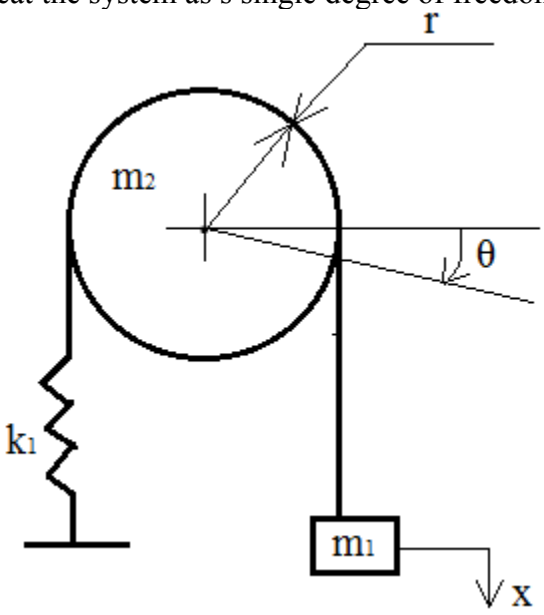
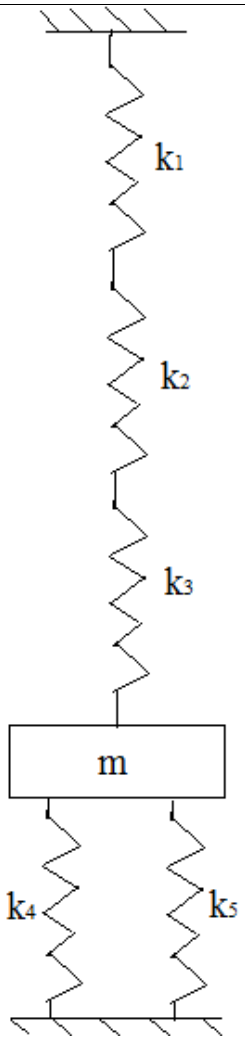
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April/May 2018

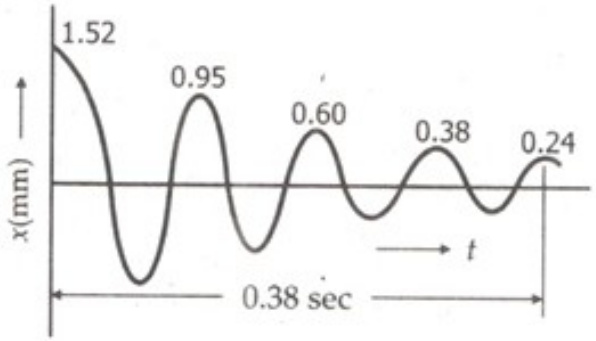
Course: Mechanical Vibrations (MHEG 481)
Semester: VIII
Program: B.Tech. Mechanical Engineering
Time: 03 hrs. **Max. Marks: 100**

Instructions: Assume any missing data.

SECTION A

S. No.		Marks	CO
Q 1	Split up the harmonic motion $x = 20 \sin(\omega t + \pi/3)$, into two harmonic motions one having a phase angle of 90º and the other of 30º.	4	CO1, CO2
Q 2	Find the time period of small vibrations of the system shown in Fig. 1 considering no-slip condition. Treat the system as s single degree of freedom system.  Fig.1: Figure for Q 2.	4	CO1, CO2
Q 3	For the system shown in Fig. 2, $k_1 = 3000$ N/m, $k_2 = 1500$ N/m, $k_3 = 4000$ N/m and $k_4 = k_5 = 100$ N/m. Find 'm' such that the system has a natural frequency of 25 Hz.	4	CO1, CO2

	 Fig.2: Figure for Q 3		
Q 4	Describe the working of an accelerometer and a vibrometer.	**4**	**CO1, CO2, CO3**
Q 5	In a spring-mass-dashpot system k = 40 kN/m, m = 120 kg, and the damping provided is only 20% of the critical value. Determine (i) the damping ratio (ii) the critical damping coefficient (iii) the natural frequency of damped vibration (iv) the logarithmic decrement	**4**	**CO1, CO2**

