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06ME62

Sixth Semester B.E. Degree Examination, June/July 2013
Mechanical Vibration

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Find the sum of the two harmonic motions $x_1(t) = 10 \cos wt$ and $x_2(t) = 15 \cos(wt+2)$ and check the solution graphically. **(10 Marks)**

b. Represent the periodic motion given in Fig.Q1(b) by harmonic series. **(10 Marks)**

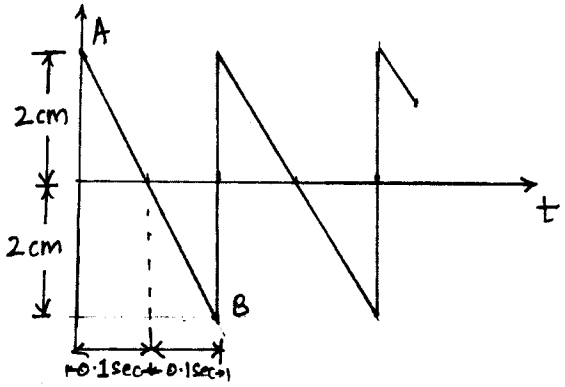

Fig.Q1(b)

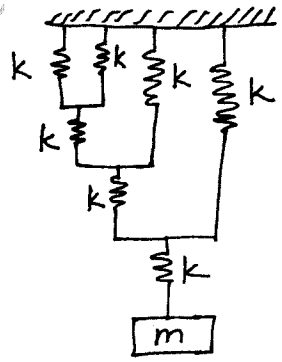

Fig.Q2(a)

2 a. Find the natural frequency of the system shown in Fig.Q2(a), $k = 2\times10^5$ N/m, m = 20 kg. **(10 Marks)**

b. Derive the differential equation of motion for a spring controlled simple pendulum as shown in Fig.Q2(b). The spring is in its unstretched position when the pendulum rod is vertical. Find the natural frequency. **(10 Marks)**

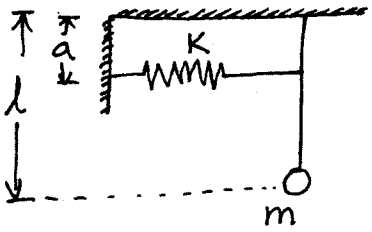

Fig.Q2(b)

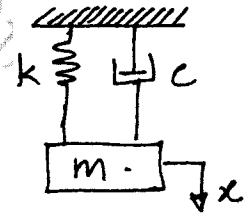

Fig.Q3(a)

3 a. Find the equation of motion for the system shown in Fig.Q3(a), when (i) $\zeta = 1.0$ (ii) $\zeta = 0.3$, (iii) $\zeta = 2.0$, if the mass m is displaced by a distance of 3 cm and released. (ζ = Damping ratio). **(10 Marks)**

b. The torsional pendulum with a disc of moment of inertia J = 0.05 kg-m^2 immersed in a viscous fluid is shown in Fig.Q3(b). During vibrations of pendulum, the observed amplitudes on the same side of the neutral axis for successive cycles are found to decay 50% of the initial value, determine i) logarithmic decrement ii) damping torque per unit velocity iii) the periodic time of vibration (iv) the frequency when the disc is removed from the fluid. Assume $G = 4.5\times10^{10}$ N/m^2 for shaft ; d = 0.10 m; l = 0.50 m, MI of disc = 0.05 kg-m^2. **(10 Marks)**

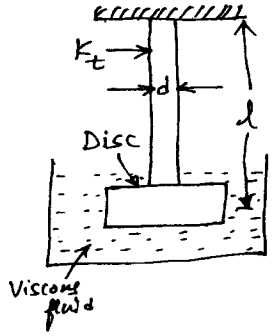

Fig.Q3(b)

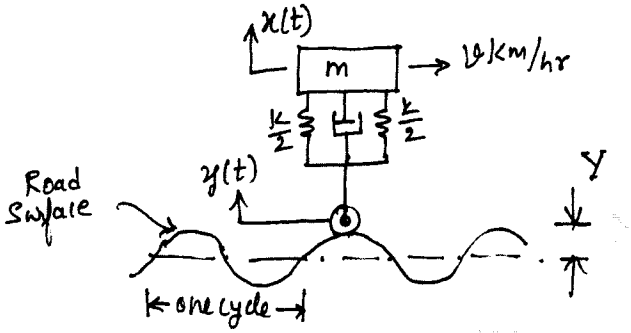

Fig.Q4(a)

4 a. Fig.Q4(a) shows a simple model of a motor vehicle that can vibrate in the vertical direction while traveling over a rough road. The vehicle has a mass of 1200 kg. The suspension system has a spring constant of 400 kN/m and a damping ratio of $\zeta = 0.5$. If the vehicle speed is 20 km/hr, determine the displacement amplitude of the vehicle. The road surface varies sinusoidally with an amplitude of Y = 0.05 m and a wavelength of 6 m. **(10 Marks)**

b. A vibratory body of mass 150 kg supported on springs of total stiffness 1050 kN/m has a rotating unbalance force of 525 N at a speed of 6000 rpm. If the damping factor is 0.3, determine (i) the amplitude caused by the unbalance and its phase angle (ii) the transmissibility (iii) the actual force transmitted and its phase angle. **(10 Marks)**

PART – B

5 a. Prove that an undamped measuring instrument will show a true response for frequency ratio $\left(\frac{w}{w_n}\right) = \frac{1}{\sqrt{2}}$. **(05 Marks)**

b. Explain working principle of vibrometer. **(05 Marks)**

c. What is the difference between a vibration isolator and a vibration absorber? **(02 Marks)**

d. A rotor of mass 4 kg is mounted on a 1 cm diameter shaft at the centre of the shaft. The 25cm shaft is supported by bearings. Calculate the critical speed. Take $E = 1.96 \times 10^{11} N/m^2$. **(08 Marks)**

6 a. Find the natural frequencies and mode shapes for the torsional system shown in Fig.Q6(a). Given $J_1 = J_0$, $J_2 = 2J_0$, $K_{t1} = K_{t2} = K_{t3} = K_t$. **(10 Marks)**

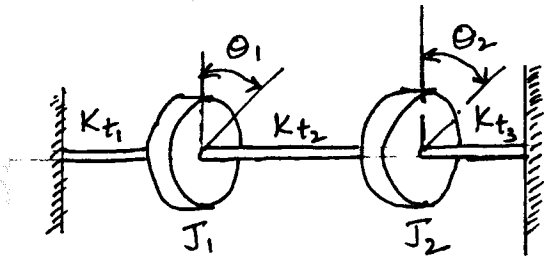

Fig.Q6(a)

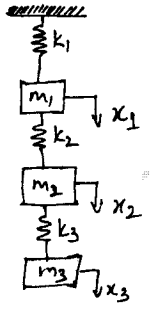

Fig.Q8

b. Explain briefly the dynamic vibration absorber, with diagram and equations. **(10 Marks)**

7 a. Derive suitable expression for longitudinal vibrations for a rectangular uniform cross-section bar of length *l* fixed at one end and free at the other end. **(15 Marks)**

b. What are continuous systems? Explain. **(05 Marks)**

8 Find the natural frequency of the system shown in Fig.Q8, by Holzer method or matrix method. Assume $m_1 = m_2 = m_3 = 1$ kg and $k_1 = k_2 = k_3 = 1$ N/m. **(20 Marks)**

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