Name:

Enrolment No:

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

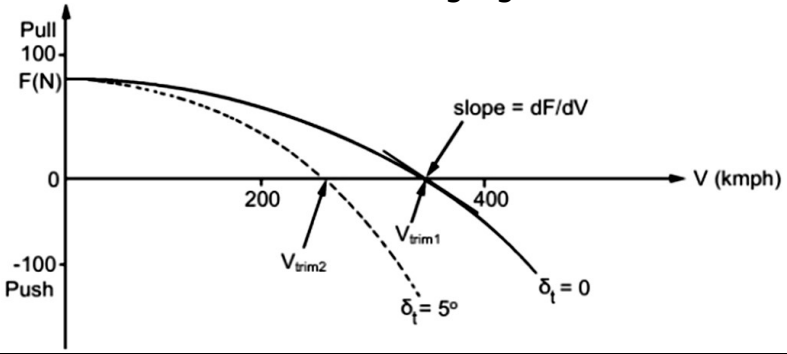
Course: Flight Mechanics II — **Semester:** VIth
Program: B.Tech ASE — **Time** 03 hrs.
Course Code: ASEG4001 — **Max. Marks:** 100

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 the following terms. (a) Neutral point (b) Static margin.	4	CO1
Q 2	Graphically represent a system, which is statically stable but dynamically unstable.	4	CO1
Q 3	What is the purpose of a dorsal fin and how is it achieved	4	CO2
Q 4	Define weathercock effect and dihedral effect in short.	4	CO3
Q 5	Whether phugoid mode is a long period mode or short period mode. How to verify.	4	CO5

SECTION B (4*10=40)

Q 6	An airplane has the following characteristics. $C_{L\alpha w} = 0.080\ deg^{-1}$, $C_{L\alpha t} = 0.05\ deg^{-1}$, $dC_L/d\delta e = 0.042$, $C_{h\alpha t} = -0.004\ deg^{-1}$, $C_{h\delta t} = -0.005$, $i_w = 0$, $\alpha_{0L} = -2^0$, $i_t = -1^0$, $\varepsilon = 0.5\ \alpha$, $S_t = 0.25S$, $l_t = 3c$, $W/S = 1500\ N/m^2$, a.c. location = 0.25c , $\eta = 1.0$, $(C_{m\alpha})_{f,n,p} = 0.32\ rad^{-1}$. Obtain i) Stick-fixed neutral point ii) Stick-free neutral point	10	CO2
Q 7	Derive and discuss the variation of stick force with velocity for different tab deflections. Use following figure for reference. 	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". 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, η_v = 0.95, $C_{L\alpha v}$ = 0.045 deg^{-1}, τ_{rudder} = 0.5**.** **(15 Marks)**	**20**	**CO 4**
Q 11	a) The roots of a longitudinal stability quartic are - 2.57 ± i 2.63; +0.02 and- 0.26. Discuss the types of motions indicated by each mode. What would be the final motion of the airplane? **b)** Derive the linearized longitudinal equation of motion for ΔX using small disturbance theory.	**20**	**CO5**