KUMARAGURU
college of technology
character is life

Register Number:………….…

M.E DEGREE EXAMINATIONS: NOV/DEC 2023

(Regulation 2018)

Third Semester

STRUCTURAL ENGINEERING

P18SEE0003**:** Earthquake Resistant Design of Structures

Use of IS 1893, IS 4326, IS 13920, IS 13827 & IS 13828 codes are permitted

COURSE OUTCOMES

CO1: Acquire knowledge on earthquake and theory of vibration

CO2: Understand response of the structures to dynamic loads and capacity design

CO3: Understand the code provisions for seismic analysis of structures

CO4: Design RC elements of frame system as per code provision

CO5: Understand Retro-fitting of existing damaged buildings and vibration control measures

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. The qualitative measure of an earthquake is called   CO1   [K$_1$]

   a) Magnitude   b) Zone

   c) Seismicity   d) Intensity

2. Assertion (A): Cyclic load behaviour of plain concrete is good and more energy   CO2   [K$_2$] absorption is observed.

   Reason (R): Cyclic load behaviour of rebar is appreciable, and more energy absorption is observed.

   a) Both A and R are Individually true and   b) Both A and R are Individually true but R is the correct explanation of A   R is not the correct explanation of A

   c) A is true but R is false   d) A is false but R is true

3. The approximate fundamental translational frequency period of oscillation for a RC   CO2   [K$_2$] Moment Resisting Framed structure of height 12 m as per IS 1893 is estimated as

   a) 0.48   b) 0.58

   c) 0.12   d) 0.22

4. Matching List I with List II.   CO1   [K$_2$]

List I (Type of system)	List II (Damping ratio)

A. Undamped system	i. Less than 1
B. Under damped system	ii. Greater than 1
C. Over damped system	iii. Equal to zero
D. Critically damped system	iv. Equal to one

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

5. The imposed load acting on a structure is 4 kN/m². The imposed load to be considered in calculation of seismic weight as per IS 1893 is equal to   CO3   [K₂]

   a) $1 \ kN/m^2$ b) $4 \ kN/m^2$

   c) $2 \ kN/m^2$ d) $3 \ kN/m^2$

6. Prioritize the following in sequential order based on the analysis by equivalent static procedure.   CO3   [K₂]

   1. Design lateral force

   2. Seismic weight

   3. Importance factor

   4. Distribution of lateral force

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

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

7. Consider the following statements: CO4   [K₂]

   1. Boundary elements are not mandatory for all types of shear walls.

   2. Not more than 75 % of area of steel bars on either top or bottom face shall be spliced at any one section of an RC element

   3. Circular columns shall have a minimum of 6 bars

   4. Ductility of a structure is improved by increasing area of reinforcement.

   Which of these statements are correct?

   a)   1,3   b)   2,4

   c)   3,4   d)   1,4

8. The minimum thickness of special shear walls shall not be less than   CO4   [K₁]

   a)   300 mm   b)   250 mm

   c)   150 mm   d)   100 mm

9. The dampers in which the energy is absorbed by metallic components that yield is, CO5 [K1]

   a) Friction   b) Viscous

   c) Metallic   d) Non-metallic

10. Crack sealing in RC elements is adopted using CO5 [K1]

    a) Injection of paint   b) Injection of epoxy

    c) Injection of cement mortar   d) Injection of quarry dust

PART B (10 x 2 = 20 Marks)

11. Compare free and forced vibration. CO1 [K2]
12. Explain two degrees of freedom system. CO1 [K2]
13. Define load path. CO2 [K2]
14. Define capacity based design. CO2 [K2]
15. Define response spectrum. CO3 [K2]
16. What is strong column weak beam concept? CO3 [K2]
17. Explain zone factor and importance factor. CO4 [K2]
18. List the types of shear walls as per IS 13920:2016 code. CO4 [K1]
19. Outline the purpose of seismic retrofitting. CO5 [K2]
20. Compare active and passive energy dissipation systems. CO5 [K2]

PART C (10 x 5 = 50 Marks)

21. Compare Magnitude and Intensity of earthquake. CO1 [K2]
22. Explain seismograph with a neat sketch. CO1 [K2]
23. List and explain the types of seismic waves. CO1 [K2]
24. List and explain the types of ductility. CO2 [K2]
25. Explain time history analysis. CO3 [K2]
26. Summarize the types of bands used in buildings as per IS code with neat sketches. CO3 [K2]
27. Explain the step-by-step procedure to determine the base shear by equivalent static procedure method. CO3 [K2]
28. Explain how to improve the seismic behaviour of masonry structures as per IS code. CO4 [K2]
29. Define special confining reinforcement. Explain under what situations it is provided. CO4 [K2]
30. Explain base isolation technique with a neat sketch and list its applications. CO5 [K2]

Answer any TWO Questions
PART D (2 x 10 = 20 Marks)

31. Explain the cyclic behaviour of plain concrete, Reinforcement bar and Reinforced concrete with suitable sketches.   10   CO2   [K2]

32. A rectangular RC beam simply supported at its ends is of size 300 x 600 mm. The hogging bending moment = 225.576 kN-m and sagging bending moment = 142.004 kN-m. Design the beam for flexure as per IS: 13920-2016. Take grade of concrete as M20 and steel as Fe415.   10   CO4   [K3]

33. Define soil liquefaction. List and explain the types of liquefaction. Also outline the effects of liquefaction and anti-liquefaction measures.   10   CO5   [K2]

****