SECTION B			
Q 6	a) Derive the dynamic equation of motion for a vibrating cantilever beam. OR b) Derive the dynamic equation of motion for a vibrating string.	**10**	**CO4**
Q 7	A system of beams supports a motor of mass 1600 kg. The motor has an unbalanced mass of 1.5 kg located at 5 cm radius. It is known that the resonance occurs at 2400 r.p.m. What amplitude of vibration can be expected at the motor's operating speed of 1500 r.p.m. if damping factor is assumed to be less than 0.15?	**10**	**CO3**
Q 8	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 8	**10**	**CO1, CO2**
Q 9	A single rotor of mass 10 kg is mounted midway between long bearings on a steel shaft 15 mm diameter. The bearings span is 0.5 m. It is known that C.G. of the rotor is 0.030 mm from its geometric axis. If the system rotates at 2000 r.p.m., find out the amplitude of vibration and the dynamic load transmitted to the bearings. What is the critical speed of the system?	**10**	**CO3**
SECTION-C			
Q 10	Perform the modal analysis of the system shown in Fig.4. Take m_1 = 10 kg, m_2 = 1 kg, r = 0.1 m, length of string of pendulum, l = 1 m and k = 10000 N/m. Take g = 10 m/s^2.	**20**	**CO5**

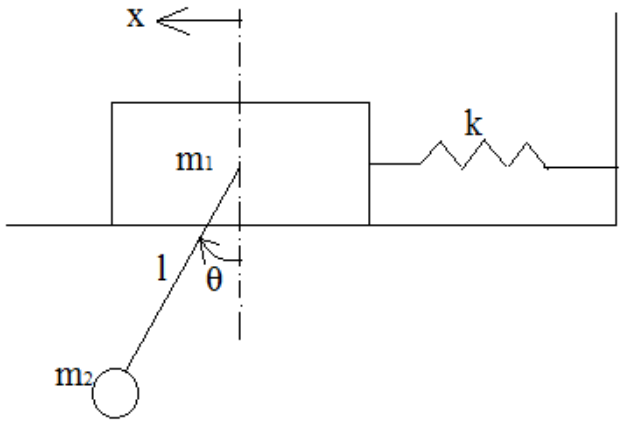


Fig. 4: Pendulum rod

Q 11 Represent the periodic motion given in Fig. 5 by harmonic series.

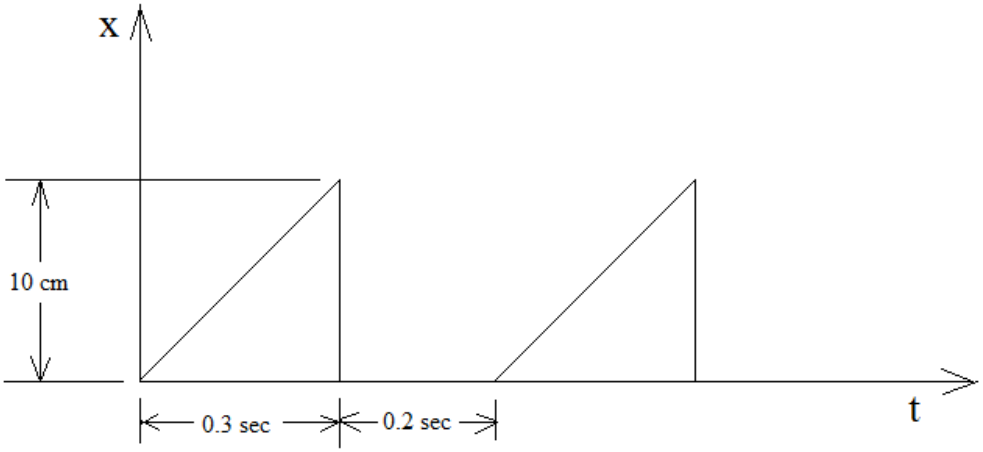


Fig.5: Figure for Q.11

20 **CO1/ CO5**

OR

a) Find the flexibility influence coefficients of the system shown in Fig. 6.

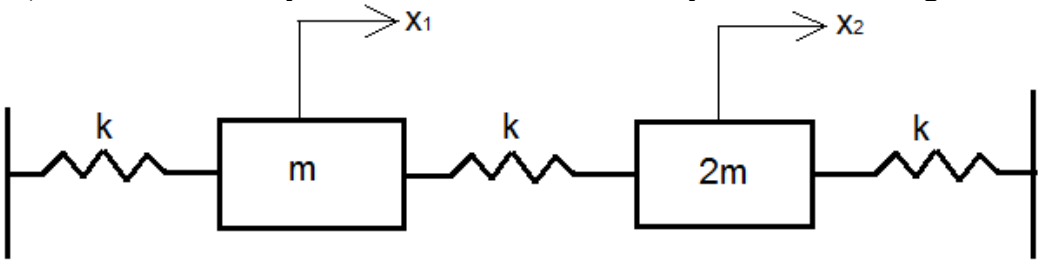


Fig.6: A 2-DoF system