

M. Tech. II Semester III

Subject Name: Earthquake Resistant Design of Structures

Subject Code: MTST14302

Type of course: PE - V

Prerequisite: Structural Analysis and Design Subjects, Introduction to Wind and Earthquake Engineering, Engineering Mathematics

Rationale: Day by Day, due to scarcity of land, it has become compulsory to go for vertical expansion than the horizontal expansion of building. Also, enormous increase in seismic activities has also been noticed worldwide. The buildings are becoming taller and thinner. These all revolutions increase the responsibilities of structural engineer as structures become more sensitive to earthquake loading. This course gives Earthquake Resistant Features and Design of civil engineering structures.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
3	0	2	4	60	25	15	30	20	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests) **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Earthquake-Resistant Building Configuration: Lateral load resisting systems- Moment Resisting Frame, Building with Shear Wall, Building with Dual System; Building Configuration – Problems and Solutions; Building Characteristics – Mode Shape and Fundamental Period, Building Frequency and Ground Period, Damping, Ductility, Seismic Weight, Liquefaction, General detailing requirements	07	15%
2	Design forces for Buildings: Equivalent Static Method; Mode Superposition Technique; Time History Analysis; Advantages and disadvantages of these methods; Determination of lateral forces as per IS 1893(Part 1) – Equivalent static method, Model analysis using Response Spectrum	07	20%
3	Ductility considerations in earthquake resistant design of RCC buildings: Impact of ductility and its importance; Evaluation of Ductility, Structural Ductility; Factor influencing ductility; Codal Provision for Ductility : IS13920	07	10%
4	Earthquake resistant Analysis and Design of two-storey RCC building: Determination of lateral forces on an intermediate plane frame using Equivalent Static Method and using Response Spectrum; Analysis of the intermediate frame for various load combinations as per IS1893 (Part 1); Identification of design forces and moments in the members; Design and detailing of typical flexural member, typical column, footing and detailing of a exterior joint as per IS13920.	20	45%

PE - V: Programme Elective - V

5	Base Isolation of Structures: Introduction; Considerations for Seismic Isolation; Basic Elements of Seismic Isolation; Design Principle-Seismic Isolation, Feasibility of Seismic Isolation; Seismic Isolation configurations	04	10%
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Suggested Specification table with Marks (Theory/Practical):

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% Distribution of Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	20	20	20	15	10

Legends: R: Remembrance, U: Understanding; A: Application, N: Analyze, E: Evaluate C: Create and above Levels (**Revised Bloom's Taxonomy**)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of Publication	Publication Edition
01	Earthquake Resistant Design of Structures	Pankaj Agarwal & Manish Shrikhande	PHI 978-8120328921	2011	1 st Edition
02	Seismic design of reinforced concrete and masonry buildings	T. Paulay and M.J.N. Priestley	Wiley 978-8126540549	2013	1st Edition
03	Earthquake Resistant Design of Structures	S. K. Duggal	Oxford 978-0198083528	2013	1 st Edition
04	Structural Dynamics and Introduction to Earthquake Engg.	Chopra A. K.	Prentice Hall	2012	4 th Edition
05	Wind and Earthquake Resistant Buildings	Taranath B. S.	Marcel Dekker 0-8247-5934-6	2004	1 st Edition
06	Dynamics of Structures	Clough R. W. and Penzien J	McGraw Hill	1995	3 rd Edition

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Understand Earthquake Resistant Building Configuration and Calculate Design Forces for Buildings (<i>R, U, A, N – Cognitive Level</i>)	15%
CO-2	Understand and Calculate Design Forces for Buildings (<i>R, U, A, N – Cognitive Level</i>)	15%
CO-3	Understand and Apply Ductility Criteria in Buildings (<i>R, U, A – Cognitive Level</i>)	25%
CO-4	Analyze and Design the Earthquake Resistant Two Storey Buildings (<i>R, U, A, N, C – Cognitive Level</i>)	35%
CO-5	Understand and Apply the Concept of Base Isolation in Analysis Procedures (<i>R, U, A, N – Cognitive Level</i>)	10%

List of Tasks to be Performed by Students:

- Group of Students have to prepare presentation based on topics of subject as well as individually students have to write / solve assignments. Also, student need to execute software based earthquake resistant design of structure as assigned in assignment work.

List of Open Source/learning website:

- <https://nptel.ac.in/courses/105/101/105101004/>
 - Lecture Series on Introduction of Earthquake Engineering by Dr. R. S. Jangid, IIT Bombay.
- <https://nptel.ac.in/courses/105/102/105102016/>
 - Lecture Series on Seismic Analysis of Structures by Dr. T. K. Datta, IIT Delhi.
- <https://nptel.ac.in/courses/105/107/105107204/>
 - Lecture Series on Earthquake Resistant Design of Foundation by Dr. B. K. Maheshwari, IIT Roorkee.
- www.nicee.org
 - National Information Centre for Earthquake Engineering, IIT Kanpur.
- www.eeri.org
 - Earthquake Engineering Research Institute