Roll No: ----------

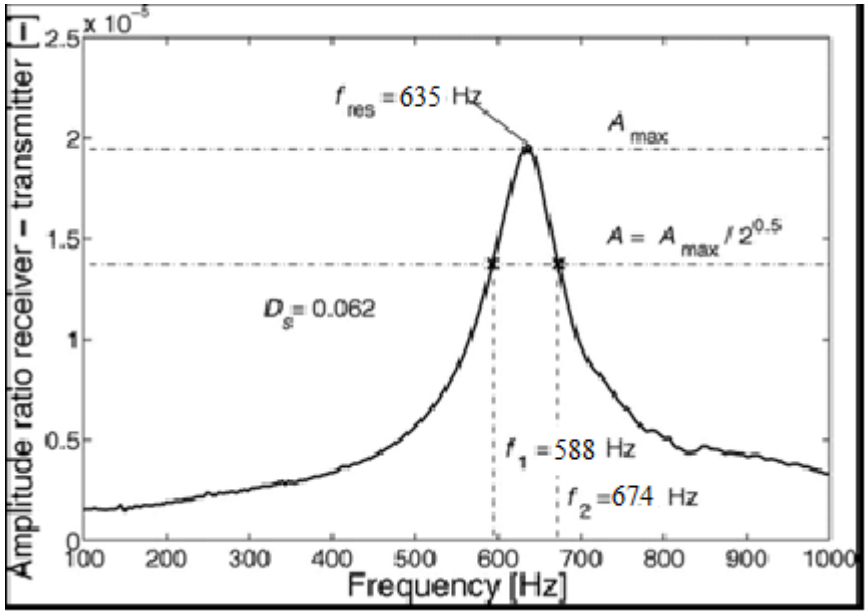
UPES

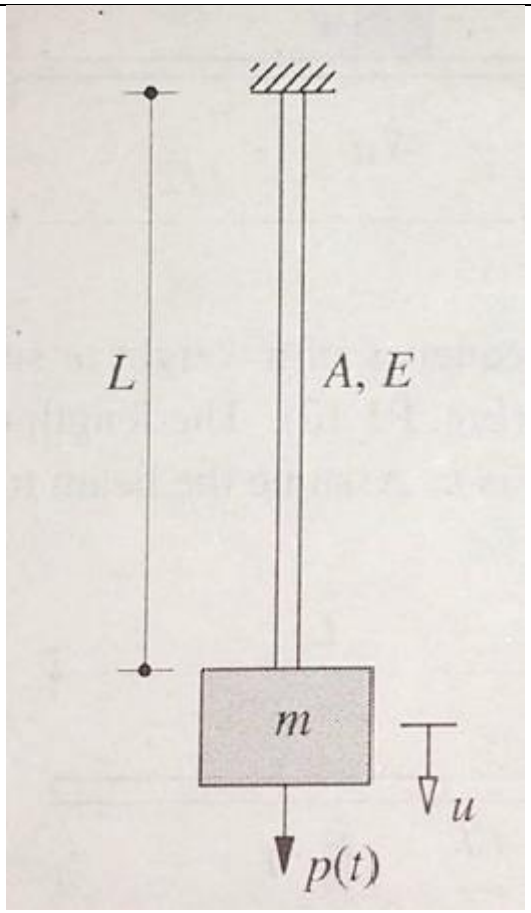
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: MTECH IN STRUCTURAL ENGINEERING **Semester – I**
Subject (Course): STRUCTURAL DYNAMICS **Max. Marks : 100**
Course Code : CIVL 7006 **Duration : 3 Hrs**
No. of page/s: 5

SECTION -A
ALL QUESTIONS ARE COMPULSORY FOR SECTION -A

Q1	For the given Dynamic Response Factor (Amplitude Ratio of Receiver to transmitter) vs Frequency of a system, determine the damping ratio of the system by using Half Power Bandwidth method. 	**5 Marks**	**CO 4**
Q2	Develop the equation of motion of the system in figure. The rod is made of an elastic material with modulus of elasticity E, its cross sectional area is A and its length is L. Ignore the mass of the rod and measure u from the static equilibrium position.	**5 Marks**	**CO 1**



Q3 Determine the natural vibration period and damping ratio of the plexiglass frame model from the acceleration period vibration shown in table.

Peak	Time, t_i (sec)	Peak, $\ddot{u}_i$ (g)
1	1.110	0.915
11	3.844	0.076

5 Marks **CO 1**

Q4 A sensitive instrument with weight 100 lb (i.e mass = 100/g= 100/396) is to be installed at a location where the vertical acceleration is 0.1 g at a frequency of 10 Hz. The instrument is mounted on a rubber pad of stiffness 80 lb/in and damping ratio for the system is 10 %. What acceleration is transmitted to the instrument?

