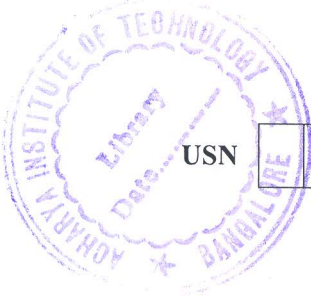


CBCS SCHEME



USN

--	--	--	--	--	--	--	--	--	--

15AE73

Seventh Semester B.E. Degree Examination, Jan./Feb. 2021 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. Explain longitudinal static stability. (06 Marks)
- b. Derive an expression for wing contribution $\left(\frac{dc_m}{dc_L}\right)_w$ for the longitudinal static stability of an airplane and discuss the significance of C.G. position with respect to the wing aerodynamic center. (10 Marks)

OR

- 2 a. Define stick fixed neutral point and static margin. Give the expression for stick fixed neutral point and discuss the effect of C.G. shift on pitching movement. (08 Marks)
- b. A high performance glider has the following characteristics: $C_D = 0.02 + 0.025C_L^2$, $C_{L_{\alpha_w}} = 0.093$, $\alpha_{OL_w} = -4$, $i_w = 0$, $C_{m_{ac}} = -0.08$, $X_{ac} = 0.24 \bar{C}$, $S_t = \frac{S}{7}$, $l_t = 4\bar{C}$, $\varepsilon = 0.4 \alpha$, $C_{L_{\alpha_t}} = 0.05$ and $\eta = 0.9$. All the angles are in degrees. Neglect the contribution of fuselage. Find the C.G. location (X_{cg}) for which the equilibrium is reached with zero lift on the tail at the lift coefficient corresponding to the best gliding angle. Calculate the tail settling angle (i_t). Is the glider stable? (08 Marks)

Module-2

- 3 a. Briefly explain hinge moment parameters and trim tabs. (08 Marks)
- b. Obtain the expression for $(\delta_e)_{free}$: elevator deflection condition for stick-free condition. (08 Marks)

OR

- 4 a. Explain the following terms using in directional control:
(i) Adverse yaw (ii) Cross Wind Landings
(iii) Asymmetric power (iv) Spin recovery (08 Marks)
- b. Explain the function of dorsal fin in directional stability. Also explain with example of the effect of dorsal fin on pedal free versus sideslip characteristics. (08 Marks)

Module-3

- 5 a. Explain dihedral effect and describe on the aspect of estimation of airplane dihedral effect. (08 Marks)
- b. Obtain the relation for lateral control power $\left(C_{l_{\delta_a}}\right)$. (08 Marks)

OR

- 6 a. Explain the various methods of Aileron Balancing. (06 Marks)
- b. Briefly describe the longitudinal types of modes with relevant sketches of phugoid motion and short period motion. (10 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.

15AE73

Module-4

- 7 a. Derive rigid body equation of motion. (12 Marks)
b. Briefly explain gravitational and thrust forces. (04 Marks)

OR

- 8 a. Explain with expressions of aerodynamic forces and moments representation. (10 Marks)
b. Derive the derivatives due to the time rate of change of angle of attack. (06 Marks)

Module-5

- 9 a. Briefly explain Routh's criterion and determine whether the characteristic equations given below have stable or unstable roots:
i) $\lambda^4 + 2\lambda^3 + 5\lambda^2 + 2\lambda + 2 = 0$
ii) $\lambda^3 + 6\lambda^2 + 12\lambda + 8 = 0$ (08 Marks)
b. Write short note on Cooper-Harper scale. (08 Marks)

OR

- 10 Write short notes on the following:
a. Wing rock
b. Roll control reversal
c. Dutch roll instability
d. Autorotation and spin (16 Marks)
