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Seventh Semester B.E. Degree Examination, Jan./Feb. 2023
Mechanical Vibrations

Time: 3 hrs.

Max. Marks: 100

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

Module-1

1 a. Explain the following : (i) Causes of vibration and it's types (ii) Beats phenomenon
(10 Marks)

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

OR

2 a. Define the following : (i) Simple harmonic motion (ii) Degrees of freedom (iii) Natural frequency (iv) Phase difference. **(08 Marks)**

b. A periodic motion is shown in Fig. Q2 (b). Determine the harmonic series of this motion.
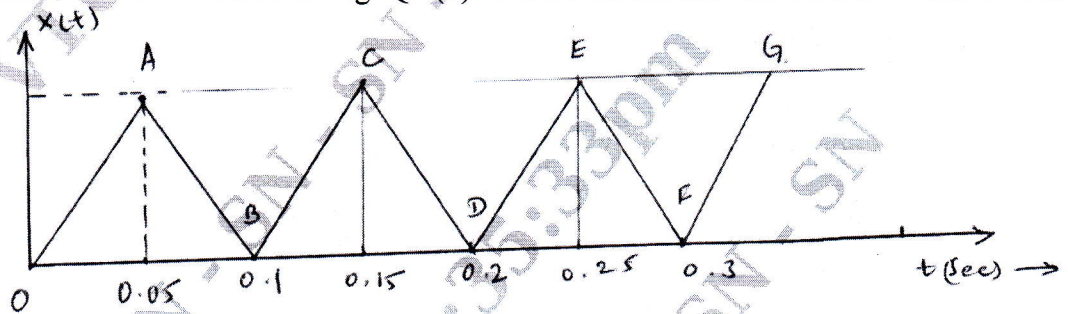

Fig. Q2 (b) **(12 Marks)**

Module-2

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

b. Determine the equation of motion and the natural frequency of the system shown in the Fig. Q3 (b)
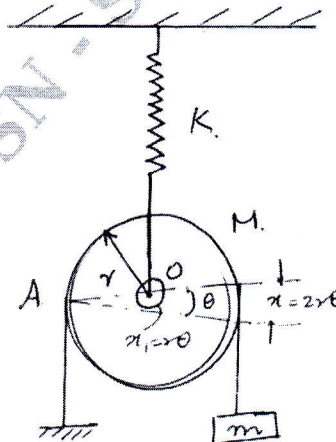

Fig. Q3 (b) **(10 Marks)**

OR

4 a. Define logarithmic decrement. Derive an expression for logarithmic decrement and show
      that $\delta = \ln\left(\dfrac{x_0}{x_1}\right) = \dfrac{1}{n}\ln\left(\dfrac{x_0}{x_n}\right)$

      (08 Marks)

   b. A mass of 2 kg is supported on an isolator having a spring scale of 2940 N/m and viscous
      damping. If the amplitude of free vibration of the mass falls to one half it's original value in
      1.5 seconds, determine the damping co-efficient of this isolator. **(12 Marks)**

Module-3

5 a. What is Magnifaction Factor and Transmissibility? Show the plots of M.F versus frequency
      ratio and phase angle versus frequency ratio for various values of damping factor and write
      their observations.
      (10 Marks)

   b. A machine of mass one tone is acted upon by an external force of 2450 N at a frequency of
      1500 rpm. T = reduce the effects of vibration, isolator of rubber having a state deflection of
      2 mm under the machine load and an estimated damping factor of 0.2 are used. Determine,
      (i) Force transmitted to the foundation   (ii) Amplitude of vibration of the machine
      (iii) Phase lag of the transmitted force with respect to the external force.   **(10 Marks)**

OR

6 a. Sketch the dimensionless amplitude versus frequency ratio characteristics (curves) of a
      vibration measuring instrument. Explain in what region it can be used as vibrometer and as
      accelerometer.
      (08 Marks)

   b. A rotor of mass 12 kg is mounted midway on a 25 mm diameter horizontal shaft supported
      at the end of two bearings. The span between span between the bearings is 900 mm. Because
      of some manufacturing defect the Cg of the rotor is 0.02 mm away from geometric centre of
      rotor. If the system rotates at 3000 rpm, determine the amplitude of steady state vibrations
      and the dynamic force on the bearings. Take E = 200 GPa.   **(12 Marks)**

Module-4

7 By the Holzer method find the natural frequencies of the system shown in Fig. Q7. Assume
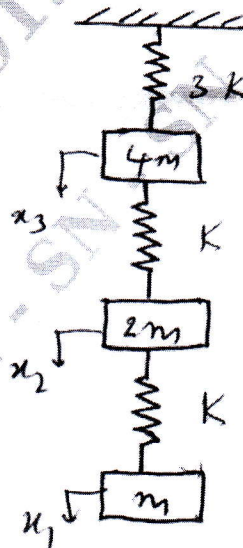   K = 1 N/m ; m = 1 kg

Fig. Q7

(20 Marks)

OR

8 a. For the system shown in Fig. Q7, find the lowest natural frequency by Stodola's method.
      (12 Marks)

b. Find the lowest natural frequency of vibration for the system in Fig. Q8 (b) by Rayleigh's method. $E = 1.96 \times 10^{11}$ N/m^2, $I = 4 \times 10^{-7}$ m^4.

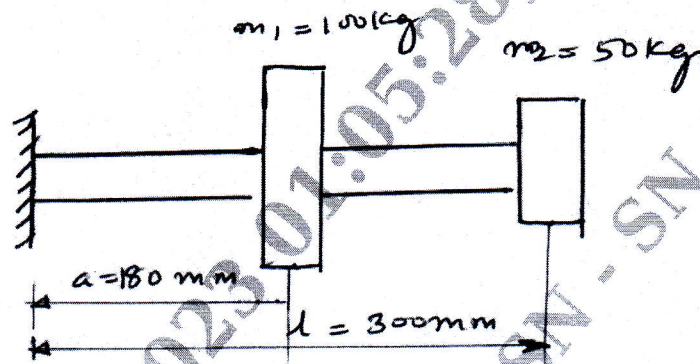Fig. Q8 (b)   (08 Marks)

Module-5

9   a. Write a short note on dynamic testing of machines and structures.   (10 Marks)
    b. Explain the following:
        (i)   Signal analysis
        (ii)   Sound level meters.   (10 Marks)

OR

10 a. Sketch and explain the assignment for experimental modal analysis.   (10 Marks)
    b. Explain the various techniques for machine condition monitoring with a schematic diagram.
                                                                            (10 Marks)

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