UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2020

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) : 03	

SECTION – A (30 MARKS)

Q1: Choose the appropriate word/phrase, out of the four option given below: (10 x 1 = 10 Marks)

I. The number of natural frequencies in case of simply supported beam is:
   A. Zero   B. One   C. Two   D. Infinite

II. If the flexural axes and the aerodynamic center coincides then the wing is:
   A. Unstable   B. Stable   C. Neutral   D. Can't say

III. A ¼ kg mass is suspended by a spring having a stiffness of 0.1533 N/mm. The natural frequency in cycles per second of the system is:
   A. 1.27 Hz   B. 24.76 Hz   C. 12.7 Hz   D. 4.33 Hz

IV. When there is a reduction in amplitude over every cycle of vibration, then the body is said to have
   A. free vibration   B. forced vibration   C. damped vibration
   D. none of the mentioned.

V. Longitudinal vibrations are said to occur when the particles of a body moves
   A. perpendicular to its axis   B. parallel to its axis   C. in a circle about its axis
   D. none of the mentioned.

VI. When a body is subjected to transverse vibrations, the stress induced in a body will be
   A. shear stress   B. bending stress   C. tensile stress   D. compressive stress

VII. The divergence speed is dependent on:
   A. Thrust   B. Drag.   C. Camber   D. None of the these

VIII. If $V_d = V_r$, then the aileron is completely:
   A. Ineffective at all speeds   B. Effective at all speeds
   C. Unstable   D. None of the above

IX. Flutter occurs largely on:
   A. Wings   B. Landing Gear   C. Longerons   D. cockpit control

X. Buffeting is a high-frequency instability, caused by:
   A. Deformation of components   B. Flow separation
   C. Twisting of components   D. None of the these.

Q2: Fill in the blanks with the correct idiom/phrase: (10x1= 10 Marks)

    I.   Natural frequency of a system is due to----------------------.
    II.   wing divergence occurs due to interaction of ----------------- and ----------------.
    III.   Flutter is a ------------------- of an elastic structure in a fluid flow.
    IV.   Buffeting is a high-frequency instability, caused by ------------------------- oscillations from one object striking another.
    V.   An elastic system having just ------------- degree of freedom system cannot be unstable unless some peculiar mechanical characteristic exists.
    VI.   Aileron reversal speed is ---------------- proportional to the rate of change of wing pitching moment coefficient with aileron deflection.
    VII. ,------------------ is the non-classical form of flutter.
    VIII. The aerodynamic forces, which oscillate in a flutter condition, act through a center analogues to the aerodynamic center of a wing in steady motion; this center is known as----------------------.
    IX.   Inertial coupling is prevented if the center of gravity ---------------- with the flexural axis.
    X.   If the aerodynamic center coincides with or aft of the flexural center then the wing is ---------------at all speeds

Q3: Mark the following "True" or "False" (10x1 = 10 Marks)

    I.   Aerodynamic coupling is associated with changes of lift produced by wind rotation or translation.
    II.   Buffeting is Produced most commonly in a power-plant.
    III.   Frequencies at which the response amplitude is a relative maximum are also known as resonant frequencies.
    IV.   The synthesis of aero-elasticity with thermodynamics is known as aerothermoelasticity.
    V.   Swept forward wing produces bending deflection and having stabilizing effect and divergence speeds are high.
    VI.   Aircraft structures, being extremely flexible, are prone to distortion under the loads.
    VII. Aileron buzz may be prevented bu employing control jacks of sufficient stiffness.
    VIII. All materials used in aerospace vehicles are designed by keeping in mind the aero-elastic effects.
    IX.   Flutter is a static stability of an elastic structure in a fluid flow.
    X.   Buffeting is a high-frequency instability, caused by airflow separation or shock wave oscillations from one object striking another.

SECTION – B (10 X 5 = 50 Marks)

Q4: Define the following terms: Natural frequency, Resonance, Degree of Freedom, Amplitude of vibration and Time period.

Q5: Explain the Good and Bed effect of vibration.

Q6: With the help of Collar's, define the different aero-elastic problems.

Q7: What are the difference between static and dynamic aero-elasticity. Mention different types of static and dynamic aero-elastic problem in general.

Q8: Explain FIVE methods for Prevention of Aero-elastic Instabilities.

Q9: Write shot notes on Aerothermoelasticity and Aeroservoelasticity

Q10: What do mean by the term control surface reversal? Explain.

Q11: What do you mean by the term Buffeting? Which component effects the most by buffeting and why?

Q12: Write shot notes on swept wing divergence.

Q13: What do you mean by the term thermal instability? Explain in detail.

SECTION – C (1 X 20 = 20 Marks)

Q14: Explain the cause/failure of any ONE of the following. Also, Mention the effects of failure and methods to reduce the effects. (Braniff International Airways Flight 542/Elephant Mountain B-52 1963).