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

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, Dec 2021

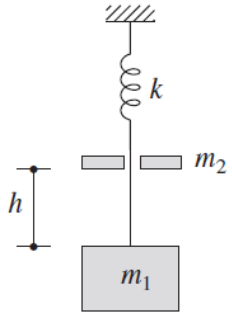
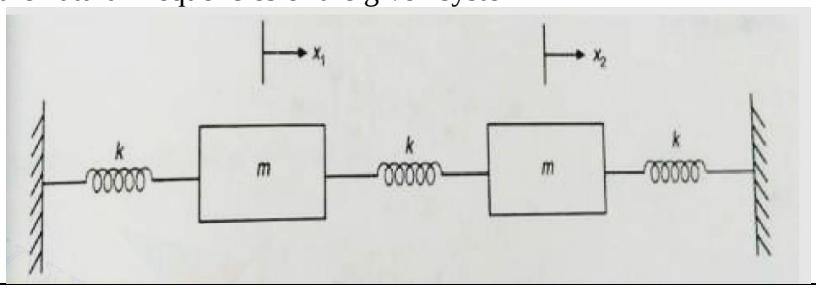
Course: **Structural Dynamics** **Semester: I**
Program: **M.Tech. Structural Engineering** **Time 03 hrs.**
Course Code: CIVL 7024 **Max. Marks: 100**
Instructions:

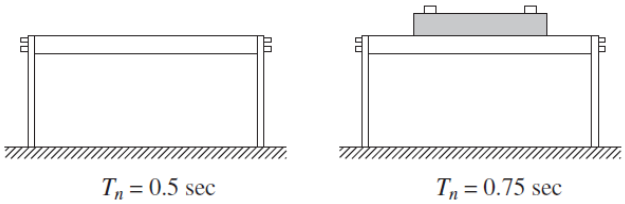
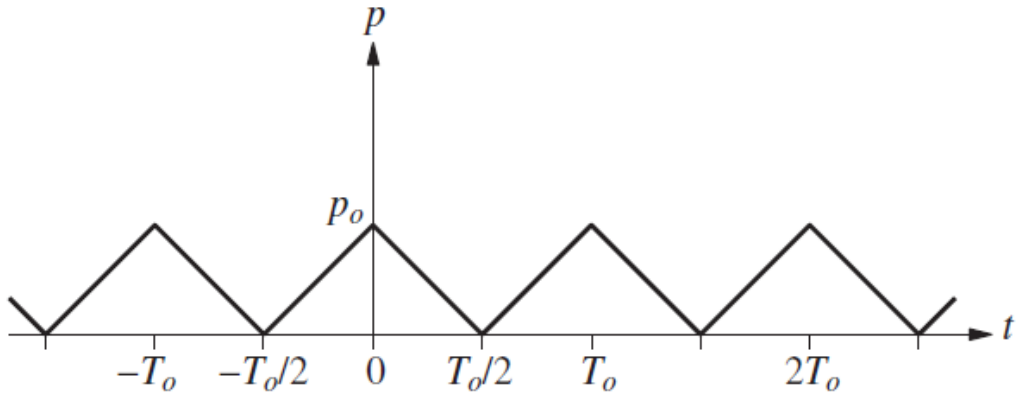
(Internal choice is available for Q 6 and Q 11)

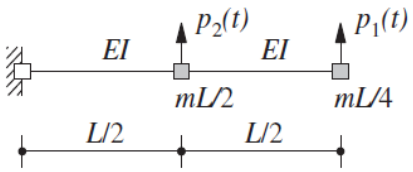
SECTION A

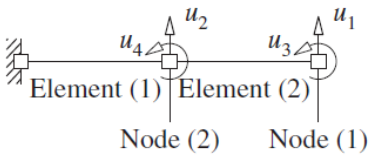
S. No.		Marks	CO
Q 1	Distinguish between free and forced vibration.	**4**	**CO3**
Q 2	What is the difference between constant mass and lumped mass?	**4**	**CO3**
Q 3	Define generalized system properties.	**4**	**CO3**
Q 4	What is mean by mode shape? Briefly explain with help of figures.	**4**	**CO4**
Q 5	How resonance occurs in the MDOF Structure.	**4**	**CO2**

SECTION B

Q 6	A mass m1 hangs from a spring k and is in static equilibrium. A second mass m2 drops through a height h and sticks to m1 without rebound Determine the subsequent motion u(t) measured from the static equilibrium position of m1 and k.  OR Determine the natural frequencies of the given system  	**10**	**CO3**

Q 7	In a forced vibration test under harmonic excitation it was noted that the amplitude of motion at resonance was exactly four times the amplitude at an excitation frequency 20% higher than the resonant frequency. Determine the damping ratio of the system.	**10**	**CO4**
Q 8	A heavy table is supported by flat steel legs (Figure). Its natural period in lateral vibration is 0.5 sec. When a 50-lb plate is clamped to its surface, the natural period in lateral vibration is lengthened to 0.75 sec. What are the weight and the lateral stiffness of the table?  $T_n = 0.5$ sec $\quad$ $T_n = 0.75$ sec	**10**	**CO4**
Q 9	The vertical suspension system of an automobile is idealized as a viscously damped SDF system. Under the 3000-lb weight of the car the suspension system deflects 2 in. The suspension is designed to be critically damped. (a) Calculate the damping and stiffness coefficients of the suspension. (b) With four 160-lb passengers in the car, what is the effective damping ratio? (c) Calculate the natural vibration frequency for case (b).	**10**	**CO3**
	SECTION-C		
Q 10	An SDF system with natural period Tn and damping ratio ζ is subjected to the periodic force shown in Figure with an amplitude Po and period T_0. (a) Expand the forcing function in its Fourier series. (b) Determine the steady-state response of an undamped system. For what values of T0 is the solution indeterminate? (c) For $T_0/Tn = 2$, determine and plot the response to individual terms in the Fourier series. How many terms are necessary to obtain reasonable convergence of the series solution?  	**20**	**CO1**
Q 11	A massless cantilever beam of length L supports two lumped masses mL/2 and mL/4 at the midpoint and free end as shown in figure a. The flexural rigidity of the uniform beam is EI. With the four DOFs chosen as shown in Figure b and the applied forces p1(t) and p2(t), formulate the equations of motion of the system. Axial and shear deformations in the beam are neglected. a) $\quad$ b)	**20**	**CO2**





OR

Formulate the equations of motion for the two-story frame in Figure. The flexural rigidity of the beams and columns and the lumped masses at the floor levels are as noted. The dynamic excitation consists of lateral forces p1(t) and p2(t) at the two floor levels. The story height is h and the bay width 2h. Neglect axial deformations in the beams and the columns.