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06ME62

Sixth Semester B.E. Degree Examination, June/July 2011

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. Define the following :
   i) Forced vibration.
   ii) Simple harmonic motion.
   iii) Degree of freedom. **(06 Marks)**

b. What is beats phenonenon? Briefly explain. **(04 Marks)**

c. Add the following motions analytically and check the solution graphically :
   $x_1 = 2\cos(t + 0.5)$
   $x_2 = 5\sin(wt + 1.0)$. **(10 Marks)**

2 a. Explain energy method that is used to determine the natural frequency of undamped free vibratory system. **(04 Marks)**

b. A semicircular disc of radius r and mass m is pivoted freely about the center as shown in Fig.Q.2(b). Determine its natural frequency of oscillation for small displacement. Use energy method. **(08 Marks)**

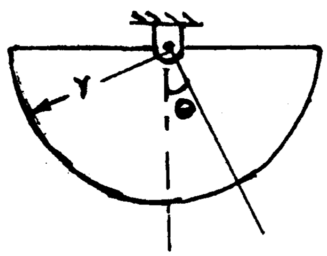


Fig.Q.2(b).

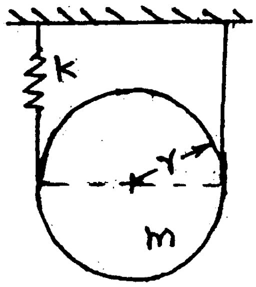


Fig.Q.2(c).

c. A homogeneous cylinder of mass 'm' and radius 'r' is suspended by a spring and an inextensible cord as shown in Fig.Q.2(c). Obtain the equation of motion and find the natural frequency of vibration of the cylinder. **(08 Marks)**

3 a. What is critical damping coefficient? **(02 Marks)**

b. A spring – mass – dashpot system consists of a spring of stiffness 343 N/m. The mass is 3.43 kg. The mass is displaced 20 mm beyond the equilibrium position and released. Find the equation of motion for the system, if the damping coefficient of the dashpot is 13.72 N-sec/m. **(10 Marks)**

c. A spring – mass – damper system is having a mass of 10 kg and a spring of such stiffness which causes a static deflection of 5mm.The amplitude of vibration reduces to ¼ the initial value in 10 oscillations. Determine :
   i) Logarithmic decrement.
   ii) Actual damping present in the system.
   iii) Damped natural frequency. **(08 Marks)**

4 a. Define "transmissibility". Derive an expression for "motion transmissibility". **(12 Marks)**

b. A machine of mass 500 kg is supported on spring of stiffness 10^6 N/m. If the machine has a rotating unbalance of 0.25 kg-m, determine :
   i) The force transmitted to the floor at 1200 rpm.
   ii) The dynamic amplitude at this speed. **(08 Marks)**

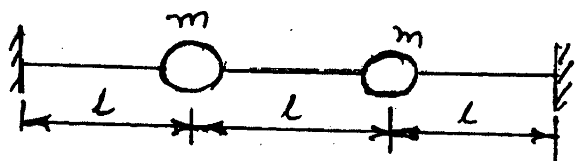
PART – B

5 a. Discuss the principle of operation of a vibrometer and an accelerometer. **(08 Marks)**

b. A rotor of mass 12 kg is mounted in the middle of 25mm diameter shaft supported between two bearings placed at 900 mm from each other. The rotor is having 0.02mm eccentricity. If the system rotates at 3000 rpm, determine the amplitude of steady state vibrations and the dynamic force transmitted to the bearing. Neglect damping and weight of the shaft. Take $E = 2 \times 10^5$ N/mm^2. **(12 Marks)**

6 a. Determine the two natural frequencies and the corresponding mode shapes for the system shown in Fig.Q.6(a). The string is stretched with a large tension T. Also sketch the mode shapes. **(12 Marks)**

Fig.Q.6(a).



b. Explain the principle of dynamic vibration absorber. **(08 Marks)**

7 a. Derive the differential equation for the
   i) Lateral vibration of a string.
   ii) Longitudinal vibration of a bar. **(14 Marks)**

b. Specify the boundary condition for a cantilever beam, simply supported beam and fixed – fixed beam to determine the lateral vibration frequency. **(06 Marks)**

8 a. Determine the fundamental natural frequency and mode shape of the system shown in Fig.Q.8(a) using Stodola's method. **(10 Marks)**

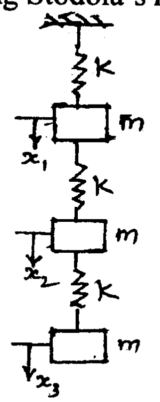


Fig.Q.8(a)

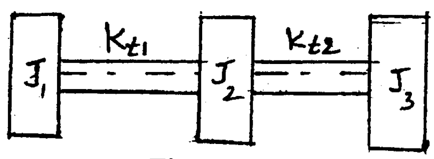


Fig.Q.8(b)

b. Calculate all the natural frequencies of a three rotor system shown in Fig.Q.8(b) by Holzer's method. Take $J_1 = J_2 = J_3 = 1$ and $K_{t_1} = K_{t_2} = 1$ **(10 Marks)**

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