5 Marks **CO 1**

SECTION -B
ALL QUESTIONS ARE COMPULSORY FOR SECTION –B

Q5 A free vibration test is conducted on an empty elevated water tank such as the one in figure. A cable attached to the tank applies a lateral (Horizontal) force of 16.4 kips and pulls the tank horizontally by 2 in. The cable is suddenly cut and the resulting free vibration is recorded. At the end of four complete cycles, the time is 2.0 seconds and the amplitude is 1 in. From these data compute the following: (a) damping ratio (b) natural period of undamped vibration (c) stiffness (d) weight (e) damping coefficient and (f) number of cycles required for displacement amplitude to decrease to 0.2 in.

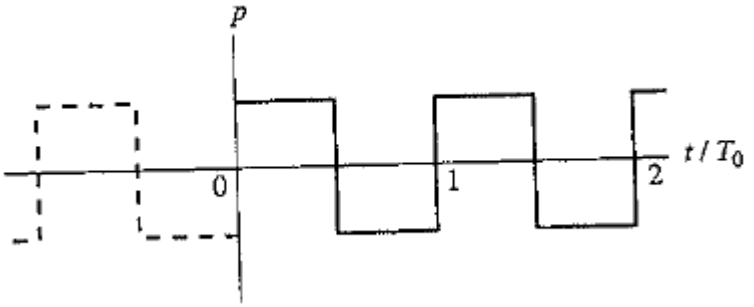
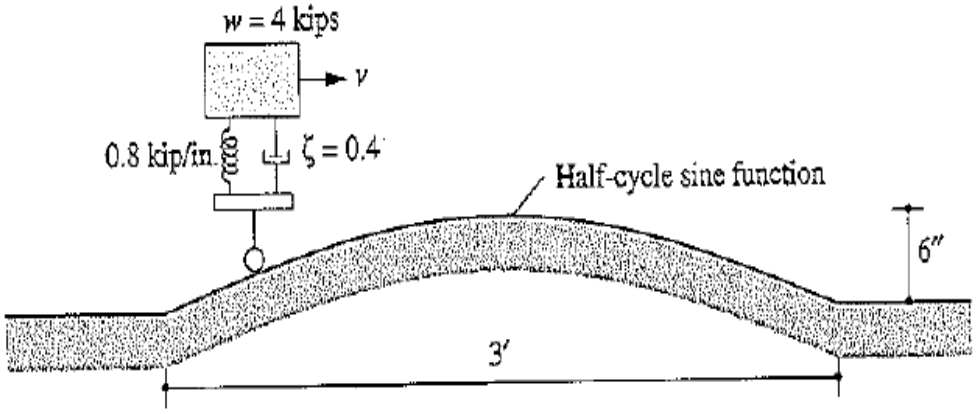
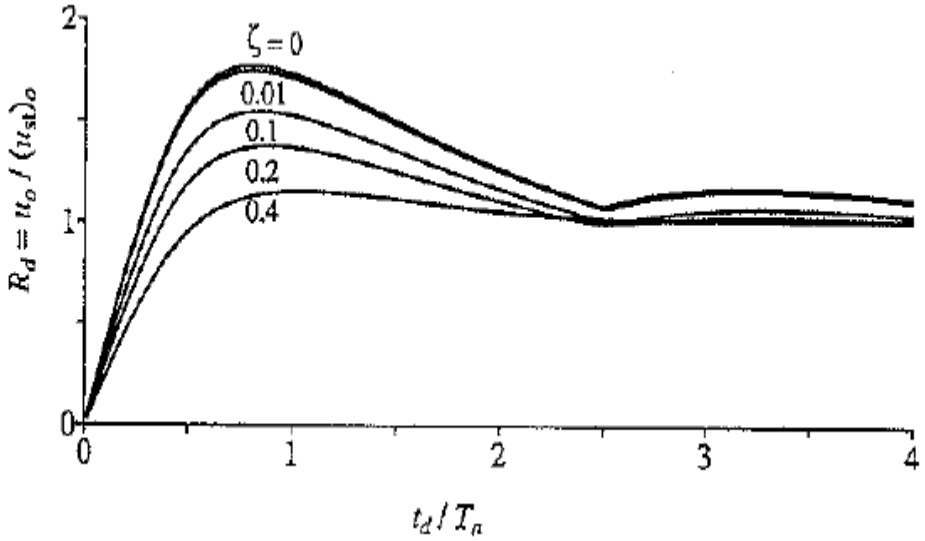
10 Marks **CO 1 & CO 4**

