GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

EARTHQUAKE RESISTANT DESIGN OF BUILDINGS

(Professional Elective IV)

Course Code: GR20D5019 **L/T/P/C: 3/0/0/3**
I Year II Semester

Prerequisite: Engineering Mechanics, Engineering Geology, Strength of Materials, Structural Analysis, Design of Reinforced Concrete Structures and Design of Steel.

Course Objectives:

1. To impart knowledge on the seismology and behavior of buildings during earthquakes.
2. Geology of the Earth, Movements of Tectonic Plates, and Effects of Earthquakes
3. Dynamic Behavior of simple structural systems
4. Structural dynamics of simple systems subject to harmonic and random earthquake loading
5. To involve the application of scientific and technological principles of planning, analysis, design of buildings according to earthquake design philosophy.

Course Outcome: At the end of the course, the student will be able to

1. To understand the fundamentals of earthquake engineering and seismicity conditions of the country and world.
2. To perform site specific deterministic seismic hazard analysis.
3. To understand the concepts of dynamic equations of motion and perform analysis for dynamic systems in civil engineering applications
4. Capable to correlate information from various engineering and scientific discipline to understand complex behavior of RC structure subjected to seismic forces.
5. Capable to design RC structures in accordance with the provisions of Indian and International Building Codes considering seismic forces

Unit I

Engineering Seismology: Earthquake phenomenon cause of earthquakes, Faults, Platetectonics, Seismic waves, Terms associated with earthquakes Magnitude/Intensity of an earthquake scales, Energy released, Earthquake measuring instruments, Seismoscope, Seismograph, accelerograph, Characteristics of strong ground motions, Seismic zones of India.

Introduction of Functional planning, Continuous load path, Overall form, simplicity andsymmetry, elongated shapes, stiffness and strength. Seismic design requirements, regularand irregular configurations, basic assumptions.

UNIT II

Conceptual Design - Horizontal and Vertical Load Resisting Systems - System and Members for Lateral Loads and High Rise / Tall Structures.Twisting of Buildings – Flexible Building and Rigid Building Systems. Strength and Stiffness – Ductility – Definition – Ductility Relationships – Choice of construction Materials – Unconfined Concrete & Confined Concrete – Masonry, Steel Structures. Design Earthquake Loads – Basic Load Combinations – Permissible Stresses. Seismic Methods of Analysis – Static Method – Equivalent Lateral Force Method. Dynamic Analysis – Response Spectrum Method – Modal Analysis Torsion.

UNIT III

Introduction to Earthquake Resistant Design – Seismic Design Requirements and Methods. RC Buildings – IS Code based Method. - Vertical Irregularities – Mass Irregularity Torsional Irregularity - Plan Configuration Problem - Design Lateral Force, Base Shear Evaluation – Lateral Distribution of Base Shear – Structural Walls Strategies and the Location of Structural Walls – Sectional Shapes – Behaviour of Unreinforced and Reinforced Masonry Walls – Behaviour of Walls Box Action and Bands – Behaviour of infill Walls - Non Structural Elements – Failure Mechanism of Nonstructural Elements – Effects of Nonstructural Elements on Structural System – Analysis – Prevention of Damage to Nonstructural Elements – Isolation of Non-Structures.

UNIT IV

Design of Shear walls: Classification according to Behavior, Loads in Shear walls, Design of Rectangular and Flanged Shear walls, Derivation of Formula for Moment of Resistance of Rectangular Shear walls – Coupled Shear Walls. Introduction to non-linear static Oush Over Analysis.

UNIT V

Ductility Considerations in Earthquake Resistant Design of RC Buildings: Introduction-Impact of Ductility- Requirements for Ductility- Assessment of Ductility- Factors affecting Ductility- Ductile detailing considerations as per IS 13920.Behavior of beams, columns and joints in RC buildings during earthquakes-Vulnerability of open ground storey and short columns during earthquake- Seismic Evaluation and Retrofitting.

Capacity Based Design: Introduction to Capacity Design, Capacity Design for Beams and

Columns -Case studies.

REFERENCES:

1. Earthquake Resistant Design of structures – S. K. Duggal, Oxford University Press
2. Earthquake Resistant Design of structures – Pankaj Agarwal and Manish Shrikhande, Prentice Hall of India Pvt. Ltd.
3. Seismic Design of Reinforced Concrete and Masonry Building – T. Paulay and M.J.N. Priestly, John Wiley & Sons
4. Masory and Timber structures including earthquake Resistant Design –Anand S.Arya, Nemchand& Bros
5. Earthquake –Resistant Design of Masonry Building –MihaTomazevic, Imperial college Press.
6. Design of Reinforced Concrete Structures by N.Subramanian, Oxford University Press.
7. Earthquake Tips – Learning Earthquake Design and Construction C.V.R. Murty

Reference Codes:

1. IS: 1893 (Part-1) -2002. "Criteria for Earthquake Resistant – Design of structures."B.I.S., New Delhi.
2. IS:4326-1993, "Earthquake Resistant Design and Construction of Building", Code of Practice B.I.S., New Delhi.
3. IS:13920-1993, "Ductile detailing of concrete structures subjected to seismic force" – Guidelines, B.I.S., New Delhi.