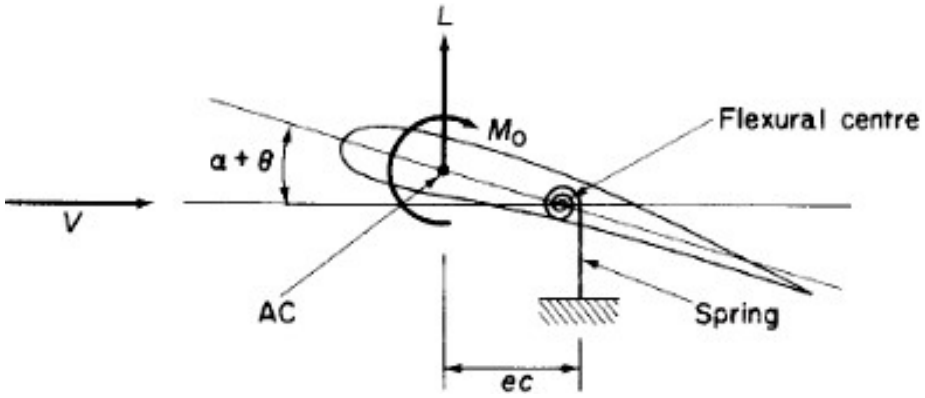
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April 2018

Course: Aero-Elasticity **Semester: VIII**
Program: B.Tech ASE
Time: 03 hrs. **Max. Marks: 100**

Instructions: Make use of sketches/plots to elaborate your answer. Brief and to the point answers are expected. The Question paper has three sections: Section A, B and C.

SECTION A (5 x 4 = 20 Marks)

S. No.		Marks	CO
Q 1	Differentiate between: Static and Dynamics Aero-Elasticity, Flexural and Elastic axis.	**5**	**CO1**
Q 2	Classify the different types of Aero-Elastic problem in general.	**5**	**CO1**
Q 3	Explain how the sweep back wing is reducing the possibility of wing divergence, whereas the swept forward wing having very low divergence speed.	**5**	**CO2**
Q 4	What do you mean by aileron reversal speed? Explain in details.	**5**	**CO2**
	SECTION B (10 x 4 = 40 Marks)		
Q 5	Flutter is the dynamic instability of an elastic body in an airstream. Support the statement with explanation. Also explain the different types of flutters.	**10**	**CO3**
Q 6	What do you mean by aileron buzz? Explain the methods to prevent aileron buzz.	**10**	**CO3**
Q 7	What do you mean by coupling? Define the Inertial, elastic and Aerodynamic coupling.	**10**	**CO4**
Q 8	Consider a 2-D wing as shown in figure below. Derive and obtain the expression of reversal speed. Also mention the importance of divergence speed in aircraft design. 	**10**	**CO5**
	SECTION-C (20 x 2 = 40 marks)		
Q 9	An initially untwisted rectangular wing of semi-span ‘s’ and chord ‘c’ has its flexural	**20**	**CO5**

	axis normal to the plane of symmetry, and is of constant cross-section with torsional rigidity 'GJ'. The aerodynamic center is 'ec' ahead of the flexural axis, the lift coefficient slope is 'a' and the pitching moment coefficient at zero lift is $C_{m,0}$. At speed 'V' in air of density 'ρ' the wing-root incidence from zero lift is α_0. Using simple strip theory, i.e. ignoring downwash effects, show that the incidence at a section distant y from the plane of symmetry is given by, $$\alpha_0 + \theta = \left(\frac{C_{m,0}}{ea} + \alpha_0\right)\frac{\cos\lambda(s-y)}{\cos\lambda s} - \frac{C_{m,0}}{ea}$$ where $$\lambda^2 = \frac{ea\frac{1}{2}\rho V^2 c^2}{GJ}$$ Assuming $C_{m,0}$ to be negative, find the condition giving the speed at which the lift would be reduced to zero.		
Q 10	Write short notes on the following: (5 x 4 = 20 Marks) 1. Prevention of Flutter. 2. Control surface flutter. 3. Buffeting. 4. Static and dynamic Aero-elasticity.	**20**	**CO4**