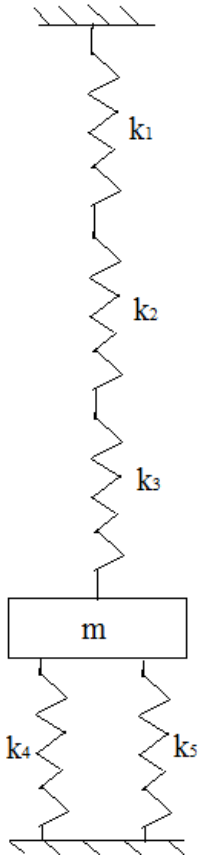
Name: Enrolment No:	UPES

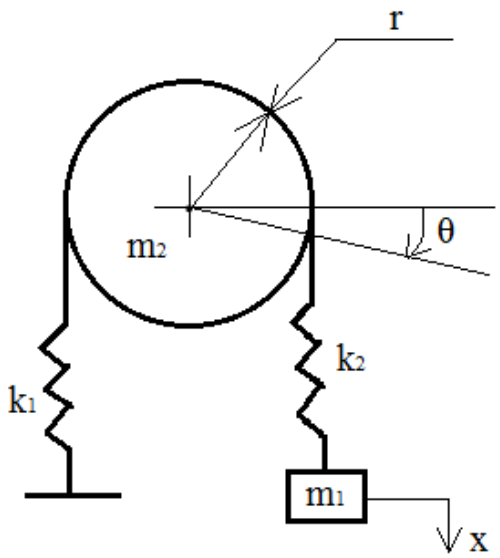
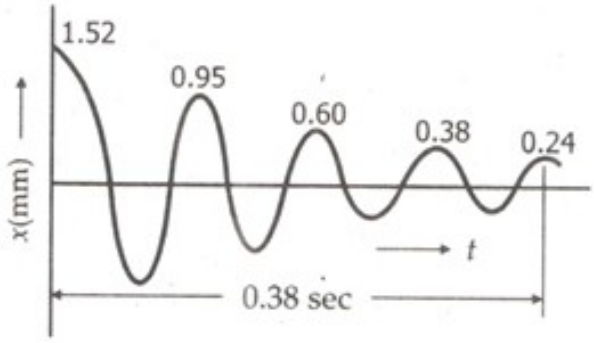
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

