Name: **Enrolment No:**	UPES

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

Course: Seismic Design of Structures (CIVL 7013) **Semester: II**
Program: M.Tech. Structural Engineering
Time: 03 hrs. **Max. Marks: 100**

Instructions: Answer all questions of Section A, B & C; Internal choice is provided in section B & C questions; write 2 question s from section C

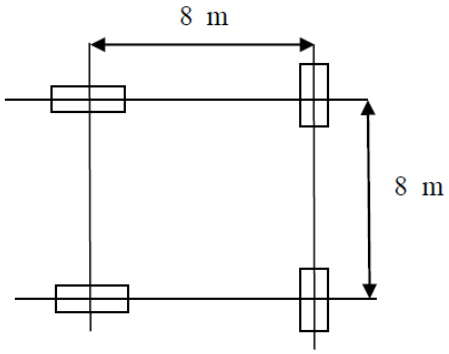
(Assume all the necessary data if necessary)
NOTE: IS 1893:2016 should be Allowed/Provided

SECTION A

Q. No.		Marks	CO
1	State whether following statements are true or false. Give logical reason for your answer **:** i. Numbers of intra-plate earthquakes in world are more than numbers of inter-plate earthquakes. ii. Kochi is having maximum earthquake risk. iii. Peak ground acceleration (PGA) & Zero period acceleration (ZPA) are same. iv. Performance of shear walls, which are located near geometric centre of building, is better than the identical shear wall located on periphery. v. A building is located on the boundary of zone IV & V. It will be designed as if it is in zone IV. vi. Code specifies higher value of R for building having better performance. vii. Two identical building to be constructed in zone IV & V. Building in zone V should be designed for lower lateral load than building in zone IV. viii. Energy released in an earthquake of magnitude 6, is double compared that released in magnitude 3 earthquake. ix. Intensity scale X is the highest intensity scale. x. Generally, shallow focus earthquakes are more destructive compared to deep focus earthquakes of same magnitude.	**10 x 2 = 20**	**CO1 CO2 CO3 CO4**

SECTION B

2	Calculate base shear for hotel of Garhwal Tourism (100 rooms) in Mausoorie with following data by static coefficient method. a) No. of storey = 15 (b) No. of bay in x direction = 2 c) No. of bay in y direction = 5 (d) storey height = 4.0 m (e) Width of each bay = 5 m (f) Size of beam = 300 x 450 mm (g) size of column = 600 x 300 m (h) LL = 3 kN/m2 (i) Thickness of slab = 150 mm (j) Damping = 9% of critical damping	**20**	**CO2**

	(k) Type of soil = Soft soil Assume suitable data if required. Write all your assumptions & clauses of IS 1893 (2016).		
3	**Explain any two** 1. Philosophy of Earthquake resistant design. Give four virtue of good earthquake resistant design. 2. Differentiate Static DOF & Dynamic DOF. Explain assumptions to reduce dynamic DOF of multi-storey building. 3. Differentiate (i) Magnitude & Intensity (ii) Seismograph Vs Seismogram (iii) S wave & Love wave (iv) center of mass & center of stiffness	**5 x 2 =10**	**CO1 CO3**
4	**Attempt any two** 1. Explain mathematical modeling in detail. Draw mathematical model for any two structural system. 2. Enlist various codes of practice along with correct name related to earthquake engineering. 3. Elastic rebound theory	**5 x 2 =10**	**CO1 CO3**
	SECTION-C		
5	(A) **Attempt any two** 1. Explain various irregularities found in the civil engineering structures from earthquake point of view. 2. Enlist two major/great Indian intra-plate & two interpolate earthquake with usual details. 3. Two pendulums are hanging on an ideal spring. The frequency of first pendulum is twice the frequency of second pendulum & the mass of first pendulum is four times the mass of second pendulum. What is the stiffness of the second pendulum with respect to first? (B) For a floor slab shown in the fig.1, Locate centre of mass and stiffness. Find design eccentricity and torsional moment if 200 kN force acts long Y direction. All columns are of 300 X 600 mm c/s with same height. Mass is uniformly distributed.  	**10 + 10 = 20**	**CO1 CO2**
6	(A) **Attempt any two** 1. Explain soft storey & discuss its performance of soft storey building in past earthquakes. How will you avoid soft storey? 2. Explain the concept of base isolation. Discuss its suitability. 3. A spring mass (k1, m1) system has a natural frequency f1. Calculate the value of stiffness of other spring which when connected to k1 in series decreases the frequency by 50%. (B) Explain ductile detailing of column as per IS 13920 – 1993. Also give limitation	**10 + 10 = 20**	**CO1 CO2 CO3**

	of this code.		
7	A 20m span long bridge is severly damaged due to an earthquake of magnitude 8 and need to retrofit urgently. Kindly provide the retrofitting solution.	**20**	**CO4**

