Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2021

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.

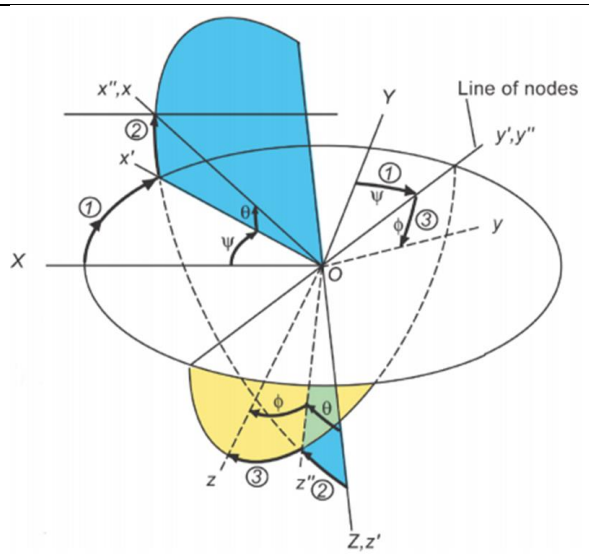
SECTION A (6*5 =30)

S. No.		Marks	CO
Q 1	Define the following terms. (a) Neutral point (b) Static margin.	**5**	**CO1**
Q 2	What do you understand by tail efficiency? How does it change with the location of tail surface? Give proper examples.	**5**	**CO2**
Q 3	Define a) Elevator control power b) Flap effectiveness	**5**	**CO3**
Q 4	Discuss when yaw and sideslip angle are equal in magnitude and opposite in direction and when not.	**5**	**CO4**
Q 5	How dorsal fin is useful in preventing the rudder lock?	**5**	**CO4**
Q 6	Define Euler angles and Euler angle rate.	**5**	**CO5**

SECTION B (5*10=50)

Q 7	An airplane has the following characteristics. Obtain the movement of neutral point on freeing the stick **$S= 40\ m^2, C_{L\alpha w} = 4.6\ rad^{-1}$, $C_{L\alpha t} = 0.05\ deg^{-1}$, $dC_{Lt}/d\delta e = 1.9\ rad^{-1}$, $C_{h\alpha t} = -0.008\ deg^{-1}$, $C_{h\delta e} = -0.013$ deg-1, $\varepsilon = 0.39\ \alpha$, $S_t = 4.6\ m^2$, $l_t = 7.6m$, $\eta=0.98$**	**10**	**CO2**

Q 8	Derive the expression for damping moment using strip theory. Or A light airplane has a wing of rectangular planform 12 m span, 2 m chord and C_{Lmax} of 1.5. The wing loading is 850 N/m^2. The airplane is rolled through 40^0 in one second when flying at 3.5 times its stalling speed. Estimate the rolling moment created by the ailerons assuming steady motion	**10**	**CO4**
Q 9	Answer the following. (a) Define the term maneuver point stick-fixed and maneuver point stick-free. (b) For a given value of C_L the elevator deflection required in pull-up is more than that in a steady level flight. Explain. Or Define Aerodynamic balancing and discuss following methods of aerodynamic balancing. a) Horn Balance b) Set back hinge	**10**	**CO3**
Q 10	Explain how adverse yaw is brought about in an airplane. The wind tunnel tests on an airplane model indicate that full aileron deflection to right introduces an adverse yaw causing Cn = -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. Or Discuss the influence of wing-body combination on directional stability contribution of vertical tail. Use proper diagrams and expression of $\mathbf{C_{n\beta v}}$ to explain the same.	**10**	**CO4**
Q11	Derive the X,Y,Z force equation using 6DoF model for undisturbed motion Or Derive the equations of first and second rotation for the orientation and position of the airplane from inertial axis to body axis. Use the following diagram for reference.	**10**	**CO5**



SECTION-C (1*20=20)

Q 12	a) With the application of small perturbation theory, derive the ΔX force equation and ΔM- moment equation in linearized mode.(equations are shown below for your reference) **(15)** $\left(\frac{d}{dt} - X_u\right)\Delta u - X_w\,\Delta w + (g\cos\theta_0)\,\Delta\theta = X_{\delta_e}\,\Delta\delta_e + X_{\delta_T}\,\Delta\delta_T$ — (i) $-M_u\,\Delta u - \left(M_{\dot{w}}\frac{d}{dt} + M_w\right)\Delta w + \left(\frac{d^2}{dt^2} - M_q\frac{d}{dt}\right)\Delta\theta = M_{\delta_e}\,\Delta\delta_e + M_{\delta_T}\,\Delta\delta_T$ — (ii)	**20**	**CO5**
	b) Discuss the short period and long period mode of longitudinal motion in brief using proper figures**. (5)**		