Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, May 2024

Course: Flight Stability and Control **Semester: VI**

Program: B.Tech Aerospace Engineering **Time : 03 hrs.**

Course Code: ASEG 3023 **Max. Marks: 100**

Instructions: State Assumptions clearly.

SECTION A

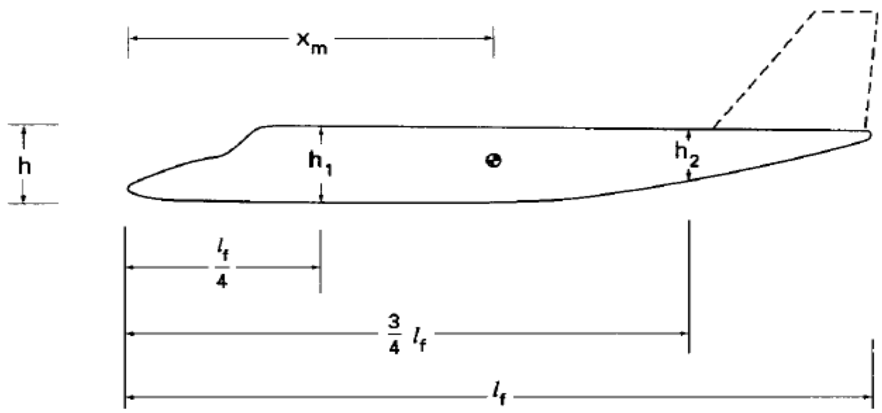
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	What is the significance of Neutral Point in airplane?	**4**	**CO1**
Q 2	Compare *most forward* and *most aft* Center of Gravity (CG) Limits on airplane.	**4**	**CO2**
Q 3	State 'Dihedral effect' for roll stability of airplane.	**4**	**CO3**
Q 4	What is importance of Dorsal fin on airplane?	**4**	**CO4**
Q 5	Characterise Phugoid motion of aircraft.	**4**	**CO5**

SECTION B

(4Qx10M= 40 Marks)

S. No.		Marks	CO
Q 6	For conventional configuration airplane derive the expression for longitudinal stability due to a) Wing contribution b) Tail contribution and compare both contributions.	**10**	**CO1**
Q 7	How set-back hingeline *Aerodynamic balancing* affects longitudinal stick free stability?	**10**	**CO2**
Q 8	An aircraft weighs 65,000 N and has a wing area of 46 m^2 and a tail length of 10.64 m. The center of gracity and wing aerodynamic centers in terms of mean aerodynamic chord are, respectivly, at 0.35 and 0.26 from the leading edge of *mac*. The lift-curve slope of wing and that of horizontal tail are 0.085/deg and 0.072/deg, respectively. The tail volume ratio is 0.61. Assuming $C_{m,f}$=0.1 C_L, $\in= 0.3\ \alpha$, $\eta_t = 0.9$, $\tau = 0.5$, $C_{h\alpha} = -0.003/\text{deg}$, $C_{h\delta} = -0.006/\text{deg}$, $S_e = 1.9\ \text{m}^2$, $c_e = 0.55$ m, and $G = 1.2$ rad/m, Determine the stick-fixed maneuver margin and b) incremental elevator setting for a coordinated turn with 20 deg bank at sea level.	**10**	**CO3**

Q 9	For pure aircraft rolling motion derive expression for damping ratio and natural frequency. OR For pure aircraft yawing motion derive expression for damping ratio and natural frequency.	**10**	**CO4**
	SECTION-C **(2Qx20M=40 Marks)**		
Q 10	Size the vertical tail for the airplane configuration shown below so that its weathercock stability has a value of $C_{n\beta} = 0.1\ \text{rad}^{-1}$. Assume V=150 m/s at sea level. $S = 21.3\ m^2$ $b = 10.4\ m$ $z_w = 0.4\ m$ $d = 1.6\ m$ $l_f = 13.7\ m$ $x_m = 8.0\ m$ $w_f = 1.6\ m$ $S_{f_s} = 15.4\ m^2$ $h = 1.6\ m$ $h_1 = 1.6\ m$ $h_2 = 1.07\ m$ 	**20**	**CO4**
Q11	For pure pitching motion of aircraft, derive the pxpression for damping ratio and natural frequency B) The differential equation for the constrained center of gravity pitching motion of an airplane is computed to be $\ddot{\alpha} + 4\dot{\alpha} + 36\alpha = 0$ Find the following: (a) natural frequency, rad/s; (b) damping ratio (c) damped natural frequency, rad/s OR A) Derive the expression for steady state roll response of aircraft with step aileron input delfection. B) Calculate the roll response of the F04 A aircraft to a 4 degree step change in aileron deflection. Assume the airplane is flying at sea level with a velocity of 80 m/s. The F104A has the following aerodynamic and geometric characterisitics. $I_x = 4676\ \text{kg} \cdot \text{m}^2$ $C_{l_p} = -0.285\ \text{rad}^{-1}$ $S = 18\ \text{m}^2$ $C_{l_{\delta_a}} = 0.039\ \text{rad}^{-1}$ $b = 6.7\ \text{m}$	**20**	**CO5**