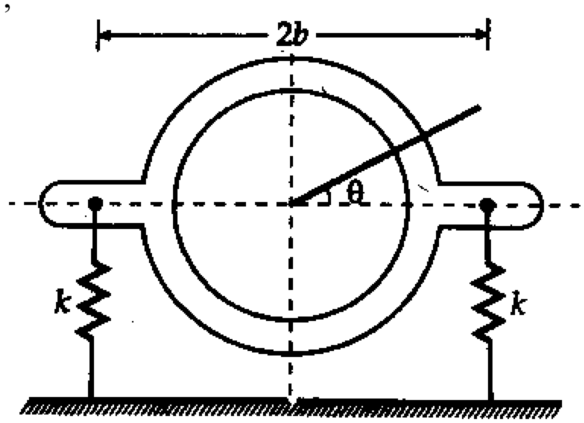
Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

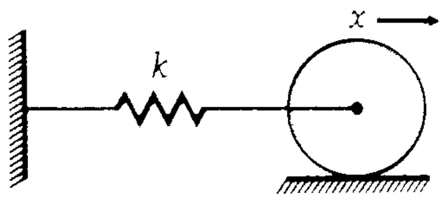
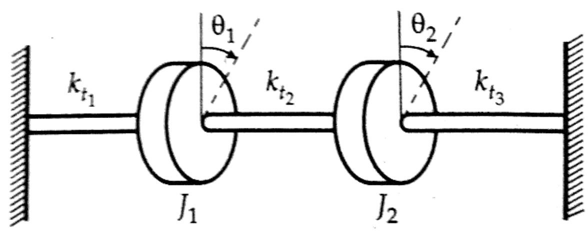
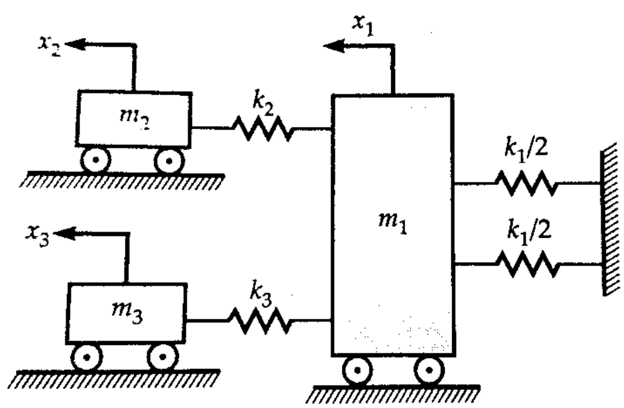
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

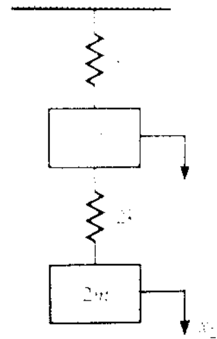
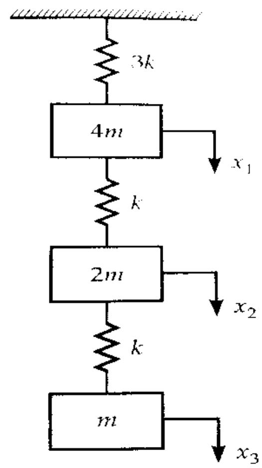
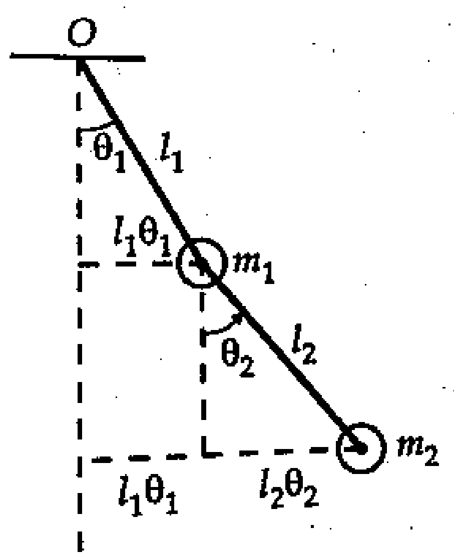
Course: Introduction to Vibration **Semester: VI**
Program: B.Tech ASE **Time 03 hrs.**
Course Code: ASEG316 **Max. Marks: 100**

