Name:

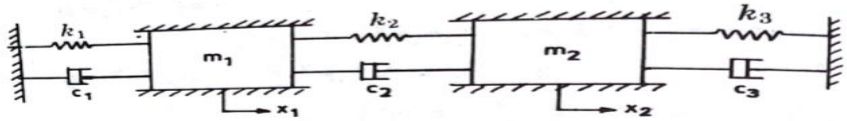
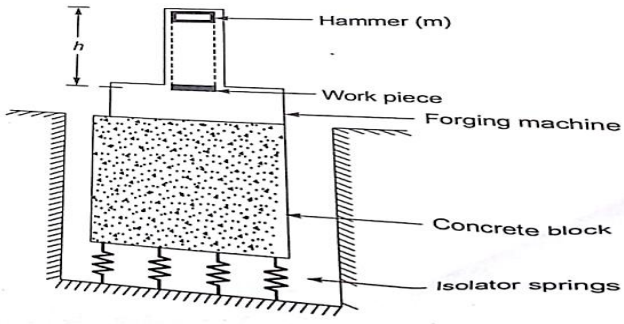
Enrolment No:

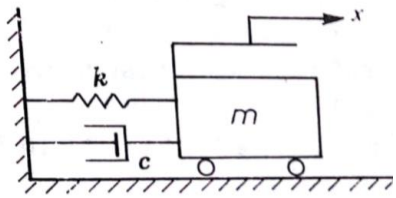
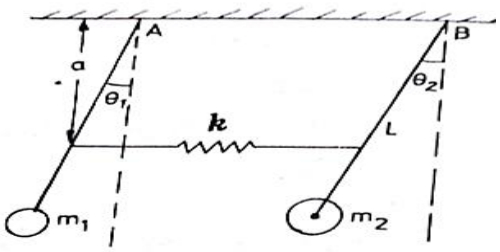
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2018

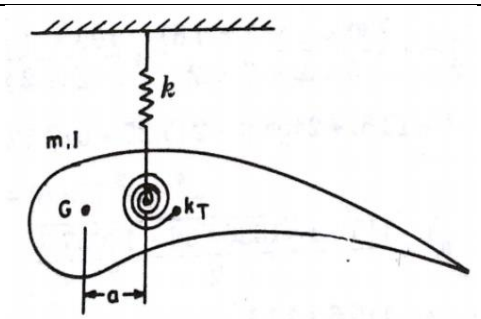
Program: B.Tech ASE **Semester: VI**
Course: Introduction to Vibration **Time: 03 hrs.**
Course Code: ASEG361 **Max. Marks: 100**

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 (5X4= 20 Marks)

Q. No.		Marks	CO
1	An aircraft radio transmitter weights 26 kg and is mounted on five springs, which deflects 8 mm when the transmitter is placed upon them. Neglecting damping calculate the percentage of engine vibration received by transmitter for engine speed of 1500 rpm and 2500 rpm.	**4**	**CO2**
2	Using Holzer's method derive equation for the natural frequency for two mass rotor system.	**4**	**C03**
3	Derive the equation of motion through Lagrange's Equation for the given system. 	**4**	**C03**
4	Analyze and determine the motion (amplitude) of the machine as shown below an impact type forging machine mounted rigidly on a large concrete block with total mass , M = 10000 Kg. The Concrete block is placed on ground through isolators of total stiffness , K= 1.7 MN/m. A hammer with a mass, m = 500 Kg falls from height, h= 2 m on to the work piece as shown in the Figure. Assuming that the impact is inelastic and instantaneous,. Also, find the natural frequency. 	**4**	**C03**

5	Define the following term a) Magnification factor b) Resonance speed and critical speed c) Absolute amplitude and relative amplitude d) Various type of Isolation device	**4**	**C02**
SECTION B (10 x 4= 40 Marks)			
6	Derive the equation of motion of simple forced damped system and analyze the complete response of the system and plot the different forces on the vector diagram	**10**	**C01**
7	The system shown below is displaced from its static equilibrium position to the right distance of 0.01 m. An impulsive force acts towards the left on the mass at the instant of its release to give it an initial velocity Vo in that direction. If the system has the following parameters K= 16000 N/m, C= 1400 N-s/m, m= 10 kg a) Derive the expression for displacement from the equilibrium position in terms of time t and initial velocity Vo. b) What value of Vo would be required to make the mass pass the position of the static equilibrium 1/100 sec after it is applied. 	**10**	**C02**
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**	**C03**
9	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 , Kt= $0.4x10^3$ Nm/rad, a= 0.1 m	**10**	**C04**

