Register No.: …… Name: ……..

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIRST SEMESTER M.TECH DEGREE EXAMINATION (Regular), FEBRUARY 2022

CIVIL ENGINEERING (GEOMECHANICS AND STRUCTURES)

(2021 Scheme)

Course Code : 21GS105-D

Course Name: Earthquake Analysis and Design of Structures

Max. Marks : 60 **Duration: 3 Hours**

Use of IS1893, IS456, IS13920 and SP16 is permitted in the examination hall. Assume suitable data, if necessary.

PART A

(Answer all questions. Each question carries 3 marks)

1. What is the basis of assignment of an earthquake's magnitude? Is magnitude the same as intensity? Explain.
2. What is the basic design philosophy of seismic design of structures?
3. Discuss how the mode shapes are used in the dynamic analysis of the building for calculating earth quake forces.
4. Describe the various factors that influence the ductility of structures.
5. What is the difference in the structural behaviour of long and short shear wall?
6. Discuss the concept of flanged shear wall.
7. Detail the concept of isolating devices with examples.
8. Discuss the ways and means to prevent an earthquake force from acting on the superstructure of a building.

PART B

(Answer one full question from each module, each question carries 6 marks)

MODULE I

9. a) The January 12, 2010 earthquake in Haiti generated a left-lateral strike-slip of 5m along the Leogan fault. The earthquake ruptured an area 30km wide and 35km long. If the shear modulus of rock is approximately 6.8 x 10^{10} dyne/cm^2, estimate the moment magnitude of the Haiti earthquake. (3)

   b) Classify and describe with suitable sketches different types of waves generated by an earthquake and their effects on structures. (3)

OR

10. Evaluate any six of the following statements as true/false giving justification/reason. (6)

(1) Energy released in an earthquake of magnitude 6, is double compared that released in magnitude 3 earthquake.
(2) Intensity scale X is the highest intensity scale.
(3) Generally shallow focus earthquakes are more destructive compared to deep focus earthquakes of same magnitude.
(4) Natural frequency of vibrating system will remain unchanged if damping level is increased.
(5) During Liquefaction, underground lighter objects are raising up.
(6) Moment resisting Capacity of a column should be more than that of beam framing on it.
(7) Ductility of RCC column increases by providing sufficient confining reinforcement
(8) Love-waves are most damaging seismic waves.
(9) Damping can be neglected in the dynamic analysis of buildings.

MODULE II

11. a) With detail sketch explain the essential requirements to ensure box action in a masonry building. (3)
    b) Explain the terms: (i) Story drift and story shear (ii) soft story and weak story (3)

OR

12. Attempt following any two
    1. Enlist three latest great earthquakes of the world and the lessons learnt from it. Name two inter plate & two intra plate earthquakes of India. (6)
    2. Define & explain liquefaction.
    3. Explain four virtue of good earthquake resistant design.

MODULE III

13. For a RCC framed office building, find the design lateral forces and its distribution along the height, using static co-efficient method. Consider following data.
    i. Location: Gandhidham
    ii. Soil condition: Medium soil
    iii. Plan dimensions: 5 bays of 6 m each along X direction and 6 bays of 5 m each along Y direction
    iv. Elevation: 6 storey including Ground storey, each with 3.5 m floor height (6)
    v. Columns: 400 x 400 mm all
    vi. Beams: 300 x 500 mm
    vii. Slab: 150 mm thick RCC
    viii. Walls: outer 230 mm brick masonry, inner 150 mm brick masonry
    ix. (ix) Parapet walls: 230 mm thick 1 m height brick masonry.

OR

14. A three storeyed hospital building located in Ahmedabad resting on medium soil is analyzed for free vibration and the results are as mentioned. W1 = 1100kN, W2 = 1300kN and W3 = 1000kN. ω1 = 8.3407 rad/sec. ω2 = 23.2831 rad/sec and ω3 = 31.5954 rad/sec. The three corresponding mode shapes are {0.2980, 0.5977, 0.7443}, {0.6623, 0.3535,-0.6607} and {0.7031, -0.6237, 0.3415}. Calculate the storey shears by the dynamic analysis. (6)

MODULE IV

15. Do as directed: (i) Sketch the reinforcement details for c/s of RCC column 400 x 400 mm, having 8 nos. 20 mm dia. main bars as ductile requirement (ii) Sketch the qualitative L/S of 6 m long RCC beam of special moment resisting frame having cross section 300 mm wide 600 mm deep. (6)

OR

16. Design and detail rectangular beam for 8m span to support a DL of 10kN/m and a LL of 12kN/m inclusive of its own weight. Moment due to earthquake load is 100kNm and shear force is 80kN. Use M20 grade concrete and Fe415 steel. (6)

MODULE V

17. Enumerate the procedure for design of shear wall and ductile detailing. (6)

OR

18. Design and detail shear wall for a two-storey building subjected to the following forces. The materials are M15 concrete and Fe 415 steel. The unfactored forces in the panel between the ground level and first floor are obtained by analysis as follows. (6)

Sl.No.	Load Case	Bending Moment (kN-m)	Axial Force (kN)	Shear Force (kN)
1	DL+LL	-577.5	1922.9	19.7
2	Earthquake	4830.9	255.7	699.1

MODULE VI

19. Enlist the different methods of structural control and explain any one in detail (6)

OR

20. What is tuned mass dampers? Explain its principle and application. (6)

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