

**(ELECTIVE – B/I)**  
**4/4 B.Tech. SEVENTH SEMESTER**

**CE7T5B**

**EARTHQUAKE RESISTANT DESIGN**

**Credits: 3**

**Lecture: 3 periods/week**

**Internal assessment: 30 marks**

**Tutorial: 1 period /week**

**Semester end examination: 70 marks**

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**Objectives:**

- To estimate the lateral loads and to design the structures for lateral and gravity load combinations.
- To learn earthquake engineering concepts and design philosophies.

**Learning outcomes:**

At the end of course the student will be able to:

- Have knowledge of structural dynamics in view of earthquake problem.
- Understand the earthquake engineering terminology and aseismic planning.
- Apply the IS codal design & detailing provisions in earthquake resistant structures.

**UNIT – I**

**INTRODUCTION TO STRUCTURAL DYNAMICS:**

Theory of vibrations – Lumped mass and continuous mass systems – Single Degree of Freedom (SDOF) Systems – Formulation of equations of motion – Undamped and damped free vibration – Damping – Response to harmonic excitation – Concept of response spectrum.

**UNIT – II**

**MULTI-DEGREE OF FREEDOM (MDOF) SYSTEMS:**

Formulation of equations of motion – Free vibration – Determination of natural frequencies of vibration and mode shapes – Orthogonal properties of normal modes – Mode superposition method of obtaining response.

**UNIT – III**

**EARTHQUAKE ANALYSIS:**

Introduction – Rigid base excitation – Formulation of equations of motion for SDOF and MDOF Systems – Earthquake response analysis of single and multi-storied buildings – Use of response spectra.

**UNIT – IV**

**CODAL DESIGN PROVISIONS:**

Review of the latest Indian seismic code IS:1893 – 2002 (Part-I) provisions for buildings – Earthquake design philosophy – Assumptions – Design by seismic coefficient and response spectrum methods – Displacements and drift requirements – Provisions for torsion.

**UNIT – V**

**EARTHQUAKE ENGINEERING:**

Engineering Seismology – Earthquake phenomenon – Causes and effects of earthquakes – Faults – Structure of earth – Plate Tectonics – Elastic Rebound Theory – Earthquake Terminology – Source, Focus, Epicenter etc - Earthquake size – Magnitude

and intensity of earthquakes – Classification of earthquakes – Seismic waves – Seismic zones – Seismic Zoning Map of India – Seismograms and Accelegrams.

#### **UNIT – VI**

##### **CODAL DETAILING PROVISIONS:**

Review of the latest Indian Seismic codes IS: 4326 and IS: 13920 provisions for ductile detailing of R.C buildings – Beam, column and joints

#### **UNIT – VII**

##### **ASEISMIC PLANNING:**

Plan Configurations – Torsion Irregularities – Re-entrant corners – Non-parallel systems – Diaphragm Discontinuity – Vertical Discontinuities in load path – Irregularity in strength and stiffness – Mass Irregularities – Vertical Geometric Irregularity – Proximity of Adjacent Buildings.

#### **UNIT – VIII**

##### **SHEAR WALLS:**

Types – Design of Shear walls as per IS: 13920 – Detailing of reinforcements.

### **Learning resources**

#### **Text books:**

1. Dynamics of Structures, (2<sup>nd</sup> edition) by Clough and Penzien, McGrawHill, 1993.
2. Earthquake Resistant Design of Structures by Pankaj Agarwal and Manish Shrikhande, Prentice Hall of India, New Delhi, 2008.

#### **Reference books:**

1. Dynamics of Structures, (2<sup>nd</sup> edition) by Chopra, A.K., Pearson Education, Indian Branch, Delhi, 2001.
2. Structural Dynamics, (2<sup>nd</sup> edition) by Mario Paaz. 2004.
3. Basics of Structural Dynamics and Aseismic Design by S.R. Damodarasamy & S. Kavitha, PHI Learning PVT. Ltd., Delhi, 2013.

**IS CODES:** IS: 1893, IS: 4326 and IS: 13920

**Web Reference:** [www.nicee.org](http://www.nicee.org)