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

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIRST SEMESTER M.TECH DEGREE EXAMINATION (Regular), DECEMBER 2023

(MACHINE DESIGN)

(2021 Scheme)

Course Code : **21MD102**

Course Name: **Theory of Vibration**

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

PART A

(Answer all questions. Each question carries 3 marks)

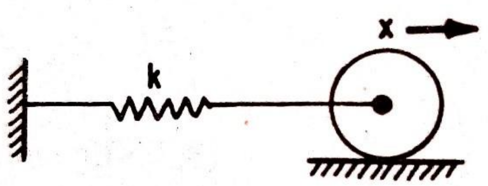
1. Derive the equation of motion of a spring-mass system subjected to free vibration using Newton Method.
2. A shock absorber is to be designed so that its overshoot is 10% of the initial displacement when released. Determine the damping factor. If the damping factor is reduced to one-half this value, what will be the overshoot?
3. Explain Force Transmissibility?
4. Discuss the basis for expressing the response of a system under periodic excitation as a summation of several harmonic responses?
5. What is Duhamel integral. What is its use.
6. Find the steady state response of a damped spring-mass system subjected to a step function of magnitude F_0 by using the method of Laplace transformation.
7. Find the frequencies of a semi definite system.
8. What do you mean by Eigen values and Eigen vectors.

PART B

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

MODULE I

9. Determine the equation of motion and natural frequency of the system shown in the figure. (6)



OR

10. A Shaft of diameter 75 mm and length 1000 mm is fixed at one end and carries a flywheel of mass 1500 kg and radius of gyration 0.4 m at the other end. For the shaft material E= 210 GPa, G= 84 GPa. Find the natural frequencies of free longitudinal, (6)

transverse and torsional vibrations.

MODULE II

11. A vibrating system is defined by the following parameters: m= 3Kg, k = 100N/m, c = 3 Ns/m. Determine (i) the damping factor, (ii) natural frequency of damped vibration, (iii) logarithmic decrement, (iv) the ratio of two successive amplitudes, and (v) the number of cycles after which the original amplitude is reduced to 20 percent? (6)

OR

12. A horizontal spring mass system with coulomb damping has a mass of 5 Kg attached to a spring of stiffness 980N/m. If the coefficient of friction is 0.025, calculate (i) the frequency of free oscillation (ii) the number of cycles corresponding to 50% reduction in amplitude if the initial amplitude is 5 cm and (iii) the time taken to achieve this 50% reduction? (6)

MODULE III

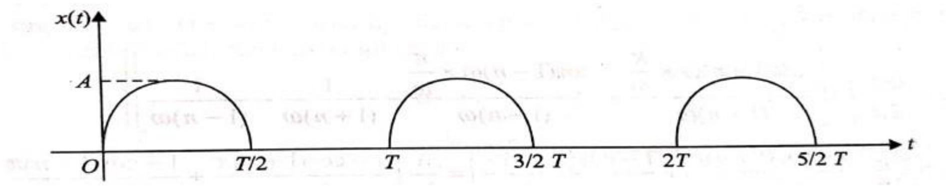
13. A reciprocating machine weighing 25N running at 6000 rpm after installation has a natural frequency very close to the forcing frequency of vibrating system. Design a dynamic vibration absorber of the nearest frequency of the system which is to be at least 20% from the excitation frequency? (6)

OR

14. A single degree of freedom damped system is composed of mass of 10 Kg, a spring having a spring constant of 2000 N/m and a dashpot having a damping constant of 50 Ns/m. The mass of the system is acted on by a harmonic force $F = F_0 \sin(\omega t)$ having a maximum value of 250 N and a frequency of 5 Hz. Determine the complete solution for the motion of the mass? (6)

