Name: Enrolment No:	UPES

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

Programme Name: B.Tech ASE — **Semester : VIII**
Course Name : Aero-Elasticity — **Time : 03 hrs**
Course Code : ASEG 451 — **Max. Marks : 100**
Nos. of page(s) : 02

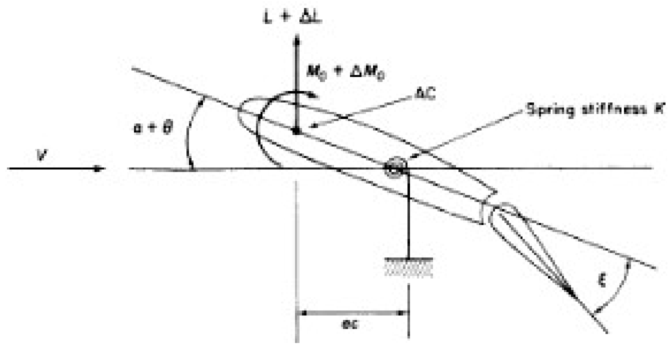
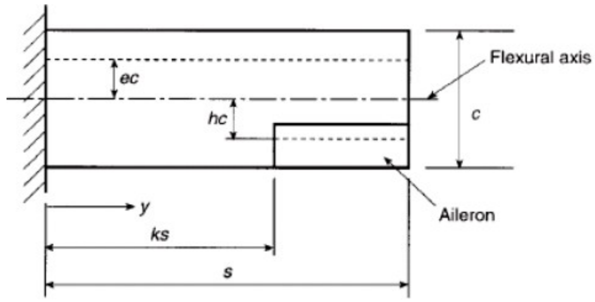
Instructions: Mention Roll No. at the top of the question paper. Do not write anything else on the question paper except your roll number. ATTEMPT ALL THE PARTS OF A QUESTION AT ONE PLACE ONLY. Assume any suitable data if missing.

SECTION A (4x5 =20 Marks)

S. No.		**Marks**	**CO**
Q 1	Define the following Terms: Aerodynamics Center, Center of Pressure, Neutral axis, Elastic Axis and Spring coefficient.	**5**	**CO1**
Q 2	(a) What happens to the response of an un-damped system at resonance? Explain. (b) Is the frequency of the damped free vibration smaller or greater than the natural frequency of the system? Give your answer with proper reason.	**5**	**CO1**
Q 3	Explain FIVE methods for Prevention of Aeroelastic Instabilities.	**5**	**CO2**
Q 4	What do you mean by the term Buffeting? Explain the major effects of buffeting.	**5**	**CO2**

SECTION B (10 x 4 = 40 marks)

S. No.		**Marks**	**CO**
Q 5	What do you mean by Aero-Elasticity? With the help of collar's triangle Define the term Static and Dynamic Aero-Elasticity.	**10**	**CO3**
Q 6	What are the Aero-Elastic effects in the failure of Tacoma Narrow Bridge? How to reduce these effects? Explain in details.	**10**	**CO4**
Q 7	Consider a 2-D wing with aileron attached as shown in figure below. Derive and obtain the expression of aileron reversal speed.	**10**	**CO4**

			
Q8	Define the term Inertial coupling, Aerodynamic coupling and Elastic coupling. How can you overcome the problem of Inertial coupling? Or What do you mean by Classical Flutter, Stall Flutter and Aileron buzz? Also explain how to prevent the Aileron Buzz.	**10**	**CO3**
SECTION-C (20 x 2 = 40 Marks)			
Q 9	The rectangular wing as shown in figure below has a constant torsional rigidity GJ and an aileron of constant chord. The aerodynamic centre of the wing is at a constant distance "ec" ahead of the flexural axis while the additional lift due to operation of the aileron acts along a line a distance "hc" aft of the flexural axis, the local two-dimensional lift-curve slopes are a_1 for wing and a_2 for aileron deflection. Using strip theory and considering only the lift due to the change of incidence arising from aileron movement. Show that the aileron reversal speed is given by $\tan \lambda ks \int_0^{ks} y \sin \lambda y \, dy - \tan \lambda s \int_0^{s} y \sin \lambda y \, dy - \int_{ks}^{s} y \cos \lambda y \, dy = \frac{(e+h)}{2h \cos \lambda ks}[(ks)^2 - s^2]$  where $\lambda^2 = \frac{1}{2}\rho V^2 a_1 ec^2/GJ$	**20**	**CO4**
Q10	Write shot notes on the following: (4x5 = 20 Marks) I. Swept wing divergence. II. Control effectiveness and reversal.	**20**	**CO2, CO3**

	III. Control surface flutter. IV. Aero-Thermoelasticity.		