# Soil Mechanics
**BEG352CI**

**Year: III** **Semester: I**

| Teaching Schedule Hours/week | | | Examination Scheme | | | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | Final | | | | Internal Assessments | | |
| | | | Theory | | Practical | | Theory | Practical | |
| L | T | P | Duration | Marks | Duration | Marks | | | |
| 3 | 3 | 2/2 | 3 | 80 | - | - | 20 | 25 | 125 |

**Course Objective:**
The objective of this course is to provide the students concepts and nature of soil with relating to index and engineering properties of soil. It will also provide the knowledge about the slope stability.

**Course Content:**

**1.0 Introduction (2 hrs)**
- 1.1 Importance of soil and soil problems in Civil engineering
- 1.2 Historical development of soil mechanics
- 1.3 General approach of solving soil mechanics problems

**2.0 Physical and Index Properties of Soils (5 hrs)**
- 2.1 Soil as a three –phase material
- 2.2 Index properties of soil
- 2.3 Determination of various index properties

**3.0 Soil Identification and Classification (4 hrs)**
- 3.1 Field identification of soils
- 3.2 Soil Classification: Descriptive, Textural, ISI, MIT and Unified
- 3.3 Practical implications of the soil classification system

**4.0 Soil Compaction (3 hrs)**
- 4.1 Compaction process and compaction theories
- 4.2 Moisture – density relationship and degree of compaction
- 4.3 Laboratory determination of compaction characteristics
- 4.4 Field compaction and compaction control
- 4.5 Effects of compaction on engineering behaviour of soils

**5.0 Soil – Water Interaction (4 hrs)**
- 5.1 Mode of occurrence of water in soils
- 5.2 Surface tension and the capillary phenomenon
- 5.3 Flow of water through the soil mass
- 5.4 Permeability of soils
- 5.5 Determination of the coefficient of permeability: laboratory and field methods
- 5.6 Pumping tests through confined and unconfined aquifers
- 5.7 Effects of water on swelling and shrinkage of soils

**6.0 Principles of Effective Stress (3 hrs)**
- 6.1 Stresses in subsoil
- 6.2 Effective stress principle
- 6.3 Physical interpretation of effective stress equations of the static and flow conditions
- 6.4 Quick sand phenomenon and remedial measures

**7.0 Seepage Analysis (5 hrs)**

7.1 Two dimensional fluid flow
7.2 Conditions for continuity of flow
7.3 Laplace's equation, flow nets and their principles
7.4 Boundary conditions
7.5 Flow nets and their application
7.6 Laplace's equation for an Isotropic soil and its application
7.7 Deflection of flow lines at the interface of two different soils
7.8 Phreatic line in an earth dam
7.9 Design of filter

**8.0 Stress Distribution in Soils (4 hrs)**

8.1 State of stress at a point in the subsoil
8.2 Stress from elastic theories
8.3 Boussinesqu's theory of stress distribution
8.4 Extension of Boussinesq's analysis to uniformly loaded areas
8.5 Use of Newmark's charts and other tables and charts in computing stresses
8.6 Effects of layer systems on stress distribution
8.7 Elastic settlement and contact pressure

**9.0 Shear Strength of Soils (5 hrs)**

9.1 Concept of shear strength
9.2 Principal planes and principal stresses
9.3 Mohr – Coulomb theory of shear strength
9.4 Mohr's stress Circle and failure envelop
9.5 Relation between Principal stresses at failure
9.6 Types of shear tests
9.8 Vane shear test
9.9 Shear strength of sands
9.10 Shear strength of saturated and unsaturated clays

**10.0 Consolidation and Settlement (5 hrs)**

10.1 Behaviour of soil under compressive loads
10.2 Settlement of structures resting on soil: its nature, causes and remedial measures
10.3 The consolidation process and Terzaghi's spring Analogy.
10.4 Primary and secondary consolidation
10.5 Consolidation test
10.6 Compressibility of soil
10.7 Normally consolidated (NC) clays, over consolidated (OC) clays and pre-consolidation pressure
10.8 Determination of field pressure – void curve
10.9 Estimation of consolidation settlement
10.10 Rate and degree of consolidation
10.11 Terzaghi's theory of one dimensional consolidation
10.12 Determination of coefficient of consolidation
10.13 Estimation of rate and magnitude of settlement

**11.0 Stability of Slopes (5 hrs)**

11.1 Causes of slope movements and failures
11.2 Types of slope and slope failures
11.3 Critical surfaces and factors of safety
11.4 Method of stability analysis and stability number
11.5 Stability Analysis of Infinite slopes
11.6 Stability Analysis of finite slopes

11.7 Methods of slices
11.8 Remedial measures for slope stability problems

**Laboratories:**

Seven Laboratory exercises will be performed in this course, in addition to one-day field trip. They are:

(i) Determination of Atterberg limit of soil
(ii) Use of in – situ density core cutter and the method of sand replacement
(iii) Determination of optimum moisture content and maximum dry density
(iv) Unconfined compression test
(v) Direct shear test
(vi) Constant head permeability test
(vii) UU triaxial test

**References:**


- "A Text Book of Soil Mechanics", Dr. Sehgal, S. B. CBS Publishers and Distributors, New Delhi, 1988.
- " Soil Mechanics in Engineering practice" , Terzaghi, K and Peck, R.B. , John Wiley, 2nd Edition, New York, 1967.
- "Soil mechanics and Foundation engineering" Dr. K.R.Arora
- Soil mechanics and Foundation engineering" B.C. Punmia
- "Geotech Engineering" V.N.S. Murthy