CBCS SCHEME

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18AE56

Fifth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Theory of Vibrations

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Write notes on :
(i) Degrees of freedom.
(ii) Amplitude
(iii) Causes of vibration
(iv) Beats **(10 Marks)**

b. A periodic motion is as shown in Fig. Q1 (b). Determine the harmonic series of this motion. **(10 Marks)**

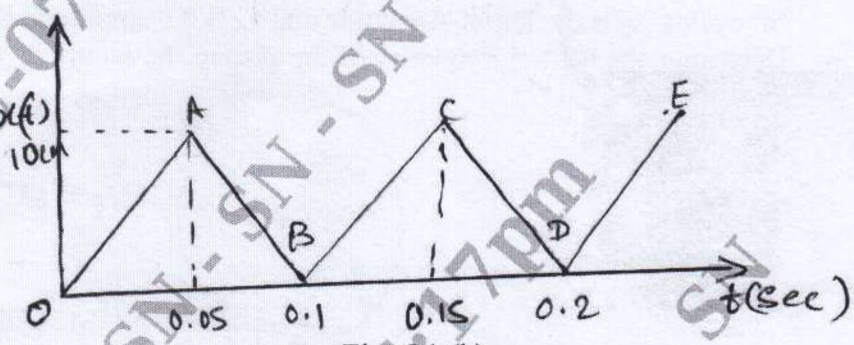

Fig. Q1 (b)

OR

2 a. Represent the periodic motion of the given Fig. Q2 (a). **(10 Marks)**

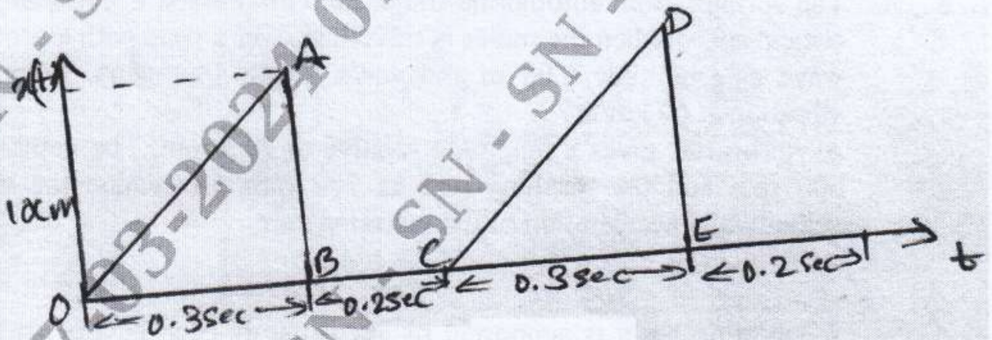

Fig. Q2 (a)

b. Split the harmonic motion $x = 5\sin\left(\omega t + \frac{\pi}{4}\right)$ into two harmonic motions one having phase of zero and the other 60°. **(10 Marks)**

Module-2

3 a. Determine the natural frequency of a spring mass system where the mass of the spring is also taken into account. **(10 Marks)**

b. Obtain the differential equation of motion for the system shown in Fig. Q3 (b) and hence find (i) Critical damping of Co-efficients. (ii) Damping ratio (iii) Natural frequency of damped oscillations. (iv) Natural frequency of undamped vibration.

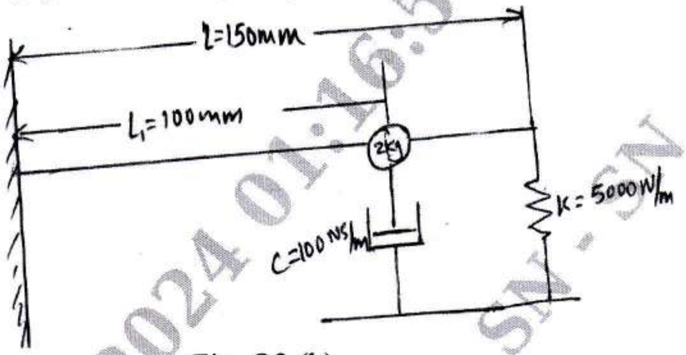

Fig. Q3 (b) **(10 Marks)**

OR

4 a. Define logarithmic decrement and show that it can be expressed as $\delta = \frac{1}{n}\log\left(\frac{x_0}{x_1}\right)$, where 'n' cycles, x_0 is the initial amplitude and x_n is the amplitude after 'n' cycles. **(10 Marks)**

b. Determine the natural frequency of the system shown in Fig. Q4 (b). **(10 Marks)**

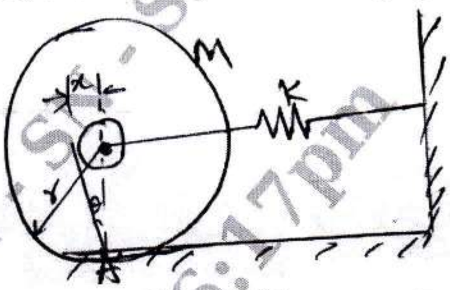

Fig. Q4 (b)

