree Examination, Feb./Mar. 2022 Aircraft Stability and Control

Time: 3 hrs.

Max. Marks: 80

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

Module-1

- 1 a. Define stick fixed neutral point and static margin. (04 Marks)
- b. On a line representing mean aerodynamic chord, mark the forward limit of CG in free flight, forward limit and CG in ground effect, Neutral point with power on. Neutral point with power off. (04 Marks)
- c. Derive the expression for trail contribution to longitudinal static stability $\left(\frac{dC_m}{dC_L}\right)_{\text{Tail}}$. (08 Marks)

OR

- 2 a. Explain various factors that contribute to static longitudinal stability of an aircraft with a Jet engine. Draw suitable figures for the explanation. (12 Marks)
- b. Differentiate Stability and Control. (04 Marks)

Module-2

- 3 a. Explain with suitable figures floating Hinge Moment C_{hx} and Restoring Hinge Moment $C_{h\delta c}$. (06 Marks)
- b. Derive the expression for stick force gradient $\frac{dF_s}{dV}$ in an Unaccelerated flight. (10 Marks)

OR

- 4 a. Define static directional stability with a plot of C_n Vs. β . (06 Marks)
- b. Explain contribution of Vertical Tail to Directional Stability. (06 Marks)
- c. Explain Rudder Lock. (04 Marks)

Module-3

- 5 a. Define static Lateral stability with a plot of C_l Vs. β . (06 Marks)
- b. Explain Adverse and Proverse Y_{aw} due to aileron deflection. How are spoilers different from aileron in this context? (06 Marks)
- c. Explain Frise Aileron with a suitable figure. (04 Marks)

OR

- 6 a. Define Dynamic stability. What are the two modes of Longitudinal dynamic stability? (04 Marks)
- b. On an Argand Plane, show the roots for stable, unstable and neutral stability for both modes. (08 Marks)
- c. What are the inputs the pilot has to apply to excite the two mode of longitudinal dynamic stability? (04 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.

Module-4

- 7 Derive the six rigid body equations of motions for an aircraft (i.e. F_x, F_y, F_z, L, M, N) (16 Marks)

OR

- 8 a. Derive the Dynamic Derivatives for an aircraft for change in forward velocity (i.e. C_{Xu}, C_{Zu}) and for change in pitching velocity (i.e. C_{mq}, C_{zq}). (12 Marks)
b. Briefly explain Small Disturbance Theory. (04 Marks)

Module-5

- 9 a. Explain Routh's criteria. (06 Marks)
b. What are the modes of lateral and directional dynamic stability? Explain them. (10 Marks)

OR

- 10 a. Explain Cooper Harper Rating scale with a neat diagram. (12 Marks)
b. Explain Autorotation with a suitable figure of C_L Vs. α graph. (04 Marks)

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