Hall Ticket No | | | | | | | | | | |

Question Paper Code: AAEC35

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal-500043, Hyderabad

B.Tech VII SEMESTER END EXAMINATIONS (REGULAR) - DECEMBER 2023
Regulation: UG-20

AEROSPACE STRUCTURAL DYNAMICS

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

Answer ALL questions in Module I and II
Answer ONE out of two questions in Modules III, IV and V
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) Briefly discuss the vibration analysis procedure. Determine the vibration response of a system subjected to periodic excitation. [BL: Understand| CO: 1|Marks: 7]

   (b) An undamped single degree of freedom system has a mass of 1 kg and a stiffness of 2500N/m. Find the magnitude and the phase of the response of the system when the initial displacement is -2 mm and initial velocity of 100 mm/s. [BL: Apply| CO: 1|Marks: 7]

MODULE – II

2. (a) What is meant by static and dynamic coupling? How can you eliminate coupling of the equations of motion? [BL: Understand| CO: 2|Marks: 7]

   (b) Find the steady-state response of the 40 kg mass of the system shown in Figure 1 when subject to a sinusoidal force of magnitude 200 N at a frequency of 50 rad/s.

   [BL: Apply| CO: 2|Marks: 7]

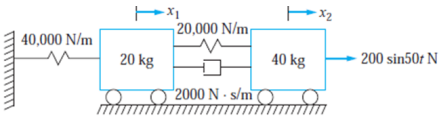

Figure 1

MODULE – III

3. (a) Discuss the standard Eigen value problem of a multi degree of freedom system.

   [BL: Understand| CO: 3|Marks: 7]

   (b) Determine the stiffness matrix for the system shown in Figure 2 by employing stiffness influence coefficient method. [BL: Apply| CO: 3|Marks: 7]

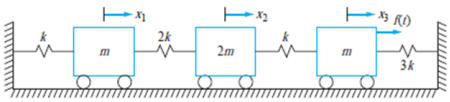

Figure 2

4. (a) Discuss the procedure that can be adopted to derive the equation of motion of a multi degree of freedom. [BL: Understand| CO: 4|Marks: 7]

   (b) Find the natural frequencies and mode shapes of the system shown in Figure 3 for K1= K2 = K3= K and m1= m2= m3=m [BL: Apply| CO: 4|Marks: 7]

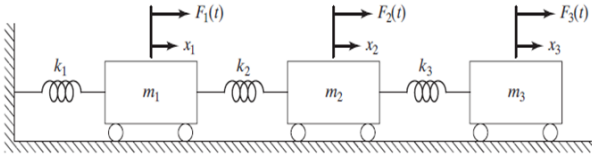

Figure 3

MODULE – IV

5. (a) Illustrate various boundary conditions for uniform shafts (rods) subjected to torsional vibration along with their natural frequency and normal mode shapes. [BL: Understand| CO: 5|Marks: 7]

   (b) Use the Rayleigh-Ritz method to approximate the three lowest natural frequencies and their corresponding mode shapes of a fixed-free beam. Use polynomials of order six or less as trial functions. [BL: Apply| CO: 5|Marks: 7]

6. (a) Obtain an expression for the natural frequencies for the transverse vibration of a uniform beam with both ends simply supported. [BL: Understand| CO: 5|Marks: 7]

   (b) Find the fundamental frequency for torsional vibration of a shaft of length 2 m and diameter 50 mm when both the ends are fixed. The density of the material is 7800kg/m^3 and the modulus of rigidity is 8.2×10^{11}N/m^2. [BL: Apply| CO: 5|Marks: 7]

MODULE – V

7. (a) How many types of control reversal can happen in the flying airplane? Discuss different types and suggest remedies. [BL: Understand| CO: 6|Marks: 7]

   (b) List dynamic aeroelastic phenomena. State the difference between control effectiveness and control system reversal. [BL: Understand| CO: 6|Marks: 7]

8. (a) Use Hamilton's principle to find the equations of motion of a particle ofunit mass moving on a plane in a conservative force field. [BL: Understand| CO: 6|Marks: 7]

   (b) Determine the effect of spanwise position of the control surface on the aeroelasticity behaviour of airfoil. [BL: Understand| CO: 6|Marks: 7]

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