	 **Or** Determine the natural frequency of the spring mass system shown in figure 1 by matrix method.		
SECTION-C (20x2= 40 Marks)			
10	Derive the equation using Holzer's method to find the natural frequency of the multi degree of freedom system shown in Figure 2. Assume m1=m2=m3=1 Kg and K1=K2=K3=1 N/m.	**20**	**C03**
11	Determine the lowest natural frequency of the system shown in figure 3 by matrix method. And 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 4 for K1=K2=K3 and m1=m2=m3 using matrix iteration method.	**20**	**C04**

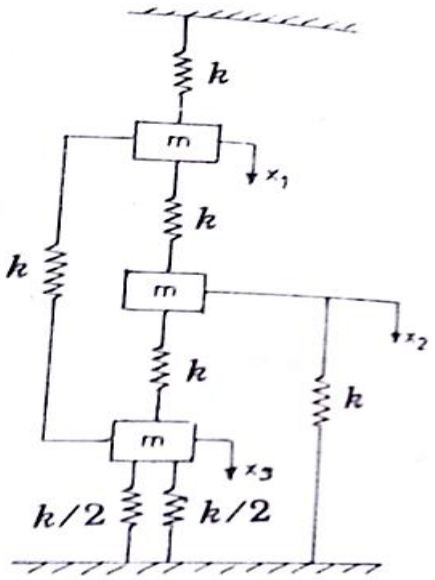


Fig: 1

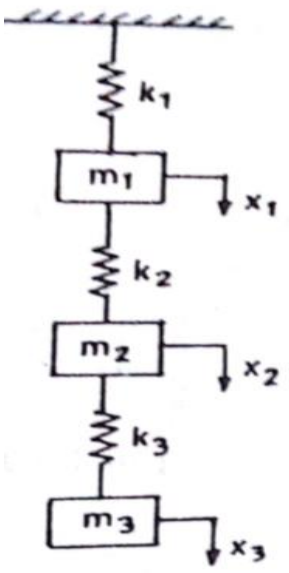


Fig:2

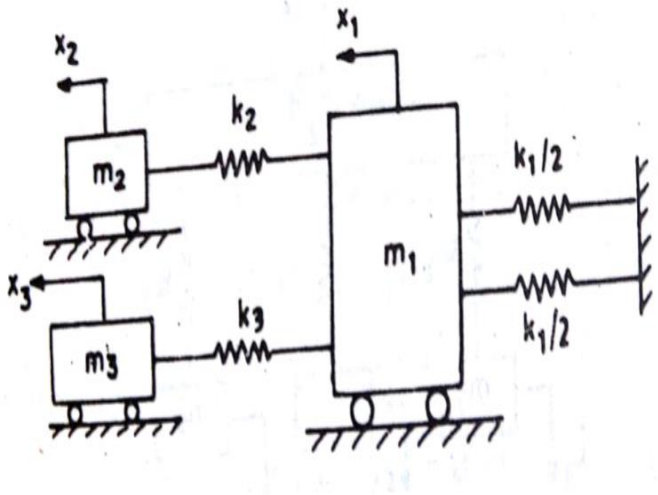


Fig : 3

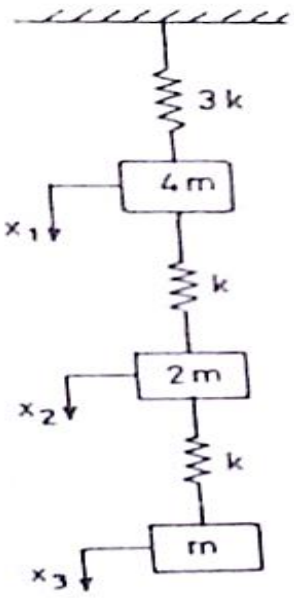


Fig : 4

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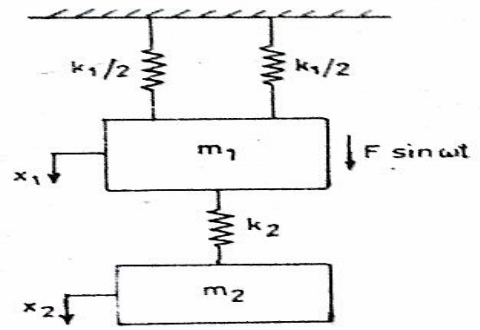
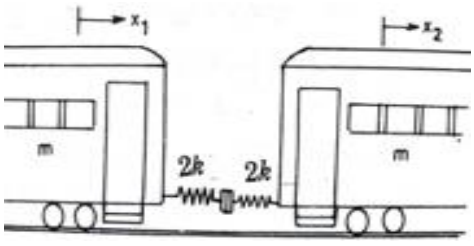
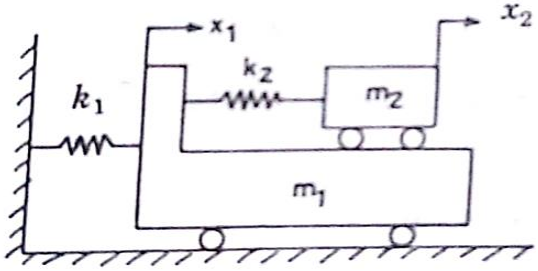
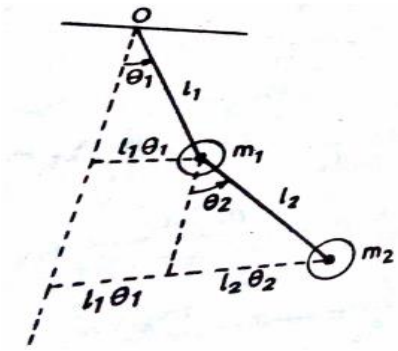
SECTION A (5 x 4= 20 Marks)

Q. No.		Marks	CO
1	Define the Rayleigh's energy method for multi loading beam system to find the natural frequency	**4**	**CO1**
2	Define and discuss the following parameters on frequency curve a) Magnification factor b) Effect of damping factor on absolute amplitude	**4**	**C02**
3	Derive the equation of motion through Lagrange's Equation for the given system. 	**4**	**C02**
4	Define the Eigen Values and Eigen vector method for multi mass system to find the natural frequency	**4**	**C03**
5	Determine the natural frequency of an electric train made of two cars each of mass 2000 kg is connected by couplings of stiffness equal to $40x10^6$ N/m , as shown in fig below 	**4**	**C03**

SECTION B (10 x 4= 40 Marks)			
