

# GEOTECHNICAL ENGINEERING-I

Course Code: 22CE1113

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**Pre-requisites:** Applied Mechanics, Fluid Mechanics

**Course Outcomes:**

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

**CO1:** Classify soil and their engineering properties (L2)

**CO2:** Explain the importance of permeability, seepage and its effects (L2)

**CO3:** Calculate the stresses in soils under external loads (L2)

**CO4:** Analyse the settlement behavior of soils under compaction and consolidation (L4)

**CO5:** Analyse the failure mechanism under the influence of different loading and drainage Conditions (L4)

**UNIT-I**

**(10 Lectures)**

**INTRODUCTION AND INDEX PROPERTIES OF SOILS:** Soil formation – Soil structure and clay mineralogy – Adsorbed water– Mass- Volume relationships – Relative density. Grain size analysis– Sieve and Hydrometer methods – Consistency limits and indices– IS Classification of soils.

**Learning outcomes:**

At the end of the unit, the student will be able to

1. explain mass- volume relationships and consistency limits and indices of soils (L2)
2. explain the soil structure and clay mineralogy (L2)
3. explain IS classification of soils (L2)

**UNIT-II**

**(10 Lectures)**

**PERMEABILITY & SEEPAGE THROUGH SOILS:**

Soil water – Capillary rise – Flow of water through soils – Darcy's Law- Permeability – Factors affecting permeability, Capillary phenomenon in soils – Laboratory determination of coefficient of permeability – Permeability of layered systems. Total, neutral and effective stresses – Quick sand condition – Seepage through soils –Flow nets: Construction, Characteristics and Uses.

**Learning outcomes:**

At the end of the unit, the student will be able to

1. explain permeability and seepage properties of soils(L2)
2. analyse total, neutral and effective stresses –quick sand condition (L4)
3. explain flow nets and their construction for seepage prediction (L2)

### **UNIT-III**

**(10 Lectures)**

#### **STRESS DISTRIBUTION IN SOILS:**

Boussinesq's and Westergaard's theories for point loads and areas of different shapes – Newmark's influence chart.

#### **Learning outcomes:**

At the end of the unit, the student will be able to

1. discuss about the vertical stress distribution in soils (L2)
2. explain Boussinesq's and Westergaard's theories for different types of loads (L2)
3. explain Newmark's influence chart importance for any shape & any size of external loading on soils (L2)

### **UNIT-IV**

**(10 Lectures)**

#### **COMPACTION:**

Mechanism of compaction – Factors affecting compaction– Effects of compaction on soil properties – Field compaction Equipment –compaction control.

#### **CONSOLIDATION:**

Stress history of clay; Compressibility of soils, Terzaghi's one dimensional consolidation theory, Consolidation test, pre-consolidation pressure,  $e - p$  and  $e - \log p$  curves, total settlement.

#### **Learning outcomes:**

At the end of the unit, the student will be able to

1. describe the importance of compaction as a soil improvement method (L2)
2. explain effects of compaction on soil properties (L2)
3. explain consolidation theory and its practical importance (L2)

### **UNIT-V**

**(10 Lectures)**

#### **SHEAR STRENGTH OF SOILS:**

Mohr – Coulomb failure theories – Types of laboratory strength tests– Strength tests based on drainage conditions – Shear strength of sands – Critical Void Ratio – Liquefaction- shear strength of clays, pore pressure coefficients.

#### **Learning outcomes:**

At the end of the unit, the student will be able to

1. explain the shear strength of soils and its influence (L2)
2. discuss effects of shear strength on soil properties (L2)
3. analyse Mohr – Coulomb failure theories (L4)

**Text Books:**

1. Arora. K.R., “Soil Mechanics and Foundation Engineering”, 5<sup>th</sup> Edition, Standard Publishers and Distributors, 2001.
2. Gopal Ranjan, Rao A.S.R., “Basic and Applied Soil Mechanics”, 2<sup>nd</sup> Edition, New Age Intl. (P) Ltd., 2005.

**References:**

1. Das. B.M., “Principles of Geotechnical Engineering”, 7<sup>th</sup> Edition, Cengage Learning, 2010.
2. Murthy V. N. S., “Textbook of Soil Mechanics and Foundation Engineering”, 1<sup>st</sup> Edition, CBS Publishers, 2018.
3. Venkataramiah. C., “Geotechnical Engineering”, 3<sup>rd</sup> Edition. New Age International Pvt. Ltd, 2008.

**Web References:**

1. <https://nptel.ac.in/courses/105/101/105101201/>
2. <https://nptel.ac.in/courses/105/105/105105168/>