

Branch Name:	CIVIL ENGINEERING
Program Code:	ET106
Course Title:	Earthquake Engineering
Course Code:	2ET1060506T
Pre-requisite Course:	Mechanics of Solids, Structural Analysis I,II and III

Course Objectives:

CO-1: This subject is conceptual applications of principles of dynamics and earthquake resistant design & detailing of RC structures. Some special topics like Earthquake resistant masonry structures, liquefaction, structural controls and seismic strengthening are included aiming students know that these are challenges in this subject.

CO-2: This subject is useful to understand the behavior of the structure subjected to earthquake forces and earthquake resistant design of the structure.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								
					Theory (Marks)				Practical (Marks)				Total (Marks)
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
4	3	1	-	4	24	60	16	40	-	-	-	-	100

Course Contents:

Unit No	Topic	Total Hours	Weight age (%)
01	Earthquake Basics Interior of Earth, plate tectonics, faults, consequences of earthquake, Basic parameters of earthquake, magnitude & intensity, scales, Seismic zones of India, damages caused during past earthquakes (worldwide).	03	10
02	Fundamentals of Earthquake Vibrations of buildings Static load v/s Dynamic load (force control and displacement control), simplified single degree of freedom system, mathematical modeling of buildings, natural frequency, resonance v/s increased response, responses of buildings to different types of vibrations like free and forced, damped and un-damped vibration, response of building to earthquake ground motion, Response to multi degree (maximum three) of freedom systems up to mode shapes.	11	25

03	Design Philosophy Philosophy of earthquake resistant design, earthquake proof v/s earthquake resistant design, four virtues of earthquake resistant structures (strength, stiffness, ductility and configuration), seismic structural configuration, Introduction to IS: 1893 (Part I), IS: 875 (Part V). Seismic load: Seismic Coefficient Method – base shear and its distribution along height. Introduction to Response spectrum, IS code provisions.	11	25
04	Lateral Loads on Buildings Lateral Load Distribution (SDOF): Rigid diaphragm effect, centers of mass and stiffness, torsionally coupled and uncoupled system. Lateral Load Analysis Analysis of frames using approximate methods like portal & cantilever methods.	06	15
05	Ductile Detailing: Concepts of Detailing of various structural components as per IS: 13920 provisions.	05	10
06	Special topics: Introduction to Earthquake Resistant Features of un-reinforced & reinforced masonry Structure, Confined Masonry, Soil liquefaction, Structural controls, Seismic strengthening.	06	15

List of Text and Reference Books:

1. Manish Shrikhande & Pankaj Agrawal; Earthquake resistant design of structures, PHI Publication, New Delhi.
2. S.K.Duggal; Earthquake resistance design of structures; Oxford University Press, New Delhi.
3. A.K.Chopra; Dynamics of structures , Pearson, New Delhi.
4. Clough & Penzin; Dynamics of structures.
5. Park & Pauly; Behaviour of RC structure.
6. John M.Biggs; Introduction to Structural Dynamics.
7. C V R Murthy - Earthquake Tips, NICEE.
8. IITK-GSDMA EQ26 – V -3.0 Design Example of a Six Storey Building.
9. S S Rao; Mechanical Vibration; Pearson, New Delhi.

IS Codes:

- I. Criteria for earthquake resistant design General provision & Building - IS: 1893 (Part I)- 2002
- II. Code of Practice for Ductile Detailing of RC Structures - IS: 13920 (1993).
- III. Code of Practice for earthquake resistant design & Construction of buildings – IS 4326 (1993).
- IV. Improving Earthquake Resistance of Earthen Buildings - IS 13827(1993)
- V. Guide lines for Improving Earthquake Resistance low strength masonry buildings - IS 13828 (1993)

E-Resources:

1. www.nicee.org
2. www.eeri.org
3. www.gsdma.org
4. www.ndma.gov.in
5. www.nptel.iitm.ac.in/courses/
6. www.nisee.berkeley.edu/elibrary/getpkg?id=NONLIN

Course Learning Outcomes (CLO):

1. Determine the response of SDOF & MDOF structural system subjected to vibration including earthquake.

2. Apply the concept of Earthquake Resistant Design & concept of lateral load distribution on buildings.
3. Determine the lateral forces generated in the structure due to earthquake.
4. Apply the concept of ductile detailing in RC structures.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Determine the response of SDOF & MDOF structural system subjected to vibration including earthquake.	L-2
CLO2	Apply the concept of Earthquake Resistant Design & concept of lateral load distribution on buildings.	L-3, L-4, L-5
CLO3	Determine the lateral forces generated in the structure due to earthquake.	L-2, L-4
CLO4	Apply the concept of ductile detailing in RC structures.	L-3

L1- Remember, **L2-** Understand, **L3-** Apply, **L4-** Analyze, **L5-** Evaluate, **L6-** Create

Mapping of CLOs with POs & PSOs

	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
Course Learning Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CLO1	M	M	M	M								M	M	M	
CLO2	M	M	M									M	M	M	
CLO3	M	M	M									M	M	M	
CLO4	M	M	M	M							M	M	M	M	

H: High, **M:** Medium, **L:** Low