

**Course Name:**  
Geotechnical Earthquake Engineering

**Course Number:**  
20440

**Credit:**  
3

**Course Content (outline):**

**1. Introduction to Geotechnical Earthquake Engineering**

- 1.1 Introduction
- 1.2 Background
- 1.3 Seismic Hazards
- 1.4 Mitigation of Seismic Hazards
- 1.5 Significant Historical Earthquakes

**2. Seismology and Earthquakes**

- 2.1 Introduction
- 2.2 Internal Structure of the Earth
- 2.3 Continental Drift and Plate Tectonics
- 2.4 Faults
- 2.5 Elastic Rebound Theory
- 2.6 Other Sources of Seismic Activity
- 2.7 Geometric Notation
- 2.8 Location of Earthquakes
- 2.9 Size of Earthquake

**3. Strong Ground Motion**

- 3.1 Introduction
- 3.2 Strong-Motion Measurement
- 3.3 Ground Motion Parameters
- 3.4 Estimation of Ground Motion Parameters
- 3.5 Spatial Variability of Ground Motions

**4. Seismic Hazard Analysis**

- 4.1 Introduction

4.2 Identification and Evaluation of Earthquake Sources

4.3 Deterministic Seismic Hazard Analysis

4.4 Probabilistic Seismic Hazard Analysis

## **5. Wave Propagation**

5.1 Introduction

5.2 Waves in Unbounded Media

5.3 Waves in a Semi-infinite Body

5.4. Waves in a Layered body

5.5. Attenuation of Stress Waves

## **6. Dynamic Soil Properties**

6.1 Introduction

6.2 Representation of Stress Conditions by the Mohr Circle

6.3 Measurement of Dynamic Soil Properties

6.4 Stress-Strain Behavior of Cyclically Loaded Soils

6.5 Strength of Cyclically Loaded Soils

## **7. Ground Response Analysis**

7.1 Introduction

7.2 One-Dimensional Ground Response Analysis

7.3 Two-Dimensional Ground Response Analysis

7.4 Three-Dimensional Ground Response Analysis

7.5 Soil-Structure Interaction

## **8. Local Site Effects and Design Ground Motions**

8.1 Introduction

8.2 Effects of Local Site Conditions on Ground Motion

8.3 Design Parameters

8.4 Development of Design Parameters

8.5 Development of Ground Motion Time Histories

## **9. Liquefaction**

- 9.1 Introduction
- 9.2 Liquefaction-Related Phenomena
- 9.3 Evaluation of Liquefaction Hazards
- 9.4 Liquefaction Susceptibility
- 9.5 Initiation of Liquefaction
- 9.6 Effects of Liquefaction

## **10. Seismic Slope Stability**

- 10.1 Introduction
- 10.2 Types of Earthquake-Induced Landslides
- 10.3 Earthquake-Induced Landslide Activity
- 10.4 Evaluation of Slope Stability
- 10.5 Static Slope Stability Analysis
- 10.6 Seismic Slope Stability Analysis

## **11. Seismic Design of Retaining Walls**

- 11.1 Introduction
- 11.2 Types of Retaining Walls
- 11.3 Types of Retaining Wall Failures
- 11.4 Static Pressures on Retaining Walls
- 11.5 Dynamic Response of Retaining Walls
- 11.6 Seismic Pressures on Retaining Walls
- 11.7 Seismic Displacements of Retaining Walls
- 11.8 Seismic Design Considerations

## **12. Soil Improvement for Remediation of Seismic Hazards**

- 12.1 Introduction
- 12.2 Densification Techniques

- 12.3 Reinforcement Techniques
- 12.4 Grouting and Mixing Techniques
- 12.5 Drainage Techniques
- 12.6 Verification of Soil Improvement
- 12.7 Other Considerations

**References:**

Kramer, S. L. (1996) "Geotechnical Earthquake Engineering" Prentice Hall, New Jersey, USA

Ishihara, K. (1985) "Stability of Natural Deposits during Earthquakes" Theme Lecture, Proc. 11th ICSMFE, San Francisco, Vol.2, pp.321-376

Ishihara, K. (1993) "Liquefaction and Flow Failure during Earthquakes" The 33th Rankin Lecture, Geotechnique, Vol. 43, No. 3, 351-415

Many other papers are assigned for further readings