CBCS SCHEME

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15AU82

Eighth Semester B.E. Degree Examination, July/August 2021
Mechanical Vibrations

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

1 a. Explain longitudinal, transverse and torsional vibrations. **(06 Marks)**

b. Add the following harmonics analytically and validate graphically $x_1 = 4\cos(\omega t + 10^\circ)$, $x_2 = 6\sin(\omega t + 60^\circ)$. **(10 Marks)**

2 a. Find equivalent stiffness of springs connected in series and parallel, with usual notations. **(08 Marks)**

b. Determine the natural frequency of mass m = 15 kg as shown in Fig. Q2 (b), assuming that chords do not stretch and slide over the pulley rim. Assume pulley has no mass and take $K_1 = 8\times10^3$ N/m and $K_2 = 6\times10^3$ N/m. **(08 Marks)**

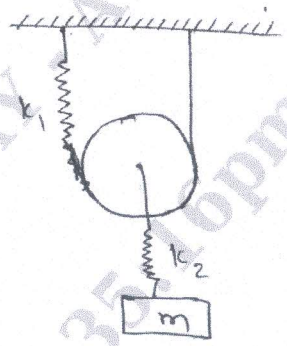


Fig. Q2 (b)

3 a. Set up the differential equation for damped free vibration and obtain the complete solution for critically damped system. **(10 Marks)**

b. Vibratory system in a vehicle is to be designed with K = 100 N/m, C = 2 NS/m, M = 1 kg. Calculate the (i) Decrease of amplitude from its starting value after complete oscillations (ii) The frequency of oscillation. **(06 Marks)**

4 a. Obtain the relationship for shaft running at critical speed with damping. **(08 Marks)**

b. The rotor of a turbo super charged weighing 9 kg is keyed to the center of 25 mm diameter steel shaft 40 cm between bearings. Determine

(i) The critical speed of shaft.

(ii) The amplitude of vibration of the rotor at a speed of 3200 rpm if the eccentricity is 0.015 mm. Assume shaft supported by simply supported. Take E = 210 GPa, $\rho = 8000$ kg/m^3 **(08 Marks)**

5 a. Define transmissibility. Derive expression for motion transmissibility. **(08 Marks)**

b. A machine of total mass 17 kg is mounted on springs having stiffness 11000 N/cm. A piston within the machine has a mass of 2 kg has a reciprocating motion with stroke 7.5 cm and speed 6000 rpm. Assume the motion is SHM. Determine

(i) Amplitude of machine (ii) Transmissibility. (iii) Force transmitted. **(08 Marks)**

6 a. Derive an expression for motion of rotating unbalanced machine. **(08 Marks)**

b. The weight of an electric motor is 125 kg and it runs at 1500 rpm. The armature weighs 35 kg and its centre of gravity lies 0.05 cm from axis of rotation. The motor is mounted on 5 springs of negligible damping so that the force transmitted is one-eleventh of impressed force. Assuming the weight is equally distributed among the 5 springs.
Determine following :

(i) Stiffness of each spring.
(ii) Dynamic force transmitted to base.
(iii) Natural frequency of the system. **(08 Marks)**

7 a. What is dynamic vibration absorber? **(02 Marks)**

b. The figure Fig. Q7 (b) below shows a vibrating system having 2 degrees of freedom. Determine the 2 natural frequencies of vibrations and the ratio of amplitudes of motion of m_1 and m_2. For the two modes of vibration. **(14 Marks)**

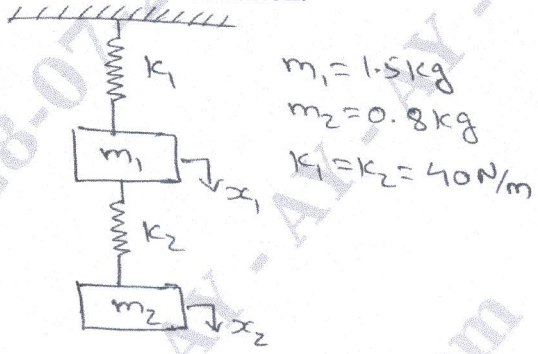


Fig. Q7 (b)

8 a. Explain Fullerron and Fran m tachometer with neat sketches. **(12 Marks)**

b. A vibrometer indicates 2 percent error in measurement and its natural frequency is 5 Hz. If the lowest frequency that can be measured is 40 Hz. Find the value of damping factor (ξ). **(04 Marks)**

9 a. Explain Maxwell reciprocal theorem. **(06 Marks)**

b. Find the influence coefficients, for the system shown in Fig. Q9 (b). **(10 Marks)**

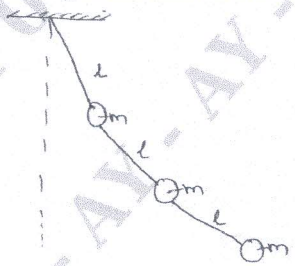
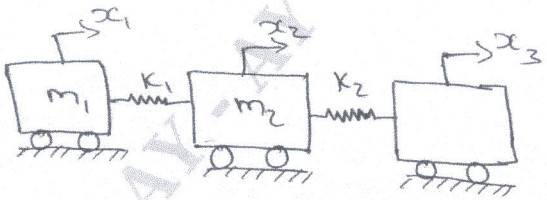


Fig. Q9 (b)

10 Determine natural frequency and mode shape of system shown in Fig Q10 by Holzer's method. **(16 Marks)**



$m_1 = 2$ kg ;
$m_2 = 4$ kg ;
$m_3 = 2$ kg ;
$K_1 = 5$ N/m ;
$K_2 = 10$ N/m

Fig. Q10

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