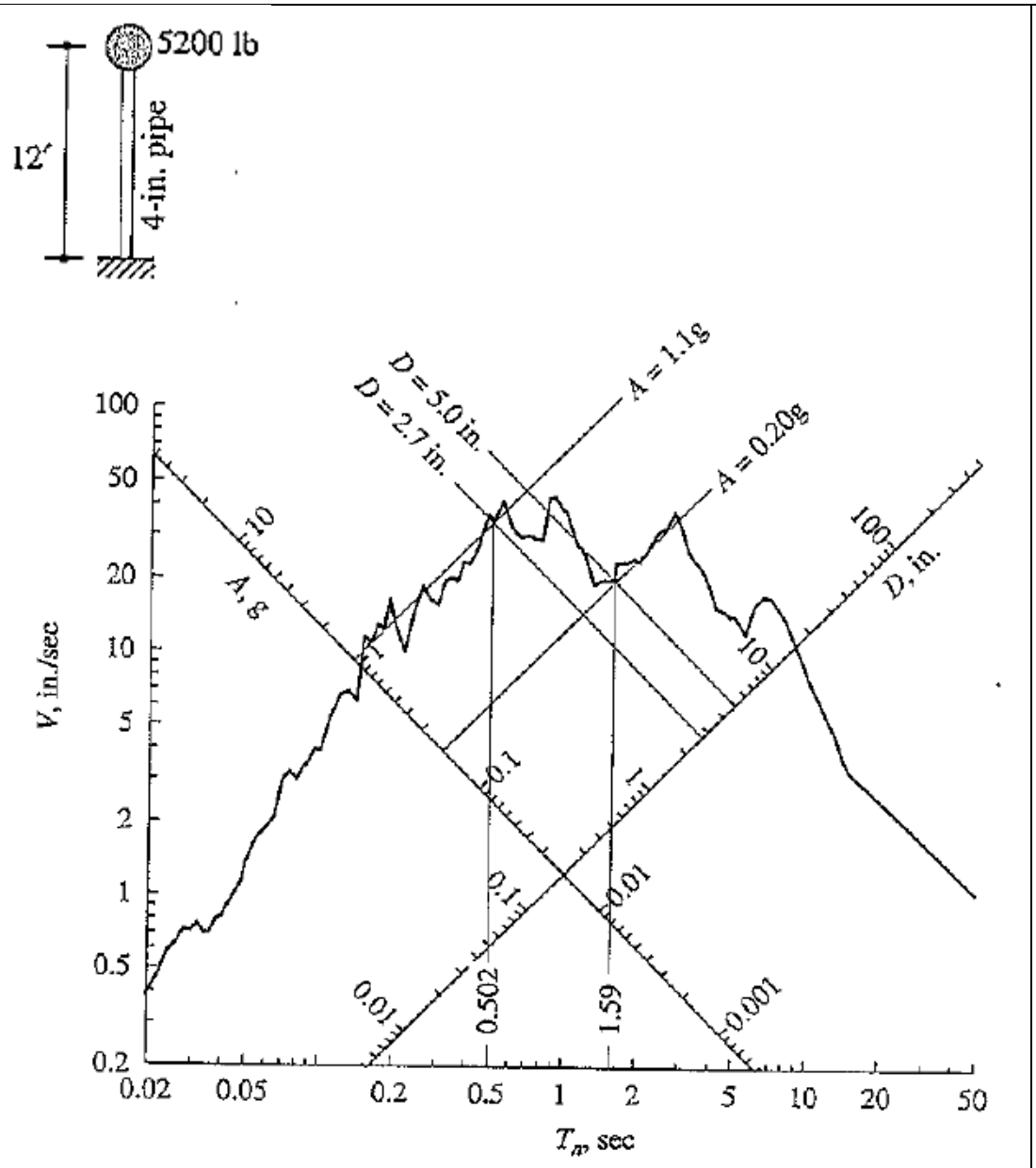
Q6 A SDOF system having mass m, stiffness k and damping ratio ζ, is subjected to a periodic loading as shown in figure defined by

