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Question Paper Code : X 86197

M.E./M.Tech. DEGREE EXAMINATIONS, NOV./DEC. 2020
First Semester
Structural Engineering
ST 5102 – DYNAMICS OF STRUCTURES
(Regulations 2017)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Distinguish between free and forced vibration.
2. What is Coulomb damping ?
3. Show one example to modify coupled system in to an uncoupled system.
4. What are normal modes of vibration ?
5. State the significance of Eigen values and Eigen vectors in a multi degree of freedom system.
6. Sketch neatly a response spectrum. State its use.
7. Give examples for continuous systems.
8. Write Rayleigh-Ritz equation and explain.
9. List any four methods of numerical algorithms for direct integration of equations of vibration.
10. Explain sub structure technique in vibration analysis.

PART – B **(5×13=65 Marks)**

11. a) Determine the natural frequency of a cantilever of length 350 mm and 25mm × 6mm cross section, width being more than the depth. At the free end, it is suspended with a weight of 200 N by a spring of stiffness 2 N/mm. Take Young's Modulus of the material of the beam as 210 GPa.

(OR)

b) A machine of weight 20 kN is mounted at the mid span of a simply supported beam of span 3 metres whose cross section is having a moment of inertia of 50×10^6 mm^4. A piston that moves up and down the machine produces a harmonic force of magnitude F_o = 30 kN and a frequency of 60 rad/sec. Assuming 10% of damping and neglecting the weight of the beam determine

i) the amplitude of motion of the machine **(5)**

ii) the force transmitted to the beam supports and **(4)**

iii) the corresponding phase angle. **(4)**

12. a) Taking a simple example of a two degree of freedom system with mass and springs, explain the steps to compute the natural frequencies and normal modes.

(OR)

b) A heavy automobile is modeled as two degree of freedom system as described below. Total weight. 15 kN, Total wheel base, 3 metres, in which centre of mass is at 1.35 m from the front wheel. The stiffnesses of the front and back suspensions assumed at the wheel locations are 36 kN/m and 37 kN/m respectively. The mass moment of inertia is 27 kg-m^2. Determine the natural frequencies and normal modes of vibration for the automobile.

(OR)

13. a) A three storey portal frame has masses of 50 kN at the roof, 100 kN in the second floor and 150 kN in the first floor all assumed to be lumped at the floor levels. The combined stiffness of the columns for the three floors from top to bottom are respectively, 20 kN/mm, 30 kN/mm and 40 kN/mm. Determine the natural frequencies and mode shapes for the frame.

(OR)

b) With a simple example, explain the procedure for analyzing a multi degree of freedom system using modal superposition method.

14. a) Derive the frequencies for the free longitudinal vibrations of a prismatic bar when one of its ends is clamped and the other, free.

(OR)

b) Determine the fundamental frequency of a propped cantilever of length 'L' loaded fully with a UDL of intensity 'w' per metre length using the polynomial , $y = C[3Lx^3 - 2Lx^4 - L^3x]$.

15. a) Briefly describe the various algorithms for numerical integration of vibration equations.

(OR)

b) A two storey shear building has total weights of 100 kN and 200 kN lumped in the top and next floor respectively. The stiffnesses of the top and bottom sets of columns are 150 kN/mm and 225 kN/mm respectively. Determine the absolute damping coefficients for the structure assuming 10% of critical damping for each mode.

PART – C **(1×15=15 Marks)**

16. a) A platform of weight 18 kN is being supported by four equal columns which are clamped to the foundation as well as to the platform. It was found that a static horizontal force of 4.5 kN has produced a displacement of 2.5 mm.

Assuming 5% of critical damping, determine for the platform

i) Undamped natural frequency **(4)**

ii) Absolute damping coefficient **(3)**

iii) Logarithmic decrement and **(3)**

iv) Number of cycles and the time required to reduce the amplitude of motion from 2.5 mm to 0.25 mm. **(5)**

(OR)

b) A water tank of weight 440 kN is mounted on a tower of lateral stiffness 40.2 kN/mm. If the tank is subjected to a triangular forcing function starting from zero to a maximum of 400 kN in a time duration of 0.1 sec., find the response of the system by any one of the numerical methods.

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