Hall Ticket No | | | | | | | | | | | Course Code: AAEB25

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

B.Tech VII SEMESTER END EXAMINATIONS (REGULAR/SUPPLEMENTARY) - DECEMBER 2022
Regulation: R18

AEROSPACE STRUCTURAL DYNAMICS

Time: 3 Hours **(AERONAUTICAL ENGINEERING)** **Max Marks: 70**

Answer FIVE Questions choosing ONE question from each module
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) Differentiate between deterministic and random vibration? Give two practical examples of each. [BL: Understand| CO: 1|Marks: 7]

   (b) A bridge structure is modeled as a single-degree-of-freedom system with an equivalent mass of 5 x 10^5 kg and an equivalent stiffness of 25 x 10^6 N/m. During a free-vibration test, the ratio of successive amplitudes was found to be 1.04. Estimate the structural damping constant and the approximate free-vibration response of the bridge. [BL: Apply| CO: 1|Marks: 7]

2. (a) Why does the amplitude of free vibration gradually diminish in practical systems? Determine the vibration response of a system subjected to step excitation. [BL: Understand| CO: 1|Marks: 7]

   (b) Find the peak time, percent overshoot, settling time and rise time from the transfer function of the system given by [BL: Apply| CO: 1|Marks: 7]

   $T(s) = \frac{X(s)}{F(s)} = \frac{225}{s^2+15s+225}$

MODULE – II

3. (a) What is meant by static and dynamic coupling? Determine the equation of motion for the two degrees of freedom system. [BL: Understand| CO: 2|Marks: 7]

   (b) Consider a two degree-of-freedom system shown in Figure 1. Determine i) The natural frequencies ii) The modes shapes. [BL: Apply| CO: 2|Marks: 7]

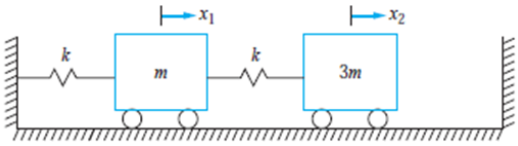

Figure 1

4. (a) Discuss the first and second mode shapes of the two rotor torsional system. [BL: Understand| CO: 2|Marks: 7]

   (b) Determine the transfer function for the 20 kg block of the system shown in Figure 2 if a force applied to first block. [BL: Apply| CO: 2|Marks: 7]

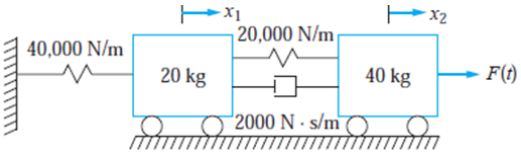

Figure 2

MODULE – III

5. (a) Summarize about torsional vibrations of a system consisting of 2 discs mounted on a single shaft. [BL: Understand| CO: 3|Marks: 7]

   (b) The three blocks slide on a frictionless surface, as shown in Figure 3. Derive the differential equations governing the vibrations of the system using x_1, x_2 and x_3 as generalized coordinates. [BL: Apply| CO: 3|Marks: 7]

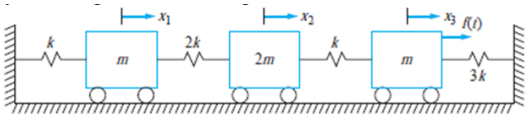

Figure 3

6. (a) Write about the flexibility and stiffness influence coefficients. What is the relation between them? [BL: Understand| CO: 4|Marks: 7]

   (b) Determine the mass matrix for the system shown in Figure 4 using inertia influence coefficients. Use θ and x as generalized coordinates. [BL: Apply| CO: 4|Marks: 7]

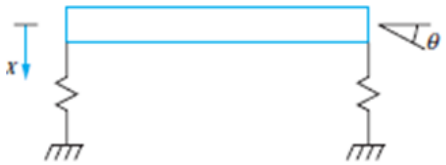

Figure 4

MODULE – IV

7. (a) Elucidate the various boundary conditions for torsional oscillations of a circular shaft having different end conditions. [BL: Understand| CO: 5|Marks: 7]

   (b) Calculate the natural frequencies of a bar with one end fixed and a mass attached at the other end, as shown in Figure 5. [BL: Apply| CO: 5|Marks: 7]

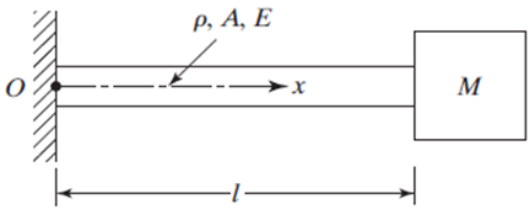

Figure 5

8. (a) How do you formulate the transverse beam vibration problem? Explain flow induced vibrations in a mechanical systems. [BL: Understand| CO: 5|Marks: 7]

   (b) Find the natural frequencies of the tapered cantilever beam shown in Figure 6 using the Rayleigh-Ritz method. [BL: Apply| CO: 5|Marks: 7]

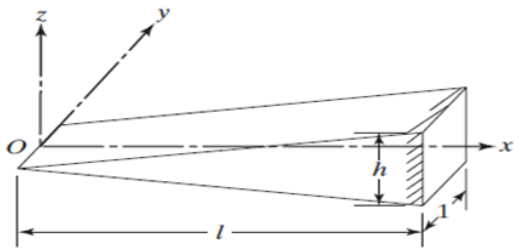

Figure 6

MODULE – V

9. (a) Demonstrate variation of the lift coefficient for different incidence and control surface angles with neat sketch. [BL: Understand| CO: 6|Marks: 7]

   (b) Find the steady state response of a pinned-pinned beam subject to a harmonic force f(x,t)= f_0 sin t applied at x=a as shown in the Figure 7. [BL: Apply| CO: 6|Marks: 7]

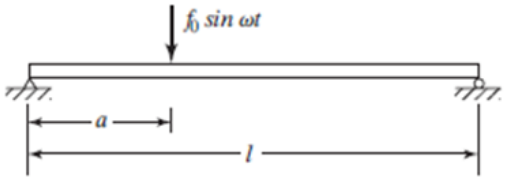

Figure 7

10. (a) Write about sweeping technique. Illustrate static aeroelasticity phenomena on a typical section model of an airfoil? [BL: Understand| CO: 6|Marks: 7]

   (b) An airfoil of mass m is suspended by a linear spring of stiffness k and a torsional spring of stiffness k_t in a wind tunnel, as shown in Figure 8. The C.G. is located at a distance of e from point O. The mass moment of inertia of the airfoil about an axis passing through point O is Io. Find the natural frequencies of the airfoil. [BL: Apply| CO: 6|Marks: 7]

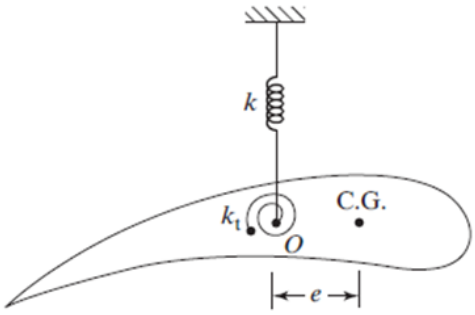

Figure 8