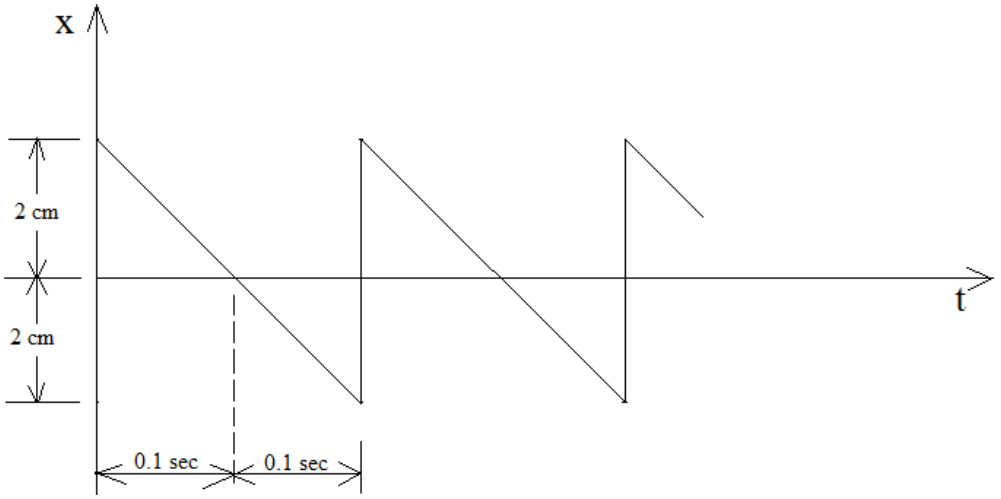
Mid Semester Examination, March 2019

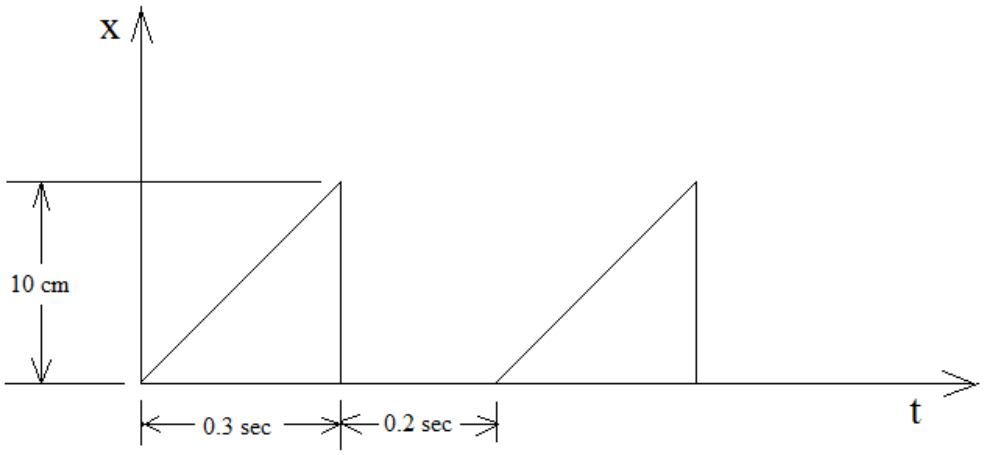
Programme Name: M.Tech. Rotating Equipment **Semester : II**
Course Name : Rotordynamics and Condition Monitoring **Time : 03 hrs**
Course Code : MREQ 812 **Max. Marks : 100**
Nos. of page(s) : 04
Instructions: Assume any missing data.

SECTION A

S. No.		Marks	CO
Q 1	Explain briefly the technique of condition monitoring used for rotating machines.	5	CO5
Q 2	For the system shown in Fig. 1, k_1 = 2000 N/m, k_2 = 1500 N/m, k_3 = 3000 N/m and $k_4 = k_5$ = 500 N/m. Find m such that the system has a natural frequency of 10 Hz.  Fig.1: Figure for Q.2	5	CO1

Q 3	Derive the equations of motion for a two degree of freedom system. Consider the forced damped case.	**5**	**CO1**
Q 4	Describe the characteristic curves for a spring-mass-damper system subjected to a harmonic force of angular frequency ω and amplitude F_o.	**5**	**CO1**
	SECTION B		
Q 5	Formulate the Eigen value problem of the system shown in Fig. 2. The cord is inextensible and there is no slippage between the cord and the pulley. The mass of the pulley is m_2. Take $m_1 = m_2$ and $k_1 = k_2$.  Fig. 2: Figure for Q.5	**10**	**CO2**
Q 6	A machine has a mass of 300 kg. Its vibration record is shown in Fig. 3. Determine the relevant information about the system.  Fig.3: Figure for Q 6	**10**	**CO3**

Q 7	a) A force $P_0 \sin \omega t$ acts on a displacement $x_0 \sin(\omega t - \pi/3)$. If P_0 = 100N, x0 = 0.02m, ω = 2π rad/s, find the work done during (i) the first cycle, (ii) the first second, (iii) the first quarter second. **OR** b) Describe the concept of coordinate coupling with the help of a two-degree of freedom system.	**10**	**CO1**
Q 8	A system of beams supports a motor of mass 1200 kg. The motor has an unbalanced mass of 1 kg located at 6 cm radius. It is known that the resonance occurs at 2210 r.p.m. What amplitude of vibration can be expected at the motor's operating speed of 1440 r.p.m. if damping factor is assumed to be less than 0.1?	**10**	**CO3**
	SECTION-C		
Q 9	a) Represent the periodic motion given in Fig. 4 by harmonic series.  Fig. 4: Figure for Q.9a **OR** b) Represent the periodic motion given in Fig. 5 by harmonic series.	**20**	**CO5**

	 Fig.5: Figure for Q.9b		
Q 10	Consider the undamped system $M(\ddot{x})+K(x)=(Q(t))$. $\begin{bmatrix}4 & 0\\ 0 & 1\end{bmatrix}\begin{Bmatrix}\ddot{x}_1\\ \ddot{x}_2\end{Bmatrix}+\begin{bmatrix}24 & -4\\ -4 & 6\end{bmatrix}\begin{Bmatrix}x_1\\ x_2\end{Bmatrix}=\begin{Bmatrix}8\\ 0\end{Bmatrix}$ i. Find the eigenvalues ii. Evaluate the modal matrix [u]. iii. Derive the uncoupled equations expressed in the principal coordinates. iv. Express the uncoupled equations in the global/normal coordinates.	**20**	**CO5**