ONE TIME EXIT SCHEME

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10AU73

Seventh Semester B.E. Degree Examination, April 2018
Mechanical Vibration & Vehicle Dynamics

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) Phase difference (ii) Periodic motion. (iii) Transient vibration (iv) Deterministic vibration. **(04 Marks)**

b. With a neat sketch, explain the beats phenomenon and obtain its resultant motion. **(08 Marks)**

c. Superimpose the harmonic motions analytically $x_1 = 2\cos(\omega_n t + 0.5)$, $x_2 = 5\sin(\omega_n t + 1.0)$ **(08 Marks)**

2 a. Show that for finding the natural frequency of a spring-mass system, the mass of the spring can be taken into account by adding one-third of its mass to the main mass. **(10 Marks)**

b. A rectangular block of mass 'm' resting on the top of a semi-cylindrical surface as shown in Fig. Q2 (b). If the block is slighting tipped at one end. Find its frequency of oscillations. **(10 Marks)**

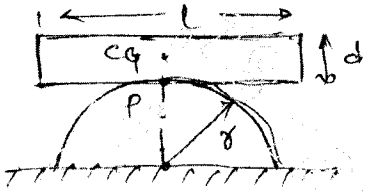

Fig. Q2 (b)

3 a. Set up the differential equation for a spring-mass-damper system and obtain the complete solution for the under-damped condition. **(10 Marks)**

b. The single pendulum is pivoted at point 'O' as shown in Fig. Q3 (b). If the mass of the rod is negligible for small oscillations. Find the damped natural frequency of the pendulum. **(10 Marks)**

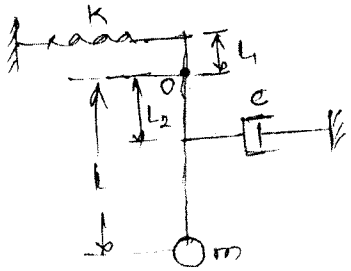

Fig. Q3 (b)

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

b. A vibratory body of mass 150 kg supported on springs of total stiffness 1050 kN/m has a rotating unbalance force of 525 N at a speed of 6000 rpm. If the damping factor is 0.3. Determine

(i) The amplitude caused by the unbalance and its phase angle.
(ii) The transmissibility.
(iii) The actual force transmitted and its phase angle. **(10 Marks)**

PART – B

5 a. What is Whisling speed? Obtain an expression for Whisling of shaft with air damping. **(10 Marks)**

b. The motion of a vibratory system is to be recorded by a seismic instrument having natural frequency 1500 Hz. What is the reading of the instrument, if the motion is given by the equation, $z = 1.5\sin 188.5t + 0.5\sin 377t$ and the damping factor is 0.65. **(10 Marks)**

6 a. A two degrees of freedom vibrating system is shown in Fig. Q6 (a). Determine

(i) The two natural frequencies of vibrations.

(ii) Ratio of amplitude of motion of m_1 and m_2 for the two modes of vibration.

(iii) Given $m_1 = 2$ kg, $m_2 = 1$ kg, $K_1 = 40$ N/m and $K_2 = 20$ N/m. **(10 Marks)**

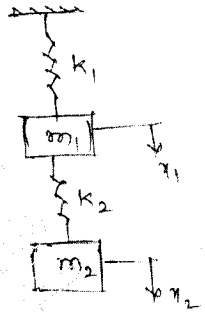

Fig. Q6 (a)

b. An aerofoil using in its first bending and torsional modes can be represented schematically as shown in Fig. Q6 (b), connected through a translational spring of stiffness 'K' and a torsional spring stiffness 'K_T'. Write the equation of motion for the system and obtain the two natural frequencies with the following data: m = 5 kg, $I = 0.12$ kg-m^2, a = 0.1 m, $K = 5\times10^3$ N/m, $K_T = 0.4\times10^3$ Nm/rad, using Lagrange's equation. **(10 Marks)**

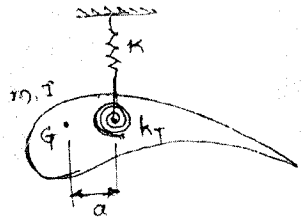

Fig. Q6 (b)

7 a. With a neat sketch, explain compensated suspension system. **(10 Marks)**

b. A trailor has 1000 kg mass, when fully loaded and 250 kg when empty. The spring of the suspension is 350 kN/m. The damping factor is 0.5 when the trailor is fully loaded. The speed is 100 km/hr. The road varies sinusoidally with a wave of length of 5 m. Determine the amplitude ratio of the trailor when fully loaded and empty. **(10 Marks)**

8 Find all the natural frequencies of the four degree of freedom system shown in Fig. Q8, by Holzer's method. **(20 Marks)**

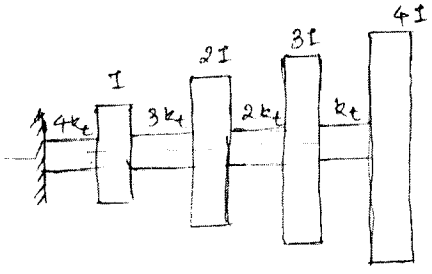

Fig. Q8

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