Register No.: …… Name: ……..

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIRST SEMESTER M.TECH DEGREE EXAMINATION (Regular), FEBRUARY 2022

(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)

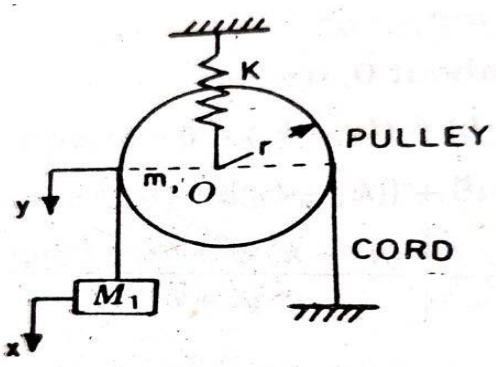
1. An unknown mass m is attached to one end of a spring of stiffness k having natural frequency of 6Hz. When 1kg mass is attached with m the natural frequency of the system is lowered by 20%. Determine the value of unknown mass m and stiffness k.
2. The ratio of successive amplitudes of a viscously damped single-degree-of-freedom system is found to be 18:1. Determine the ratio of successive amplitudes if the amount of damping is (a) doubled, and (b) halved.
3. Explain Displacement 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. Define these terms: mass coupling, velocity coupling, elastic coupling.
8. Find the frequencies of a semi definite system.

PART B

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

MODULE I

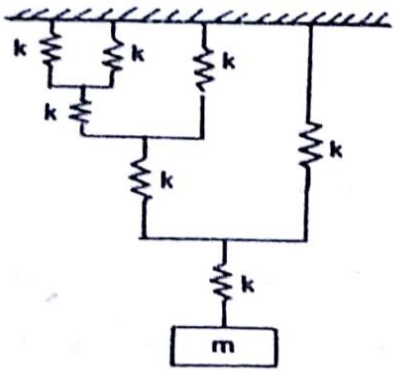
9. Determine the equation of motion and natural frequency of the system shown in the figure.



(6)

OR

10. Find the natural frequency of the system shown in the figure for m = 20 Kg and k = 200000 N/m? (6)



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 weight of 50 N is suspended from a spring of stiffness 5000 N/m and is subjected to a harmonic force of amplitude 40 N and frequency of 4 Hz. Find the (i) extension of the spring due to the suspended weight (ii) the static displacement of the spring due to the maximum applied force and (iii) the amplitude of the forced motion of the weight. (6)

MODULE III

13. A machine 100 Kg mass has a 20 Kg rotor with 0.5 mm eccentricity. The mounting springs have k = 85000 N/m, eccentricity = 0.02. The operating speed of the machine is 600 rpm and the unit is constrained to move vertically. Find (i) the dynamic amplitude of the machine and (ii) the force transmitted to the supports? (6)

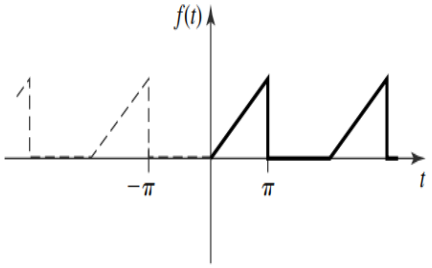
OR

14. A 50 Kg mass is attached to a base through a spring in parallel with a damper. The base undergoes harmonic excitation of $y(t) = 0.20 \sin 30t$. The stiffness of the spring is 30000 N/m and the damping constant is 200 Ns/m. Determine the amplitude of the mass (absolute displacement) and the amplitude of its displacement relative to its base. (6)

MODULE IV

15. Express the periodic function as a Fourier series (6)

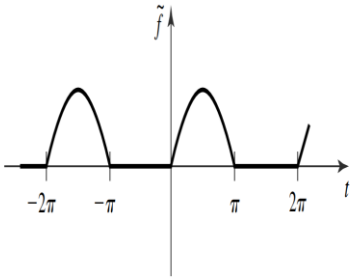
$$f(t) = \begin{cases} 0, & -\pi < t < 0 \\ t, & 0 < t < \pi \end{cases}$$



OR

16. Derive the equivalent harmonic series for the function given by

$$f(t) = \begin{cases} \sin t, & 0 \le t \le \pi \\ 0, & \pi \le t \le 2\pi \end{cases}$$



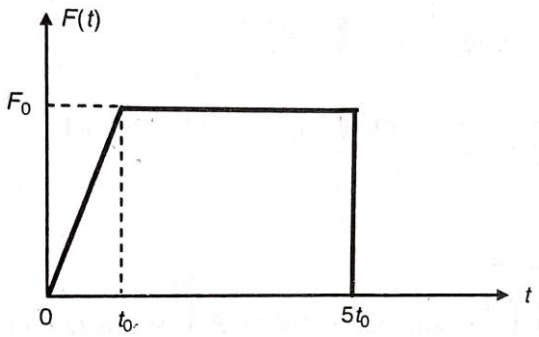
(6)

MODULE V

17. 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 0.01m and 0.01 m/s respectively. (6)

OR

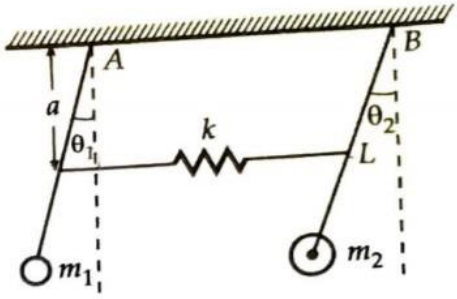
18. Find the response of an undamped, single degree of freedom system subjected to a forcing function given by



(6)

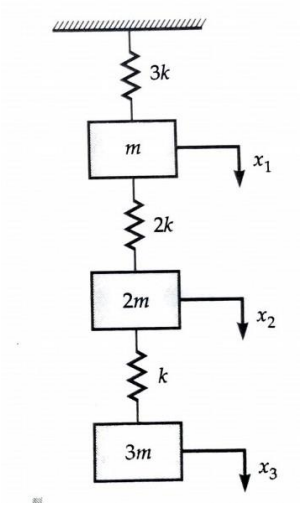
MODULE VI

19. Determine the natural frequency and mode shapes of the coupled pendulum given in Fig., if k = 100 N/m, m_1 = 2 Kg, m_2 = 5 Kg, L = 0.20 m and a = 0.10 m? (6)



OR

20. Determine the flexibility influence coefficients of the spring-mass system shown in the figure? (6)



****