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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Sixth Semester, B.E. - Automobile Engineering

Semester End Examination; May / June - 2019

Mechanical Vibrations

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. Explain the different types of Vibration. 10

b. Determine the effect of the mass of the spring on the natural frequency of the system as shown in Fig. 1(b). 10

2 a. Define Damping. With an example explain the different types of Damping. 10

b. A gun barrel having mass 560 kg is designed with Initial recoil velocity 36 m/s and recoil distance on firing 1.5 m. Calculate Spring Constant, Damping Coefficient and time required for the barrel to return to a position 0.12 m from its initial position. 10

UNIT - II

3 a. The Springs of an automobile trailer are compressed 0.1 m under its own weight. Find the critical speed when the trailer is travelling over a road with a profile approximated by a sine wave of amplitude 0.8 m and wavelength of 14 m. What will be the amplitude of vibration at 60 km/hr? 8

b. An electric motor is supported on a Spring and a dashpot. The Spring has the stiffness 6400 N/m and the dashpot offers resistance of 500 N at 4.0 m/s. The unbalanced mass 0.5 kg rotates at 5 cm radius and the total mass of vibratory system is 20 kg. The motor runs at 400 rpm. Determine; 12

i) Damping Factor

ii) Amplitude of Vibration and phase angle

iii) Resonant speed and resonant amplitude

iv) Forces exerted by the spring and dashpot on the motor

4 a. Explain Absolute motion in a Vibratory system where the support is put to excitation. Derive an expression. 10

b. An industrial machine of mass 455 kg is supported on a spring with a statistical deflection of 0.5 cm. If the machine has a rotating imbalance of 2.5 N-m, determine the force transmitted at 1200 rpm and the dynamic amplitude at that speed. 10

UNIT - III

5 a. With necessary sketches, explain how frequency and acceleration of a vibrating body is measured? 12

Contd…2

b. A Trailer has 1000 kg mass when fully loaded and 250 kg when empty. The spring of the suspension is 350 kN/m. The damping factor is 0.5 when the trailer is fully loaded. The speed is 1000 km/hr. The road varies sinusoidally with a wavelength of 5 m. Determine the amplitude ratio of the trailer when fully loaded and empty. 8

6 a. Explain the Analytical and Numerical method of Harmonic Analysis. 8

b. A device used to measure torsional acceleration consists of a ring having a moment of inertia of 0.049 kg-m^2 connected to a shaft by a spiral spring having a scale of 0.98 N-m/rad, and a viscous damper having a constant of 0.11 N-m-s/rad. When the shaft vibrates with a frequency of 15 cpm, the relative amplitude between the ring and the shaft is found to be 2°. What is the maximum acceleration of the shaft? 12

UNIT - IV

7 a. Fig. 7(a) shows a vibrating system having two degrees of freedom. Determine the two natural frequencies of vibrations and the ratio of amplitudes of the motion of m_1 and m_2 for the two modes of vibration. 10

b. Two bodies having equal masses as 60 kg each and radius of gyration 0.3 m are keyed to both ends of a shaft 0.80 m long. The shaft is 0.08 m in diameter for 0.30 m length, 0.10 m diameter for 0.20 m length and 0.09 m diameter for rest of the length. Find the frequency of torsional vibrations. Take; G = $9x10^{11}$ N/m^2. 10

8 a. Explain Un-damped dynamic vibration absorber. 12

b. A Vibrating system performs the motions as expressed by the following equations;

$\ddot{x} + 800x + 90\theta = 0$; $\ddot{\theta} + 800\theta + 90x = \theta$

If the system is turned through 1.5 radians and released, find the frequencies and mode shapes. 8

UNIT - V

9 a. Explain Orthogonality Principle. 8

b. Find the lowest natural frequency of Transverse vibrations for the system in Fig. 9(b) by Rayleigh's method. Take; E =$1.96x10^{11}$ N/m^2 and I = 10^{-6} m^4. 12

10 a. Using matrix method, determine the natural frequencies of the system shown in Fig. 10 (a). 10

b. A shaft of negligible weight 6 cm diameter and 5 m long is simply supported at the ends and carries four weights 50 kg each at equal distance over the length of the shaft as shown in Fig. 10 (b). Find the frequency of vibration by Dunkerley's method.

Take; E = $2x10^6$ kg/cm^2. 10

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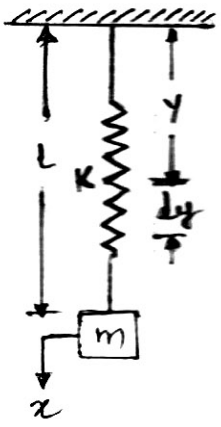

Fig. 1(b)

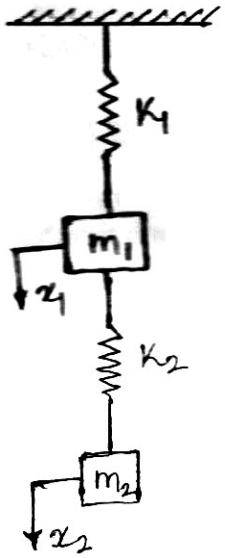

Fig. 7(a)

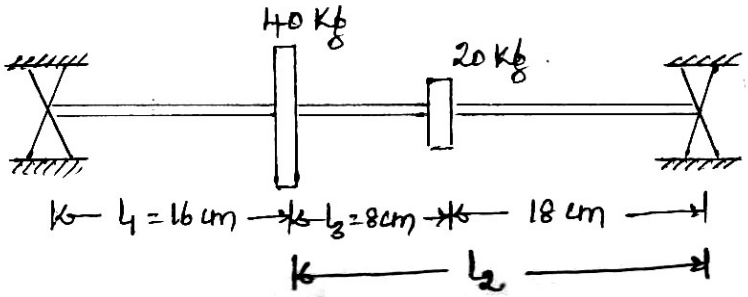

Fig. 9(b)

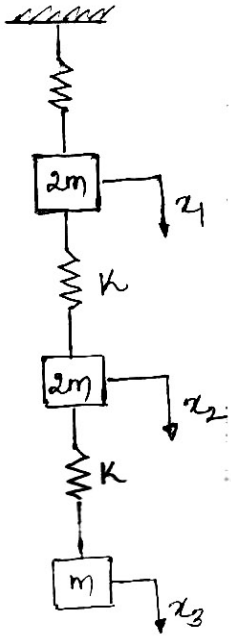

Fig. 10(a)

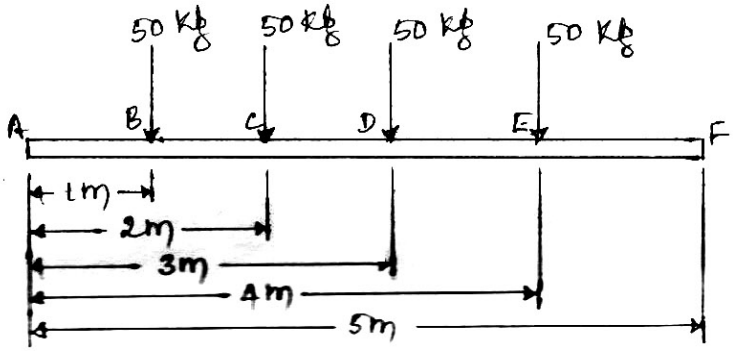

Fig. 10(b)

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