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10ME72

Seventh Semester B.E. Degree Examination, Dec.2015/Jan.2016
Mechanical Vibrations

Time: 3 hrs. Max. Marks:100

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

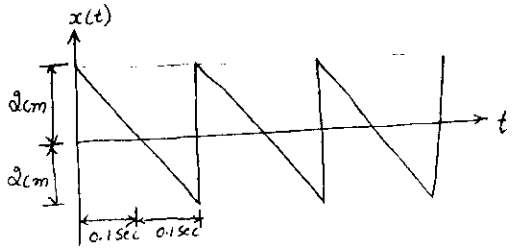
Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART - A

1 a. Add the following harmonic motion and check the solution graphically :
$x_1 = 2\cos(wt + 0.5)$ $x_2 = 5\sin(wt + 1.0)$. **(10 Marks)**

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

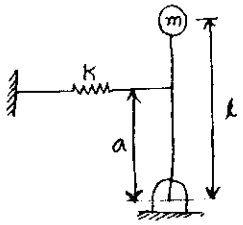
Fig.Q1(b)



2 a. Determine the natural frequency of undamped free vibration system using energy method. **(06 Marks)**

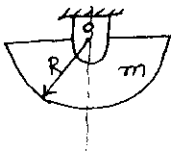
b. Determine the natural frequency of the system shown in fig. Q2(b). **(07 Marks)**

Fig.Q2(b)



c. A semicircular disc of radius 'R' and mass 'm' is pivoted freely about the center as shown in fig. Q2(c). Determine its natural frequency of oscillation for small displacement. Use energy method. **(07 Marks)**

Fig.Q2(c)



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

b. A spring mass damper system is having a mass of 10kg 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. **(10 Marks)**

4 a. Define "transmissibility". Derive an expression for motion transmissibility. **(10 Marks)**

b. A machine of mass 500kg is supported on spring of stiffness 10^6N/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 iii) The phase angle. **(10 Marks)**

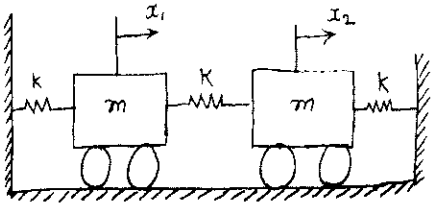
PART - B

5 a. Mention the instruments used to measure displacement and acceleration. Discuss the relevant frequency response curves. **(10 Marks)**

b. A rotor of mass 12 kg is mounted midway on a 25mm diameter horizontal shaft supported at the ends by two bearings. The span between the bearing is 900mm. Because of some manufacturing defect the Cg 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 dynamic force on the bearing. Take E = 200Gpa. **(10 Marks)**

6 a. For the system shown in fig. Q6(a), i) Derive the equation of motion ii) Setup frequency equation and obtain natural frequencies of the system iii) Obtain modal vectors iv) Draw mode shapes. Neglect the inertia of wheels and friction between wheel and surface. **(12 Marks)**

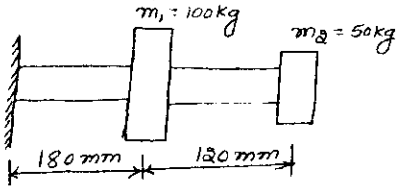
Fig.Q6(a)



b. Explain the principle of undamped dynamic vibration absorbers. Obtain an expression for $\frac{X_1}{X_{st}}$ for main mass and $\frac{X_2}{X_{st}}$ for absorber mass. **(08 Marks)**

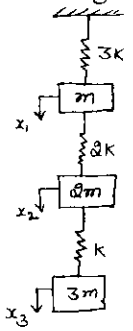
7 a. Find the lowest natural frequency of vibration for the system shown in Fig. Q7(a), by Rayleigh's method. $E = 1.96 \times 10^{11}$ N/m^2, $I = 4 \times 10^{-7}$ m^4. **(08 Marks)**

Fig.Q7(a)



b. Using Stodola's method, determine the fundamental mode of vibration and its natural frequency of the spring mass system shown in fig. Q7(b). **(12 Marks)**

Fig.Q7(b)



8 a. Explain the role of i) Exciter ii) Transducer iii) Signal conditioner and iv) Analyzer used in experimental modal analysis. **(08 Marks)**

b. Explain briefly dynamic testing of machines. **(04 Marks)**

c. Describe the three types of maintenance schemes given below :
i) Break down maintenance ii) Preventive maintenance iii) Condition based maintenance. **(08 Marks)**

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