INSTITUTE	**FACULTY OF TECHNOLOGY**
PROGRAM	**BACHELOR OF TECHNOLOGY (CIVIL ENGINEERING)**
SEMESTER	**6**
COURSE TITLE	**EARTHQUAKE ENGINEERING**
COURSE CODE	**01CI0618**
COURSE CREDITS	**4**

Objective:

1 To Develop an understanding to SDOF and MDOF structural system subjected to vibration
2 To apply the principles of structural dynamics and earthquake-resistant design in RC structures
3 To Understand the ductile detailing of the building using IS: 13920
4 To identify the lateral forces generated in the structure due to earthquake

Course Outcomes: After completion of this course, student will be able to:

1 Apply the concept of seismology, liquefaction, and structural control systems for preparedness against earthquakes.
2 Apply the planning and design requirements for earthquake-resistant features in RCC and Masonry structures, as per relevant IS codes.
3 Calculate the response of Single and Multi-Degree of Freedom systems.
4 Analyze structural frames considering lateral force distribution.

Pre-requisite of course: Applied Differential Equations, Basics of Geology, Structural Analysis

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Engineering Seismology** 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)	3

DR. ANKUR CHANDRAKANT BHOGAYATA
Digitally signed by (Name of HOD)

DR. RAJENDRASINH BAHADURSINH JADEJA
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Contents : Unit	Topics	Contact Hours
2	**Structural Dynamics** Static load v/s Dynamic load (force control and displacement control), Lumped mass model, Simplified single degree of freedom system, mathematical modelling of buildings, natural frequency, Time period resonance v/s increased response, Responses of buildings to different types of vibrations like free and forced, damped and un-damped vibration, Response of the building to earthquake ground motion, Response to multi-degree (maximum three) of freedom systems up to mode shapes, Response Spectrum Method.	14
3	**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 Earthquake Resistant Features of un-reinforced & reinforced masonry Structure, Confined Masonry, Introduction to IS: 1893-2016 (Part I). Seismic Analysis Methods, Seismic Coefficient Method – base shear and its distribution along height	12
4	**Lateral Load Distribution** Rigid diaphragm, Flexible Diaphragm, Center of mass and stiffness, Uniform and Non-Uniform mass distribution, Torsionally couple and uncoupled system, Lateral load distribution in floors with columns or shear walls	8
5	**Ductile Detailing** Concepts of Detailing of various structural components as per IS: 13920 provisions	2
6	**Special Topics** Soil liquefaction, Structural controls system, Structural dampers, base isolation, Seismic strengthening	3
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Experiment-1** Spring Mass Model	2
2	**Experiment-2** Mode shape of 3 storey building	4
3	**Experiment-3** Response of structure with and without shear wall and bracing system	2
4	**Experiment-4** Response of building with re-entrant corner	2
5	**Experiment-5** Behaviour of structure under pounding	2

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
6	**Experiment-6** Liquefaction potential of clayey & sandy soil	2
7	**Tutorial-1** Calculate the response of free undamped and damped vibration.	2
8	**Tutorial-2** Calculate base shear using Seismic coefficient method.	4
9	**Tutorial-3** Calculate base shear using Response Spectrum Method	2
10	**Tutorial-4** Calculate the lateral load in various lateral load resisting element according to its centre of mass and stiffness.	4
11	**Tutorial-5** Prepare the structural drawing of the different elements by considering the provisions of Ductile Detailing.	2
Total Hours		**28**

Textbook :

1 Earthquake Resistant Design of Structures, Shrikhande, Manish., & Agrawal, Pankaj., PHI Publication, New Delhi, 2010

2 Earthquake resistance design of structures, Duggal, S. K., Oxford University Press, New Delhi, 2010

3 Mechanical Vibration, S S Rao, Pearson, New Delhi, 2010

References:

1 Dynamics of Structures: theory and applications to earthquake engineering, Dynamics of Structures: theory and applications to earthquake engineering, Chopra, A. K., Pearson Education, New Delhi, 2012

2 Dynamics of structures, Dynamics of structures, Clough, R. W., & Penzien, Joseph, MacGraw Hill, 2010

3 Structural Dynamics: theory and computation, Structural Dynamics: theory and computation, Mario, Paz., CBS Publishers & Distributors Pvt. Ltd, 2004

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
5.00	20.00	30.00	25.00	10.00	10.00

DR. ANKUR CHANDRAKANT BHOGAYATA
Digitally signed by (Name of HOD)

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Instructional Method:

1 At the start of course, the course delivery pattern, prerequisite of the subject will be discussed
2 Lectures will be taken in class room with the use of multi-media presentations, white board– mix of both
3 Attendance is compulsory in lectures and laboratory which carries a 5% component of the overall evaluation
4 Minimum two internal exams will be conducted and average of two will be considered as a part of continuous evaluation
5 Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval. It carries a weightage of 5%
6 Surprise tests/Quizzes will be conducted which carries 5% component of the overall evaluation
7 The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures

Supplementary Resources:

1 https://www.nicee.org/EQTips.php
2 www.nicee.org
3 www.eeri.org
4 www.gsdma.org
5 www.ndma.gov.in
6 www.nptel.iitm.ac.in/courses

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