Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

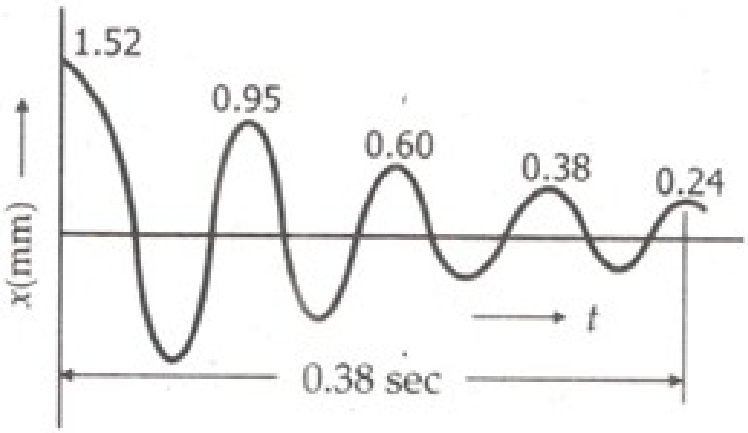
End Semester Examination, March 2019

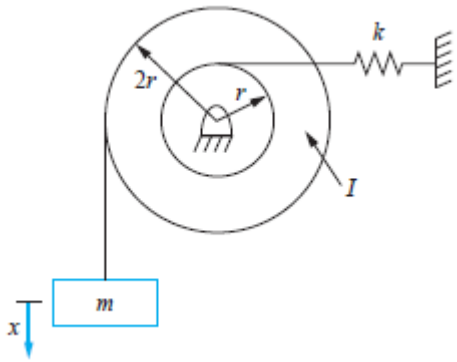
Programme Name: B.Tech/Mechanical | **Semester : VI**
Course Name : Mechanical Vibration | **Time : 03 hrs**
Course Code : MECH 4009 | **Max. Marks: 100**
Nos. of page(s) : 03
Instructions: Attempt all the questions as directed. Assume suitable data if missing.

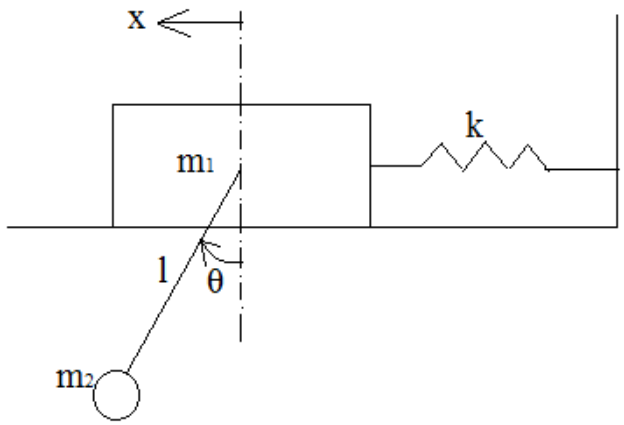
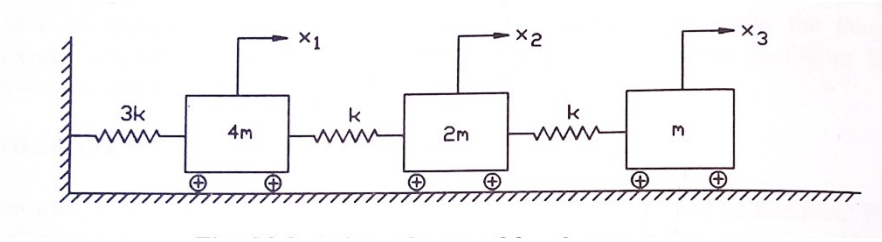
SECTION A

S. No.	Statement	Marks	CO
Q 1	Describe the working of an accelerometer.	5	CO3
Q 2	Distinguish between the viewpoints of lumped parameters system and continuous system applied for vibration analysis.	5	CO4
Q 3	Distinguish between linear and nonlinear vibrations with examples.	5	CO1
Q 4	Explain with the help of neat figure the whirling motion of the shaft. Also, explain the critical speed of the shaft.	5	CO4

SECTION B

Q 5	A machine has a mass of 300 kg. Its vibration record is shown in Fig. Determine the relevant information about the system.  	10	CO1
Q 6	Find the natural frequency of the system showm in figure.Consider the system as one DOF system.	10	CO3

			
Q 7	A uniform bar of length L is fixed at one end and connected at the other end by a spring of stiffness k as shown in figure. Derive the frequency equation of the system. 	**10**	**CO5**
Q 8	The springs of an automobile trailer compress 0.15 m under its own weight. Find the critical speed when the trailer is travelling over the road with a profile approximated by a sine wave of amplitude 0.1 m and length 16 meters. Also, find the amplitude of vibration at 65 km/hr. OR Derive an expression for Transmissibility Ratio (TR) for the case when isolation is achieved using spring and dampers. Discuss the results with the help of graph between transmissibility ratio and frequency ratio.	**10**	**CO3**
	SECTION-C		
Q 9	Perform the modal analysis of the system shown in Fig. Take m_1 = 10 kg, m_2 = 1 kg, r = 0.1 m, length of string of pendulum, l = 1 m and k = 10000 N/m. Take g = 10 m/ s^2.	**20**	**CO2**

