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Question Paper Code: 18073

M.E. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

First Semester

Structural Engineering

ST 7102 — STRUCTURAL DYNAMICS

(Regulations 2013)

Time: Three hours

Maximum: 100 marks

Answer ALL questions.

PART A — (10 x 2 = 20 marks)

1. What do you mean by damping? What are its forms?

2. Define the term: Dynamic load factor.

3. What are the normal modes of vibration?

4. State the concept of shear building.

5. State the orthogonality conditions.

6. List the approximate methods used to find the mode shapes and frequencies.

7. Write down the governing differential equation for flexural vibration of continuous systems.

8. How will you approximate the two lowest frequencies of the continuous system using Rayleigh Ritz method?

9. What is the principle involved in direct integration method?

10. Name some of the numerical procedures for finding the transient response of structure.
PART B — (5 × 13 = 65 marks)

11. (a) A platform of weight 20 kN is being supported by four equal columns which are clamped to the foundation as well as to the platform. A force of 10 kN applied horizontally to the platform produces a displacement of 5 mm. Damping is in the order of 6% of critical damping. Determine undamped natural frequency, absolute damping present in the system, logarithmic decrement and number of cycles and the time required for the amplitude of motion to be reduced from an initial value of 5 mm to 0.5 mm.

Or

(b) A single degree of system consists of a mass 20 kg, spring of stiffness 2200 N/m and a dashpot with a damping coefficient of 60 Ns/m is subjected to a harmonic excitation of \( F = 200 \sin 5t \) Newtons. Determine the steady state of response and write the solution of equation of motion.

12. (a) For the two degree of system shown in figure Q. 12 (a). The system parameters are given by \( m_1 = m, \ m_2 = 2m, \ k_1 = k \) and \( k_2 = 2k \). Determine the frequencies and the corresponding mode shapes.

![Figure Q. 12 (a) ](www.recentquestionpaper.com)

Or

(b) Determine the natural frequencies and mode shapes for the system shown in figure Q. 12 (b).

![Figure Q. 12 (b) ](www.recentquestionpaper.com)

13. (a) Determine the natural frequencies and mode shapes for the framed structure shown in figure Q. 13 (a).

![Figure Q. 13 (a) ](www.recentquestionpaper.com)

Or
(b) A three storey frame shown in figure Q. 13 (b) is subjected to an excitation force of \( P \cos wt \) at the top level due to steady state vibration. Determine the response at the top level on the basis of consideration of first mode only and first two modes only for \( w = 0 \) and \( w = 0.5 \rho_1 \).

![Fig. Q. 13 (b)](www.recentquestionpaper.com)

14. (a) Derive an expression for natural frequencies of transverse vibration and mode shapes of a uniform simply supported beam.

Or

(b) Determine the fundamental frequency for a uniform simply supported beam by assuming the static deflection curve as \( Y = (\rho Ag / 24EI) (L^2 x - 2Lx^3 + x^4) \). Compare the frequency with that of exact solution.

15. (a) Derive the expression for computing the response of a multi degree of freedom system using Wilson's \( \theta \) method.

Or [www.recentquestionpaper.com](www.recentquestionpaper.com)

(b) (i) Write down the procedure of numerical integration technique. (6)

(ii) Write down the procedure involved in the Non-Linear MDOF systems. (7)
PART C — (1 x 15 = 15 marks)

16. (a) Determine the dynamic response of a tower subjected to blast loading. The idealisation of the structure and the blast loading are shown in figure Q. 16 (a). Neglect damping.

(b) What is modal analysis? Which property of the eigen vector facilitates the modal analysis? Briefly explain the procedure of modal analysis.