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

# SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

**SECOND SEMESTER M.TECH DEGREE EXAMINATION (S), AUGUST 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. Determine the natural frequency of the fixed beam of span L meters carrying a concentrated weight W newton at its centre. Neglect the mass of the beam.
2. Sketch the mathematical model for damped SDOF system.
3. Write short note on passive isolation?
4. Derive the characteristic equation for an undamped two degree of freedom system under free vibration.
5. List out three approximate methods for obtaining the response of MDOF systems with free vibration. Explain the steps involved in any one of the methods.
6. Describe the mode superposition method for the forced vibration analysis of a multi-degree of freedom system.
7. List out various methods to solve nonlinear vibration problems.
8. What is the importance of using Runge Kutta method as a Numerical Techniques?

## PART B

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

### MODULE I

9. a) Discuss the importance of dynamic analysis in Civil Engineering Structures. (3)
   b) Differentiate between linear and non-linear vibration. (3)

**OR**

10. A system vibrating with a natural frequency of 6 Hz starts with an initial amplitude of 1.5 cm and an initial velocity of 20 m/s. Determine the natural period, amplitude, maximum velocity, maximum acceleration and phase angle. Also write equation of motion of the vibrating system. (6)

**MODULE II**

11. A damped free vibration test is conducted to determine the dynamic properties of a single storey building. The mass of the building is 10,000 kg. Initial displacement of the building is 0.702 cm. Maximum displacement on the first cycle is 0.53 cm and the period of this displacement cycle is 1.7 s. Determine the effective weight, undamped frequency, logarithmic decrement, damping ratio, damping coefficient, damped frequency and the amplitude after 6 cycles. (6)

**OR**

12. Describe the components of a dashpot and develop the characteristic equation of motion for viscous damping. (6)

**MODULE III**

13. Draw and describe the salient features of the characteristic curves of a SDOF with damped harmonic excitation. (6)

**OR**

14. Derive the dynamic load factor for the rectangular impulse shown in figure 1 using Duhamel's integral. (6)

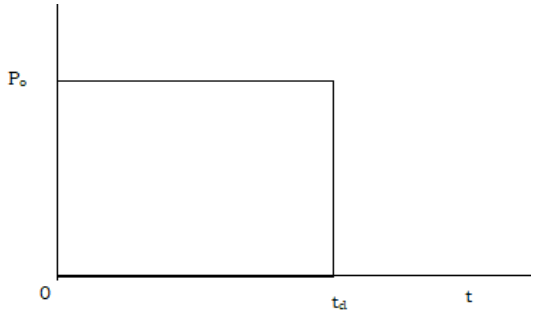


Figure 1

**MODULE IV**

15. Find the natural frequencies and mode shapes of the three degree of freedom, for a shear building frame with span 6m. Mass at each floor are, $m_1$ = 10000 kg, $m_2$ = 12000 kg and $m_3$ = 12000 kg. Each floor height of the frame is 4m each. EI = 4.5 x $10^6$ N-$m^2$ (6)

**OR**

16. Determine the natural frequencies and mode shapes of a uniform thin slender rod having one end fixed and other end free. Plot the first three principle mode shapes. (6)

**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 x $10^7$ $mm^4$ and if E = 2 x $10^5$ N/$mm^2$, compute the (6)

frequencies and mode shapes of the frame using Stodola's method.

**OR**

18. Find the fundamental frequency of a three-storey building shown in figure 2 by assuming $\Phi = \begin{matrix} 1 \\ 0.6 \\ 0.3 \end{matrix}$, by using Rayleigh's method. ( )

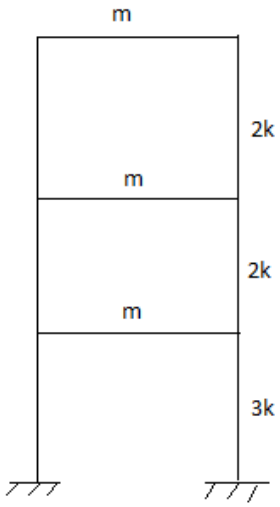


Figure 2

**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 Newmark Beta method used for non-linear dynamic analysis (6)

**********