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10ME72

Seventh Semester B.E. Degree Examination, June/July 2016
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 terms :
(i) Periodic motion (ii) Degree of freedom (iii) Resonance (iv) Phase difference. **(04 Marks)**

b. Add the following motion analytically and check the solutions graphically.
$x_1 = 3\sin(8t + 30°)$, $x_2 = 2\cos(8t - 15°)$ **(08 Marks)**

c. Represent the periodic motions given by following Fig Q1(c) by harmonic series.

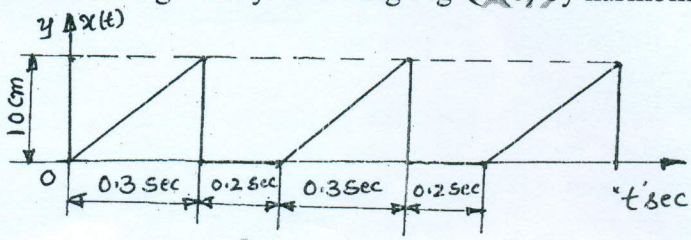


Fig. Q1(c)

(08 Marks)

2 a. Find out the natural frequency of the system shown in Fig. Q2 (a) by using (i) Newton's method (ii) Energy method. **(10 Marks)**

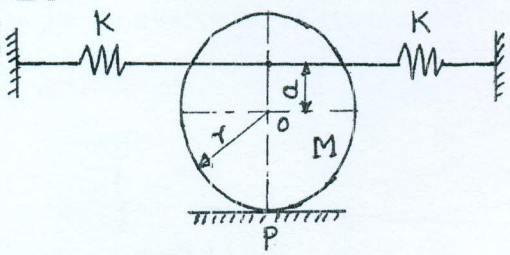


Fig. Q2(a)

b. Determine the natural frequency of spring mass system taking the mass of the spring into account. **(10 Marks)**

3 a. Set up differential equation for a spring mass damper system and obtain the complete solution for the under damped condition. **(08 Marks)**

b. Derive the equation of motion for the system shown in Fig. Q3(b). If m = 1.5kg, K = 4900N/m, a = 6cm, b = 14cm, determine the value of "C" for which the system is critically damped. **(06 Marks)**

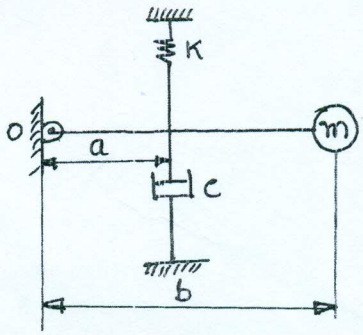


Fig. Q3(b)
Rod is stiff and of negligible mass

c. In a spring mass system, the mass of 10kg makes 40 oscillations in 20 seconds without damper. With damper, the amplitude decreases to 0.20 of the original value after 5 oscillations. Find out (i) stiffness of the spring (ii) Logarithmic decrement (iii) Damping factor (iv) Actual damping coefficient. **(06 Marks)**

4 a. Define the term "Transmissibility", and derive the expression for transmissibility ratio due to harmonic excitation. **(08 Marks)**

b. A machine mass on ton is acted upon by an external force 2450N at a frequency of 1500rpm. To reduce the effects of vibration, isolator of rubber having a static deflection of 2mm under the machine load and an estimated damping factor of 0.2 are used. Determine:

i) Force transmitted to the foundation
ii) Amplitude of vibration of the machine
iii) Phase lag of the transmitted force with respect to the external force. **(12 Marks)**

PART – B

5 a. Discuss the principle of operation of a vibrometer and an accelerometer. Draw the relevant frequency response curve **(10 Marks)**

b. A shaft 1.5m long is supported in flexible bearing at the ends carries a wheel of 50kg mass at a distance 0.375m from the left hand side bearing. The shaft is hollow of external diameter 75mm and internal diameter 40mm. the density of the shaft material is 7.7 Mg/m^3 and its modulus of elasticity is $200GN/m^2$. Find the whirling speed of shaft, taking into account the mass of the shaft. **(10 Marks)**

6 a. What is dynamic vibration absorber? Explain briefly the dynamic vibration absorber with diagram and equations. **(10 Marks)**

b. Find the natural frequencies of the system shown in Fig. Q6(b). Also draw the mode shapes and locate the node. **(10 Marks)**

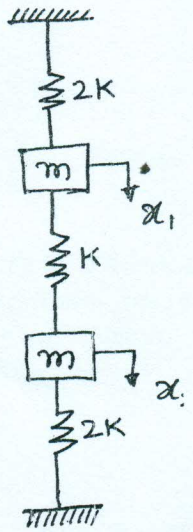
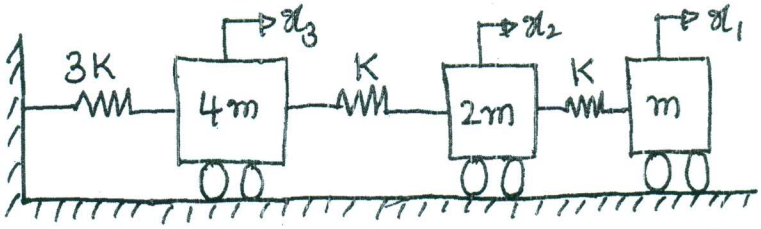
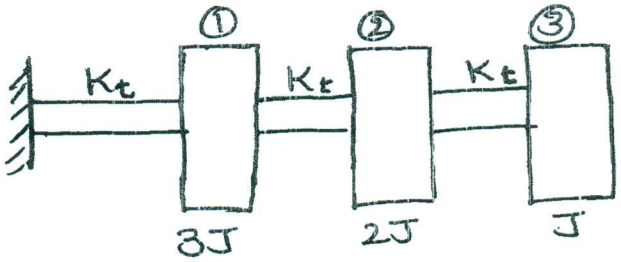


Fig. Q6(b)

7 a. Determine the natural frequency of the system shown in Fig. Q7(a), by using Holzer's method. Assume K = 1N/m, m = 1kg. **(10 Marks)**



b. Determine the first natural frequency of the system shown in Fig. Q7 (b), by using matrix iteration method. **(10 Marks)**



8 Write a short notes on any FOUR
a. Dynamic testing of machines
b. Machine condition monitoring
c. Orthogonality of principal modes
d. Machine vibration monitoring
e. Experimental modal analysis. **(20 Marks)**

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