CBCS SCHEME

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15AE553

Fifth Semester B.E. Degree Examination, Aug./Sept. 2020
Theory of Vibrations

Time: 3 hrs. Max. Marks: 80

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. **(08 Marks)**

b. A periodic motion is as shown in Fig. Q1 (b). Determine the harmonic series of this motion. **(08 Marks)**

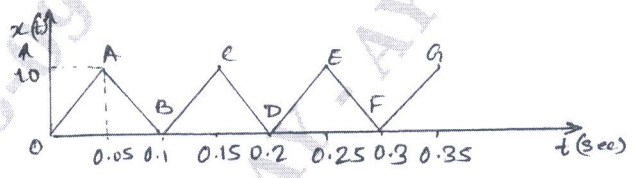

Fig. Q1 (b)

OR

2 a. 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 of 60°. **(08 Marks)**

b. Represent the periodic motion given in Fig. Q2 (b) by harmonic series. **(08 Marks)**

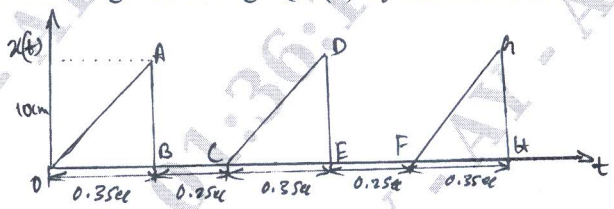

Fig. Q2 (b)

Module-2

3 a. Determine the natural frequency of a spring mass system where the mass of the spring is also taken into account. **(08 Marks)**

b. Obtain the differential equation of motion for the system shown in Fig. Q3 (b) and hence find
(i) Critical damping co-efficient. (ii) Damping ratio.
(iii) Natural frequency of damped oscillations (iv) Natural frequency of undamped vibration. **(08 Marks)**

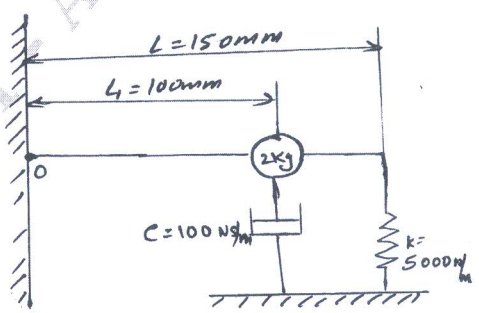

Fig. Q3 (b)

OR

4 a. Define logarithmic decrement and ST it can be expressed as $\delta = \frac{1}{n}\log\left(\frac{u_0}{x_1}\right)$, where n cycles, u_0 is the initial amplitude and x_n is the amplitude after n cycles. **(08 Marks)**

b. Determine the natural frequency of the system shown in Fig. Q4 (b). **(08 Marks)**

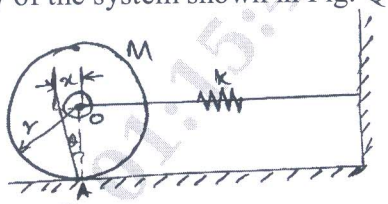

Fig. Q4 (b)

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 wavelength 14 meters. What will be amplitude of vibration at 60 km/hr? **(08 Marks)**

b. A vibrometer gives a reading of relative displacement 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 machine part. **(08 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 a 0.06 mm at 600 rpm. Take m = 30 kg. Determine the amplitude of vibration of the body and dynamic load on each isolator. **(08 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 up conditions of the system. Assume the stiffness of the shaft as 36000 N/m and the external damping ratio as 0.1. **(08 Marks)**

Module-4

7 a. Fig. Q7 (a) shows 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. **(08 Marks)**

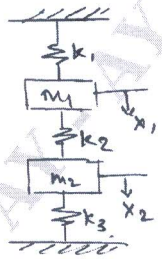

Fig. Q7 (a)

b. Determine the frequency equation and the general solution of the two degrees of freedom torsional system shown in Fig. Q7 (b) **(08 Marks)**

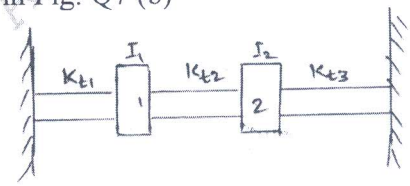

Fig. Q7 (b)

OR

8 a. Fig. Q8 (a) shows a system subjected to vibration. Find an expression for the natural frequency. **(08 Marks)**

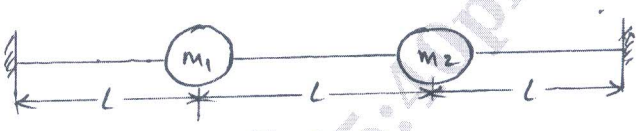

Fig. Q8 (a)

b. Determine the differential equation, natural frequency and the amplitude ratio of the system shown in Fig. Q8 (b) **(08 Marks)**

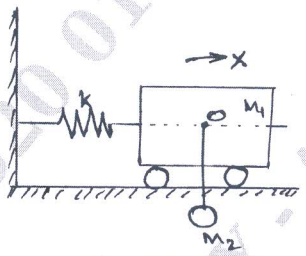

Fig. Q8 (b)

Module-5

9 Using Stodala's method, determine the lowest natural frequency of the torsional system shown in Fig. Q9 **(16 Marks)**

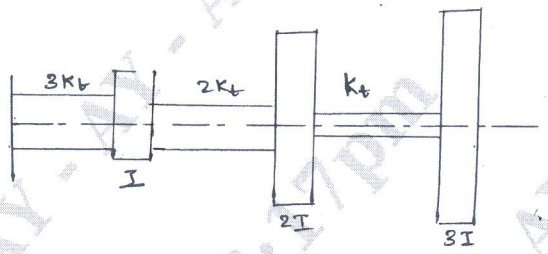

Fig. Q9

OR

10 Using Holzer's method find the natural frequencies of the four mass system as shown in Fig. Q10, if K = 1 N/m and m = 1 kg. **(16 Marks)**

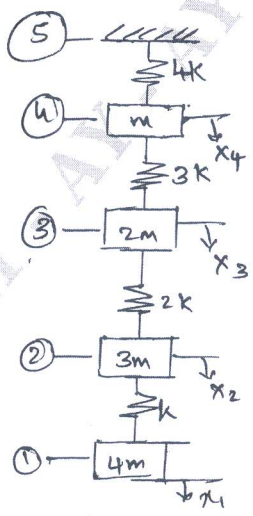

Fig. Q10

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