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10ME/MR72

Seventh Semester B.E. Degree Examination, Dec.2019/Jan.2020

Mechanical Vibrations

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

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.

PART - A

1 a. Define Vibrations. Explain any four type of vibrations. **(06 Marks)**

b. Write a short note on Beats. **(04 Marks)**

c. Add the following motions analytically and check the solution graphically :
$x_1 = 4\cos(wt + 10^0)$; $x_2 = 6\sin(wt + 60^0)$. **(10 Marks)**

2 a. Determine the natural frequency of the system shown in fig. Q2(a). **(10 Marks)**

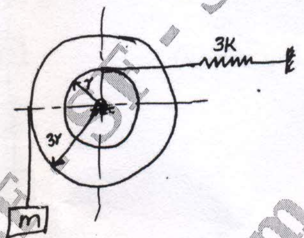


Fig. Q2(a)

b. Determine the natural frequency of the system shown in fig. Q2(b). **(10 Marks)**

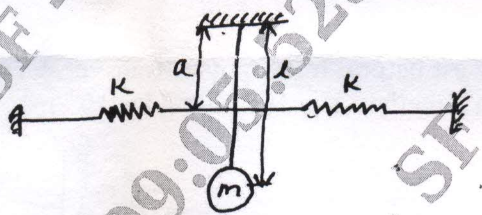


Fig. Q2(b)

3 a. Find the equation of motion for the system of spring mass and damper system when
i) $\xi = 1$ ii) $\xi = 0.3$ iii) $\xi = 2$.
If the mass 'm' is displaced by a distance of 3 cm and released. **(10 Marks)**

b. A vibrating system is having mass 3 kg and spring stiffness 100 N/m, damping co-efficient is 3N-S/m. Determine damping ratio, damped natural frequency, logarithmic decrement, ratio of law consecutive amplitudes and number of cycles when the original amplitude is reduced to 20%. **(10 Marks)**

4 a. What is Magnification Factor? Derive an expression for the same and discuss its variation with frequency ratio. **(10 Marks)**

b. A machine of total mass 68kg mounted on spring of stiffness K = 11000 N/cm. With an assumed dumping factor $\varsigma = 0.2$. A piston within the machine has a mass of 2kg has a reciprocating motion with stroke 7.5cm and a speed of 3000 rpm. Assuming the motion of piston to be S.H.M. Determine i) Amplitude of Machine
ii) Phase angle with respect to exciting force.
iii) Transmissibility and force transmitted to foundation.
iv) Phase angle of transmitted force with respect to exciting force. **(10 Marks)**

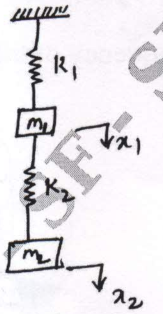
PART - B

5 a. With a neat schematic diagram, explain seismic instrument as :
i) a vibrometer ii) an accelerometer. **(10 Marks)**

b. A rotor of mass 12kg is mounted midway on a 25mm diameter horizontal shaft supported at the ends of two bearings. The span between the bearings is 900mm. Because of same manufacturing defects the C.G (Centre of gravity) of the rotor is 0.02mm away from geometric centre of rotor. If the system rotates at 3000 rpm, determine the amplitude of steady state vibrations and the dynamic force on the bearings. Take E = 200 GPa. **(10 Marks)**

6 a. A two degrees of freedom vibrating system is shown in fig. Q6(a). Determine i) The two natural frequencies of vibrations ii) Ratio of amplitudes of motion of m_1 & m_2 for the two modes of vibration iii) Model vector and Model shapes.
Given m_1 = 2kg , m_2 = 1 kg , k_1 = 40 N/m and k_2 = 20N/m. **(15 Marks)**

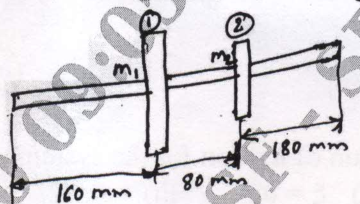
Fig. Q6(a)



b. Explain Dynamic Vibration Absorber with a sketch of a spring mounted dynamic absorber? **(05 Marks)**

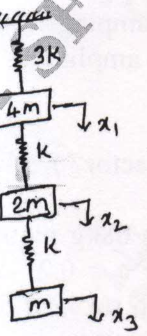
7 a. Find the lowest natural frequency of transverse vibrations of the system shown in fig.Q7(a), by Rayleigh's method E = 196 GPa , I = 10^{-6} m^4 , m_1 = 40 kg , m_2 = 20kg. **(10 Marks)**

Fig. Q7(a)



b. For the system shown in fig.Q7(b), find the lowest natural frequency by Stodola's method. **(10 Marks)**

Fig. Q7(b)



8 a. Explain Dynamic testing of Machines. **(06 Marks)**
b. Explain the experimental modal analysis. **(06 Marks)**
c. Explain machine condition monitoring techniques. **(08 Marks)**

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