	 OR In a refrigeration plant, a section of pipe carrying the refrigerant vibrated violently at a compressor speed of 240 rpm. To eliminate this difficulty, it was proposed to clamp a cantilever spring mass system to the pipe to act as an absorber. For a trail test, a 900 gm absorber tuned to 240 rpm, resulted in two natural frequencies of 198 and 272 cpm. If the absorber system is to be designed so that the natural frequencies lie outside the region 160 and 360 cpm. Calculate the weight and spring stiffness.		
Q 10	Find the natural frequency of the three degree of freedom system shown in figure. 	**20**	**CO4**

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, March 2019

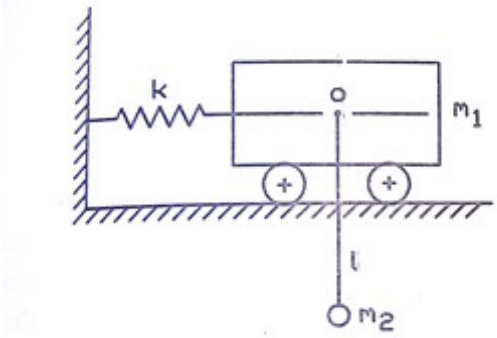
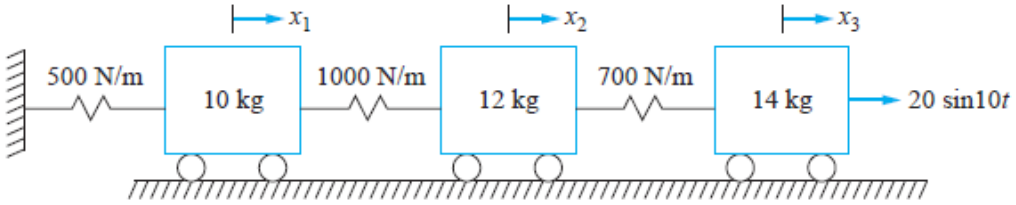
Programme Name: B.Tech/Mechanical | **Semester : VI**
Course Name : Mechanical Vibration | **Time : 03 hrs**
Course Code : MHEG 373 | **Max. Marks: 100**
Nos. of page(s) : 02
Instructions: Attempt all the questions as directed. Assume suitable data if missing.

SECTION A

S. No.	Statement	Marks	CO
Q 1	Discuss the working principal of a vibrometer.	5	CO3
Q 2	Discuss the boundary conditions applied for finding the eigen functions and natural frequencies for a continuous system.	5	CO4
Q 3	Justify the statement "Vibration analysis of a non-linear system involves much complexities"	5	CO1
Q 4	Define the synchronous whirl. Also, discuss the causes of whirling of a shaft.	5	CO4

SECTION B

Q 5	A body of mass 5 kg is supported on a spring of stiffness 200 N/m and has a dashpot connected to it, which produces a resistance of 0.002 N at a velocity of 1 cm/s. Find the reduction of amplitude of vibration after 5 cycles.	10	CO1
Q 6	In spring-mass system, the mass of the spring is significant and cannot be neglected. Explain the accountability of mass of spring while computing the natural frequency of the spring mass system. Take M to be the vibratory mass and m to be the mass of the spring.	10	CO3
Q 7	Derive an expression for wave equation for longitudinal vibrations of bars. Also, find the solution of the equation.	10	CO5
Q 8	The phase angle ϕ between the response and the excitation in a single degree of freedom system can be non-dimensionally represented as: $$\varnothing = \tan^{-1}\left(\frac{2\xi r}{1-r^2}\right)$$ Plot this function schematically against r, for various values of ξ and thereby explain the lead/lag characteristics of response for different ξ as r varies. OR A machine of mass 25 kg is placed on an elastic foundation. A sinusoidal force of magnitude 30 N is applied to the machine. A frequency sweep reveals that the maximum steady state amplitude of 1.4 mm occurs when the period of response is	10	CO3

	0.22 s. Determine the equivalent stiffness and damping ratio of the foundation.		
	SECTION-C		
Q 9	Derive an expression for the natural frequencies and amplitude ratio for the two degree of freedom system shown in figure for small displacement in the plane of paper. The pendulum rod is stiff and pivoted at point O. Also compare the results obtained with the corresponding physical system for the following cases: (a) $k = \infty$, (b) $m_2 = 0$; and (c) $l = 0$  OR A machine runs at 5600 rpm. Its forcing frequency is very near to its natural frequency. If the nearest frequency of the machine is to be at least 15 percent from the forced frequency, design a suitable vibration absorber for the system. Assume the mass of the machine as 35 kg.	**20**	**CO2**
Q 10	Determine the forced response of the three degree-of-freedom system shown in Figure.  	**20**	**CO4**