GOVERNMENT COLLEGE OF ENGINEERING, AURANGABAD

(An Autonomous Institute of Government of Maharashtra

M.E. (Structural Engineering)-II

End-Semester Examination

AM-558 –Earthquake Resistant Design of Structures

Duration: Three Hours 17 NOV 2016 Maximum Marks: 60

Instructions:

1. *All questions are compulsory*
2. *Use of non-programmable calculators is permitted*
3. *Use of IS:1893 and 13920 is permitted*
4. *Assume suitable data where necessary and state it clearly*
5. *Figures to the right indicate full marks*

Q.1. (a) Discuss plate tectonic theory and continental drift theory. (06)

(b) Explain the different characteristics of an earthquake ground motion. Indicate the typical ranges of these characteristics. (06)

Q.2. (a) Explain the concept of an earthquake response spectrum and sketch the general nature of displacement, velocity and acceleration spectra. (05)

(b) A water tank is modeled as a SDOF system with a total lumped mass of 70 tonnes in empty condition and 90 tonnes under full condition. To determine the relevant properties, it is subjected to a lateral force of 50 kN at the container level which gives displacement of 12 mm. If the structure is subjected to a ground motion with the response spectrum as shown in Fig. 1, determine the maximum displacement and maximum base shear for the tank both in empty and full condition neglecting damping. (10)

Q.3. (a) A three storeyed residential building has lumped floor weights (W) and storey stiffnesses for first, second and third stories are respectively W_1 = 1079.1kN, W_2 = 1863.9 kN, W_3 = 294.3 kN and k_1 = 40000 kN/m, k_2 = 100000 kN/m, k_3 = 100000 kN/m. The building has SMRF founded on hard soil and situated in zone-IV. The storey heights for the three storeys are respectively, 4 m, 3.2 m and 3.2 m. The free vibration results are

$$\omega = \begin{Bmatrix} 10.035 \\ 40.347 \\ 64.148 \end{Bmatrix} rad/s, \Phi = \begin{bmatrix} 1 & 1 & 1 \\ 0.97 & 0.511 & -0.235 \\ 0.76 & -1.311 & 0.075 \end{bmatrix}$$

Determine the maximum seismic forces in the structure for an earthquake spectra shown in Fig. 1 assuming 5% damping. (12)

OR

(b) If the above structure is subjected to a 1g design spectrum as given below determine the maximum forces in the structure for a PGA = 0.3 g.

Range of time period T - (s)	< 0.03	0.03 - 0.125	0.125 - 0.66	0.66 - 4.0
Spectral acceleration (g)	1.00	$11.7\ T^{0.074}$	2.73	1.8/T

(12)

Q. 4. (a) Explain the behavior of a plan unsymmetrical building subjected to an earthquake. What is its effect on lateral resisting elements of the structure. (06)

(b) What is accidental eccentricity? What is its significance? How it is incorporated in the codal provisions? Explain with an example. (06)

OR

Q. 4. A single storey two-bay structure is 12 m × 16 m in plan supported on 9 columns of The bays in x-direction are 7 m and 5 m, in y-direction they are 6 m and 10 m measured from lower left corner. The static eccentricity are found to be e_x=0.8 m and e_y=0.9m. If the building is subjected to a horizontal force of 100 kN applied at the mass centre, determine the shear force in all the corner columns. (12)

Q. 5. (a) Explain the significance of the design load combination 0.9DL ± 1.5EL as defined in IS:1893. (03)

(b) Discuss the significance of ductility in earthquake resistant design. (03)

(c) Explain the concept of strong-column weak beam. Point out the provisions of IS:13920 which enable this concept to be incorporated in the design process. (06)

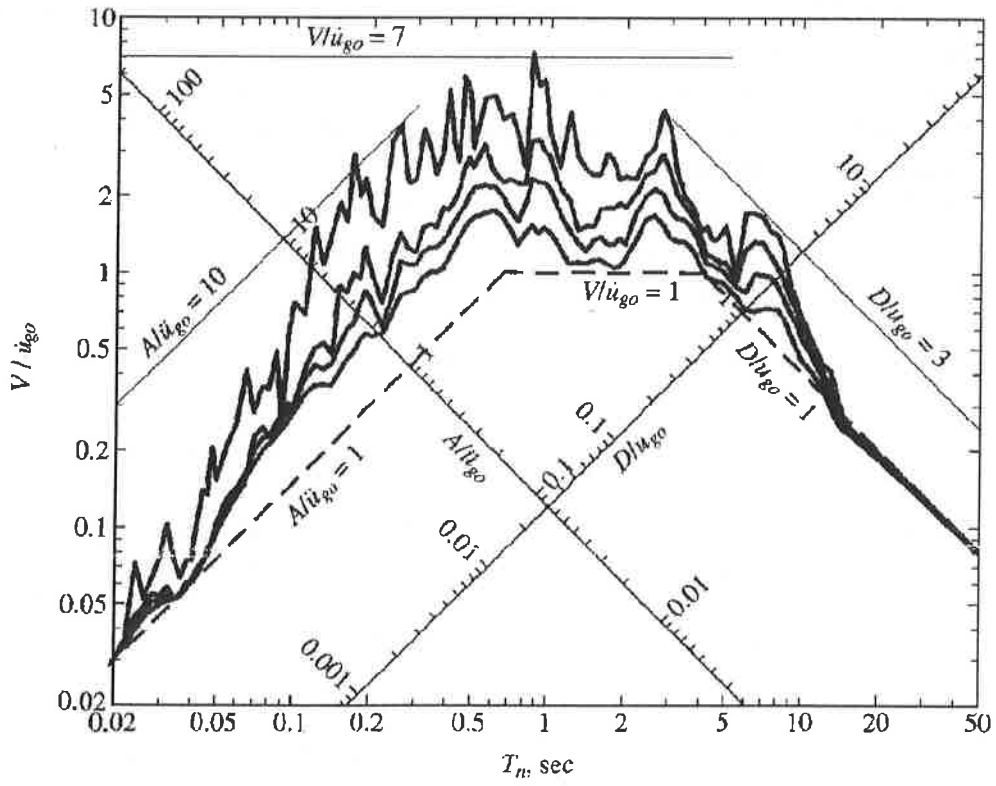

Figure 1. El Centro response spectra (normalised with respect to peak ground responses) for damping ratios 0%, 2%, 5% and 10% (Q. No. 2(b) and 3(a))