Name:

Enrolment No:

UPES

End Semester Examination, May 2025

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

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

Course Code: ASEG3023 — **Max. Marks: 100**

Instructions:

+ *Read all questions carefully before attempting them.*
+ *Write neatly and legibly. Illegible answers may not be evaluated.*
+ *Show all necessary calculations and clearly state any assumptions made.*
+ *Use appropriate formulas and standard values where applicable.*
+ *Any extra answers beyond the specified number of questions will not be evaluated and will be treated as an over-attempt.*
+ *Always mention appropriate units in all numerical answers.*
+ ***Note:** Section C contains internal choice. Read the instructions carefully before attempting.*

SECTION A
(5Qx4M=20Marks)

S. No.	Statement of question	Marks	CO
Q1.	What is the significance of flap in the elevator effectiveness, write an expression for the same.	**4**	**CO2**
Q2.	Mathematically how you define neutral point.	**4**	**CO2**
Q3.	Explain the difference between power-off and power-on neutral point of an aircraft. How does engine power influence the location of the neutral point?	**4**	**CO2**
Q4.	Explain what happens to δ_e when CG shifts forward.	**4**	**CO2**
Q5.	Graphically represents a system which is statistically stable but dynamically unstable.	**4**	**CO4**

SECTION B
(4Qx10M= 40 Marks)

Q6.	Show with some example how much a designer will take the CG forward or restrict the forward CG by elevator deflection limitations by taking appropriate values. Assume $\delta_{e\ max}$ as 10 degrees and 15 degrees.	**10**	**CO3**
Q7.	Differentiate between stick-fixed and stick-free neutral points. Differentiate between CG limits with and without power. Why is this distinction important for aircraft stability?	**10**	**CO3**
Q8.	Derive an expression for $\delta_{e\ trim}$ and $\delta_{e\ reqd.}$	**10**	**CO3**
Q9.	Explain Neutral point and fuselage contribution with the help of an expression.	**10**	**CO2**

SECTION-C (2Qx20M=40 Marks)			
Q10.	The characteristic equation of an airplane is $\lambda 2 - 0.5\lambda + 9.5 = 0$. Determine whether the motion is dynamically stable or unstable. **OR** For an aircraft neutral point stick fixed is 0.5, static margin is located at 30% of MAC. Now we have to trim our aircraft at 0.6, elevator deflection is 0° and trim at 0.4, elevator deflection 4° downward then calculate: (a) elevator control power (b) if new CG is at 40% or MAC, what is the $C_{L_{trim}}$ for $\delta_e = 0°$	**20**	**CO4/CO3**
Q11.	An airplane has the following hinge moment characteristics: An airplane has the following hinge moment characteristics: Wing lift curve slope, $C_{L\alpha w} = 0.09$ per degree, Tail lift curve slope, $C_{L\alpha t} = 0.08$ per degree, Hinge moment derivative with respect to angle of attack, $C_{h\alpha} = -0.003$ per degree, Hinge moment derivative with respect to elevator deflection, $C_{h\delta} = -0.005$ per degree, Hinge moment constant, $C_{h_0} = 0.0$, Tail volume ratio, $V_H = 0.4$, Tail area ratio, $S_t/S = 0.35$, Downwash gradient, $d\varepsilon/d\alpha = 0.4$. Determine the location of the stick-free neutral point for the given configuration. **OR** Show that directional stability of airplane is given by $C_{n\beta_v} = V_v \eta_v C_{L_{\alpha_v}} \left(1 + \frac{d\sigma}{d\beta}\right)$	**20**	**CO3/C04**