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**SECOND SEMESTER 2018-2019**

**Course Handout Part-II**

**Date: 16-01-2021**

In addition to part -I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

**Course No. : CE F428**

**Course Title : Earthquake Resistant Design and Construction**

**Instructor-in-charge : G MUTHUKUMAR (M – 10<sup>TH</sup> HOUR; T, TH – 3<sup>RD</sup> HOUR)**

**Google Meet link: [meet.google.com/cik-iaso-iun](https://meet.google.com/cik-iaso-iun)**

**1 Course Description:** This course covers the fundamentals of dynamics of structures and design aspects of structures subjected to earthquake. Since the code provisions have been revised in the last few years, stronger emphasis will be given to understand the basic premise on which codes were built. Emphasis will also be given on the best construction practices.

**2 (a): Scope of the Course:**

The scope of the course is to know the various aspects in the analysis, design and construction to achieve safe and economical earthquake resistant Reinforced Concrete structures. This course includes, introduction to structural dynamics with strong emphasis on design aspects. The concepts of the earthquake resistant design will be discussed in detail along with the design examples of different structures (framed structures, shear wall-frame, water tank, Chimney etc).

**2(b): Objectives of the course:**

- To understand the basic concepts of earthquake engineering in general and structural dynamics in particular [Module - I]
- To study important methods to solve the equation of dynamic equilibrium [Module - II]
- To study response analysis methods using mode superposition and response spectrum [Module-III]
- To understand various codal provisions for safe and effective design of RC structures for seismic loading [Module-IV]
- To understand the various design steps for columns, beams, beam-column joint [Module-V]
- To understand intricacies and guidelines for overhead tanks, chimneys and shear walls [Module VI]
- To discuss the various structural configurations and its merits & demerits [Module VII]
- To highlight the drawbacks of non-engineered construction [Module VIII]
- To highlight the good detailing practices in RCC structures [Module IX]
- To summarize the building failures and design errors [Module X]



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## 2. Text Book:

T1. Duggal, S K (2013) “Earthquake Resistant Design of Structures” Oxford University Press.

## 3. Reference Books:

R1. Chopra, A.K. (2007) “Dynamics of Structures: Theory and Application to earthquake Engineering” Pearson Education, 3<sup>rd</sup> edition.

R2. Saran, S. (2012), “Analysis and design of foundations and retaining structures subjected to seismic loads” I K Lee Publishers.

R3. Kramer S.L.(1996) “Geotechnical Earthquake Engineering” Pearson Education.

R4. Agarwal, P. and Shrikhande, M. (2006), “Earthquake Resistant Design of Structures” PHI.

R5. IS: 1893(All parts), 4326, 13827, 13828, 13920, 13938 and other relevant BIS and International, codes

## 4. Course Plan

Mod. No.	Learning Objective	Topics to be covered	No. of Lectures	Reference
1	Introduction to Earthquake Engineering & Structural Dynamics	Importance and scope of the course, Causes of earthquake, seismic waves, magnitude and intensity, Free and forced Vibration concepts;	4	T1/Class notes
2	Evaluation of equation of dynamic equilibrium	Numerical techniques for evaluation of dynamic response of system; direct integration techniques using Central Difference Method and Newmark beta method;	3	T1/Class notes
3	Concept of Response spectra	Natural frequencies and mode shapes. Damping Matrices. Mode superposition method; modal combination rules using absolute sum, SRSS and CQC method. Concept of Response spectra, Use of response and design spectra.	5	T1/Class notes
4	Concepts and principle of Earthquake resistant design	Basic principles of Earthquake resistant design; Global overview of earthquake resistant design; Load combination, increase in permissible stress, importance factor, response reduction factor, seismic weight, Codal provisions of IS: 1893- 2016 (Part-1); Equivalent Static Method of Analysis (ESMA); Design eccentricity, moment and shear forces due to torsion. Introduction to performance based design.	5	T1/Class notes
5	Framed structures and Beam-Column joints	Design of beams, columns, beam-column joint as per IS 13920-1916; Strong column and weak beam concept; Concept of ductility	6	T1/Class notes
6	EQ resistant design of special structures	Seismic analysis and design aspects of overhead water tank, chimney; Shear wall- Its structural advantage as earthquake resistant element; Design aspects as per IS codes;	4	T1/Class notes
7	Influence of structural configurations on building performance	Regular and irregular buildings, Codal provisions of IS: 1893-2016 (Part-1) for multi-storeyed buildings. Effect of irregularities on failure of buildings during past earthquakes.	5	T1/Class notes
8	Non-engineered construction	EQ resistant guidelines and provisions for construction of non-engineered earthen, stone masonry, and brick masonry buildings. Quality control in EQ resistant construction.	3	T1/Class notes
9	Introduction to computer softwares	Computer software based analysis & design. Common issues with modeling of the building systems. Structural Analysis and response Analysis.	2	T1/Class notes
10	Building failures and design errors	Case studies of building failures; Common design errors and its subsequent impact.	2	T1/Class notes
		<b>Total</b>	<b>40</b>	



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**5. Evaluation Scheme:**

Component	Duration	Weight	Date & Time	Remarks
Mid Test	90 min	35%		CB
Monthly Assignments/Class quiz		10%	Will be conducted every month	OB
End Semester Project		10%	Start date: Feb 1, 2021; Deadline: April 20 <sup>th</sup> 2021.	OB
Comprehensive Examination	3 hrs.	45%		OB

**6. Mid Semester Grading [Mid Sem. +3 Assignments/Quiz] = [35+10 = 45]**

**7. Chamber Consultation Hour: Saturday 12 Noon -1 PM**

**8. Reading assignments will be given as and when necessary [Students are expected to learn any one standard commercial finite element software in order to carry out end semester project]**

**9. Notices:** Notices will be sent through your BITS mail only.

Instructor-in-charge  
CE F428