Module-3

5 a. The springs of an automobile trailer are compressed 0.1 m under its own weight. Find the critical speed when the trailer is travelling over a road with a profile approximated by a sine wave of amplitude 0.08 m and wave length 14 meters. What will be the amplitude of vibration at 60 km/hr? **(10 Marks)**

b. A vibrometer gives a reading a relative dip/0.5 mm. The natural frequency of vibration is 600 rpm and the machine runs at 200 rpm. Determine the magnitude of displacement velocity and acceleration of the vibrating part. **(10 Marks)**

OR

6 a. A vibrating body is supported by six isolators each having stiffness 32000 N/m and dash pots each have 400 N.s/m. The vibrating body is to be isolated by a rotating device having an amplitude of 0.06 mm at 600 rpm. Take m = 30 kg. Determine the amplitude of vibration of the body and dynamic load on each isolates. **(10 Marks)**

b. A shaft carrying a rotor of weight 450 N and eccentricity 2.54 mm rotates at 1200 rpm. Determine (i) Steady state whirl amplitude (ii) Maximum whirl amplitude during start upp conditions of the system.
Assume the stiffness of the shaft as 36000 N/m and the external damping ratio as 0.1. **(10 Marks)**

Module-4

7 a. Fig. Q7 (a) shows a spring mass system. If the mass m_1 is displaced 20 mm from its static equilibrium position and released determine the resulting displacements $x_1(t)$ and $x_2(t)$ of the masses. **(10 Marks)**

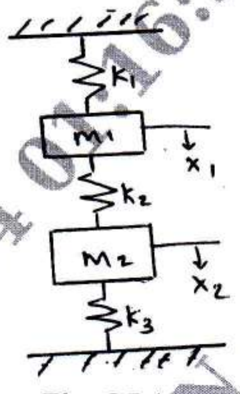

Fig. Q7 (a)

b. Determine the frequency equation and the general solution of the two degrees of freedom torsional system shown in Fig. Q7 (b).

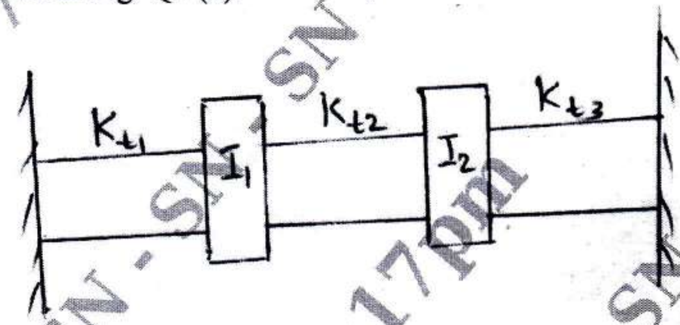

Fig. Q7 (b) **(10 Marks)**

OR

8 a. Fig. Q8 (a) shows a system subjected to vibration. Find an expression for the natural frequency. **(10 Marks)**

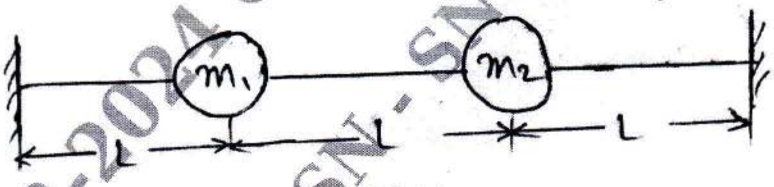

Fig. Q8 (a)

b. Determine the differential equation, natural of sequences and the amplitude ratio of the system shown in Fig. Q8 (b). **(10 Marks)**

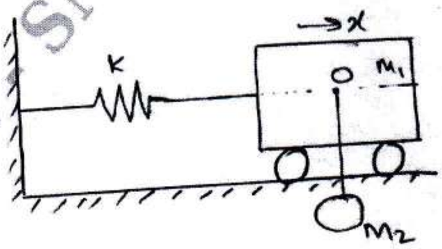

Fig. Q8 (b)

Module-5

9 Using Stodala's method, determine the lowest natural frequency of the torsional system shown in Fig. Q9.

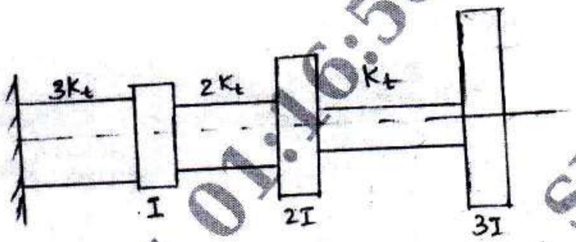

Fig. Q9 **(20 Marks)**

OR

10 Using Holder'z method to find the natural frequencies of the 4 mass system as shown in Fig. Q10, if K = 1 N/m and m = 1 kg.

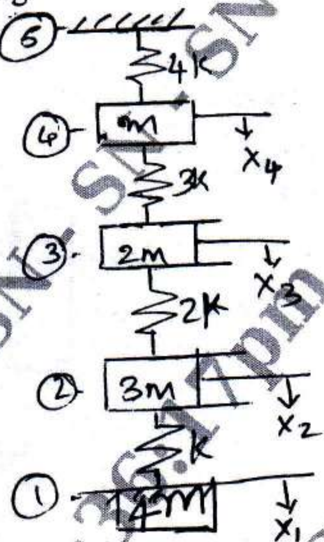

Fig. Q10 **(20 Marks)**

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