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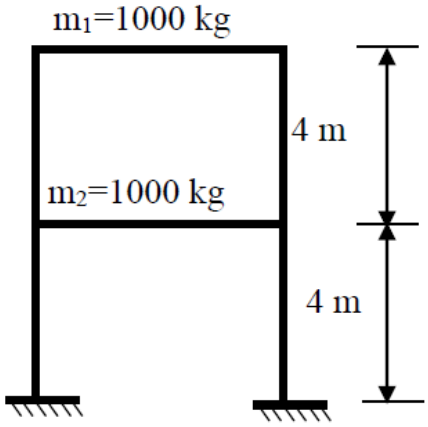
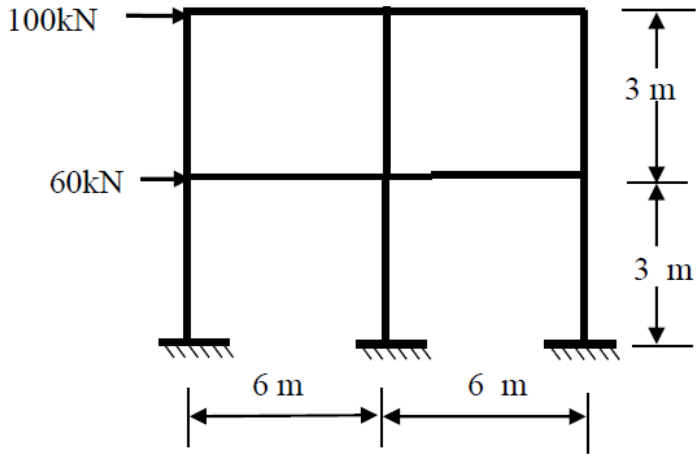
SECTION A

S. No.		Marks	CO
Q 1	**Fill in the banks and provide justification.** 1. According to IS 1893 (Part 1) – 2016, India is divided into _____ Seismic zones. 2. The ground motion during a Richter magnitude 8 earthquake is _____ times larger than the ground motion during a Richter magnitude 6 earthquake. 3. How many seismograph stations are needed to locate the epicenter of an earthquake? 4. A soft storey is one in which the lateral stiffness is less than _____ percent of that in the storey above or less than _____ percent of the average lateral stiffness of the three storeys above. 5. A weak storey is one in which the storey lateral strength is less than _____ percent of that in the storey above. 6. According to IS 13920 : 1993, for all buildings which are more than 3 storeys in height, the minimum grade of concrete shall preferably be _____ 7. As per IS 13920 : 1993, the thickness of any part of the shear wall shall preferably, not be less than _____. 8. Which are the fastest & the slowest waves? 9. The distance between focus & epicenter is known as _____. 10. Which is the most difficult structural element to retrofit?	**10 x 2 = 20**	**CO1 CO2 CO3 CO4**

SECTION B

Q 2	Earthquake force acting in horizontal direction at the top of a single storey building frame is 2000 kN. & slab is supported on three columns. What is the shear force distribution in the column if column having different moment of inertia? Take (I)1 = 0.5(I)2 = 0.25(I)3	**20**	**CO2 CO3**
Q 3	Explain Retrofitting techniques with examples.	**10**	**CO4**
Q 4	**Explain following** 1. Earthquake resistant feature of masonry structure. 2. Liquefaction and give remedial measures for it.	**5 x 2 =10**	**CO1 CO4**

SECTION C			
Q 5	Plot the mode shapes for the frame shown in the figure. Take $EI_{column} = 1.0 \times 10^{12}$ Nmm, $EI_{beam} = \infty$. 	**20**	**CO3**
Q 6	Analyse the frame shown in the fig.4 using appropriate approximate method and plot BM and SF force diagrams. Consider columns are of same cross section 	**20**	**CO2**
Q 7	A. Describe strengthening Methods for RC columns with sketches B. Sketch and describe a RCC beam showing qualitative ductile detailing.	**20**	**CO4** **CO1**