KUMARAGURU
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M.E DEGREE EXAMINATIONS: DEC 2022

(Regulation 2018)

Third Semester

STRUCTURAL ENGINEERING

P18SEE0003: Earthquake Resistant Design of Structures

Use of IS 1893, IS 4326, IS 13920, IS 13827 and 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. Modified Mercalli scale is used to measure   CO1   [K_1]

   a)   Magnitude   b)   Intensity

   c)   Acceleration   d)   Stiffness

2. Response spectrum theory is applicable to determine maximum   CO2   [K_1]

   a)   Velocity   b)   Acceleration

   c)   Displacement   d)   All the above

3. Consider the following statements as per IS code.   CO4   [K_2]

   1. The spacing of special confining reinforcement shall not be less than 200 mm.

   2. Reinforcement in shear wall shall be provided in single layer when the wall thickness is more than 200 mm.

   3. Beams shall have width to depth ratio of more than 0.5

   4. For bars of diameter lesser than 32 mm, mechanical splicing shall be adopted

   Which of these statements is incorrect?

   a)   1,4   b)   1,3

   c)   2,4   d)   3,4

4. Match List with List II. CO3 [K$_2$]

List I	List II
A. LL > 3 kN/m^2 on floors	i. $\dfrac{ZIS_a}{2Rg}$
B. Floating column	ii. Equal to 1 for residential buildings
C. Horizontal seismic coefficient	iii. Special confining reinforcement
D. Importance factor	iv. 50% is considered

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

5. When a structure is designed to distribute the inelastic deformation throughout the structures by the formation of plastic hinges at predetermined positions in the members, the design is called, CO3 [K$_1$]

   a) Dynamic design   b) Capacity based design
   c) Plastic design   d) Limit state design

6. The point directly above the focus point on the earth is called CO1 [K$_1$]

   a) Epicentre   b) Focal depth
   c) Hypocentre   d) Fault

7. In the load-deflection curve for an RC element, the dlope of the curve tend to pinch-in near zero loads. This effect is known as CO2 [K$_1$]

   a) Stiffness degradation   b) Bauschinger effect
   c) Capacity design   d) Plastic degradation

8. The transverse reinforcement for an RC column CO4 [K$_1$]

   a) Shall have a 2-legged 135 degree hook   b) Shall have a 2-legged 135 degree hook with an extension of 6 times its diameter
   c) Shall have a 2-legged 90 degree hook   d) Shall have a 2-legged 135 degree hook with a cross tie

9. **Assertion (A):** Shear wall is a lateral load resisting system.   CO5 [K$_2$]

   Reason (R): It is advantageous to provide Boundary elements in shear wall with dimensions greater than the thickness of the wall web.

   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

10. Consider the following steps of seismic retrofitting of an RC column.   CO5 [K$_2$]

    1. Surface cleaning
    2. Arrangement of new reinforcement
    3. Inspection and identification
    4. Jacketing technique

    The correct sequence of retrofitting process is

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

PART B (10 x 2 = 20 Marks)

11.	Compare magnitude and Intensity of earthquake.	CO1 [K$_2$]
12.	Explain the terms: (i) Amplitude and (ii) Frequency.	CO1 [K$_2$]
13.	Explain strong column – weak beam concept.	CO2 [K$_2$]
14.	Define ductility and list the types of ductility.	CO2 [K$_2$]
15.	Explain how the strength of adobe is ascertained as per IS:13827:1993?	CO3 [K$_2$]
16.	What is meant by pushover analysis?	CO3 [K$_2$]
17.	List the types of shear walls as per IS code.	CO4 [K$_2$]
18.	Compare Special Moment Resisting Frames and Ordinary Moment Resisting Frames.	CO4 [K$_2$]
19.	Compare active and passive energy dissipation systems.	CO5 [K$_2$]
20.	What is retrofitting?	CO5 [K$_2$]

PART C (10 x 5 = 50 Marks)

21.	Explain the types of seismic waves with neat sketches.	CO1 [K$_2$]
22.	Explain the working of a seismograph with a neat sketch.	CO1 [K$_2$]
23.	Explain the cyclic behaviour of Reinforcement bar and RCC.	CO2 [K$_2$]
24.	Explain the common types of inelasticity in buildings.	CO2 [K$_2$]
25.	Explain the step-by-step procedure to determine the design base shear by equivalent static procedure.	CO3 [K$_2$]

26.	Explain response spectrum theory with a neat sketch.		CO2	[K2]
27.	Explain the provision of special confining reinforcement as per IS 13920:2016.		CO4	[K2]
28.	With a neat sketch briefly explain the section of the earth.		CO1	[K2]
29.	List the various types of energy dissipation devices. Explain any one with a neat sketch.		CO5	[K2]
30.	Explain the effect of Soil liquefaction.		CO5	[K2]

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

31.	Explain the various seismic strengthening arrangements with neat sketches as per IS 4326-1993 provisions.	10	CO3	[K2]
32.	A rectangular RC beam simply supported 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 Fe 415.	10	CO4	[K4]
33.	Explain Base isolation method in detail with suitable sketches.	10	CO5	[K2]

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