SECOND SEMESTER 2015-2016

Course Handout Part-II

Date: 12-01-2016

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**

1 (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. Earthquakes are one of the most destructive forces that nature unleashes on earth. This course includes, introduction to structural dynamics with emphasis on design aspects. Now provisions of BIS codes on earthquake engineering are mandatory for any new construction after June 30, 2007. Earthquake codes and their provisions are to be studied in-depth related to design and construction of buildings, bridge, tanks, chimneys, retaining structures, embankments and dams.

1(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 appreciate various geotechnical design aspects of RCC structures [**Module VII**]
- To discuss the various structural configurations and its merits & demerits [**Module VIII**]
- To highlight the drawbacks of non-engineered construction [**Module IX**]
- To highlight the good detailing practices in RCC structures [**Module X**]

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, 3rd 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
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; Basic principles of Earthquake resistant design; Global overview of earthquake resistant design	5
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
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
4	Concepts and principle of Earthquake resistant design	Load combination, increase in permissible stress, importance factor, response reduction factor, seismic weight, Codal provisions of IS: 1893- 2002 (Part-1); Equivalent Static Method of Analysis (ESMA); Design eccentricity, moment and shear forces due to torsion. Introduction to performance based design.	5
5	Framed structures and Beam-Column joints	Design of beams, columns, beam-column joint as per IS 13920-1993; Strong column and weak beam concept; Concept of ductility	6
6	EQ resistant design of special structures	Seismic analysis and design aspects of over head water tank, chimney; Shear wall- Its structural advantage as earthquake resistant element; Design aspects as per IS codes;	4
7	Geotechnical aspects of building construction	Safe Bearing Capacity from shear criterion and settlement criterion; Seismic design aspects of shallow and deep foundations; Liquefaction of soil;	3
8	Influence of structural configurations on building performance	Regular and irregular buildings, Codal provisions of IS: 1893-2002 (Part-1) for multi-storeyed buildings. Effect of irregularities on failure of buildings during past earthquakes.	5
9	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
10	Importance of Detailing of R.C.C. structures	Causes of failure of RCC structures; Case studies; Good detailing practices	3
		Total	**42**

5. Evaluation Scheme:

Component	Duration	Weight	Date & Time	Remarks
Mid Test	90 min	35%	16/3 2:00 -3:30 PM	CB
Monthly Assignments		10%	Will be announced every month	OB
End Semester Project		10%	Start date: Feb 1, 2016; Deadline: April 20th 2016.	OB
Comprehensive Examination	3 hrs	45%	9/5 FN	OB

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

7. Chamber Consultation Hour: Thursday 5 pm - 6 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