10MT754

Seventh Semester B.E. Degree Examination, June/July 2023
Mechanical Vibrations

Time: 3 hrs.   Max. Marks:100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1 a. x_1 and x_2 are SHMs of same frequency. The sum of x_1 and x_2 is 6.17 sin (wt + 1.28). If x_1 = 2 cos (wt + 0.5), find x_2 analytically and also graphically.   **(10 Marks)**

   b. A force 25 sin 20πt N acts on a body and results a displacement 0.05 sin (20πt - π/6)m. Find the work done during the first second.   **(06 Marks)**

   c. What is Fourier series? Explain in brief.   **(04 Marks)**

2 a. A circular cylinder of mass 'M' and radius 'R' is connected by spring of stiffness 'k' as in Fig.Q2(a)(i). If it is free to roll on the rough surface which is horizontal without slipping. Find its natural frequency what will happen to frequency if the system is placed on an inclined plane as in Fig.Q2(a)(ii).   **(06 Marks)**
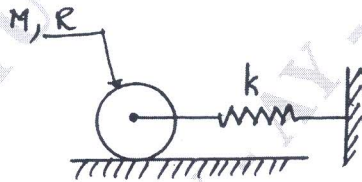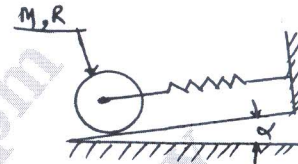

Fig.Q2(a)(i)   Fig.Q2(a)(ii)

   b. Determine the natural frequency of the system as shown in Fig.Q2(b).   **(10 Marks)**
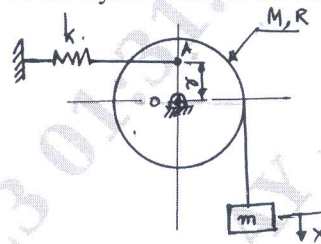

Fig.Q2(b)

   c. Derive the equation of motion for a torsional pendulum and determine its natural frequency as shown in Fig.Q2(c).
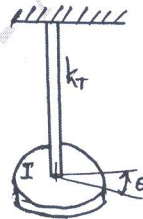

Fig.Q2(c)   **(04 Marks)**

3 a. Derive an equation for logarithmic decrement for an underdamped system.   **(10 Marks)**

   b. In a damped free vibration system following data are noted:
      K = 15000 N/m,   C = 120 NS/m,   M = 5 kg
      Determine: (i) Undamped natural frequency   (ii) Damped natural frequency
      (iii) Critical damping coefficient   (iv) Logarithmic decrement
      (v) Ratio of amplitudes of two successive waves   **(10 Marks)**

4 a. The springs of an automobile trailer are compressed 0.1m under its own weight. Find the critical speed in kmph of the automobile when it is travelling over a road with a profile approximated by a sine wave of amplitude 0.08m and wavelength of 14m. Also find the amplitude of vibration at 60 kmph. **(10 Marks)**

   b. Define 'Transmissibility'. State the expression for the same. How do you achieve effective transmissibility when $w \gg w_n$? Explain in brief with the help of transmissibility versus $\dfrac{w}{w_n}$ curves. **(10 Marks)**

PART – B

5 a. What are the principle of vibrometer and accelerometer? What is the difference between the two? **(08 Marks)**

   b. List the devices used for measurement of frequency and explain any one. **(06 Marks)**

   c. A rotor of mass 12 kg is mounted in the middle of the shaft having diameter 25mm and supported between two bearing placed at 900mm from each other. The rotor is having 0.02mm eccentricity. If the system rotates at 3000 rpm. Determine the amplitude of vibration $E = 2 \times 10^5 \, N/mm^2$. **(06 Marks)**

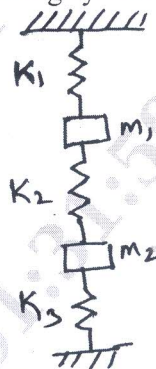6 a. Find the natural frequencies of the following system and draw the mode shapes of vibration.

Fig.Q6(a) **(14 Marks)**

   b. Explain the working principle of dynamic vibration absorber. **(06 Marks)**

7 Write short notes on:
   i)   Maxwell's reciprocal theorem.
   ii) Influence coefficients.
   iii) Dunkerly's method.
   iv) Orthogonality of principal modes. **(20 Marks)**

8 a. Define the following terms:
      i) Exciter   ii) Coherence   iii) Modulation   iv) Transducer. **(04 Marks)**

   b. Explain Basic elements of vibration measurement system with block diagram. **(10 Marks)**

   c. Explain Hydraulic exciter. **(06 Marks)**

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