10ME/MR72

Seventh Semester B.E. Degree Examination, Dec.2019/Jan.2020
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. Define Vibrations. Explain any four type of vibrations.   (06 Marks)
   b. Write a short note on Beats.   (04 Marks)
   c. Add the following motions analytically and check the solution graphically :
      $x_1 = 4 \cos(wt + 10^0)$; $x_2 = 6 \sin(wt + 60^0)$.   (10 Marks)

2 a. Determine the natural frequency of the system shown in fig. Q2(a).   (10 Marks)
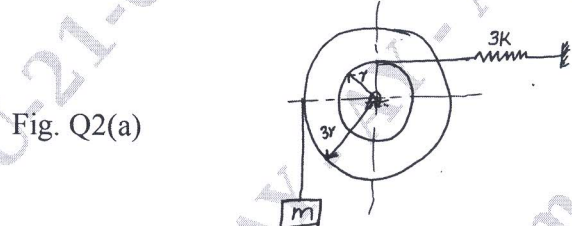

Fig. Q2(a)

   b. Determine the natural frequency of the system shown in fig. Q2(b).   (10 Marks)
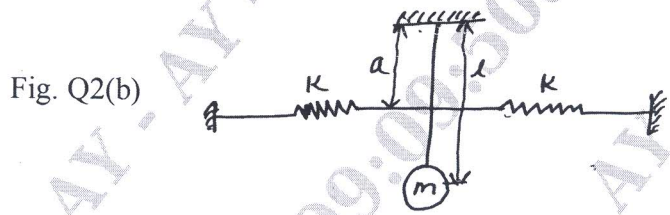

Fig. Q2(b)

3 a. Find the equation of motion for the system of spring mass and damper system when
      i) $\xi = 1$ ii) $\xi = 0.3$ iii) $\xi = 2$.
      If the mass 'm' is displaced by a distance of 3 cm and released.   (10 Marks)
   b. A vibrating system is having mass 3 kg and spring stiffness 100 N/m, damping co-efficient
      is 3N-S/m. Determine damping ratio, damped natural frequency, logarithmic decrement ,
      ratio of law consecutive amplitudes and number of cycles when the original amplitude is
   reduced to 20%.   (10 Marks)

4 a. What is Magnification Factor? Derive an expression for the same and discuss its variation
      with frequency ratio.   (10 Marks)
   b. A machine of total mass 68kg mounted on spring of stiffness K = 11000 N/cm. With an
      assumed dumping factor $\varsigma = 0.2$. A piston within the machine has a mass of 2kg has a
      reciprocating motion with stroke 7.5cm and a speed of 3000 rpm. Assuming the motion of
      piston to be S.H.M. Determine   i) Amplitude of Machine
      ii) Phase angle with respect to exciting force.
      iii) Transmissibility and force transmitted to foundation.
      iv) Phase angle of transmitted force with respect to exciting force.   (10 Marks)

PART - B

5 a. With a neat schematic diagram, explain seismic instrument as :
   i) a vibrometer   ii) an accelerometer.   **(10 Marks)**

   b. A rotor of mass 12kg is mounted midway on a 25mm diameter horizontal shaft supported at the ends of two bearings. The span between the bearings is 900mm. Because of same manufacturing defects the C.G (Centre of gravity) of the rotor is 0.02mm 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. **(10 Marks)**

6 a. A two degrees of freedom vibrating system is shown in fig. Q6(a). Determine i) The two natural frequencies of vibrations   ii)   Ratio of amplitudes of motion of m_1 & m_2 for the two modes of vibration   iii) Model vector and Model shapes.
   Given $m_1 = 2kg$, $m_2 = 1$ kg , $k_1 = 40$ N/m and $k_2 = 20$N/m.   **(15 Marks)**
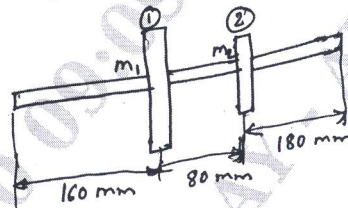
Fig. Q6(a)
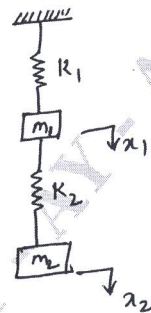
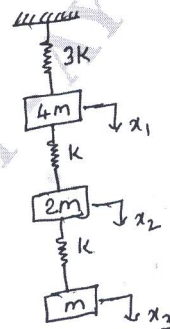   b. Explain Dynamic Vibration Absorber with a sketch of a spring mounted dynamic absorber?   **(05 Marks)**

7 a. Find the lowest natural frequency of transverse vibrations of the system shown in fig.Q7(a), by Rayleigh's method E = 196 GPa , I = 10^{-6} m^4 , $m_1 = 40$ kg , $m_2 = 20$kg.   **(10 Marks)**

Fig. Q7(a)

   b. For the system shown in fig.Q7(b), find the lowest natural frequency by Stodola's method.   **(10 Marks)**

Fig. Q7(b)

8 a. Explain Dynamic testing of Machines.   **(06 Marks)**
   b. Explain the experimental modal analysis.   **(06 Marks)**
   c. Explain machine condition monitoring techniques.   **(08 Marks)**

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