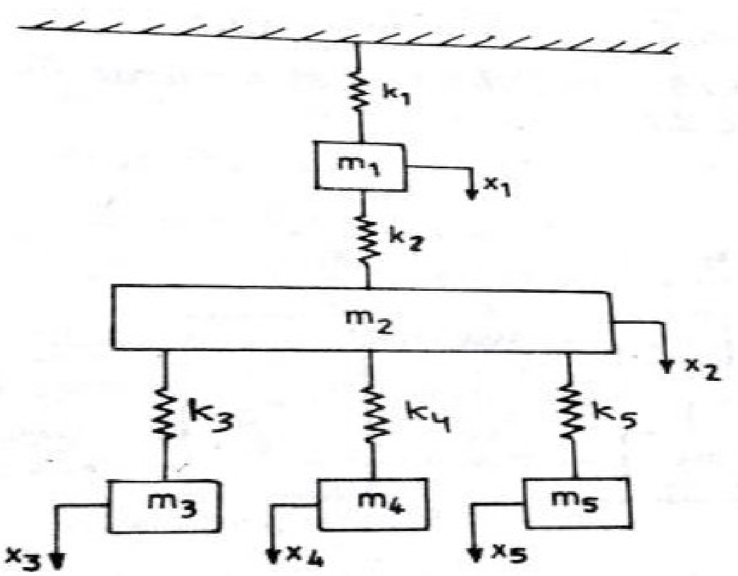
Instructions: Make use of sketches/plots to elaborate your answer. Brief and to the point, answers are expected. The Question paper has three sections: Section A, B and C, Section B and C have internal choices

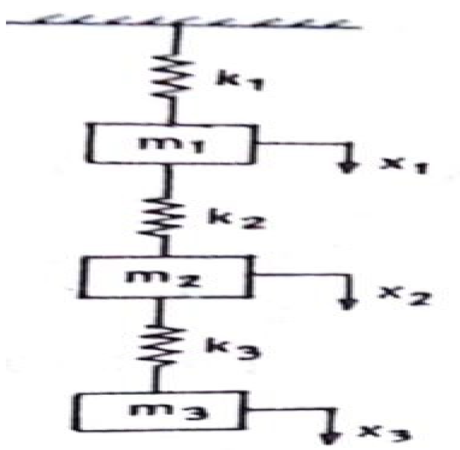
SECTION A

S. No.		Marks	CO
Q 1	Draw free body diagram for under-damped spring mass system for 2DoF and write equation of motion using Energy method.	4	CO1
Q 2	State Rayleigh's energy method and find out natural frequency of a simple pendulum using it.	4	CO2
Q 3	An electric motor is supported by eight springs of stiffness k each. The moment of inertia of the motor is I. Determine the natural frequency of the system. Refer the figure given below,  	4	CO3
Q 4	Describe the steps involved in Matrix method for 3DoF spring mass system to find the natural frequency.	4	CO2
Q 5	A circular cylinder of mass 4kg and radius 15cm is connected by a spring of stiffness 4000 N/m as shown in Fig. it is free to roll on horizontal rough surface without slipping. Determine the natural frequency.	4	CO3

