CBCS SCHEME

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15AE553

Fifth Semester B.E. Degree Examination, Jan./Feb. 2023
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) Degree of reaction
ii) Simple Harmonic motion
iii) Resonance **(06 Marks)**

b. Represent the periodic motion given in the following Fig.Q1(b) by Harmonic series.

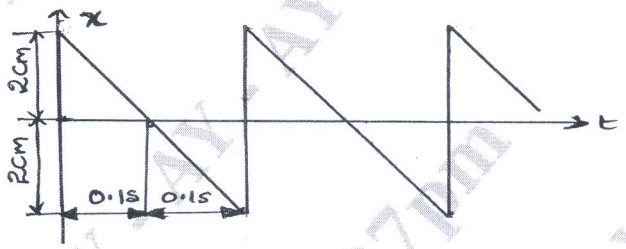

Fig.Q1(b) **(10 Marks)**

OR

2 a. Split the Harmonic motion $x = 5\sin(\omega t + \pi/4)$ into two harmonic motions one having phase of zero and other 60°. **(06 Marks)**

b. With a neat sketch, explain the beats phenomenon and obtain its resultant motion. **(10 Marks)**

Module-2

3 a. Determine the natural frequency of a spring mass system where the mass of the spring is also to be 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 coefficient and
ii) Natural frequency of damped oscillation.

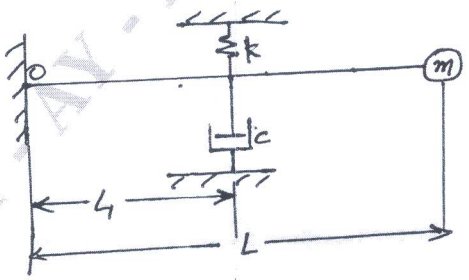

Fig.Q3(b) **(08 Marks)**

OR

4 a. Determine the natural frequency of the system shown in Fig.Q4(a). Neglecting the mass of rod.

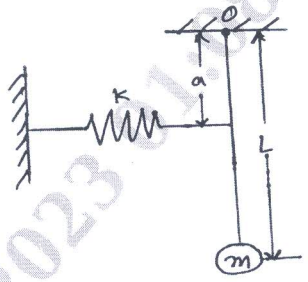

Fig.Q4(a) **(08 Marks)**

b. 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_0 is the amplitude after 'n' cycles. **(08 Marks)**

Module-3

5 a. Define the term transmissibility and derive the expression for transmissibility ratio due to harmonic excitation. **(08 Marks)**

b. A machine tool of mass 200 kg is supported in spring of total stiffness 16000 N/cm has an unbalanced rotation element which results in a disturbing force 800 N at a speed of 3000 rpm. Assume $\xi = 0.2$. Determine:
i) Amplitude of motion due to unbalance
ii) Transmissibility
iii) Transmitted force. **(08 Marks)**

OR

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

b. A vibrometer gives a reading of relative displacement 0.5 mm. The natural frequency of vibration is 600 rpm and the machine owns at 200 rpm. Determine the magnitude of displacement, velocity and acceleration of the vibrating machine part. **(06 Marks)**

Module-4

7 a. Derive an expression for natural frequencies of dynamic and static coupling systems. **(10 Marks)**

b. Determine the frequency of the system Fig. Q7 (b), $K_1 = K_2 = 40$ N/m, $K = 60$ N/m, $m_1 = m_2 = 10$ kg .

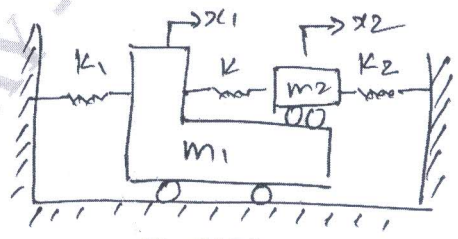

Fig.Q7(b) **(06 Marks)**

OR

8 a. With a neat sketch, explain Lanchester Damper and Houdaille damper. **(10 Marks)**

b. Derive ID wave equation for transverse vibration of beams. **(06 Marks)**

Module-5

9 Using Stodola method, determine the lowest natural frequency of the four degree of freedom of spring mass system shown in Fig.Q9.

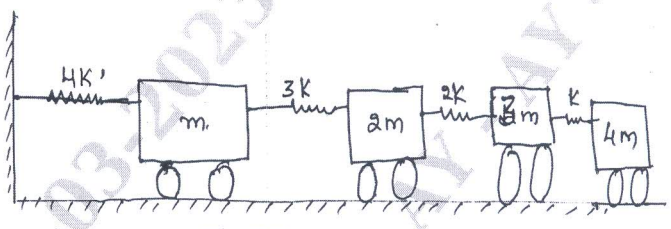

Fig.Q9 **(16 Marks)**

OR

10 a. Explain Dunkerly's method of determining the fundamental natural frequency of a multidegree freedom system. **(08 Marks)**

b. Find the lowest natural frequency of vibration for the system shown in Fig.Q10(b) by Rayleigh's method. $E = 1.96 \times 10^{11}$ N/m^2, $I = 4 \times 10^{-7}$ m^4.

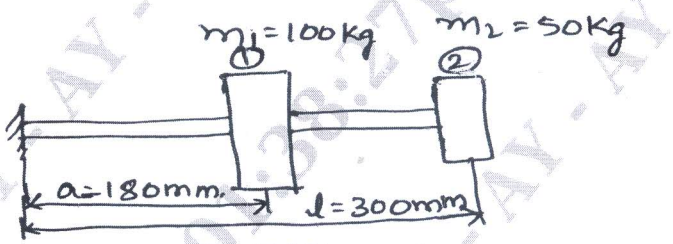

Fig.Q10(b) **(08 Marks)**

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