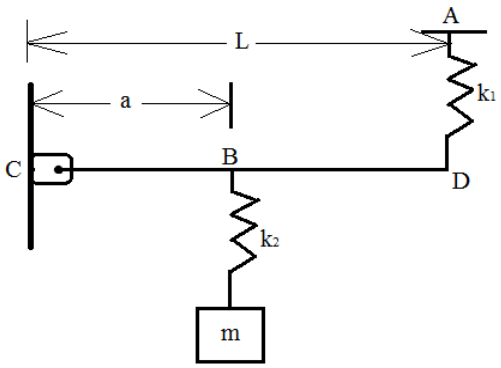
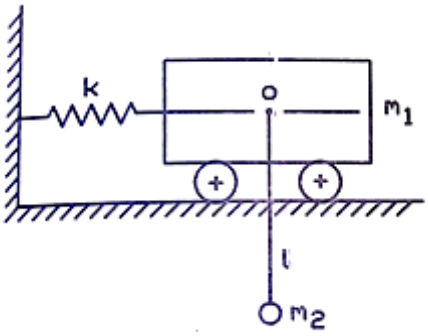
Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, Dec 2020

Programme Name: B.Tech/Mechanical **Semester : VII**
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.

S. No.	Statement	Marks	CO
	SECTION A (Type the answer)		
Q 1	Discuss the importance and main causes of vibration.	**5**	**CO1**
Q 2	Justify the statement "Vibration analysis of a non-linear system involves much complexities"	**5**	**CO1**
Q 3	Discuss the boundary conditions applied for finding the Eigen functions and natural frequencies for a continuous system.	**5**	**CO4**
Q 4	Define the following: a) Eigen valve b) Eigen Vector c) Mode shape d)Normal mode of vibration e) principal mode of vibration	**5**	**CO2**
Q 5	**Fill in the blanks:** **(a)** If a body is in equilibrium under the action of dynamic forces, the inertia force equals …… (Complete the sentence) **(b)** Vibrations cannot occur in absence of …… and …..… in a mechanical system. **(c)** Natural frequency of a mechanical system is ……. (Complete the sentence) **(d)** Degree of freedom in mechanical system is defined as ……. (Complete the sentence) **(e)** D'Alembert's principle applied to a rigid body undergoing planar motion reveals that the …… (Complete the sentence)	**5**	**CO3**
Q 6	Differentiate between the lumped parameter approach and continuous system approach for analyzing the vibrations of a system.	**5**	**CO4**
	SECTION B (Scan and upload)		
Q 7	A 65 kg industrial sewing machine operates at 125 Hz and has a rotating unbalance of 0.15 kg-m. The machine is mounted on a foundation with a stiffness of 2 x 10^6 N/m and a damping ratio of 0.12. Determine the machine's steady amplitude.	**10**	**CO3**

Q 8	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 the road with a profile approximated by a sine wave of amplitude 0.08 m and length 14 meters. Also, find the amplitude of vibration at 60 km/hr.	**10**	**CO3**
Q 9	Derive an expression for wave equation for longitudinal vibrations of bars.	**10**	**CO4**
Q 10	Derive the expression of natural frequency for the system shown in. Assume the bar CD to be weightless and rigid. 	**10**	**CO2**
Q 11	For a spring mass damper system, m = 50 kg and k = 5000 N/m. Find the following (i) critical damping constant c_c, (ii) damped natural frequency when $c = c_c/2$ (iii) logarithmic decrement. OR The following data are given for a system with viscous damping: mass m = 4 kg, spring constant k = 5 kN/m, and the amplitude decreases to 0.25 of the initial value after five consecutive cycles. Find the damping coefficient of the damper.	**10**	**CO2**
SECTION-C (Scan and upload)			
Q 12	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 =∞, (b) m_2 =0; and (c) l =0	**20**	**CO5**



OR

Find the natural frequency of the three degree of freedom system shown in figure.