6E7014

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B.Tech. VI Semester (Main & Back) Examination, April/May-2017

Mechanical Engineering

6ME4A Vibration Engineering

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

Min. Passing Marks : 26

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 suitable be assumed and stated clearly.) Units of quantities used/calculated must be stated clearly.*

Unit-I

1. a) Enlist the major noise sources in industrial environment. What control measures can be adopted for noise control at the source? **(8)**

b) What do you understand by sound pressure dependent human response? Derive the relationship between sound power level and sound intensity level. **(8)**

OR

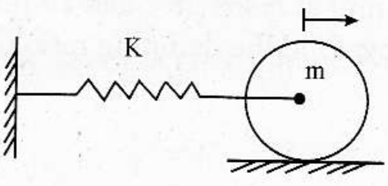
1. a) For the complex numbers $z_1 = (1 + 2i)$ and $z_2 = (3 - 4i)$, find the ratio z_1/z_2 and express the result in the form of $Ae^{i\theta}$. **(8)**

b) Find the sum of the two harmonic motions $x_1(t) = 5 \cos (3t + 1)$ and $x_2(t) = 10 \cos (3t + 2)$ using trignometric relations. **(8)**

Unit-II

2. a) A spring-mass system k_1, m_1 has a natural frequency 'f_1'. Calculate the value of k_2, another spring which when connected to k_1 in series decreases the frequency by 20%. **(8)**

b) A circular cylinder of mass 4kg and radius 12cm is connected by a spring of stiffness 6000 N/m as shown in figure. It is free to roll on horizontal rough surface without slipping, determine the natural frequency. **(8)**



OR

2. a) A vibrating system is defined by the following parameters : m = 3kg, k = 100 N/m and c = 3 N-sec/m. Determine **(8)**

i) the damping ratio

ii) the natural frequency of damped vibration

iii) logarithmic decrement

iv) the number of cycles after which the original amplitude is reduced to 20 percent.

b) A body of mass m = 1kg, lies on a dry horizontal plane and is connected by spring to a rigid support. The body is displaced from the unstressed position by an amount equal to 0.25 m with the tension of 50 N in the spring for this new position. How many complete cycles of motion will be performed after being released from this position. How much time it will take to perform this motion if the coefficient of friction is 0.25? **(8)**

Unit-III

3. a) Derive the relation for force transmissibility and draw a neat plot of the force transmissibility ratio with frequency ratio for different values of damping. **(8)**

b) A 70 kg machine is mounted on a springs of stiffness $k = 14 \times 10^5$ N/m with an assumed damping factor of $\zeta = 0.20$. A 2kg piston within the machine has a reciprocating motion with a stroke of 0.08m and a speed of 2700 rpm. Assuming the motion of the piston to be harmonic, calculate the amplitude of vibration of the machine and the vibratory force transmitted to the foundation. **(8)**

OR

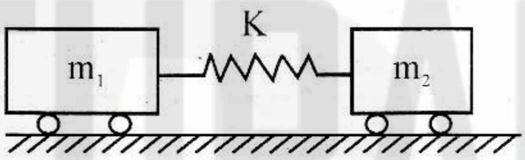
3. a) A 100 kg machine is mounted at the midspan of a 2.0 m long simply supported beam of elastic modulus $E = 200 \times 10^9$ N/m^2 and cross section moment of inertia $I = 2\times10^{-6}$ m^4. This system during an experiment was subjected to a harmonic excitation magnitude 2000 N at different excitation frequency. The largest steady-state amplitude recorded during experiment was 2.4 mm. Determine the damping ratio of the system. **(8)**

b) A spring - man - damper system is subjected to a harmonic force. The amplitude is found to be 20 mm at resonance and 10 mm at a frequency 0.75 times the resonant frequency. Find the damping ratio of the system. **(8)**

Unit-IV

4. a) With the help of suitable mathematical derivation explain the principle of undamped dynamic vibration absorber. **(8)**

b) Determine the natural frequencies and mode shaper of the system shown in figure. **(8)**



$m_1 = 5$ kg

$m_2 = 10$ kg

$k = 3000$ N/m

Comment on the rigid body mode obtained.

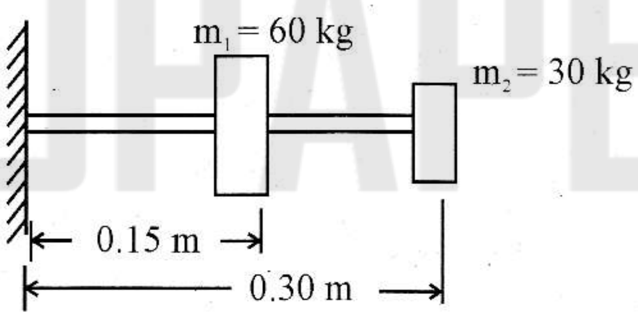
OR

4. a) Derive the mathematical relationship between the deflection of the geometric centre and the eccentricity with other system parameter for a single rotor shaft with damping. **(8)**

b) A rotor has a mass of 10 kg mounted midway on a 24 mm diameter horizontal shaft supported at the ends by two bearings which are 1m apart. The shaft rotates at 2400 rpm. If the centre of mass m of the rotor is 0.12mm away from geometric centre of the rotar due to certain manufacturing defects, find the amplitude of the steady state vibration and dynamic force transmitted to the bearing. Take $E = 200$ GN/m^2. **(8)**

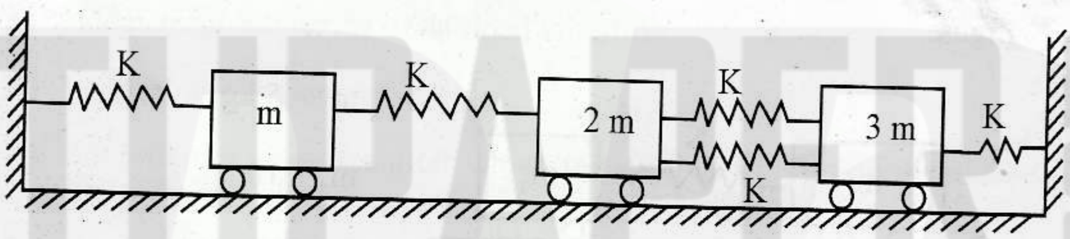
Unit-V

5. a) Find the lowest natural frequency of the system shown in figure using dunkerley's method. **(8)**



Take $E = 2 \times 10^{11}$ N/m^2 and cross section moment of inertia of the beam $I = 4 \times 10^{-7}$ m.

b) Draw the free body diagram of each of the mass shown in the following many degrees of freedom system shown in figure. Derive the governing differential equation of motion using Newton's law of motion. Arrange thus obtained equation in matrix form. **(8)**



OR

5. Derive the governing equation of motion for the torsional vibration of a shaft. Obtain the frequency equation and mode shape for the shaft fixed at one end while free at the other end. **(16)**

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