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10ME72

Seventh Semester B.E. Degree Examination, June/July 2015
Mechanical Vibrations

Time: 3 hrs. Max. Marks:100

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

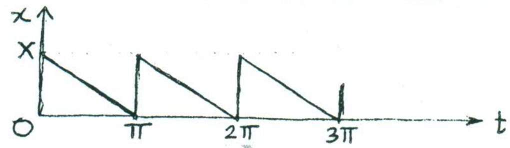
PART – A

1 a. Define the terms 'Periodic motion', 'Resonance', 'Degree of Freedom' and 'Phase difference'. **(04 Marks)**

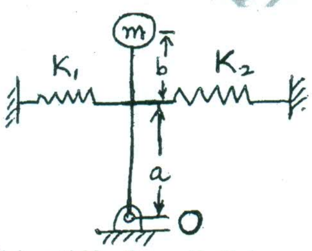
b. The motion of a particle is given by $x = 2\sin\left(wt + \frac{\pi}{6}\right)$. This motion is due to two components and one of this is $\sin\left(wt - \frac{\pi}{3}\right)$. Find the other component analytically and verify the same graphically. **(08 Marks)**

c. Represent the periodic motion shown in Fig.Q.1(c) by harmonic series. **(08 Marks)**

Fig.Q.1(c)



2 a. Obtain differential equation of motion for the system shown in Fig.Q.2(a) for small amplitude of vibration. Also determine: i) Natural frequency and ii) The value of 'a' for which the system will not vibrate. **(10 Marks)**



Rod is stiff of negligible mass

Fig.Q.2(a)

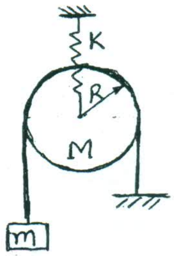


Fig.Q.2(b)

b. Obtain differential equation of motion for the system of single degree of freedom shown in Fig.Q.2(b). The cord is inextensible and does not slip with pulley. **(10 Marks)**

3 a. State the types of damping and explain in brief 'Viscous damping'. **(06 Marks)**

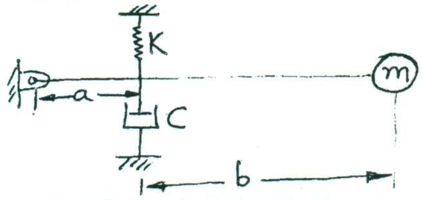
b. A spring-mass-dashpot system has, mass = 10kg and stiffness = 40 N/m. If the amplitude of free vibration decreases to 25%of original value after 5 cycles, determine the damping coefficient. **(06 Marks)**

c. For the system of single degree of freedom shown in Fig.Q.3(c), obtain

i) differential equation of motion and

ii) expression for critical damping coefficient. **(08 Marks)**

Fig.Q.3(c)



Rod is stiff and of negligible mass

4 a. Define 'Force Transmissibility' and obtain expression for
i) Force transmissibility and
ii) Phase lag of transmitted force with impressed force. **(10 Marks)**

b. A machine of mass 100kg operating at 600rpm has a rotating unbalance of 100 kg-mm. The machine is mounted on springs having stiffness 85 kN/m and negligible damping. The system is constrained to move vertically.
i) Determine the steady state amplitude.
ii) If the damping is introduced to reduce the amplitude by 50%, what should be the damping coefficient? Also find damping factor. **(10 Marks)**

PART – B

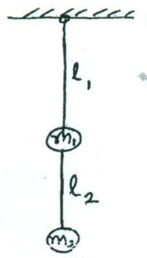
5 a. Explain in brief 'seismic instrument' with a neat sketch. **(05 Marks)**

b. Write a brief note on 'Frahm's Reed Tachometer'. **(05 Marks)**

c. A rotor of mass 10kg is mounted on a 20mm diameter shaft supported at the ends by two bearings. Rotor is mounted in the middle of span of 500mm. The centre of gravity of rotor is 0.03mm away from the geometric centre. If the system rotates at 2500 rpm, find the amplitude of steady state vibrations and dynamic force on bearings, neglecting damping and mass of shaft (E = 200 GPa). **(10 Marks)**

6 Obtain the differential equations of motion for the double pendulum shown in Fig.Q.6.

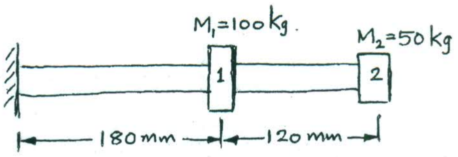
Fig.Q.6



If $m_1 = m_2 = m$ and $l_1 = l_2 = l$. Find: i) Natural frequencies; ii) ratio of amplitudes and draw mode shapes. **(20 Marks)**

7 a. Find the fundamental natural frequency of transverse vibration for the system shown in Fig.Q.7(a) by Dunkerle's method. **(08 Marks)**

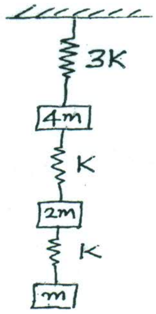
Fig.Q.7(a)



$I = 4 \times 10^{-7}\ m^4$ and $E = 1.96 \times 10^{11}\ \frac{N}{m^2}$

b. Find the fundamental natural frequency for the system shown in Fig.Q.7(b) by the method of matrix iteration. **(12 Marks)**

Fig.Q.7(b)



8 a. Explain in brief the hardware of an equipment necessary for experimental modal analysis. **(12 Marks)**

b. State the various types of machine maintenance techniques. Explain in brief. **(08 Marks)**

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