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10ME72

Seventh Semester B.E. Degree Examination, Jan./Feb. 2023
Mechanical Vibrations

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting at least TWO full questions from each part.*
2. Missing data assume suitably.

PART – A

1 a. Write notes on: i) Degrees of Freedom ii) Amplitude of Vibration iii) Causes of Vibration iv) Beats. **(08 Marks)**

b. A force F_o sinwt acts on a body results in a displacement of $x_o \sin\left(wt - \frac{\pi}{4}\right)$ where $F_o = 20N$, $x_o = 0.029m$ and $w = 10\pi$ rad/sec. Determine the work done during i) First second ii) First $\frac{1}{20}$ th of second and iii) First $\frac{1}{40}$ th of second. **(12 Marks)**

2 a. Determine the natural frequency of a spring mass system by considering the mass of the spring. **(10 Marks)**

b. Determine the natural frequency of the system shown below. **(10 Marks)**

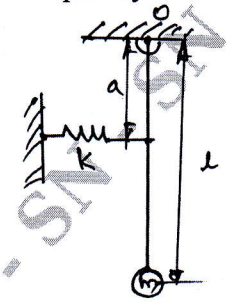

Fig.Q.2(b)(i)

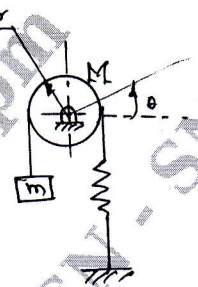

Fig.Q.2(b)(ii)

3 a. Define a logarithmic decrement, show that the logarithmic decrement can be expressed as $\delta = \frac{1}{n} \log_e \frac{x_0}{x_n}$, where x_o = Amplitude at particular maximum and x_n = Amplitude after 'n' cycles. **(08 Marks)**

b. A machine of mass 100kg is mounted on springs and is fitted with a dashpot to damp the vibrations. These are four springs each of stiffness 7.5N/mm and it is found that the amplitude of vibration diminishes from 38.4mm to 6.4mm in 2 complete oscillations. Assuming that the damping force various as the velocity, determine resistance of dashpot at unit velocity and compare the frequency of damped vibration with the frequency when the dashpot is not in operation. **(12 Marks)**

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

b. An engine weighing 1000N including reciprocating parts mounted on springs, the weights of the reciprocating parts 22N and the stroke is 90mm. The engine speeds 720rpm, i) Neglecting damping, find the stiffness of the springs, so that force transmitted to the foundation is 5% of the amplitude force ii) If under the actual working condition the damping reduces the amplitude of successive vibration by 25%, determine the force transmitted at 720rpm. **(10 Marks)**

PART – B

5 a. Explain with neat sketch the following: i) Vibrometer ii) Accelerometer. **(10 Marks)**

b. A rotor of mass 12kg is mounted midway on a 25mm diameter horizontal shaft supported at the ends of two bearings. The span between the bearings is 900mm. Because of some manufacturing defect the C.G. of the rotor is 0.02mm away from geometric centre of rotor. If the system rotates at 3000rpm, determine the amplitude of steady state vibrations and the dynamic force on the bearings. Take E = 200Gpa. **(10 Marks)**

6 a. Explain working principle of dynamic vibration absorber. **(06 Marks)**

b. For a spring – mass system shown in Fig.Q.6(b), if the mass 'm_1' is displaced 20mm from its static equilibrium position and released, determine the resulting displacement $x_1(t)$ and $x_2(t)$ of the masses. **(14 Marks)**

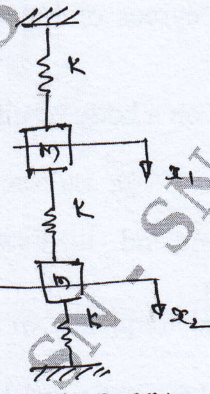

Fig.Q.6(b)

7 a. By the Holzer method find the natural frequencies of the system shown in Fig.Q.7(a). Assume K = 1N/m and m = 1kg **(16 Marks)**

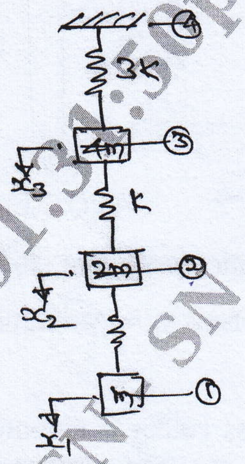

Fig.Q.7(a)

b. State and prove Maxwell reciprocal theorem. **(04 Marks)**

8 Write short notes on any four:

a. Experimental modal analysis
b. Machine condition monitoring
c. Dunkerly's method applied to multi degree freedom systems
d. Rayleigh-Ritz method approach
e. Different types of damping
f. Vibration isolation principle. **(20 Marks)**

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