

B. Tech. (Mech. Engg.) (Semester – 7th)
MECHANICAL VIBRATIONS
Subject Code: BMECD1723
Paper ID: [18112343]

Time: 03 Hours

Maximum Marks: 60

Instruction for candidates:

1. Section A is compulsory. It consists of 10 parts of two marks each.
2. Section B consist of 5 questions of 5 marks each. The student has to attempt any 4 questions out of it.
3. Section C consist of 3 questions of 10 marks each. The student has to attempt any 2 questions.

Section – A

(2 marks each)

Q1. Attempt the following:

- a) What is a mechanical vibration?
- b) Differentiate between continuous and discrete systems.
- c) Use Rayleigh's method to derive the formula for the natural frequency of a mechanical system.
- d) What is the difference between linear and non-linear vibrations?
- e) What is meant by the magnification factor? What are the factors on which it depends?
- f) List out the materials used for vibration isolation. Which material is most suitable for compressive loads?
- g) Explain the concept of influence coefficients in vibration analysis.
- h) Define eigenvalues and eigenvectors in the context of vibrational analysis.
- i) What different end conditions affect the natural frequency of a vibrating beam?
- j) What factors influence the torsional vibration frequency of a shaft?

Section – B

(5 marks each)

- Q2 The springs of an automobile trailer are compressed 0.7 m under its own weight. Find the critical speed when the trailer is passing over a road with a profile of a sine wave whose amplitude is 80 mm and the wavelength is 14 m. find the amplitude of vibrations at a speed of 60 km/hr.
- Q3 Prove that an undamped measuring instrument will show a true response for frequency ratio ($\omega/\omega_n = 1/\sqrt{2}$).
- Q4 A vibratory system in a vehicle is to be designed with the following parameters: $k = 100$ N/m, $c = 2$ N-sec/m, $m = 1$ kg. Calculate the decrease of amplitude from its starting value after 3 complete oscillations and the frequency of oscillation.
- Q5 What is the purpose of the vibrometer? Explain how it works.
- Q6 Find the natural frequency of the system shown in Fig. 1. $k = 2 \times 10^5$ N/m, $m = 20$ kg.

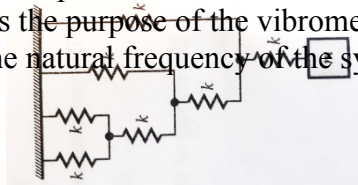


Fig. 1

Section – C

(10 marks each)

Q7 Determine the natural frequencies of the system shown in Fig. 2.

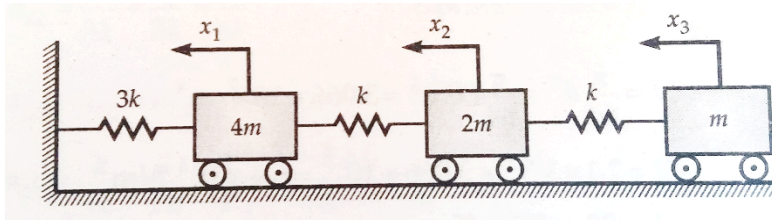


Fig. 2

Q8 Find the lowest natural frequency of vibration for the system shown in Fig. 3. $E = 1.96 \times 10^{11} \text{ N/m}^2$, $I = 4 \times 10^{-7} \text{ m}^4$.

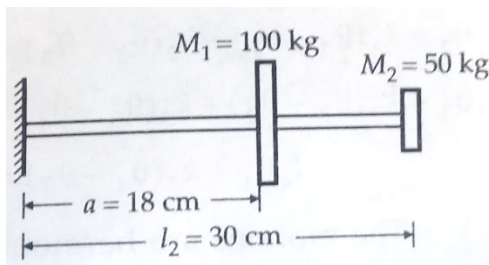


Fig. 3

Q9 A gun barrel having a mass of 560 kg is designed with the following data: initial recoil velocity = 36 m/sec; recoil distance on firing = 1.5 m. Calculate **(a)** spring constant, **(b)** damping coefficient, and **(c)** time required for the barrel to return to a position 0.12 m from its initial position.