P.E.S. COLLEGE OF ENGINEERING

(AN AUTONOMOUS INSTITUTE)

CHH. SAMBHAJINAGAR-431002

Regular Winter Examination – 2025

Course: F.Y.M.Tech. Branch :Structural Engineering Semester : I
Subject Code & Name: MTPESSE102T – Earthquake Engineering

Max Marks: 60 Date: Duration: 3 Hr.

Instructions to the Students:

1. *All the questions are compulsory.*
2. *The level of question/expected answer as per OBE or the Course Outcome (CO) on which the question is based is mentioned in ( ) in front of the question.*
3. *Use of non-programmable scientific calculators is allowed.*
4. *Assume suitable data wherever necessary and mention it clearly.*
5. *Use of IS1893:2002 and IS 13920:1993 is allowed.*

		(Level/CO)	Marks
Q. 1	**Solve Any one of the following.**		
A)	How do the properties of the Earth's layers, such as the crust and mantle, influence the propagation of seismic waves and the design of earthquake-resistant structures?	K2/CO1	**12**

Solution:- Marking Scheme

Content	**Marks Distribution**
Explanation of Earth crust	3
Explanation of Lithosphere	3
Explanation of Asthenosphere	3
Explanation of Barysphere	3

B)	Enlist different types of seismic waves and Explain them in detail.	K2/CO1	**12**

Solution:- Marking Scheme

Content	**Marks Distribution**
Main or P waves	3
Secondary or S waves	3
Rayleigh waves	3
Diagrams	3

Q.2	**Solve Any one of the following.**		
A)	Explain free body diagram of SDOF. Differentiate over damped and under damped system.	K3/CO2	**12**

Solution:- Marking Scheme

Content	**Marks Distribution**
Explanation of FBD of SDOF	3
Nature of response	2
Roots of characteristic equation	2
Damped frequency	2
Return to equilibrium	2
Typical application	1

B)	A vibrating system consisting of a weight of 1000kN and a spring stiffness of 80kN/m is viscously damped so that the ratio of two consecutives amplitude is 1 to 0.85. Determine: (i) Logarithmic decrement (ii) natural frequency (iii) damping ratio (iv)damping coefficient and (v)damped natural frequency.	K3/CO2	**12**

Solution:- Marking Scheme

Content	Marks Distribution
Logarithmic decrement	3
natural frequency	3
damping ratio	3
damping coefficient	2
damped natural frequency	1

Q. 3	**Solve Any one of the following.**		
A)	Explain the effects of earthquakes on reinforced concrete (RC) structures. Discuss various structural and non-structural damages with suitable examples from past earthquakes.	K4/CO3	**12**

Solution:- Marking Scheme

Content	Marks Distribution
Effects of earthquakes on reinforced concrete (RC) structures	4
Soft Storey Collapse	1
Short Column Failure	1
Inadequate Transverse Reinforcement/Poor Detailing	1
Strong Beam-Weak Column Mechanism	1
Pounding Effect	1
Non-Structural Damage	1
Infill Wall Cracking and Collapse	1
Damage to Architectural Elements	1

B)	Describe various seismic methods of analysis used for RC buildings. Compare Equivalent Static Analysis, Response Spectrum Analysis, and Time History Analysis with rest to assumptions, applicability, and limitations.	K4/CO3	**12**

Solution:- Marking Scheme

Content	Marks Distribution
Seismic methods of analysis used for RC buildings	3
Compare Assumptions	3
Compare Applicability	3
Compare Limitations	3

Q.4	**Solve Any one of the following.**		
A)	A two stroyed building is to be constructed on a 10m wide and 18m deep plot. Determine the lateral seismic loads on the building with given data. The height of each story of the building is 3.5m. Thickness of floor and roof slab = 12cm.	K4/CO4	**12**

	Thickness of wall = 15cm Density of concrete = 25 KN/m^3. Density of masonry = 20 KN/m^3. Live load on roof = 0 Live load on floors = 1 KN/m^2. Seismic zone = V Zone factor = 0.36 Importance factor = 1.0 Reduction factor = 3.0 The foundation soil is medium hard		

Solution: - Marking Scheme

Content	Marks Distribution
Given Data & Assumptions	1
Calculation of Dead Load (DL) **1)** Dead load of slabs (floor + roof) **2)** Dead load of walls	4
Calculation of Live Load (LL)	1
Seismic Weight of Building	2
Design Horizontal Seismic Coefficient	2
Total Base Shear	1
Vertical Distribution of Base Shear	1

B)	A six Storey building on a 20 m X 20 m plot is to be constructed in Shimla. The plan and elevation of the building are shown in figure. The height of each Storey is 3.5m. The construction is of ordinary shear walls with special moment resisting frame (SMRF). The loads may be assumed as given below. Determine the seismic forces and shear at different level. 1) The dead load = 4 KN/m^2. 2) Weight of partitions = 2 KN/m^2. 3) The intensity of live load on each floor = 3 KN/m^2. 4) The intensity of live load on roof = 1.5 KN/m^2. The soil below the foundation is hard. The size of beam and column assumed as 30 cm X 60cm.	K4/CO4	**12**

Solution: - Marking Scheme

Content	Marks Distribution
Given Data, Seismic Parameters & Assumptions	1
Calculation of Seismic Weight per Floor 1) Dead Load + Partition Load 2) Live Load Contribution	4
Total Seismic Weight of Building	1
Time Period of Building	1
Design Horizontal Seismic Coefficient	2
Calculation of Base Shear	1
Vertical Distribution of Seismic Forces	2

Q. 5	**Solve Any one of the following.**		
A)	Define ductility in structural engineering. Explain its importance in seismic resistant design with reference to energy dissipation and collapse prevention.	K3/CO5	**12**

Solution:- Marking Scheme

Content	Marks Distribution
Definition of ductility	2
Stress–strain behavior of ductile materials	3
Role of ductility in seismic performance	4

	Importance in life safety and collapse prevention — 3		
B)	Explain various factors affecting ductility of reinforced concrete structures. **Solution:- Marking Scheme**	K3/CO5	**12**

Content	**Marks Distribution**
Material properties (steel, concrete)	3
Reinforcement detailing and confinement	4
Geometry and loading conditions	3
Construction quality and workmanship	2

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