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

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

Course: Introduction to vibration **Semester: VI**
Program: B.Tech. ASE **Time 03 hrs.**
Course Code: MECH 3012 **Max. Marks: 100**

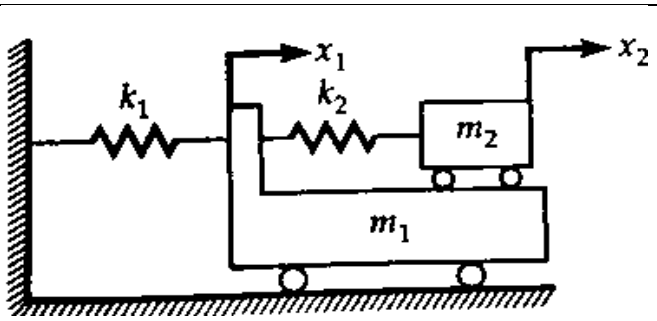
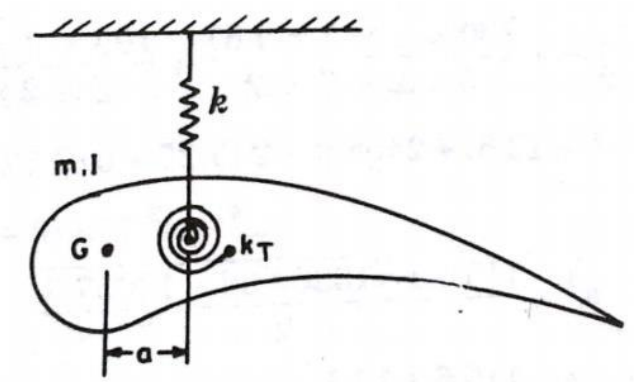
Instructions:

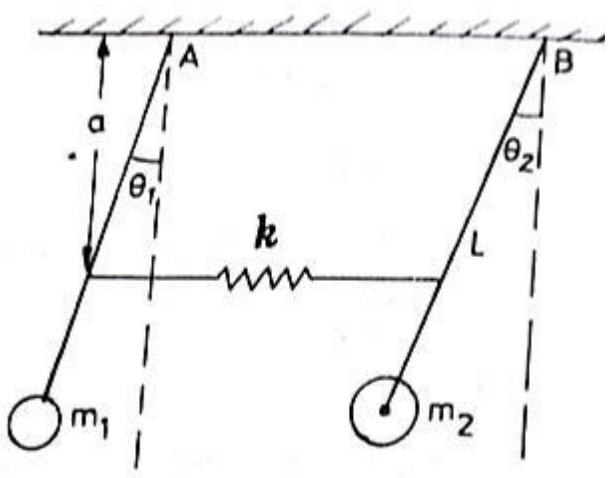
1. **Read the Instruction carefully before attempting**
2. **For Theory based : Type the Answers in word file**
3. **For Figures if any : Draw a free hand sketch and insert the same word file**
4. **For Numerical : Solve it in a paper and insert in the same word file**
5. **Upload as a single word file for all the Question in Blackboard.**

Note : Please upload the word document only, Do not upload PDF and or other format. The answer scripts will be considered for evaluation only through Blackboard. No other mode of submission is acceptable.

SECTION A (5*4)

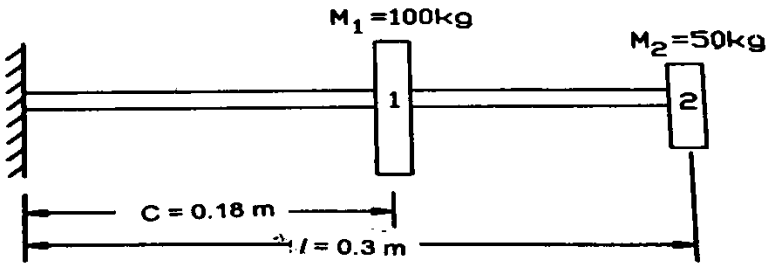
S. No.		Marks	CO
Q 1	Define and explain mode shape of 2DoF system with one example.	**4**	**CO1**
Q 2	State Rayleigh's energy method and find out natural frequency of a simple pendulum using it.	**4**	**CO1**
Q 3	A shock absorber is to be designed so that its overshoot is 10% of the initial displacement when released. Determine the damping factor. If damping is reduced to one-half this value, what will be the overshoot?	**4**	**CO1**
Q 4	Define generalized coordinates and influence coefficients?	**4**	**CO2**
Q 5	The natural frequency of a spring mass system is 15 Hz. An extra 3kg mass is coupled to its mass and natural frequency reduces by 3hz. Find the mass and stiffness of the system.	**4**	**CO2**
SECTION B (4*10)			
Q 6	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**	**CO1**

			
Q 7	An industrial machine of mass 455 kg is supported on springs with a static deflection of 0.5cm. If the machine has a rotating imbalance of 2.5Nm. Determine the force transmitted at 12000 rpm and dynamic amplitude at that speed.	**10**	**CO2**
Q 8	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  Or Derive the equation of motion of the system shown above using Lagrange's equation. In addition, find the natural frequencies. Numerical data given is same as previous problem.	**10**	**CO3**
Q 9	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**



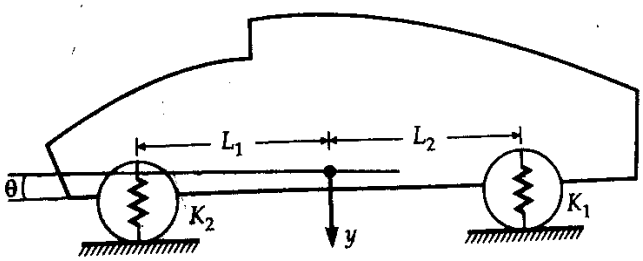
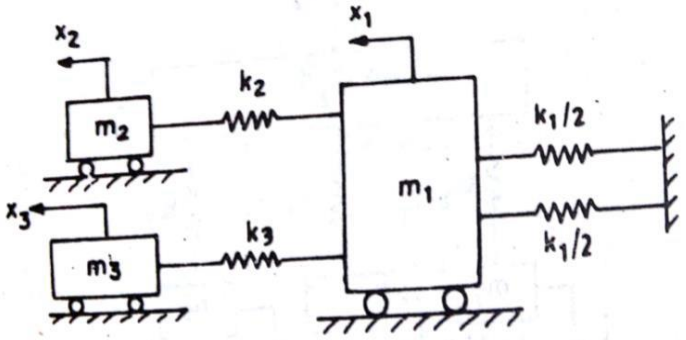
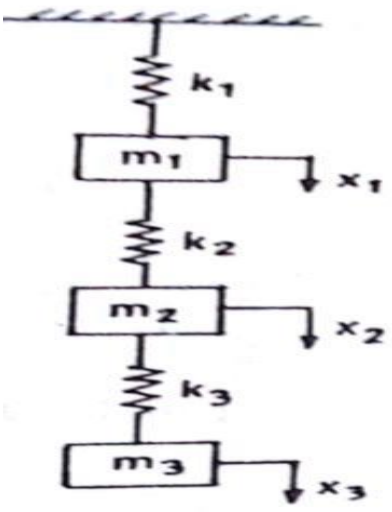
Or

Find the lower natural frequency of vibration for the system as shown in figure by Rayleigh's method or by Dunkerley's Method(any one method)



SECTION-C(2*20)

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**	**CO3**

			
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.  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. 	**20**	**CO4**