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10MT754

Seventh Semester B.E. Degree Examination, Feb./Mar. 2022

Mechanical Vibrations

Time: 3 hrs. Max. Marks:100

Note: Answer any FIVE full questions, selecting at least TWO questions from each part.

PART – A

1 a. Derive an expression for work done by a harmonic force and comment on, the magnitude of work done when phase angle is 0° and 90° respectively. **(10 Marks)**

b. A particle is subjected to two harmonic motions as given below. Add them analytically and check graphically.

$$x_1 = 15\sin(\omega t + 30^\circ)$$
$$x_2 = 8\cos(\omega t + 60^\circ)$$ **(10 Marks)**

2 a. Determine the natural frequency of the following system if the weight of the roller is 80 N and spring stiffness = 15 N/mm.

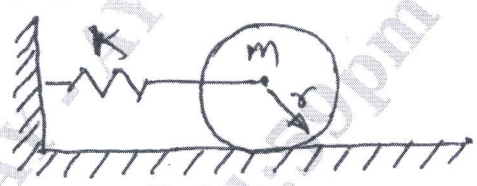

Fig.Q2(a) **(10 Marks)**

b. Find the natural frequency of the following inverted peridolum.

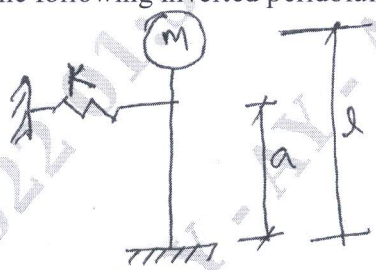

Fig.Q2(b) **(10 Marks)**

3 a. Derive an equation for logarithmic decrement for an underdamped system. **(10 Marks)**

b. In a damped free vibration system following data are noted:
K = 15000 N/m, C = 120 NS/m, M = 5 kg
Determine: (i) Undamped natural frequency (ii) Damped natural frequency
(iii) Critical damping coefficient (iv) Logarithmic decrement
(v) Ratio of amplitudes of two successive waves **(10 Marks)**

4 a. Define transmissibility ratio and derive an equation for transmissibility ratio and phase angle. **(10 Marks)**

b. A motor weighing 1200 kg is supported by beams. It has a rotary imbalance of 1 kg at a radius of 6 cm. The operating speed of the motor is 1440 rpm. If the speed of natural rotation is 2100 rpm, find out the amplitude of vibration due to the imbalance, G = 0.1. Also estimate the magnitude of vibration at response. **(10 Marks)**

PART – B

5 a. Explain the working principle of vibrometer and velocity pick-up. **(06 Marks)**

b. With the help of neat diagram explain the functioning of Frahm's reed tachometer. **(06 Marks)**

c. A rotor having a mass of 10 kg is mounted at the midspan of 80 cm long horizontal shaft. The shaft diameter is 2 cm. CG of the rotor is 0.1 mm away from geometric center. If the shaft rotates at 3000 rpm, find amplitude of steady state vibration. ϵ = 200 GPa. **(08 Marks)**

6 a. Find the natural frequencies of the following system and draw the mode shapes of vibration.

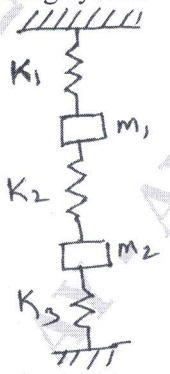

Fig.Q6(a) **(14 Marks)**

b. Explain the working principle of dynamic vibration absorber. **(06 Marks)**

7 a. State and prove Maxwell's reciprocal theorem. **(06 Marks)**

b. Find the fundamental natural frequency and first principal mode of following system.

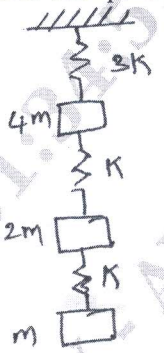

Fig.Q7(b) **(14 Marks)**

8 a. Draw a neat diagram experimental modal analysis setup and explain the different components of the same. **(10 Marks)**

b. Explain the different machine condition monitoring techniques. **(10 Marks)**

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