



**M.E DEGREE EXAMINATIONS: JUNE 2018**

(Regulation 2015)

Second Semester

**STRUCTURAL ENGINEERING**

P15SET204: Aseismic Design of Structures

(Use of IS 1893-PART I, IS 13920 and IS 4326 are permitted)

**COURSE OUTCOMES**

- CO1:** Explain behavior of structures subjected to earthquake
- CO2:** Utilize various IS codal provisions for seismic design
- CO3:** Design RC shear walls frame system
- CO4:** Perform Retrofitting and Rehabilitation for existing damaged buildings
- CO5:** Design buildings for seismic forces using various software packages

**Time: Three Hours**

**Maximum Marks: 100**

**Answer all the Questions:-**

**PART A (10 x 1 = 10 Marks)**

1. Assertion (A): Static loading on a structure has only one solution with respect to time. CO1 [K<sub>1</sub>]  
Reason (R): Dynamic loading on a structure has infinite number of solutions which are time dependent.
  - a) Both A and R are Individually true and R is the correct explanation of A
  - b) Both A and R are Individually true but R is not the correct explanation of A
  - c) A is true but R is false
  - d) A is false but R is true
2. When the frequency of the applied loading matches or equals with the undamped natural frequency of the system, the system is said to be CO1 [K<sub>1</sub>]
  - a) Resonant
  - b) Under free vibration
  - c) Under forced vibration
  - d) In equilibrium
3. The graphical representation of the relative amplitudes of the two coordinates and their phase angle relationship is called CO2 [K<sub>1</sub>]
  - a) Bending moment diagram
  - b) Mode shape
  - c) Amplitude diagram
  - d) Yield line

4. Match List I with List II.

CO2 [K<sub>2</sub>]

List I	List II
A. Response spectrum	i. Strain softening
B. Time period	ii. Large deformation
C. Inelastic behaviour	iii. Frequency
D. Loss of strength	iv. Amplitude

- |    | A   | B   | C   | D  |
|----|-----|-----|-----|----|
| a) | ii  | i   | iii | iv |
| b) | iii | iv  | ii  | i  |
| c) | ii  | iv  | iii | i  |
| d) | iv  | iii | ii  | i  |

5. Assertion (A): The minimum thickness of shear walls shall not be less than 150 mm.

CO3 [K<sub>2</sub>]

Reason (R): The minimum ratio of length of shear wall to its thickness shall be 4.

- |   |   |
|---|---|
| a) Both A and R are Individually true and R is the correct explanation of A | b) Both A and R are Individually true but R is not the correct explanation of A |
| c) A is true but R is false   | d) A is false but R is true   |

6. The design acceleration coefficient for different soil types as is applicable to buildings having

CO3 [K<sub>1</sub>]

- |               |                |
|---------------|----------------|
| a) 1% damping | b) 2% damping  |
| c) 5% damping | d) 10% damping |

7. Consider the following statements.

CO4 [K<sub>2</sub>]

- Beam-column joints transfer less load.
- A building with ductile detailing does not require special confining reinforcement.
- Retrofitting is retrieving a damaged structure to its previous capacity.
- Liquefaction can be predicted and rectified.

Which of these statements are correct?

- |        |        |
|--------|--------|
| a) 1,3 | b) 1,4 |
| c) 1,2 | d) 2,3 |

8. Which of the following corresponds to dynamic soil properties?

CO4 [K<sub>1</sub>]

- |                    |                      |
|--------------------|----------------------|
| a) Stiffness ratio | b) Slenderness ratio |
| c) Mass ratio      | d) All the above     |

9. Base isolation technique is CO5 [K<sub>1</sub>]
- a) A passive control method b) An active control method
- c) Not applicable to existing structures d) Applicable to only tall buildings

10. Consider the following steps to find the solution for a system subjected to forced vibration. CO1 [K<sub>2</sub>]
1. Free body diagram
  2. Eigen value and eigen vector
  3. Spring mass system
  4. Equations of equilibrium

The correct sequence of the equations is,

- a) 2-3-4-1 b) 1-3-2-4
- c) 3-1-4-2 d) 4-1-3-2

**PART B (10 x 2 = 20 Marks)**

11. Define the following terms (i) Amplitude and (ii) Stiffness. CO1 [K<sub>2</sub>]
12. What is logarithmic decrement? CO1 [K<sub>2</sub>]
13. What is mode shape? CO2 [K<sub>2</sub>]
14. What do you mean by earthquake response to inelastic buildings? CO2 [K<sub>2</sub>]
15. What is the cyclic behavior of prestressed concrete elements? CO3 [K<sub>2</sub>]
16. What is mathematical modelling? CO3 [K<sub>2</sub>]
17. What is strong column weak beam concept? CO4 [K<sub>2</sub>]
18. What do you mean by capacity design? CO4 [K<sub>2</sub>]
19. List the software packages available for steel and RC structural elements as per IS code provisions. CO5 [K<sub>2</sub>]
20. List the advantages of a Passive energy Dissipation systems. CO5 [K<sub>2</sub>]

**PART C (10 x 5 = 50 Marks)**

21. Compare critically damped, over damped and under damped systems. CO1 [K<sub>2</sub>]
22. What is a fault? What are the types of faults? CO1 [K<sub>2</sub>]
23. What is response spectrum? List the factors affecting Response spectrum theory. CO2 [K<sub>2</sub>]
24. Explain the common types of inelasticity with neat sketches. CO2 [K<sub>2</sub>]
25. What is ductility? List and explain the types of ductility. CO3 [K<sub>2</sub>]
26. What is pushover analysis? Explain with a neat sketch the performance check using push over analysis. CO3 [K<sub>2</sub>]

27. What is special confining reinforcement? Under what situations it is provided? CO4 [K<sub>2</sub>]
28. What is liquefaction? Explain the types of failure due to liquefaction. CO4 [K<sub>2</sub>]
29. Explain the features of any one software used for Analysis and Design of Buildings for Earthquake Loads. CO5 [K<sub>2</sub>]
30. Explain the types of dampers used for resisting earthquake loads. CO5 [K<sub>2</sub>]

**Answer any TWO Questions**

**PART D (2 x 10 = 20 Marks)**

31. What is a shear wall? List the types of shear wall. Explain the step by step procedure for design of shear wall with neat sketches. CO3 [K<sub>2</sub>]
32. A 3 storied building is in seismic zone IV. Its foundation is on isolated footing on medium soil and the period of oscillation  $T = 0.2$  seconds. Calculate the horizontal seismic coefficient by static method assuming damping factor of 5 % and SMRF and OMRF frames. CO2 [K<sub>3</sub>]
33. Explain in detail about base isolation technique. CO4 [K<sub>2</sub>]

\*\*\*\*\*