$P(t) = p_o \quad 0 <= t <= T_o/2$

$-p_o \quad T_o/2 <= t <= T_o$

10 Marks **CO 2**

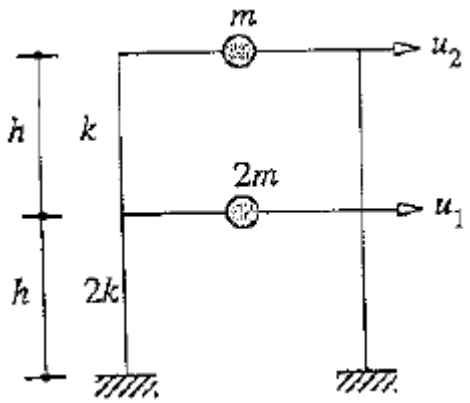
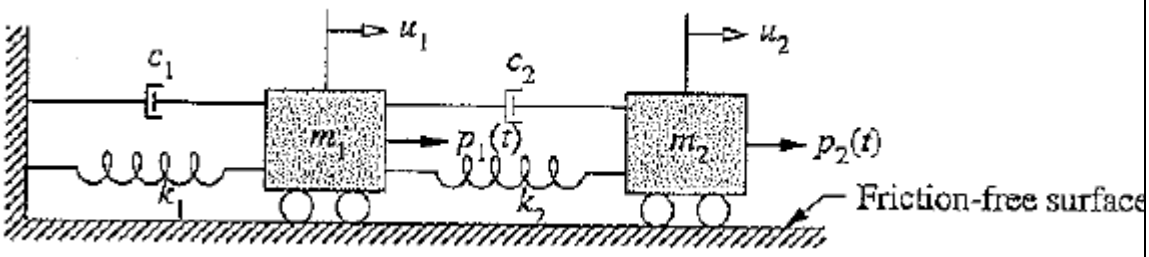
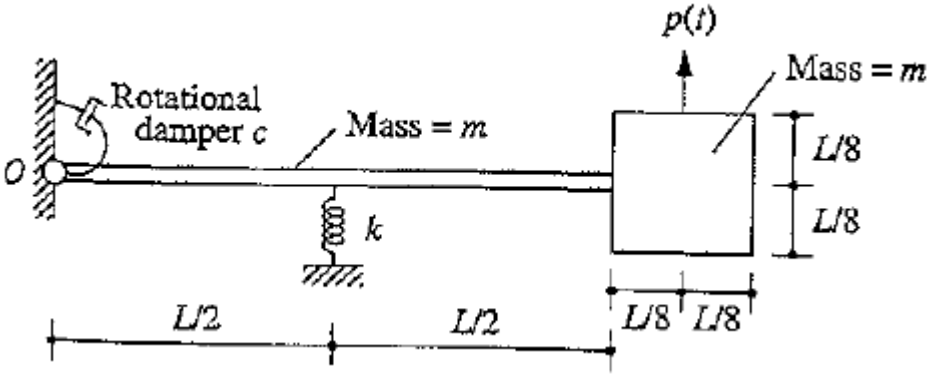
			
Q7	The SDOF system model with all parameters shown in figure of an automobile is running over the speed hump shown in figure at velocity v. Determine the maximum force developed in the suspension spring and the maximum acceleration of mass if a) v = 5 mph = 7.333 ft/sec and b) v = 10 mph = 14.666 ft/sec. Shock spectra for a half cycle sine pulse is given.  	**10 Marks**	**CO 2**
Q8	A 12 ft long vertical cantilever, a 4in nominal diameter standard pipe, supports a 5200 lb weight attached at the tip is shown in figure. The properties of the pipe are outside diameter 4.5 in and inside diameter 4.026 in, thickness 0.237 in and second moment of inertia 7. 23 in^4, elastic modulus E = 2900 ksi and weight 10.79 lb/ft. Determine the peak deformation and bending stress in the cantilever due to the El Centro ground motion. Assume that ζ = 2 %.	10 Marks	**CO 2 & CO 4**



SECTION -C

ALL QUESTIONS ARE COMPULSORY FOR SECTION –C

Q9	Determine the natural frequencies and modes of the system shown in figure with all the parameters a two story frame idealized as a shear building. Also normalize the modes so that M_n= 1. Also draw the mode shapes.	**20 Marks**	**CO 3**

			
Q10	Formulate the equation of motion for MDOF system shown in the figure. Also find the natural frequencies. Given $m_1 = 2m$, $m_2 = 5m$, $k_1 = 3k$, $k_2 = 5k$, $c_1 = 2c$ and $c_2 = c$.  **OR** For rigid body system shown in figure: a) Formulate the equation of motion governing the rotation at O. b) Determine the natural frequency and damping ratio. 	**20 Marks**	**CO 3 & CO 2**