Reg. No. ☐☐☐☐☐☐☐☐☐☐☐☐

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

II SEMESTER M.TECH. (STRUCTURAL ENGINEERING)
END SEMESTER EXAMINATIONS, April/May 2019

SUBJECT: **EARTHQUAKE RESISTANT DESIGN OF STRUCTURES (CIE- 5255)**

REVISED CREDIT SYSTEM
(04 / 05 / 2019)

Time: 3 Hours   MAX. MARKS: 50

> **Instructions to Candidates:**
> ❖ Answer **ALL** the questions.
> ❖ Missing data may be suitable assumed.
> ❖ *Use of IS -1893 – 2016, IS -1893 – 1984, SP:16 , IS 13920 & IS 456-2000 is permitted*
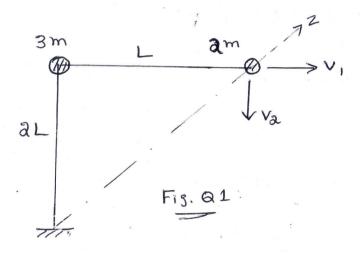
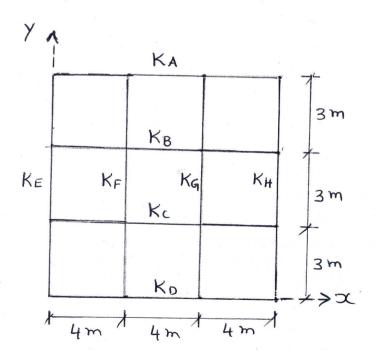|			
1	A structure is idealized as two-degree of freedom system as shown in Fig. Q1. Compute the approximate maximum moment at the column base assuming the direction of earthquake motions as (i) Horizontal (ii) Vertical (iii) Along ZZ axis. Frequency, mode shapes and acceleration response spectrum values are shown below. Take m = 250 kg, L = 3 m $$\omega = \begin{Bmatrix} 6 \\ 13 \end{Bmatrix} \text{rad/sec} \qquad \Phi = \begin{pmatrix} 1 & 1 \\ 0.9 & -2.0 \end{pmatrix}$$ $$Spa = \begin{bmatrix} 4 \\ 5 \end{bmatrix} \text{m/sec}^2$$	10	CO3
2A	In the case of SDOF system subjected to earthquake ground motion show that, $S_d\,(\xi,\omega) = [\,S_{pv}\,(\xi,\omega)\,]\,/\,\omega \quad$ and $\quad S_{pa}\,(\xi,\omega) = \omega\,[\,S_{pv}\,(\xi,\omega)\,]$	6	CO2
2B	What is the difference between Magnitude and Intensity of an earthquake?	4	CO1
3	A fixed ended RCC beam of rectangular section has to carry a distributed live load of 35 kN/m in addition to its own weight and a dead load of 30 kN/m. The maximum bending moment and shear force due to the earthquake are 70 kN-m and 50 kN respectively. Center to center distance between supports is 6m. Design the beam using M-20 grade concrete and Fe 415 steel.	10	CO5
4	A three storey shear building has four transverse and four longitudinal frames. The location of these frames are shown in Fig. Q4. The relative stiffness of these frames are K_A = 4.0, K_B = 3.5, K_C = 3.0, K_D = 2.0, K_E = 1, K_F = 2.0, K_G = 2.5 and	10	CO5

	$K_H = 3.0$. If the design seismic force in transverse and longitudinal direction is 400 kN, calculate the same for different frames. Assume center of mass at geometric center of the building.	
5	A Reinforced concrete chimney of height 25 m is to be constructed in Patna on soft soil. Let the outer diameter at the base and top be 4 m and 3 m respectively. Let the wall thickness of the structure shall be 0.3 m throughout the height. Let there be a lining 0.1 m thick. Evaluate earthquake forces on this chimney. Use I =1, R = 3 and $E_C = 2.0 \times 10^7$ kN/m^2	CO5 10

Fig. Q1

Fig. Q4