

B.E DEGREE EXAMINATIONS: NOV/DEC 2024

(Regulation 2018)

Seventh Semester

CIVIL ENGINEERING

U18CEE0012: Earthquake Engineering

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

COURSE OUTCOMES**CO1:** Understand the behaviour of earthquake and theory of vibration**CO2:** Understand the concepts of SDOF systems**CO3:** Understand the concepts of MDOF systems**CO4:** Study various IS code provisions for earthquake resistance and vibration control methods**CO5:** Design RC structural elements resisting earthquake forces as per IS code provisions**Time: Three Hours****Maximum Marks: 100****Answer all the Questions:-****PART A (10 x 1 = 10 Marks)**

1. Match Type of damping with damping ratio.

CO2 [K₂]

Type of damping	Damping ratio
A. Over damping	i. Equal to zero
B. Under damping	ii. Equal to 1
C. Critical damping	iii. Less than 1
D. No damping	iv. More than 1

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

2. The phenomenon in which the vibrational energy of the system is gradually reduced is called

CO1 [K₁]

- | | |
|---------------|--------------|
| a) Ductility | b) Damping |
| c) Mode shape | d) Frequency |

3. Consider the following statements:

CO2 [K₂]

1. Resistance encountered during vibration is called damping.
2. Periodic loads are repetitive in nature.
3. Equation of motion of SDOF system under forced vibration is equal to zero.
4. Mass is not considered in a system subjected to dynamic load.

Which of these statements are correct?

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

4. When the frequency of the applied loading matches or equals with the undamped natural frequency of the system, the system is said to be under CO2 [K₂]

- | | |
|----------------|--------------|
| a) Damping | b) Vibration |
| c) Oscillation | d) Resonance |

5. Assertion (A): An MDOF system is complex for analysis. CO3 [K₂]

Reason (R): The solutions for MDOF systems are obtained by dividing it into several SDOF systems and integrate the solutions.

- | | |
|---|---|
| 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. Choose the correct sequence of the procedure for finding eigen values and eigen vectors of an MDOF system listed below. CO3 [K₂]

1. Derive equations of motion
2. Find eigen values
3. Plot the free body diagram.
4. Find the eigen vector

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

7. As per IS1893, the relative displacements between the storey above or below the storey under consideration is called CO4 [K₁]

- | | |
|---------------------|---------------------|
| a) Storey drift | b) Storey shear |
| c) Storey stiffness | d) Storey ductility |

8. The column member shall preferably have a width-to depth ratio of more than _____ as per IS 13920. CO4 [K₁]

- | | |
|--------|--------|
| a) 0.3 | b) 0.4 |
|--------|--------|

23. a) Determine the natural frequencies and mode shapes for the structure shown in Figure 1. Take Mass $m_1 = 1360$ kg, mass $m_2 = 660$ kg, $E = 2.5 \times 10^4$ N/mm², $I = 5 \times 10^5$ mm⁴, For mass m_1 & mass m_2 , $I = 2I$. 14 CO3 [K₃]

Figure. 1

24. a) Explain Base Isolation system with a neat sketch and list its advantages. 7 CO4 [K₂]
 b) Explain the IS code specifications for shear walls with suitable sketches. 7 CO4 [K₂]
25. a) Design the reinforcement for an RC column of size 450 x 450 mm subjected to the forces as given below. The unsupported length of the column is 3.5 m. Use M25 grade concrete and Fe415 steel. 14 CO5 [K₄]

Parameter	DL	LL	EQ Load
Axial load (kN)	1000	800	550
Moment (kN-m)	50	40	100

26. a) Design a simply supported RC beam of size 300 x 600 mm. The sagging B.M = 142.004 kN-m and hogging B.M = 225.576 kN-m. Design the beam for flexure as per IS: 13920-2016. Use M25 grade concrete and Fe415 grade steel. 14 CO5 [K₄]
