Name:

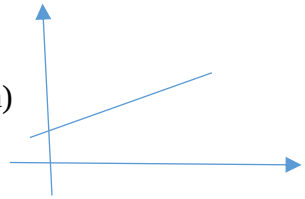
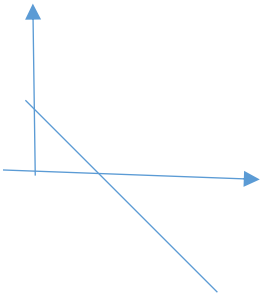
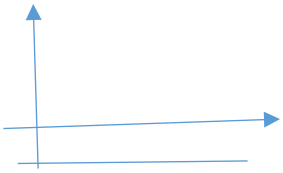
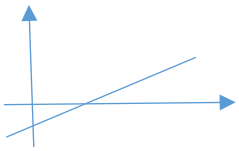
Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2019

Course: Flight Mechanics-II **Semester: VII**
Program: B-TECH ASE/ASEA **Course Code: ASEG-401**
Time: 03 hrs. **Max. Marks: 100**
No. of Pgs:-3

Instructions: Note: Make use of *sketches/plots* to elaborate your answer. Brief and to the point answers are expected. The Question Paper contain 3 Sections- Section A, B and C

SECTION A

S. No.	All questions are compulsory	Marks	CO
Q 1	Write the three types of controls with reference to C.G of an airplane. What are the two necessary criteria for longitudinal balance and static stability?	4	CO1
Q 2	Which of the following represents a graph of $C_{M,\,ac}$ (X-axis : Angle of attack,α ; Y-axis: Moment coefficient about ac, $C_{M,\,ac}$. a)  b)  c)  d)  A spring mass damper system with a mass of 1kg is found to have a damping ratio of 0.2 and a natural frequency of 5rad/s. Calculate damping of the system.	4	CO2
Q 3	Define angle of yaw and angle of side slip with figure	4	CO1
Q 4	Write short note on Crosswind landing and Adverse Yaw.	4	CO4

Q 5	What is snaking. Sketch the snaking motion of an aircraft	**4**	**CO2**
	SECTION B		
Q 6	A model of an airplane is tested in a wind tunnel without vertical tail. Contributions of various components give $C_{n\beta}$ = -0.0012 deg^{-1} .If the vertical tail is to be positioned at a point on the aft end of the fuselage giving a tail length of 4.8m, how much vertical tail area is required to give an overall $C_{n\beta}$ = 0.0012 deg^{-1} ? Assume that vertical tail would have an effective wing area is 18 m^2, wing span is 10.6m, tail moment arm is 4.8m and $C_{y\beta}$ = 0.0454 deg^{-1}.	**10**	**CO4**
Q 7	Explain in detail about the elevator control power with sketches .Derive the equation $C_{m\delta e} = - C_{L,\alpha t} V\eta\zeta$ OR Explain in detail about the elevator control effectiveness. Derive the equation for the control effectiveness of elevator $C_{L\delta e.}$	**10** **10**	**CO3**
Q 8	Explain the position and orientation of an aircraft relative to earth and describe it in terms of Euler's angles	**10**	**CO5**
Q 9	How Cl_β contributes in determining lateral stability for ailerons. Derive an expression of Cl_β.	**10**	**CO4**
	SECTION-C		
Q 10	(a) Derive an expression of Directional stability for tailless aircraft. $C_{n\beta}$ = C_D Sin 2Ω $\frac{\bar{y}}{b}$ (b)Explain effect of $Cn_{\delta r}$ in determining directional stability for rudder. Derive an expression $Cn_{\delta r.}$ (c) Explain phenomena " Rudder Lock" and methods to prevent it.	**20**	**CO4**
Q11	(a) Define Terminology:- Spiral divergence, dutch roll, directional divergence, Phugoid motion & short period motion. (b) Derive frequency and damping ratio for long- period and short-period motions. (c)Determine ω_n , ζ for short period and phugoid approximations if following data is given : X_u = -0.045s$^{-1,}$ X_w= 0.036s^{-1} $X\dot{w}$ =0 Z_u =-0.369s^{-1} Z_w= -2.02s^{-1} $Z\dot{w}$ =0 M_u=0 M_w= -0.05 M $\dot{w}$= -0.0651 X_q =0 Z_q=0 M_q= -2.05s^{-1} U_0 =176ft/s	**20**	**CO5**

	OR (a)Derive six degrees freedom equation in Inertial frame of Reference of an aircraft. (b)Derive an expression for critically damped system $\frac{c}{2m} = \sqrt{\frac{k}{m}}$ and explain under damped, overdamped, critcically damped system using graphical representation.		