6	a) Derive the equation of motion of magnification factor and plot the frequency curve **[6]** b) The rotor of a turbo super charger weighing 9 kg is keyed to the center of a 25 mm diameter steel shaft 40 cm between bearings. Determine a. The critical speed of shaft b. The amplitude of vibration of the rotor at a speed of 3200 rpm, if the eccentricity is 0.015 mm **[4]**	**10**	**C02**
7	A machine supported symmetrically on four springs has a total mass of 100 kg. It has unbalance reciprocating parts of 2 Kg. which moves through a vertical stroke of 100 with SHM. The machine is having only one degree of freedom and can undergo vertical displacement. Evaluate its natural frequency and combined stiffness of the spring if the force transmitted to the foundation is one twentieth of the applied force when there is no damping in the system. The machine is rotating at 800 rpm. When the machine is actually tested for vibration, it is found that the damping present in the system reduces the amplitude of successive free vibration by 30% Evaluate: A) The actual force transmitted to foundation at the running speed 800 rpm. B) The force transmitted to foundation at resonance C) The amplitude of vibration of the machine due to unbalance mass at resonance.	**10**	**C01**
8	Derive the equation of motion of the vibratory system shown in figure below and determine the natural frequency for given data and amplitude ratio for corresponding frequency K1= 98000 N/m, M1 =196 kg, K2= 19600 N/m, M2= 49 kg  	**10**	**C03**
9	Determine the natural frequency of multi degree freedom spring mass system shown in fig 1 **Or** Determine the natural frequency and amplitude ratio of the system shown in figure 2	**10**	**C04**

