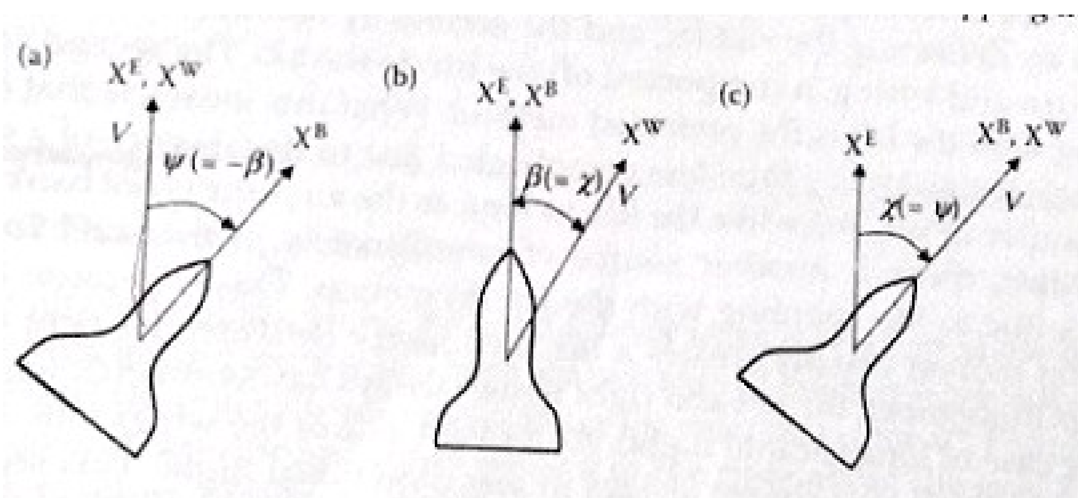
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April/May 2018

Course: Flight stability and Control **Semester: II**
Program: M-Tech (UAV)
Time: 03 hrs. **Max. Marks: 100**

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	Compare stick fixed versus stick free longitudinal static stability.	**4**	**CO1**
Q 2	Explain geometrical configuration of a hinge moment coefficient with neat sketch	**4**	**CO2**
Q 3	Explain why delta wing does not require rudder for directional stability.	**4**	**CO3**
Q 4	An airplane is flying at 10Km altitude at a level trim velocity V* = 200m/s. The aircraft is heading north east at an angle 45° with respect to an Earth-fixed inertial frame of reference as shown in fig1. The aircraft starts side-slipping in the local horizontal plane due to side-wind of magnitude v=40m/s. Determine sideslip angle and wind orientation angle.  Fig1	**4**	**CO4**
Q 5	For longitudinal static stability, Explain influence of Centre of gravity location with respect to neutral point.	**4**	**CO1**

SECTION B

Q 6	Consider the wing body model. The area and chord of the wing are $0.3m^2$ and 0.2 m respectively. Assume horizontal tail is added to this model. the distance from the airplanes COG to the tail AC is 0.15 m, the tail area is $0.05m^2$, tail setting angle is $3.7^0$the tail lift slope is 0.1 per degree ,$€_0$ =0 and d€/dα =0.35 , a =0.09 , $h - h_{acwb}$ =0.11 ,$C_{m,cg}$ = -0.032 . if α =11^0. Calculate $C_{m,cg}$ for the airplane model.	**10**	**CO1**
Q 7	Derive elevator deflection angle:- $\partial_{trim} = C_{m,o} + (\partial C_{m,g}/\partial\alpha_a)\alpha_n \;/\; V_H (\partial C_{L,t}/\partial\delta_e)$ OR Explain stick fixed versus stick free longitudinal static stability. Derive: $\delta_{free} = -[(\partial C_{he}/\partial\alpha_t)/(\partial C_{he}/\partial\delta e)]\,\alpha_t$	**10**	**CO2**
Q 8	Consider the full size airplane model. The airplane has wing area $19m/s^2$, weight of 22700N and elevator control effectiveness of 0.04 .Calculator elevator deflection angle necessary to trim the airplane at a velocity of 61 m/s at sea level if a=0.08 , $C_{m,o}$= 0.06 ,V_H=0.34 , $\partial C_{m,cg}/\partial\alpha_a$ =-0.0133	**10**	**CO2**
Q 9	How Cn_β contributes in determining weathercock stability for vertical tail. Derive its formula and draw C_n versus β curve	**10**	**CO3**
SECTION-C			
Q 10	(a)Explain: Dorsal fin, Rudder Lock, Ventral fin, bank angle, load factor, sideslip velocity with necessary figure. (b) Discuss different types of Aerodynamics tabs used in aircraft.	**20**	**CO3**
Q11	Consider an aircraft Cessna 172, NACA (0012 Series) as shown in Fig 2.1(a) and Fig 2.1(b) mentioned below having vertical tail having C_l=0.08deg^{-1}. Span efficiency factor=0.94,area of fuselage =$50m^2$,MAC=3m,span length =15m.Find rudder control power $Cn_{\delta r}$	**20**	**CO4**

