CBCS SCHEME

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18AE56

Fifth Semester B.E. Degree Examination, Dec.2024/Jan.2025
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. Define vibration and explain types of vibration. **(10 Marks)**

b. Determine the sum of following harmonic motions analytically and check the solutions graphically $x_1 = 4\cos(wt + 10°)$, $x_2 = 6\sin(wt + 60°)$. **(10 Marks)**

OR

2 a. A harmonic motion is given by the equation $X = 5\sin(3t + \phi)$ is to be split into 2 components, such that, one leads it by 30° and other lags by 80°. Determine the components. **(10 Marks)**

b. Formulate the periodic motion given in the Fig.Q.2(b) by harmonic series. **(10 Marks)**

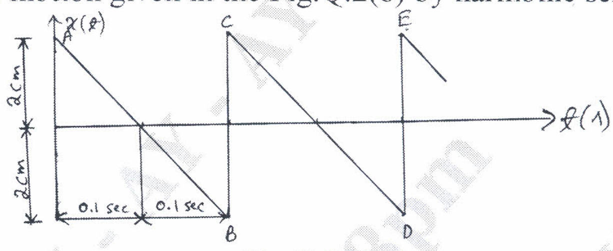

Fig.Q.2(b)

Module-2

3 a. Determine the natural frequency of the system as shown in Fig.Q.3(a), neglecting the mass of rod by i) Newton's method ii) Energy method. **(10 Marks)**

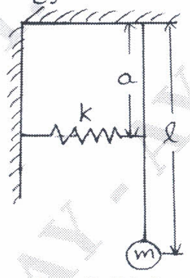

Fig.Q.3(a)

b. Determine the natural frequency of oscillation of the system shown in Fig.Q.3(b) for small amplitudes of vibration. If m, k_1, k_2, (a + b) are fixed, find the value of 'b' for which the system will not vibrate. **(10 Marks)**

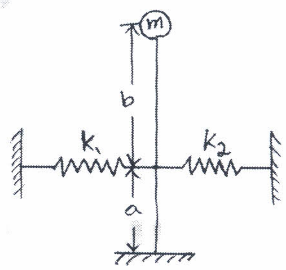

Fig.Q.3(b)

OR

4 a. What are the types of damping? Explain any two types of damping. **(10 Marks)**

b. Find the natural frequency of vibration of the half solid cylinder shown in Fig.Q.4(b), when slightly displaced from the equilibrium position and released by using i) Newton's method ii) Energy method. **(10 Marks)**

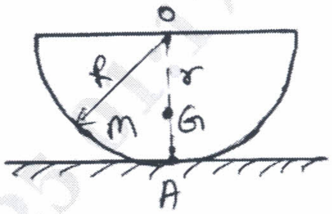

Fig.Q.4(b)

Module-3

5 a. Briefly explain vibration isolation and transmissibility. **(10 Marks)**

b. A mass of 10 kg suspended from one end of helical spring, the other end is fixed, as shown in Fig.Q.5(b). The stiffness of the spring is 10 N/mm. The viscous damping causes the amplitude to decrease $1/10^{th}$ of initial value in four complete oscillations. If a periodic force of (150 cos 50 t) N is applied at the mass with vertical direction, determine the amplitude of forced vibration. What is its value at resonance? **(10 Marks)**

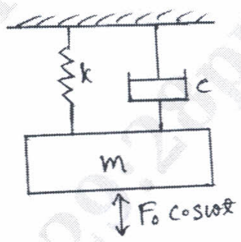

Fig.Q.5(b)

OR

6 a. Derive an expression for amplitude of a whirling shaft without air damping. **(05 Marks)**

b. Explain the working principle of
   i) Vibrometer
   ii) Fullarton Tachometer. **(10 Marks)**

c. 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. **(05 Marks)**

Module-4

7 a. Derive one dimensional wave equation for lateral vibration of a string. **(10 Marks)**

b. Derive the differential equation for torsional vibration of a uniform shaft. **(10 Marks)**

OR

8 a. Write a short note on principal modes and normal modes of vibration. **(04 Marks)**

b. The Fig.Q.8(b) shows a spring mass system. Determine:
i) Equation of motion
ii) Frequency equation and natural frequencies of the system and
iii) Modal vectors and mode shapes. **(16 Marks)**

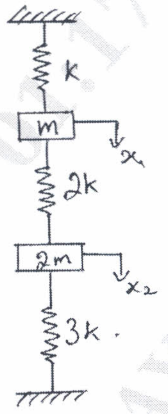

Fig.Q.8(b)

Module-5

9 a. Determine the influence coefficients for the system shown in Fig.Q.9(a). Take $m_1 = m$, $m_2 = 2$ m, $m_3 = 3$ m, $l_1 = l_2 = l_3 = l$. **(12 Marks)**

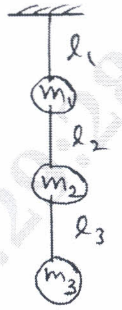

Fig.Q.9(a)

b. Find the lowest natural frequency of vibration for the system shown in Fig.Q.9(b), by Rayleigh's method. $E = 1.96 \times 10^{11}$ N/m^2, $I = 4 \times 10^{-7}$ m^4.

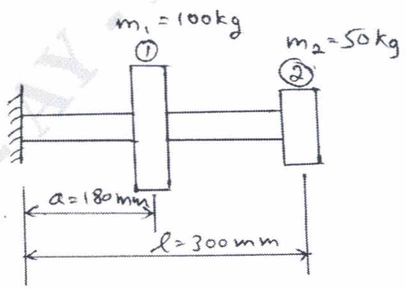

Fig.Q.9(b)

(08 Marks)

OR

10 a. A shaft of 50 mm diameter and 3 m long is supported at the ends and carries three weights of 1000 N, 1500 N and 750 N at 1 m, 2 m and 2.5 m from the left support. Taking E = 200 GPa, find the frequency of transverse vibrations. **(08 Marks)**

b. Using Stodola's method, determine the fundamental mode of vibration and its natural frequency of the spring mass system shown in Fig.Q.10(b). **(12 Marks)**

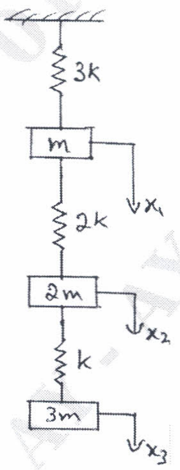

Fig.Q.10(b)

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