			
SECTION B			
Q 6	Find out the natural frequencies of the system shown in figure. Use Lagrange's method to write the equations of motion.  Or Find the lowest natural frequency of the system as shown in figure given below, K_1= , M_1=4m, K_2= 5k, M_2= 3m, K3=5k, M3=2m 	**10**	**CO4**
Q 7	a) Obtain flexibility coefficients for the system shown in figure given below	**(5*2=10)**	**CO3**

	 b) Use dunkerley's formula to find out the lowest natural frequency of the system shown in figure given below. 		
Q 8	Determine the natural frequency of oscillation of the double pendulum as shown in figure. Find its value when $m_1=m_2=m$, $l_1=l_2=l$ 	**10**	**CO4**
Q 9	The weight of an electric motor is 125N and it runs at 1500 rpm. The armature	**10**	**CO3**

	weighs 35N and its center of gravity lies 0.05 cm from the axis of rotation. The motor is mounted on five springs of negligible damping so that the force transmitted is one-eleventh of the impressed force. Assume that the weight of the motor is equally distributed among the five springs. Determine stiffness of each spring, dynamic force transmitted to the base at operating speed and natural frequency of the system.		
	SECTION-C		
Q 10	Analyze coordinate coupling using derivation, also find out the corresponding natural frequencies. Assume the suitable system and use its sketch to analyze the system.	**20**	**CO5**
Q 11	Derive the frequency equation and determine the natural frequency for five spring mass branched system shown in figure. The masses are moving in vertical direction only  **Or** Derive the equation using Holzer's method to find the natural frequency of the multi degree of freedom system shown in Figure. Assume m_1=m_2=m_3=1 Kg and K_1=K_2=K_3=1 N/m.	**20**	**CO 4**

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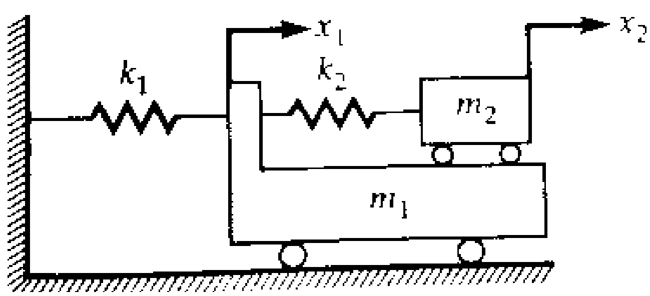
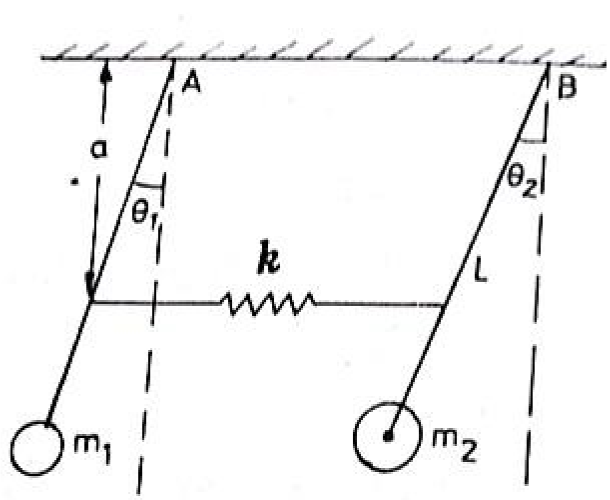
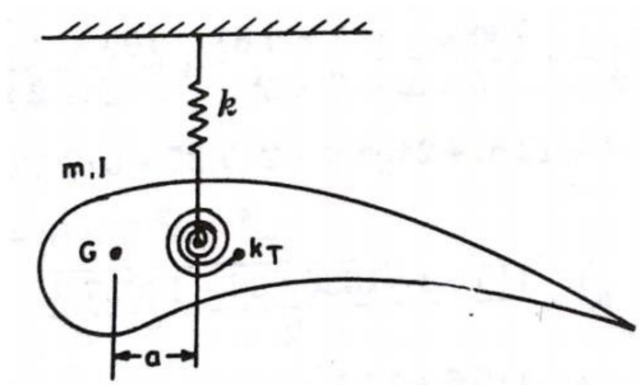
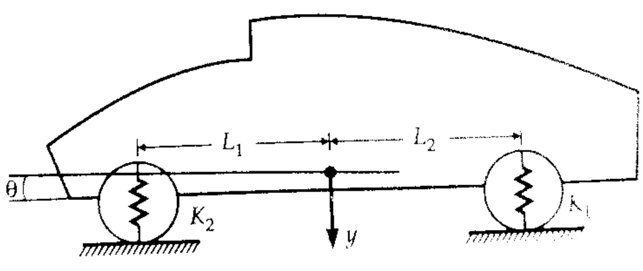
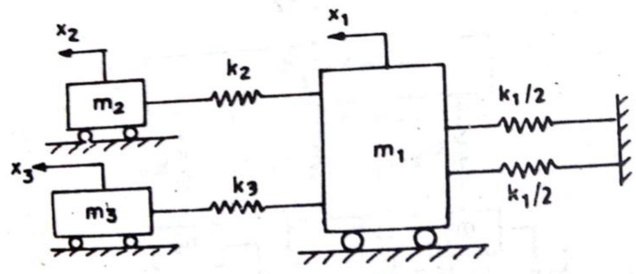
SECTION A