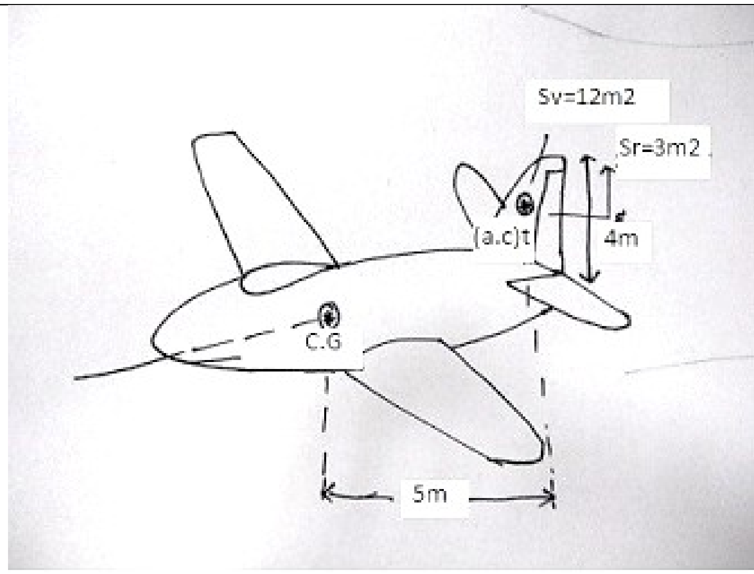


Fig 2.1(a)

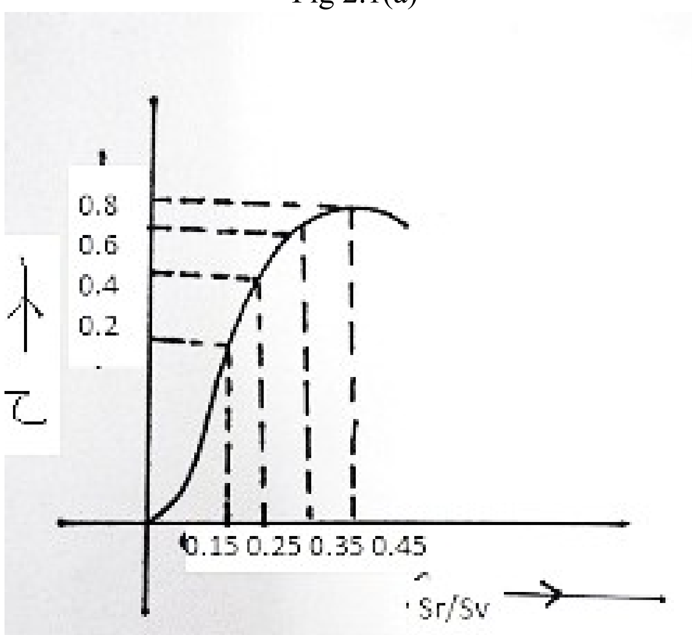


Fig2.1(b)

OR

(a)Why high wing produces more stabilizing effect than Low wing contribution.

Derive $Cl_{\beta} = \eta\, V\, Cy_{\beta}\, (1+ \frac{d\sigma}{d\beta})$.

(b)How dihedral helps in increasing stabilizing effect and Anhedral increases de-stabilizing effect.