

TME- 501

Roll No.

--	--	--	--	--	--	--	--	--	--

Odd Semester Examination, 2019-20
B.Tech-Mechanical Engineering (Semester-5th)
MECHANICAL VIBRATIONS

Max Marks-100

TIME-3 hrs

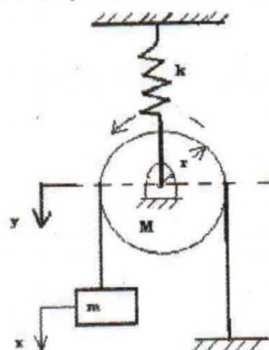
Total no. of printed pages: 2

Note: Attempt all the questions

4×5=20

Q.1 Attempt any four:

- Define degree of freedom. Also explain logarithmic decrement.
- Discuss energy method for determining natural frequency
- Differentiate the following types of Vibrations
 - Free and Forced Vibrations
 - Damped and Undamped Vibrations
 - Linear and non linear Vibrations
- Show that the resultant motion of three harmonic motions given below is zero.
 $x_1 = a\sin(\omega t)$, $x_2 = a\sin(\omega t + 2\pi/3)$, and $x_3 = a\sin(\omega t + 4\pi/3)$
- Determine the natural frequency of the system as shown in the figure



f) Explain following damping with diagram.

(i) Viscous damping

(ii) Coulomb Damping

Q.2 Attempt any two:

2×10=20

- An electric motor is supported on a spring and a dashpot. The spring has stiffness 6400 N/m and the dashpot offers resistance of 500 N at 4.0 m/sec. The unbalance 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, (iv) force exerted by the spring and dashpot on the motor.

b) A body of 7 kg is supported on a spring of stiffness 280 N/m and has dashpot connected to it which produces a resistance of 0.002 N at a velocity of 0.1 mm/s. In what ratio will the amplitude of vibration be reduced after 5 cycles?

c) Explain the terms vibration isolation and transmissibility with suitable examples

Q.3 Attempt any two:

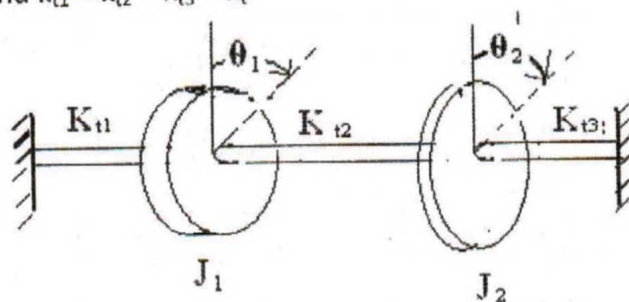
2×10=20

- a) With neat sketch explain the working of Vibration absorber. What is the difference between absorber and isolator?
- b) Explain the working of following absorbers with neat sketch.
 - (i) Untuned dry Friction Damper
 - (ii) Untuned Viscous Damper
- c) Describe the centrifugal pendulum absorber and prove that natural frequency of pendulum absorber is always proportional to the speed of rotating body.

Q.4 Attempt any two:

2×10=20

- a) Write short note on:
 - i. Influence coefficient
 - ii. Maxwell's reciprocal theorem
 - iii. Centrifugal pendulum
- b) Find the natural frequencies for the torsional system shown in figure.
Given: $J_1=J_0$, $J_2=2J_0$ and $k_{t1} = k_{t2} = k_{t3} = k_t$



c) A shaft of 2.5cm diameter carries a single concentrated load of 196.2 N midway between the bearings. The shaft is freely supported in the bearings 75cm apart. Determine the critical speed if mass density material is $8 \times 10^2 \text{ kg/m}^3$ and $E= 2.1 \times 10^{11} \text{ N/m}^2$.

Q.5 Attempt any two:

2×10=20

- a) Derive an expression for Critical speed or Whirling speed of shaft without air damping.
- b) Determine the natural frequency of 3 mass, 3 spring vibrating system by Stodola's method. Assume $m_1=m_2=m_3=2\text{kg}$ and $k_1=k_2=k_3= 2 \text{ N/m}$ (vertically suspended system).
- c) Write a short note on the following
 - i. Holzer's method