S. No.		**Marks**	**CO**
Q 1	Draw FBD for free damped spring mass system for 2DoF and write equation of motion using Newton's method.	**4**	**CO1**
Q 2	State Rayleigh's energy method and find out natural frequency of a simple pendulum using it.	**4**	**CO2**
Q 3	A shock absorber is to be designed so that its overshoot is 10% of the initial displacement when released. Determine the damping factor. If damping is reduced to one-half this value, what will be the overshoot?	**4**	**CO3**

Q 4	Define critically damped and overdamped vibration systems in short.	**4**	**CO1**
Q 5	What do you understand by generalized coordinates and influence coefficient matrix?	**4**	**CO1**
	SECTION B		
Q 6	Derive the equation of motion of simple forced damped vibration system and analyze the complete response of the system and plot the different forces on the vector diagram	**10**	**CO3**
Q 7	Derive the equation of motion of the vibratory system shown in figure below and determine the natural frequency and amplitude ratio for corresponding frequency Use data given below, K_1= 98000 N/m, M_1 =196 kg, K_2= 19600 N/m, M_2= 49 kg 	**10**	**CO3**
Q 8	Derive the equation for two pendulums of length L as shown below, determine the natural frequency of each pendulum if K=100 N/m, m1= 2 Kg, m2= 5 Kg, L= 0.20 m, a= 0.10 m. 	**10**	**CO4**
Q 9	Identify the terms involved in the equations of motion of one degree of freedom system as given by $5x+3\dot{x}+12\ddot{x}=10\sin\omega t$.	**10**	**CO4**

	Also find out, Natural frequency, damping factor, damped frequency, critical damping, amplitude at resonance, peak frequency, logarithmic decrement and phase angle. Or An aero foil wing in its first bending and torsional modes can be represented schematically as shown in fig below connected through a translation spring of stiffness K and a torsional stiffness Kt. Write the equation of motion for the system and obtain the two natural frequency assume the following data. M= 5 kg, I= 0.12 Kg m^2 , K= $5x10^3$ N/m , K_t= $0.4x10^3$ Nm/rad, a= 0.1 m  		
SECTION-C			
Q 10	A car model as shown in figure simplified by considering its rigid body supported on rear and front springs, is considered to study vertical linear vibration and angular oscillations. Write equation of motion for the car and determine natural frequencies. Car parameters are W=150N, L_1=1.35m, L_2=1.65m, K_1=360N/m, K_2=370N/m and I_{car} = 27m^4  	**20**	**CO4**
Q 11	Determine the lowest natural frequency of the system shown in figure by matrix method. In addition, explain the first mode, second mode and principal mode of vibration.	**20**	**CO4**

	 Or Derive the equation for natural frequencies and mode shapes of the system shown in figure for K1=K2=K3 and m1=m2=m3 using matrix iteration method.