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06ME62

Sixth Semester B.E. Degree Examination, Dec.2014/Jan.2015
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. Explain the beats phenomenon and obtain an expression for slope of beat. **(10 Marks)**

b. Use analytical method to split up the harmonic motion $x = 10 \sin(\omega t + 30°)$ into two harmonic motions one having a phase angle of zero and the other of 45°. Verify the result by graphical method. **(10 Marks)**

2 a. A mass 'm' guided in x-x direction is connected by a spring configuration as shown in Fig.Q2(a). Write down the expression for equivalent spring stiffness. **(10 Marks)**

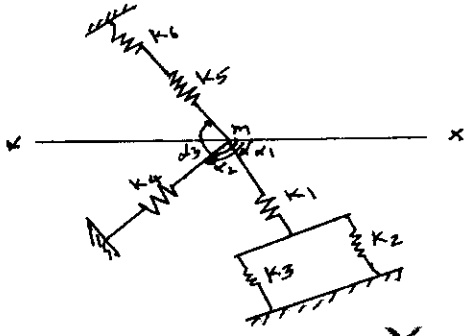

Fig.Q2(a)

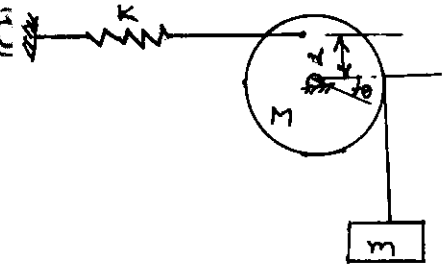

Fig.Q2(b)

b. The mass 'm' is hanging from a cord attached to the circular homogeneous disc of mass 'M' and radius 'R' as shown in Fig.Q2(b). The disc is restrained from rotating by a spring attached at radius r from the centre. If the mass is displaced downward from rest position, determine the frequency of oscillation. **(10 Marks)**

3 a. A vibrating system consists of a mass of 2 kg and a spring of stiffness 3 kN/m is viscously damped such that the ratio of any two consecutive amplitudes is 1.00 and 0.98. Determine (i) the natural frequency (ii) the logarithmic decrement (iii) the damping factor and (iv) the damping co-efficient. **(10 Marks)**

b. Set up the differential equation of motion for the system shown in Fig.Q3(b). Determine the expression for critical damping co-efficient. Also determine the value of critical damping when m = 1.5 kg, k = 4900 N/m, a = 0.06 m and l = 0.14 m. **(10 Marks)**

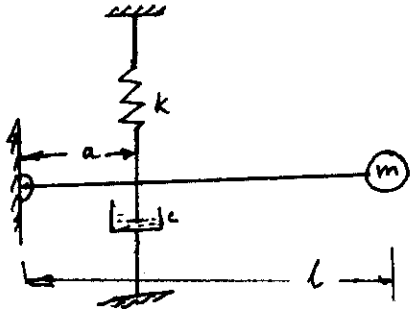

Fig.Q3(b)

4 a. Define force transmissibility and obtain an expression for the same in terms of frequency ratio and damping factor. **(08 Marks)**

b. A counter rotating eccentric mass exciter shown in Fig.Q4(b) is used to determine the vibrational characteristics of a structure of mass 180 kg. At a speed of 1000 rpm, a stroboscope shows the eccentric masses to be at the top at the instant the structure is moving upwards through its static equilibrium position and the corresponding amplitude is 20 mm. If the unbalance of each wheel of the exciter is 0.1 kg-m, determine (i) the natural frequency of the structure (ii) the damping factor of the structure (iii) the amplitude at 1200 rpm and (iv) the angular position of the eccentrics at the instant the structure is moving upward through its equilibrium position. **(12 Marks)**

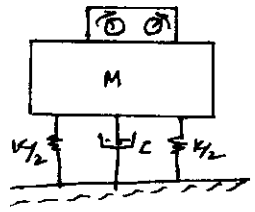

Fig.Q4(b)

PART – B

5 a. A device used to measure torsional acceleration consists of a ring having a moment of inertia of 0.05 kg-m² connected to a shaft by a spiral spring having a stiffness of 1 N-m/rad and a viscous damper having a constant of 0.15 N-m-s/rad. When the shaft vibrates with a frequency of 0.25c/s, the relative amplitude between the ring and the shaft is found to be 2°. What is the maximum acceleration of shaft? **(10 Marks)**

b. A rotor of mass 20 kg is mounted in the middle of 20 mm diameter shaft. The shaft is horizontal and supported between two bearings placed at 1000 mm from each other. The rotor is having an eccentricity of 0.02 mm. If the system rotates at 3000 rpm, determine the amplitude of steady state vibrations and the dynamic force on the bearing. Take $E = 2\times10^{11}$ N/m². **(10 Marks)**

6 The following information is given for the automobile shown in Fig.Q6. Determine the normal modes of vibration and locate the node for each mode.

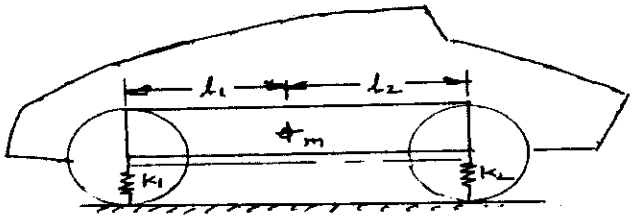

Fig.Q6

m = 1600 kg , k_1 = 30 kN/m , k_2 = 36 kN/m , l_1 = 1.34 m, l_2 = 1.70 m, Radius of gyration about c.g. r = 1.22 m. **(20 Marks)**

7 a. 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 is free. **(10 Marks)**

b. Determine the fundamental frequency of vibration for the system shown in Fig.Q7(b) using Dunkerley's method. **(10 Marks)**

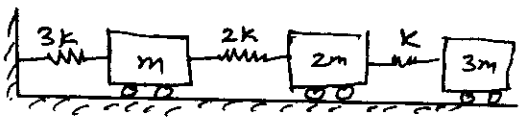

Fig.Q7(b)

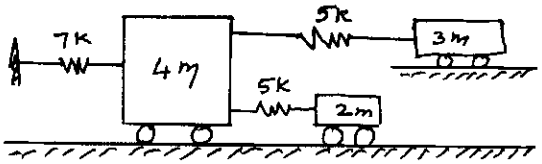

Fig.Q8

8 Determine the fundamental frequency of the branched system shown in Fig.Q8, using (i) Matrix iteration method (ii) Stodola method. **(20 Marks)**

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