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Total No. of Questions : 09] [Total No. of Pages : 03

Paper ID [ME408]

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B.Tech. (Sem. - 7th/8th)

MECHANICAL VIBRATION (ME - 408)

Time : 03 Hours Maximum Marks : 60

Instruction to Candidates:

1) Section - A is **Compulsory**.
2) Attempt any **Four** questions from Section - B.
3) Attempt any **Two** questions from Section - C.

Section - A

Q1) *(10 × 2 = 20)*

a) What is vibration?

b) Define the degree of freedom of a vibrating system.

c) What are different methods of finding the natural frequency of free longitudinal vibrations?

d) How do you add two harmonic motions having different frequencies?

e) Define the term elastic line of the shaft.

f) What is use of logarithmic decrement?

g) Define the flexibility and stiffness influence coefficient.

h) Define the hysteresis damping constant.

i) Define proportional damping and modal damping ratio.

j) Define the term magnification factor. How is the magnification factor related to the frequency ration?

Section - B

(4 × 5 = 20)

Q2) What is importance of vibration measurement? What is an electromagnetic shaker?

Q3) A suspension system is being designed for 200 Kg vehicle. It is estimated that the maximum added mass from passengers and cargo is 1000 kg. When the vehicle is empty, its static deflection is to be 3.1 mm. What is the minimum value of the damping coefficient such that the vehicle is subjected to no more than 5 percent overshoot, empty of full?

Q4) Find the total response of a viscously damped single degree of freedom system subjected to a harmonic base excitation for the following data: m = 10 kg, c = 20N-m/s, k = 4000N/m, y(t) = 0.05 sin 5t m, x_0 = 0.02 m, $\dot{x}_0$ = 10 m/s.

Q5) Three machines are equally spaced along the span of simply supported beam of elastic modulus E and mass moment of inertia I. Determine the flexibility matrix for 3-degree of freedom model of the system as shown in Fig.1.

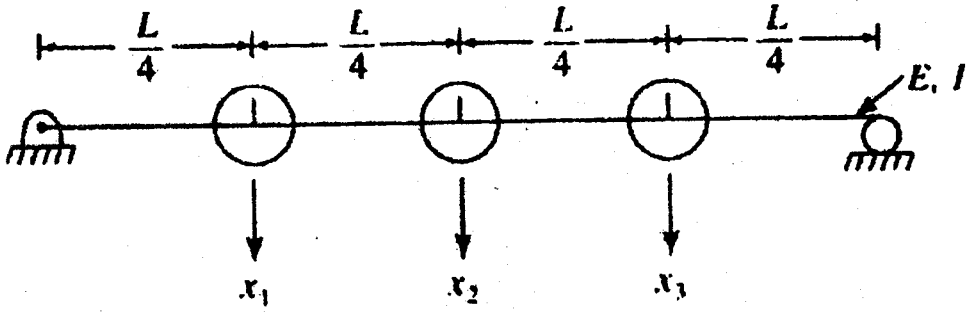

Fig. 1

Q6) An Electronic instrument is to be isolated from a panel that vibrat at frequencies ranging from 25 Hz to 35 Hz. It is estimated that at least 80% vibration isolation must be achieved to prevent damage to the instrument. If instrument weights 85 N, find the necessary static deflection of the isolator.

Section - C

(2 × 10 = 20)

Q7) A 110 kg machine with a 0.45 g-m rotating unbalance is placed at the end of a 1.5-m-long steel (E = 200 Gpa, density = 7800 kg/m^3) fixed free beam of cross sectional area 0.014 m^2, moment of inertia 3.5 × 10^{-6} m^4 and length 1.5m. The machine operates at 200 Hz. Use a 3-degree of freedom model for the beam and approximate the machine's steady state amplitude.

Q8) Estimate the fundamental frequency of the lateral vibration of a shaft carrying three rotors shown in Fig 2 with m_1 = 20 kg, m_2 = 50 kg, m_3 = 40 kg, l_1 = 1m, l_2 = 3m, l_3 = 4m and l_4 = 2m. The shaft is made of steel with solid circular cross section of diameter 10 cm.

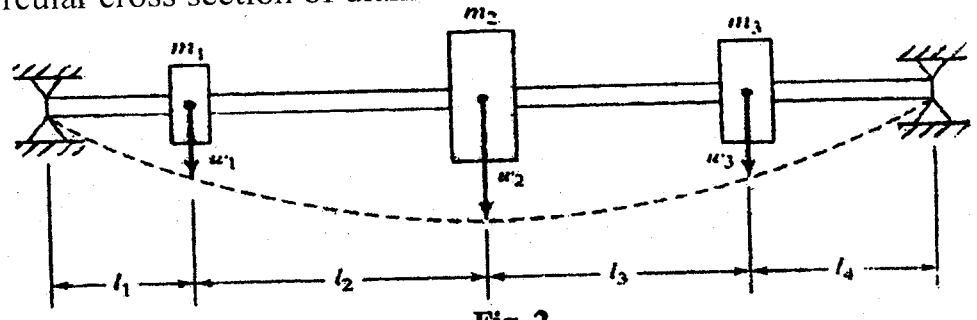

Fig. 2

Q9) A vertical shaft is held in long bearings and a disc is attached to the shaft at the mid point. The centre of gravity of the disc does not coincide with the axis of the shaft. Determine (i) critical speed of the shaft (ii) the range of the speed over which it is unsafe to run the shaft.The diameter of the shaft is 15 mm and the span of the shaft between the bearings is one meter. The mass of the disc is 10 kg and centre of gravity of the disc is 0.30 mm from the axis of the shaft. Take E =200 GPa. And permissible stress in the shaft material is 70 MPa.

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