Register No.: ..... Name: .....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SECOND SEMESTER M.TECH DEGREE EXAMINATION (Regular), MAY 2023

STRUCTURAL ENGINEERING AND CONSTRUCTION MANAGEMENT

(2021 Scheme)

Course Code: **21SC202**

Course Name: **Structural Dynamics**

Max. Marks: **60** **Duration: 3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

1. Illustrate the relevance of having vibration analysis in structural engineering problems.
2. Explain the physical importance of logarithmic decrement and define equation for the same.
3. Explain the salient features of frequency response curve of a damped SDOF system having harmonic excitation.
4. What is meant by orthogonality principle in multi degree of freedom system?
5. List out the main difference between Rayleigh's method and Rayleigh-Ritz method.
6. What is meant by Mode superposition method?
7. Write the importance of using Newmark Beta method.
8. List out various methods to solve nonlinear vibration problems.

PART B

(Answer one full question from each module, each question carries 6 marks)

MODULE I

9. Determine the natural frequency and natural period of vibration of a portal frame with one end fixed and the other end hinged having a mass of 50 kN lumped at the floor level, E = 2 x 10^5 N/mm^2, I = 15 x $10^7$$mm^4$. Storey height = 3.5 m. (6)

OR

10. What is meant by equations of motion? Explain any three methods employed for the formulation of the equations of motion. (6)

MODULE II

11. Differentiate between Undamped, Damped and Critical damping (6)

OR

12. Illustrate the role of using seismometers as one of the vibration measuring instrument. (6)

MODULE III

13. Derive the Fourier series expression for the given periodic loading and write the expression for the steady state response of an SDOF system (figure 1). (6)

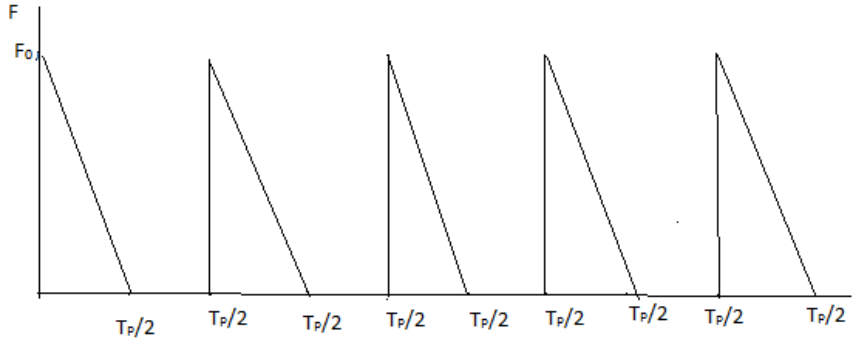

Figure 1

OR

14. A steel rigid frame of height 4 m supports a rotating machine which exerts a horizontal force at the girder level of 50000sin11t N. Assume 6% critical damping and mass of the girder as 4500 kg. What is the steady state amplitude of vibration? (Take I = 1500×10^{-7} m^4 and E = 2×10^{10} N/m^2). (6)

MODULE IV

15. Determine the natural frequency and mode shape for $[M] = \begin{Bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{Bmatrix}$ and $[K] = \begin{Bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{Bmatrix}$ (6)

OR

16. Determine the natural frequency and mode shape of a simply supported beam (figure 2). (6)

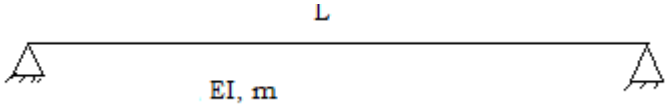

Figure 2

MODULE V

17. A three storeyed building frame of storey height 3.2 m and beam span 8 m is loaded on the top beam with a UDL of 25 kN/m and the other beams carry a UDL of 35 kN/m. If the columns have a uniform moment of inertia of 5×10^7 mm^4 and if E = 2×10^5 N/mm^2, compute the frequencies and mode shapes of the frame using Stodola's method. (6)

OR

18. Find the fundamental frequency of a three-storey building shown in figure 3 by assuming $\Phi = \begin{matrix} 1 \\ 0.6 \\ 0.3 \end{matrix}$, by using Rayleigh's method. (6)

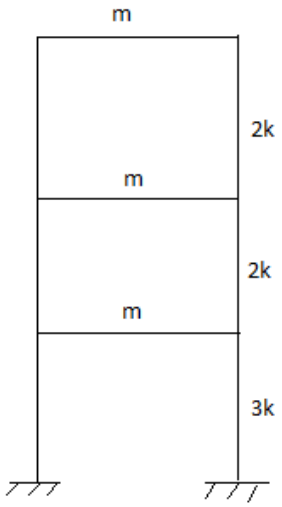

Figure 3

MODULE VI

19. Substantiate the relevance of the numerical technique Wilson Theta method used for non-linear dynamic analysis. (6)

OR

20. Substantiate the relevance of the numerical technique Runga Kutta method used for non-linear dynamic analysis. (6)

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