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Paper Id: | **140272** | **Roll No.** | | | | | | | | | | |

B.TECH.
(SEM VI) THEORY EXAMINATION 2018-19
MECHANICAL VIBRATIONS

Time: 3 Hours   *Total Marks: 70*

Note: 1. Attempt all Sections. If require any missing data; then assume suitably.

SECTION A

1.   **Attempt *all* questions in brief.**   **2 x 7 = 14**
  a.   Explain the phenomena of beat.
  b.   Explain Logarithmic decrement and also prove $\delta=\frac{x}{y}ln\frac{x0}{xn}$.
  c.   A body describes simultaneously two motions $x_1 = 3\sin 40t$, $x_2 = 4sin41t$ what is the maximum and minimum amplitude of combined motion and what is the beat frequency?
  d.   Define : i) degree of freedom ii) D' Alembert's principle
  e.   Explain various types of damping
  f.   Determine the effect of the mass of the spring on the natural frequency of the system.
  g.   Write short notes on vibration Isolation and Transmissibility.

SECTION B

2.   **Attempt any *three* of the following:**   **7 x 3 = 21**
  a.   Determine the two natural frequencies and the modes of vibration of double pendulum.
  b.   The disc of torsional pendulum has a moment of inertia of 600 kg-cm^2 and is immersed in a viscous fluid. The brass shaft attached to it is of 10 cm diameter and 40 cm long. When the pendulum is vibrating, the observed amplitudes on the same side of the rest position for successive cycles are $9^0,6^0$ and 4^0. Determine i) logarithmic decrement ii) damping torque at unit velocity, and iii) the periodic time of vibration. Assume for the brass shaft,G=4.4$\times 10^{10}\ N/m^2$
  c.   An electric motor is supported on a spring and a dashpot, the spring has the stiffness 6400 N/m and the dashpot offers resistance of 500N at 4 seconds. The unbalanced mass 0.5 kg rotates at 5 cm radius and the total mass of vibratory system is 20 kg. the motor runs at 400 rpm.
       Determine i) damping factor ii) amplitude of vibration and phase angle iii) resonant speed and resonant amplitude, and iv) forces exerted by the spring and dashpot on the motor.
  d.   State and prove Maxwell's reciprocal theorem.
  e.   Write short note on Rayleigh Ritz Method.

SECTION C

3.   **Attempt any *one* part of the following:**   **7 x 1 = 7**
  (a) The measurements on a mechanical vibrating system show that it has a mass of 8 kg and that the springs can be combined to give an equivalent spring of stiffness 5.4 N/mm. If the vibrating system have a dashpot attached which exerts a force of 40 N when the mass has a velocity of 1 m/s, find: 1) Critical damping coefficient, 2) Damping factor,3) logarithmic decrement, and 4) Ratio of two consecutive amplitudes.
  (b) Find the time period of vibration of a compound pendulum.

4.   **Attempt any *one* part of the following:**   **7 x 1 = 7**
  (a) A 1000 kg machine is mounted on four identical springs of total spring constant 'k' and having negligible damping. The machine is subjected to a harmonic external force of amplitude F_0=490 N and frequency 180 r.p.m. Determine
       a) The amplitude of motion of the machine and maximum force transmitted to foundation because of the unbalanced force when k=1.96$\times 10^6 N/m$.
       b) The same as in (a) for the case when k=9.8$\times 10^4 N/m$.

(b)   The springs of an automobile trailer are compressed 0.1 m under its own weight. Find the critical speed when the trailer is travelling over a road with a profile approximate by a sine wave of amplitude 0.08m and wave length of 14 meters. What will be the amplitude of vibration at 60 km/hr?
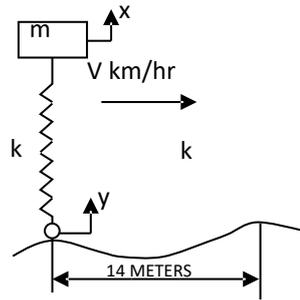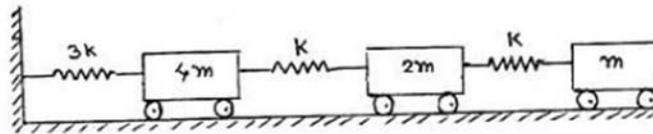

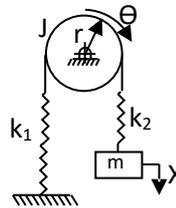5.   **Attempt any *one* part of the following:**   **7 x 1 = 7**
   (a)   What is vibration absorber? Explain centrifugal pendulum absorber with neat sketch.
   (b)   How the natural frequency of torsional vibrations for a two rotor system is obtained?

6.   **Attempt any *one* part of the following:**   **7 x 1 = 7**
   (a)   A three degree of freedom system is schematically shown in fig. Write down its three differential equations of motion by Newton's second law. Put these equations in matrix form.
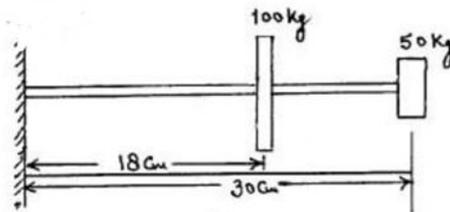

   (b)   For the combined rectilinear and rotary two degrees of freedom system, shown in figure, write down the two differential equations of motion. Put these equations in matrix form.

7.   **Attempt any *one* part of the following:**   **7 x 1 = 7**
   (a)   Find the lowest natural frequency of vibration for the system shown in figure. By Rayleigh Method. Assume E=2× $\frac{10^{11}N}{m^2}$, $I = 4 \times 10^7 m^4$.

   (b)   Discuss the Holzer's method for finding natural frequencies of multi rotor vibrating system.