**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**

**SECOND SEMESTER 2016 – 2017**

**EARTHQUAKE RESISTANT DESIGN & CONSTRUCTION - Mid Sem Exam**

**Course No: CE F428 Date: 09-03-2017 [9 am start]**

**Duration: 90 Mins (Closed book) Max. Marks: 70**

**Note: IS 1893-2002, IS: 13920-1993 are allowed**

**I: Choose the best answers: [10 x 1=10]**

1. The shape function used in IS:1893-2002 for the displaced shape is  (True/false)
2. The sources responsible for damping is always uncertain (True/False)
3. The structures are considered to be rigid if the frequency is less than 30 Hz (True/False)
4. Stiffer structures are always very good from earthquake point of view (True/False)
5. Response spectrum cannot be generated for a particular earthquake (True/False)
6. Variational approaches are mostly used for complex systems to govern the equation of motion (True/False)
7. Tall buildings of 150 m height cannot also be analyzed using ESMA as per IS:1893 -2002 (True/False)
8. 100% +30% rule is generally applicable for orthogonal lateral load resisting system (True/False)
9. Response spectra used for design are generally very scattered with sharp spikes and valleys (True/False)
10. Central difference method is a conditionally stable implicit method of direct time integration (True/False)

**II: Short answers [5 x 3 = 15]**

1. What is the relation between the magnitude and the energy released during the earthquake? What are deep focus earthquakes?
2. What are iso-seismals?
3. Name seven major tectonic plates. Which is the largest of all plates?
4. Draw the free body diagram of the SDOF viscously damped oscillator and write equation of dynamic equilibrium.
5. Is it justifiable to use the higher value of "Response reduction factor" in the determination of horizontal seismic coefficient?

**III: Long answers: [45 marks]**

1) A typical floor plan of an intermediate storey of a seven storeyed industrial building is shown in Fig. Floor masses acting on various columns are also shown in the figure. All columns have 500 mm x 500 mm size and cast in M35 grade concrete. The floor is subjected to seismic load of 500 kN in principal directions. The floor height is 3.5 m. [20]

The lateral stiffnesses of the frames are as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Frame | 1,2 | 3 | A,B,C | D,E |
| K MN/m | 20 | 10 | 20 | 15 |

10 t

10 t

20 t

A

B

C

D

E

1

2

3

5 m

5 m

5 m

5 m

3 m

3 m

40 t

40 t

40 t

20 t

10 t

20 t

20 t

20 t

20 t

20 t

20 t

10 t

Determine

a) Centre of mass and centre of rigidity

b) Accidental eccentricities and the torsion induced in the floor

c) Design base shear incorporating the torsion effects.

2) The following are the different mode shapes obtained from the computer analysis for a typical four-storeyed hospital building situated in zone V. The soil has been found to be very safe. The time-periods obtained are 4s, 2s, 1s, and 0.5s. It has been found out experimentally that damping is only of the order of 3% of critical damping. [15]



The mass matrix of the system is given below:



Determine the modal participation factor, modal mass, modal contributions for all the possible modes. Also determine the lateral load at all levels corresponding to fundamental mode.

3) Name few code provisions mentioned in IS: 1893-2002 deserve revision according to your opinion. Justify your answers with explanation. [10]

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