



MANIPAL INSTITUTE OF TECHNOLOGY MANIPAL

(A constituent institution of MAHE, Manipal)

II SEMESTER M.TECH. (STRUCTURAL ENGINEERING) END SEMESTER EXAMINATIONS, APRIL/MAY 2018

SUBJECT: EARTHQUAKE RESISTANT DESIGN OF STRUCTURES [CIE 5255] REVISED CREDIT SYSTEM

(27 / 04/ 2018)

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ALL the questions.
- ✤ Missing data may be suitable assumed.
- ♦ Use of IS -1893 2002, IS -1893 -1984, SP:16, IS 13920 & IS 456-2000 is permitted

The mass, frequency, mode shapes and response integral of a three storey shear building are shown below. Evaluate the resulting displacements, elastic force vector, base shear and overturning moment. Height of each storey is 3.0 m.

1.	$\omega = \begin{cases} 15\\ 30\\ 45 \end{cases} \text{ rad/sec } \Phi = \begin{pmatrix} 1 & 1 & 1\\ 0.8 & -0.35 & -1.8\\ 0.4 & -0.7 & 1.5 \end{pmatrix}$ $m = \begin{pmatrix} 3 & 0 & 0\\ 0 & 4 & 0\\ 0 & 0 & 5 \end{pmatrix} 10^3 \text{ kg} \qquad V_n (t) = \begin{pmatrix} 0.5\\ 0.3\\ 0.2 \end{pmatrix} \text{m/sec}$	10
2A.	Compute the maximum relative displacement and maximum base shear for the SDOF system with the properties shown below, due to an earthquake of 0.35 g peak acceleration having response spectra as in IS-1893 - 2002 for hard soil condition. $m = 7500 \text{ kg}$, $k = 2x10^6 \text{ N/m}$ and $c = 17.17x10^3 \text{ N-sec/m}$.	3
2B.	Derive the expression for displacement, elastic force vector. Base shear and overturning moment of a Generalized SDOF system subjected to earthquake ground motion	7
3.	A RCC beam of rectangular section has to carry a distributed live load of 20kN/m in addition to its own weight and a dead load of 25kN/m. The maximum bending addition to its own weight and a dead load of 25kN/m. The maximum bending moment and shear force due to the earthquake are 60 kN-m and 40 kN respectively. Center to center distance between supports is 6m. Design the beam using M-20 grade concrete and Fe 415 steel.	10

4.	A one storey residential building with plan shown in Fig. Q4 is to be constructed in Agra on	
	medium soil. Each wall is 200 mm thick and is constructed of brick masonry. The relative	
	stiffness of these walls are $K_A = 0.96$, $K_B = 0.343$, $K_c = 0.615$ and $K_D = 0.704$. The roof	10
	consists of a 150 mm thick RC slab. The walls are 4 m height except wall C which is 5 m	
	high. Calculate design earthquake force for each of the-walls. Take $I = 1$ and $R = 1.5$.	
5.	Reinforced concrete chimney of height 25 m is to be constructed in seismic zone III on hard	
	soil. The outer diameter at the base and top be 4 m and 3 m respectively. The wall thickness	10
	of the structure shall be 0.3 m throughout the height. Thickness of lining 0.1m. Evaluate	10
	earthquake forces on this chimney. Use I =1, R = 3 and Ec= $2.0 \times 10^7 \text{ kN/m}^2$	



Fig. Q4