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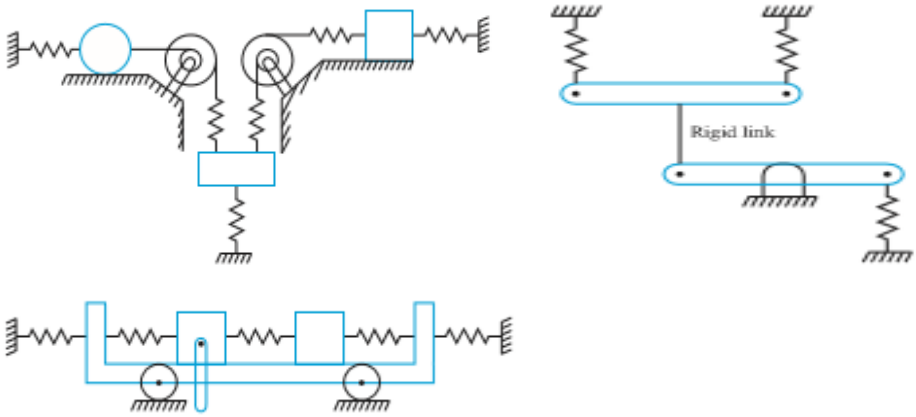
UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2018

Programme: B.Tech/Mechanical | **Semester – :VI**
Course Name: Mechanical Vibration | **Max. Marks : 100**
Course Code: MHEG 373 | **Duration : 3 Hrs**
No. of page/s: 03

Note: Attempt all the questions. There is internal choice in section B and section C. Assume suitable data if missing.

	Marks	CO
Section 'A'		
1. The response of a system is given by x (t) = 0.003 cos (30t) + 0.004 sin(30t) m Determine (a) the amplitude of motion, (b) the period of motion, (c) the frequency in Hz, (d) the frequency in rad/s, and (e) the phase angle	5	CO1
2. Explain the beats phenamenon. Also derive the expression for time period of beats.	5	CO1
3. Enumerate the degree of freedom required to model the system shown in figures shown below. 	5	CO5
4. Write a short note on vibration isolation explaining its practical aspects	5	CO3
Section 'B'		
5. Derive an expression for wave equation for transverse wave propagation on a string. Also find the solution of the equation.	10	CO4
6. The non-dimensional magnification ratio M(r, ξ) $\left(= \frac{X}{X_{st}} = \frac{m\omega_n^2 X}{F_o}\right)$ under the harmonic excitation of single degree of freedom (SDOF) system is represented as follows: $$M(r,\xi) = \frac{1}{\sqrt{(1-r^2)^2 - (2\xi r)^2}}$$	10	CO3

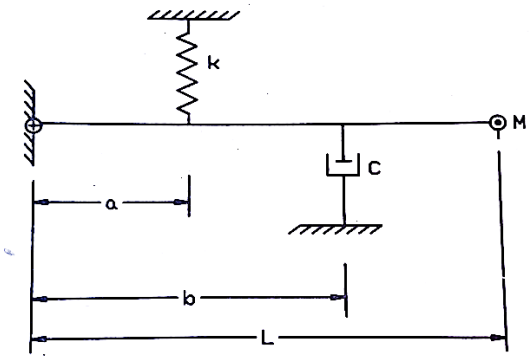
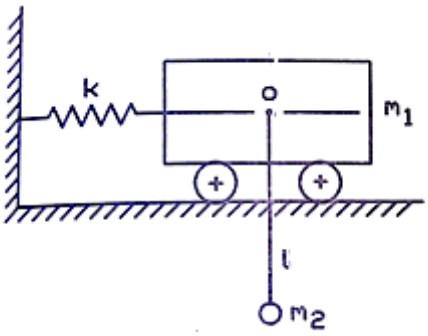
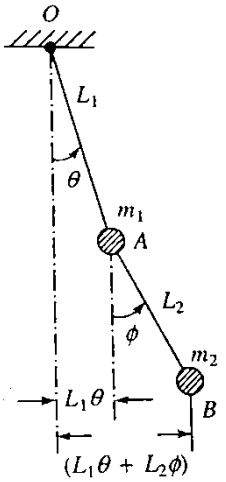
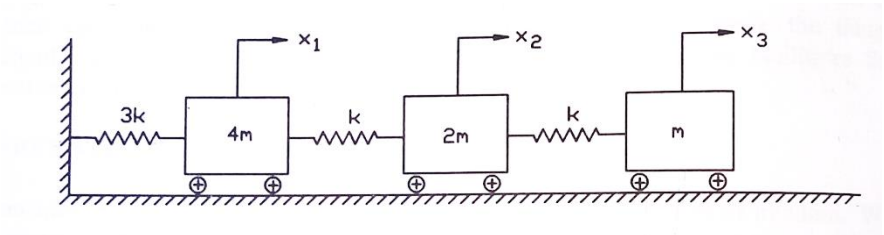
	Draw a representative graph for this function against the frequency ratio for different values of *r* and using the same explain various characteristics of a SDOF system response.		
7.	Write the differential equation of motion for the system shown in figure below and find the natural frequency of damped vibration and damping ratio for the system.  	10	CO2
8.	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. OR Find the minimum static deflection of an isolator to provide 85 percent isolation to a fan that operates at speeds between 1500 rpm and 2200 rpm if (a) the isolator is un-damped and (b) the isolator has a damping ratio 0.1?	10	CO3
	Section 'C'		
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 =∞, (b) m_2 =0; and (c) l =0  OR A double pendulum of lengths L_1 and L_2, masses m_1 and m_2 is shown in	20	CO2

figure. If $m_1=m_2=5$ kg and $L_1 = L_2=25$ cm, find the natural frequencies.  		
10. Comment on it that it is always beneficial to analyze vibratory system by considering it as a lumped parameter system rather than a continuous system. Also derive the governing equation of motion for the three degree of freedom system shown in figure and find the three natural frequencies by matrix method.  	20	CO5