Name: Enrolment No:	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2022

Course: Flight Mechanics II — **Semester:** VIth
Program: B.Tech ASE — **Time** 03 hrs.
Course Code: ASEG4001 — **Max. Marks:** 100

Instructions: Assume the necessary data if not given. Use suitable plots wherever required.

SECTION A (5*4 =20)

S. No.		Marks	CO
Q 1	Define restoring tendency and floating tendency of an airplane. Also, discuss the expressions involved.	4	CO2
Q 2	Why neutral point is called as aerodynamic center of the entire airplane. Justify	4	CO1
Q 3	Discuss about the forward and rearward limits of CG movement in an airplane	4	CO2
Q 4	Define sweepback effect and dihedral effect in short.	4	CO3
Q 5	Whether roll subsidence is a long period mode or short period mode. How to verify.	4	CO5

SECTION B (4*10=40)

Q 6	Derive and discuss the tail contribution towards static longitudinal stability.	10	CO2
Q 7	Derive the expression of tail effectiveness .what is the influence of the elevator on the Cmα curve. Use proper plots to explain.	10	CO3
Q 8	An airplane with the following characteristics is coming in to land at sea level at a speed of 1.2 times the stalling speed. What would be the amount of rudder deflection required (δr) if the airplane encounters crosswind of 10 m /s? Additional parameters are given as, W/S = 1500 N/m^2, V_v = 0.05, $C_{L\alpha v}$ = 2.87 rad^{-1}, $C_{n\beta}$ = 0.071 rad $^{-1}$, C_{Lmax} = 1.8, η_v = 1.0, τ_{rudder} = 0.5.	10	CO4
Q 9	Determine the orientation of an airplane for the “first rotation and second rotation”. Explain using figures; also write the appropriate coordinate equation in matrix form for the same.	10	CO5

SECTION-C (2*20=20)

Q 10	Explain how adverse yaw is brought about in an airplane**.** **(5 Marks)** The wind tunnel tests on an airplane model indicate that full aileron deflection to right introduces an adverse yaw causing $C_n = -0.008$. How many degrees of rudder must be applied to keep the sideslip zero during the roll? Given that $S = 16.4\ m^2$, $S_v = 2.1\ m^2$, $l_v = 5.5$ m, $b = 9.8$ m, $\eta_v = 0.95$, $C_{L\alpha v} = 0.045\ deg^{-1}$, $\tau_{rudder} = 0.5$**.** **(15 Marks)**	**20**	**CO 4**
Q 11	a) Derive the frequency and damping ratio expression for a long period motion of longitudinal stability. **b)** Derive the linearized longitudinal equation of motion for ΔM using small disturbance theory.	**20**	**CO5**