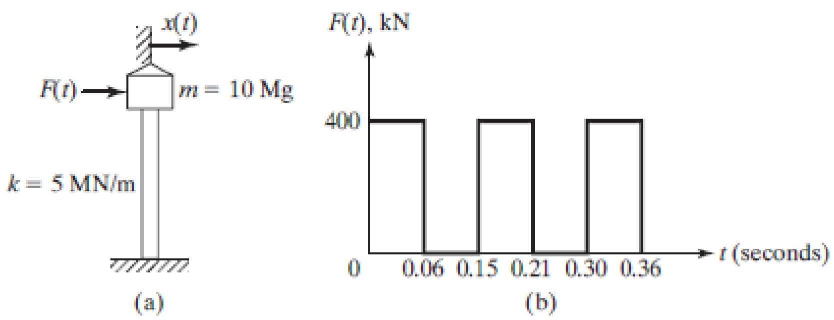
MODULE IV

15. Represent the wave in Fourier series. (6)



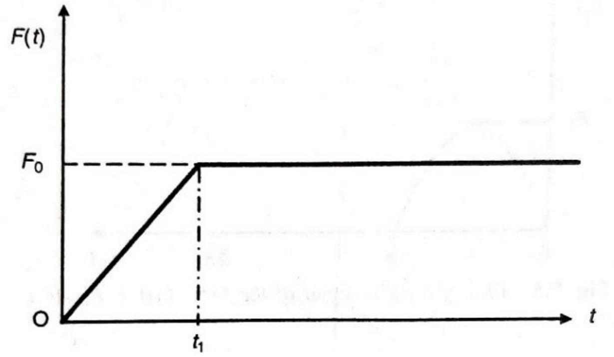
OR

16. Find the displacement of the water tank shown in Fig. under the periodic force treating it as an undamped single-degree-of-freedom system. (6)



MODULE V

17. Determine the forced response of the undamped SDOF system subjected to the rising time forcing function as shown in the figure? (6)

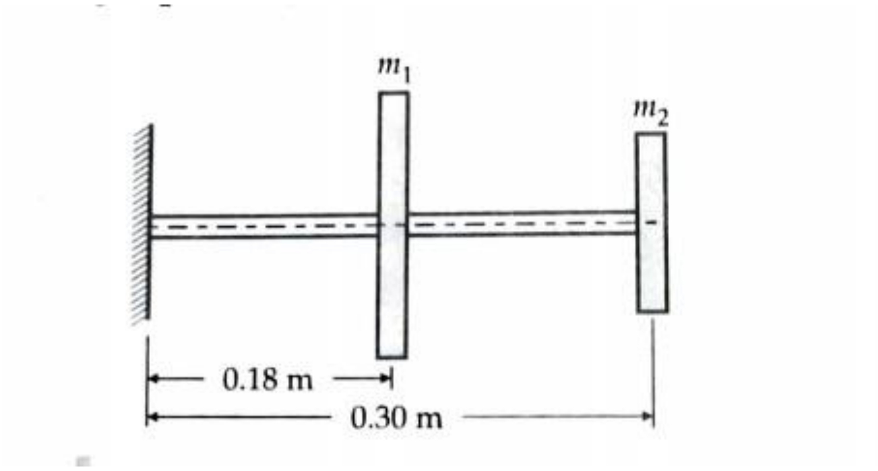


OR

18. Find the response of a single-degree-of-freedom system under an impulse for the following data: m = 2 kg, c = 4 N-s/m, k = 32 N/m, F = 4 δ(t), Initial velocity and displacement are 0.01 m and 0.01 m/s respectively. (6)

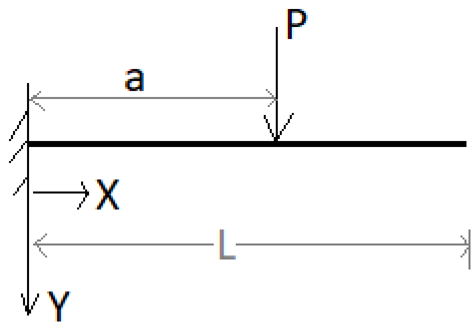
MODULE VI

19. Use Stodola's method to find the natural frequency of the system shown in the Fig. $E = 1.96 \times 10^{11}$ N/m², $I = 4 \times 10^{-7}$ m², m_1 = 100 Kg, m_2 = 50 Kg.



(6)

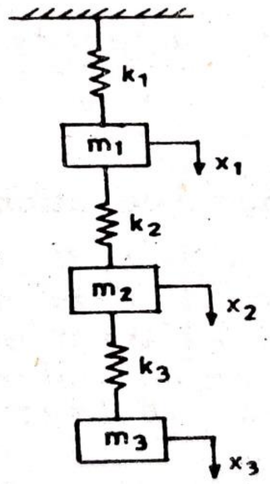
Use the notion given below for finding the solution



$$y(x) = \begin{cases} \dfrac{Px^2}{6EI}(3a - x); & 0 \le x \le a \\ \dfrac{Pa^2}{6EI}(3x - a); & a \le x \le L \end{cases}$$

OR

20. Using Holzer's method find the natural frequencies of the system shown in the Fig. Assume $m_1 = m_2 = m_3 = 1$ Kg and $k_1 = k_2 = k_3 = 1$ N/m. (6)



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