

CBCS SCHEME

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15AE73

Seventh Semester B.E. Degree Examination, July/August 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. Derive the expression for the wing contribution for the longitudinal static stability of an airplane. (10 Marks)
- b. The wing fuselage pitching moment characteristics of a high wing, single engine general aviation airplane follow, along with pertinent geometric data: $C_{m_{egwf}} = -0.05 - 0.0035 \alpha$ where α is the fuselage reference line angle of attack in degrees and wf means wing fuselage.

$$S_w = 178 \text{ m}^2, \quad \frac{X_{cg}}{C} = 0.1, \quad b_w = 35.9 \text{ m}, \quad AR_w = 7.3, \quad \tau_w = 5 \text{ m},$$

$$C_{L_{\alpha wf}} = 0.07/\text{deg}, \quad i_w = 2.0^\circ, \quad c_{t_\alpha} = 0.26$$

Estimate the horizontal tail area and tail incidence angle, so that the complete airplane has the following pitching moment characteristics, $C_{m_{gwf}} = 0.15 - 0.025 \alpha$, where α is in degrees and wft is the wing fuselage tail contribution. Assume $l_t = 14.75 \text{ m}$, $\eta = 1$, $AR_t = 4.85$, $C_{L_{\alpha t}} = 0.073/\text{deg}$. (06 Marks)

OR

- 2 a. Briefly explain fuselage contribution to stability using Multhopp's method. (08 Marks)
- b. Derive the equation for elevation deflection required for landing. (08 Marks)

Module-2

- 3 a. With the help of the diagram and expression, explain the control surface floating characteristic and aerodynamic balance. (08 Marks)
- b. Derive the stability contribution of the vertical tail with rudder free. (08 Marks)

OR

- 4 a. Explain the requirements of directional control and obtain the expression for Rudder Control effectiveness. (08 Marks)
- b. Briefly explain about the aerodynamic balancing with neat sketch for its types. (08 Marks)

Module-3

- 5 a. Explain the effect of wing sweep, flaps and power on dihedral effect. (08 Marks)
- b. Write short notes on Aileron reversal and adverse yaw effect. (08 Marks)

OR

- 6 a. Explain the various methods of Aileron balancing. (08 Marks)
- b. With neat sketch, explain dihedral angle and dihedral effect. (08 Marks)

Module-4

- 7 a. Derive rigid body equation of motion. (08 Marks)
b. Obtain derivatives due to pitching velocity. (08 Marks)

OR

- 8 a. Derive the derivatives due to time rate of change of angle of attack. (08 Marks)
b. Briefly explain gravitational and thrust force. (08 Marks)

Module-5

9 Write short notes on:

- a. Wind shear
b. Flying qualities
c. Cooper-Harper scale
d. Auto rotation and spin

(16 Marks)

OR

- 10 a. Write a short note on Cooper-Harper scale. (08 Marks)
b. Explain Dutch Roll and Spiral instability with relevant sketches. (08 Marks)