SECTION-C (20 x 2= 40 Marks)			
10	Determine the natural frequency of oscillation of the double prndulum as shown in figure below and find its value when m1= m2= 5 kg , $L_1=L_2$= 25 cm 	**20**	**C03**
11	Derive the equation using Holzer method and find the natural frequency of the system shown in figure 3 take $I_1=I_2=I_3=1$ and $Kt_1=-Kt_2$= 1 **Or** Derive the frequency equation and determine the natural frequency for five spring mass branched system shown in figure 4. The masses are moving in vertical direction only	**20**	**C04**

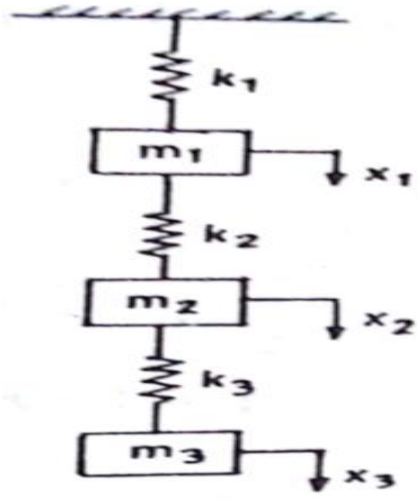


Fig: 1

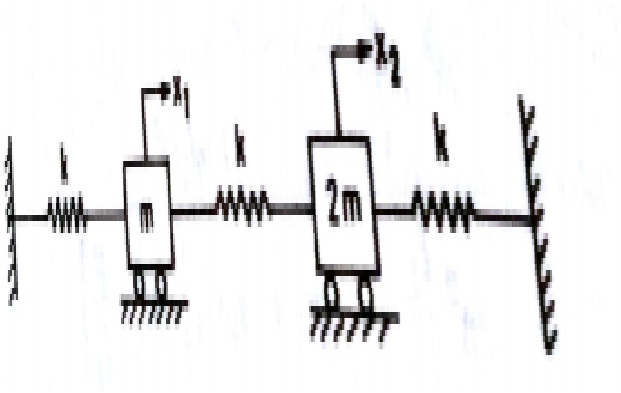


Fig: 2

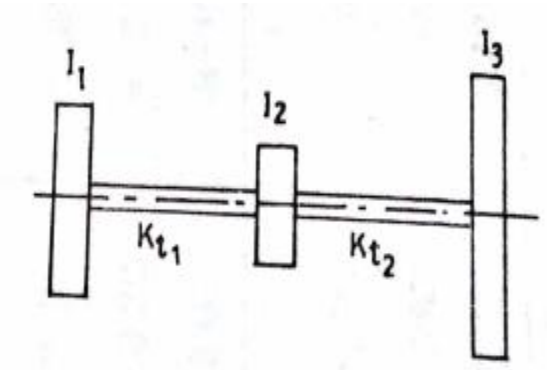


Fig: 3

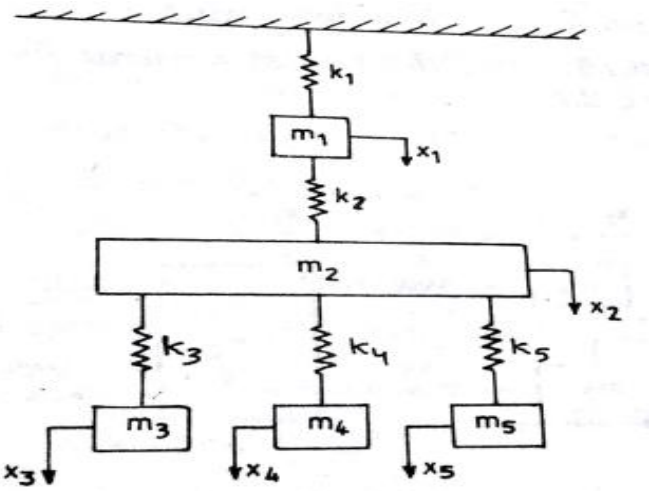


Fig : 4