6E 7014

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6E7014

B.Tech. VI Semester (Main/Back) Examination, May-June - 2015

Mechanical Engineering

6ME4A Vibration Engineering

Time : 3 Hours **Maximum Marks : 80**

Min. Passing Marks : 24

Instructions to Candidates:

*Attempt any **five** questions, selecting **one** question from **each unit**. All questions carry **equal** marks. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.*

Use of following supporting material is permitted during examination (Mentioned in form No.205)

1. Graph paper - (No. cem)

Unit - I

1. a) What is meant by frequency based hearing sensitivity? What are the usual audible frequency range and frequency range of human voice? **(8)**

b) What are the major sources of noise in urban environment? Explain the non - auditory effects of these on people. **(8)**

OR

1. a) A machine is subjected to the motion $x(t) = A\cos(50t+\phi)$ mm. The initial conditions are $x(0) = 3$ mm and $dx/dt(0) = 1$ m/sec. Find

i) The constants A and ϕ

ii) Express the motion in the form $x(t) = A_1 \cos wt + A_2 \sin wt$, and identify constants A_1 and A_2. **(8)**

b) Add the following harmonic motions analytically $x_1 = 4\cos(wt+10^0)$ and $x_2 = 6\sin(wt+60^0)$. Check this obtained solution graphically. **(8)**

Unit - II

2. a) Derive the frequency equation for a compound pendulum. Explain the importance of centre of percussion. **(8)**

   b) A steel wire with young's modulus $E = 2 \times 10^{11}$ N/m^2 is of 1.5mm diameter and is 30mm long. It is fixed at the upper end and carries a mass M kg at its lower end. Find M so that frequency of longitudinal vibration is 3 cycles/sec. **(8)**

OR

2. a) A mass of 1.2 kg is attached to a spring having stiffness of 4700 N/m. The mass slides on a horizontal surface, The coefficient of friction between the mass and surface being 0.1. Determine the frequency of vibrations of the system and the amplitude after two cycles if the initial amplitude is 0.3cm. Determine the final rest position. **(8)**

   b) A mass of 3 kg is supported on an isolator having a spring constant of 3000 N/m and viscous damping. If the amplitude of free vibration of the mass falls to one half its original value in 2 sec, determine the damping coefficient of the isolator. **(8)**

Unit - III

3. a) Derive the expression for motion transmissibility and plot the curve for the same. **(8)**

   b) A machine 90 kg mass has a 15 kg rotor with 0.4 mm eccentricity. The mounting spring have $k = 80 \times 10^3$ N/m and damping ratio $\xi = 0.02$. The operating speed of machine is 600 r.p.m. and the machine is constrained to move vertically. Find the dynamic amplitude of machine. **(8)**

OR

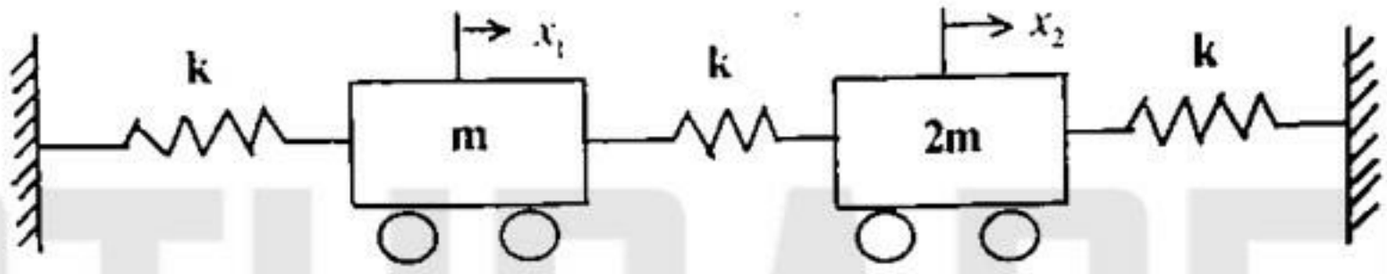
3. a) A trailer has 900 kg mass when fully loaded and 300 kg when empty. The spring of the suspension is 300 kN/m. The damping ratio $\xi = 0.5$ when the trailer is fully loaded. It travels on the road at the 90 km/Hv. The road has sinusoidal profile with a wavelength of 5m. Determine the amplitude ratio of the trailer when it is fully loaded. **(8)**

   b) A mass of 200kg is suspended on a spring having a stiffness of 30,000 N/m and is acted upon by a harmonic force of 80 N at the undamped natural frequency. The damping may be considered to be viscous with a coefficient of 200 N sec/m. Calculate the amplitude of vibration of the mass and the phase difference between the force and displacement. **(8)**

Unit - IV

4. a) Explain the principle of centrifugal pendulum absorber. Also describe with an example how such an arrangement can be utilized for an I.C engine. **(8)**

b) Figure shown an undamped two degrees of freedom system. Determine the governing equation of motion for the system. The natural frequencies of the system and the normal modes of the system. **(8)**



OR

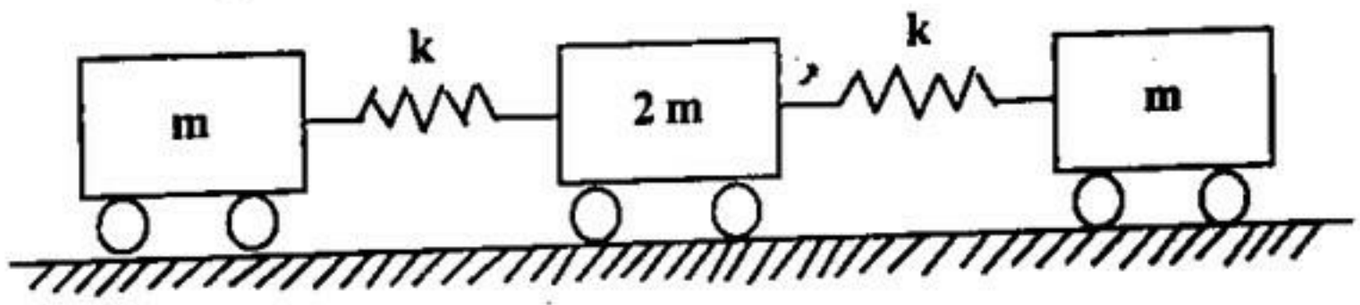
4. A vertical steel shaft of 12mm diameter is held in long bearings 1 meter a part and carries at its middle a disc of mass 12 kg. The eccentricity of the centre of gravity of the disc from the centre of the rotor is 0.30mm. The modulus of elasticity for the shaft material is 200 N/m^2 and the permissible stress is 70 MN/m^2, Determine:

i) The critical speed of the shaft and

ii) The range of speed over which it is unsafe to run the shaft. Neglect the mass of the shaft. **(16)**

Unit - V

5. Determine the natural frequencies and plot the mode shapes for the three rail bogies connected through coupler spring as shown in figure.



Where $m = 15\times10^3$ kg and $k = 30\times10^5$ N/m. **(16)**

OR

5. Derive the governing equation of vibration for a tightly stretched string with tension P. Obtain the frequency equation and mode shape for the case when one end of the string is fixed while the other end is attached to a roller free to move vertically in a slot. **(16)**