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06ME62

Sixth Semester B.E. Degree Examination, Dec.2013/Jan.2014
Mechanical Vibrations

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Add the following motions analytically and check the solution graphically:
$x_1 = 4\cos(\omega t + 10^\circ)$ $x_2 = 6\sin(\omega t + 60^\circ)$ **(10 Marks)**

b. A body is subjected to two harmonic motions, $x_1 = 15\sin\left(\omega t + \frac{\pi}{6}\right)$, $x_2 = 8\cos\left(\omega t + \frac{\pi}{6}\right)$. What harmonic motion should be given to the body to bring it to equilibrium? **(10 Marks)**

2 a. A simple pendulum is shown in Fig. Q2 (a). Determine the natural frequency of the system, if the mass of the rod is not negligible. **(10 Marks)**

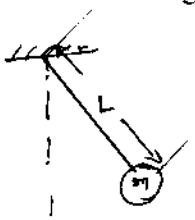

Fig. Q2 (a)

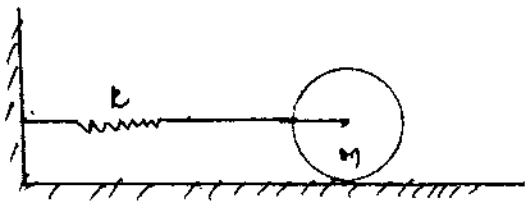

Fig. Q2 (b)

b. A circular cylinder of mass 'm' and mass moment of inertia I is connected by a spring of stiffness K as shown in Fig. Q2 (b). It is free to roll without slipping, determine the natural frequency. **(10 Marks)**

3 a. For free vibrations of an under damped spring-mass-damper, show that logarithmic decrement $\delta = \frac{2\pi\xi}{\sqrt{1-\xi^2}}$ where ξ = damping ratio. **(10 Marks)**

b. A disk of torsional pendulum has a moment of inertia of 0.6 kg-m^2 and is immersed in a viscous fluid. The shaft is of 0.1 m diameter and 0.4 m long. When the pendulum is vibrating, the amplitude of successive cycles are 9°, 6° and 4°. Determine
i) Logarithmic decrement.
ii) Damping torque at unit velocity.
iii) Periodic time of vibration.
Assume the modulus of rigidity for shaft as 44 GPa. **(10 Marks)**

4 a. Derive an expression for transmissibility and transmitted force for a spring mass damper system subjected to external excitation. **(10 Marks)**

b. A rotating machine of mass 650 kg operating at constant speed of 1500 rpm has an unbalance of 0.12 kgm. If the damping in isolator is given by damping ratio of 0.08. Determine the stiffness of isolators so that the transmissibility at the operating speed is less than or equal to 0.15. Also determine the magnitude of the force transmitted. **(10 Marks)**

PART – B

5 a. Explain the principle of 'sesmic' instrument and indicate how it can be used to measure the displant of vibrating body. (vibrometer) **(10 Marks)**

b. A rotor has a mass of 12 kg and is mounted midway on a 24 mm diameter horizontal shaft supported at the ends by two bearings. The bearings are 1 m apart. The shaft rotates at 2400 rpm. If the centre of mass of rotor is 0.11 mm away from geometric centre of the rotor due to certain manufacturing inaccuracies. Find the amplitude of steady state vibration and dynamic force transmitted to each bearing. Take E = 200 GPa. **(10 Marks)**

6 a. Consider the spring mass system which is as shown in Fig. Q6 (a). Determine its two natural frequency and ratio of amplitudes. **(10 Marks)**

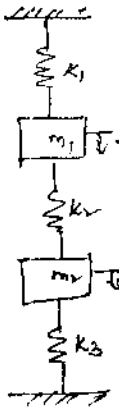

Fig. Q6 (a)

b. An electric motor rotating at 1500 rpm, drives a centrifugal pump at 500 rpm through single stage reduction gearing. The moment of inertia of pump impeller and electric motor are 1400 kgm^2 and 400 kgm^2 respectively. The pump shaft and motor shaft are 0.45 mt and 0.18 m long respectively with their diameter as 90 mm and 45 mm. Determine frequency of torsional oscillations neglecting inertia of gears. Assuming the modulus of rigidity of material as 84 GPa. **(10 Marks)**

7 a. Find frequency equation of a uniform beam fixed at one end and free at the other for transverse vibration. **(10 Marks)**

b. Determine the normal functions for free longitudinal vibration of a bar of length L and uniform cross section. One end of the bar is fixed and other free. **(10 Marks)**

8 a. Write a note on influx coefficients. **(05 Marks)**

b. Find the natural frequency of the system shown in Fig. Q8 (b). Use Holzers method, assume K = 1 N/m, m = 1 kg. **(15 Marks)**

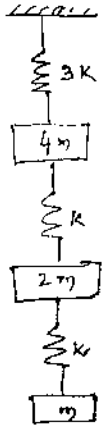

Fig. Q8 (b)

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