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Seventh Semester B.E. Degree Examination, July/August 2021 Aircraft Stability and Control

Max. Marks: 80

Note: Answer any FIVE full questions.

- 1
 - a. Using a neat sketch of the forces and moment acting on an airplane in the plane of symmetry. (04 Marks)
 - b. Define stick-fixed neutral point and static margin. Derive an expression for stick fixed neutral point and discuss the effect of CG shift on pitching moment. (12 Marks)

- 2
 - a. Define static longitudinal stability with neat sketch. (04 Marks)
 - b. Consider the wing-body contribution of an airplane, the area and chord of the wing are 0.1m^2 and 0.1m respectively. Now assume that horizontal tail is added to this model. The distance from the airplane's C.G to tail aerodynamic center is 0.17m , tail area is 0.02m^2 , tail-setting angle is 2.7° , tail slope is $0.1/\text{degree}$ and from experimental measurement $\epsilon_0 = 0$; $\frac{\partial \epsilon}{\partial \alpha} = 0.35$. If $\alpha = 7.88^\circ$, calculate CM_{cg} for the Airplane model.
 Where,
 Take, $CM_{ac_{ub}} = -0.032$,
 Moment arm = 0.11
 Wing lift slope = 0.08
 Geometric angle of attack = -1.5° (12 Marks)

- 3
 - a. Briefly discuss on elevator hinge moment parameter with suitable sketch and equations. (08 Marks)
 - b. Briefly explain about Aerodynamic balancing with neat sketch for its types. (08 Marks)

- 4
 - a. Define: Rudder lock, Dorsal fin with neat sketch. Explain them with proper advantages and disadvantages. (08 Marks)
 - b. Briefly explain about one engine inoperative condition, weather cocking effect of an airplane with neat sketch. (08 Marks)

- 5
 - a. Define dihedral angle and dihedral effect with neat sketch. (06 Marks)
 - b. Explain methods of Aileron Balancing with neat sketch. (10 Marks)

- 6
 - a. Define longitudinal dynamic stability of aircraft and plot types of modes of motion and discuss on phugoid and short period motion. (10 Marks)
 - b. Obtain relation for roll control power ($C_{L_{\delta a}}$) (06 Marks)

- 7
 - a. Derive equation of motion of rigid body airplane's orientation and position under gravitational and thrust forces. (10 Marks)
 - b. Obtain derivatives due to change in forward speed. (06 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.

- 8 a. Obtain the derivatives due to the time rate of change of angle of attack of an airplane. (10 Marks)
b. Obtain the derivative due to rolling rate. (06 Marks)
- 9 a. Define Handling qualities and Cooper-Harper rating scale. (08 Marks)
b. Briefly discuss on the Spiral Roll and Dutch Roll motions with neat sketch. (08 Marks)
- 10 a. Draw a neat flow chart of the Cooper-Harper rating scale and discuss how a pilot assigns handling qualities level for an airplane performing a specified task using the rating scale. (10 Marks)
b. Briefly explain about Auto-rotation and spin recovery with neat sketch. (06 Marks)
