

SOIL MECHANICS AND FOUNDATION ENGINEERING

ENCE 258

Lecture : 3
Tutorial : 1
Practical : 2

Year : II
Part : II

Course Objectives:

The objective of this course is to provide students with a thorough understanding of the fundamental properties, principles, and behavior of soil under various loading and environmental conditions. The course aims to equip students with the knowledge and skills to apply these principles to analyze and design different earth structures across diverse soil types.

1 Introduction (2 hours)

- 1.1 Definition of soil and rock
- 1.2 Importance of soil mechanics and soil problems
- 1.3 Historical development
- 1.4 Soil formation and soil types

2 Physical and Index Properties of Soils (6 hours)

- 2.1 Phase diagrams
- 2.2 Basic definition of phase relationship
- 2.3 Volume weight relationships
- 2.4 Water content determination
- 2.5 In-situ unit weight determination
- 2.6 Index properties of soil
- 2.7 Soil grained and soil aggregate properties of soil
- 2.8 Sieve analysis and sedimentation analysis
- 2.9 Relative density and Atterbergs limits

3 Soil Classification and Identification (3 hours)

- 3.1 Field identification of fine and coarse grained soil
- 3.2 Soil classification: Unified soil classification system, IS classification system, MIT, US bureau and international classification system, Textural classification system

4 Soil-Water Integration (4 hours)

- 4.1 Type of soil water
- 4.2 Flow of water through soil mass: Darcy's law
- 4.3 Permeability of soils
- 4.4 Permeability of stratified soil deposits
- 4.5 Determination of coefficient of permeability of soil by laboratory and field methods

5 Soil Compaction (3 hours)

- 5.1 Definition of compaction
- 5.2 Factors affecting compaction
- 5.3 Engineering significance of compaction
- 5.4 Moisture-density relationship and degree of compaction
- 5.5 Zero air void line
- 5.6 Laboratory test
- 5.7 Field compaction and compaction control

6 Principle of Effective Stress (5 hours)

- 6.1 Stress in subsoil
- 6.2 Effective stress principle / physical meaning of effective stress
- 6.3 Computation of effective stress for the static and flow conditions
- 6.4 Capillarity in soils
- 6.5 Quick sand condition and remedial measures
- 6.6 Seepage pressure
- 6.7 Two dimensional flow: Laplace's equation
- 6.8 Flow nets and their application

7 Shear Strength of Soils (5 hours)

- 7.1 Concept of shear strength
- 7.2 Principle planes and principle stresses
- 7.3 Mohr's stress circle and failure envelope
- 7.4 Mohr-coulomb theory of shear strength
- 7.5 Relation between principle stresses at failure
- 7.6 Critical void ratio
- 7.7 Types of shear tests
- 7.8 Measurement of shear strength in laboratory

- 8 Consolidation and Settlement (4 hours)**
- 8.1 Difference between compaction and consolidation
 - 8.2 Tarzaghi's piston spring analogy for primary consolidation
 - 8.3 Consolidation tests
 - 8.4 Pressures-void relationship
 - 8.5 Settlement calculation
 - 8.6 Normally consolidated and over consolidated clay
- 9 Earth Pressure (5 hours)**
- 9.1 Introduction to earth pressure
 - 9.2 Types of earth pressure
 - 9.3 Effect of wall movement on earth pressure
 - 9.4 Earth pressure at rest
 - 9.5 Rankine's earth pressure theory
 - 9.6 Coulomb's earth pressure theory
 - 9.7 Stability analysis on earth retaining structures
- 10 Foundation (3 hours)**
- 10.1 Site investigation for foundation
 - 10.2 Definition, function and types of foundation
 - 10.3 Location and depth of foundation
 - 10.4 Factors affecting types of foundation
 - 10.5 Concept of spread and mat foundation
- 11 Bearing Capacity and Settlement of Shallow Foundations (5 hours)**
- 11.1 Basic definition and their relationship
 - 11.2 Factors affecting bearing capacity
 - 11.3 Types of shear failures
 - 11.4 Tarzaghi's general bearing capacity theory
 - 11.5 Effect of water table on bearing capacity
 - 11.6 Ultimate bearing capacity in cohesive and cohesionless soils
 - 11.7 Foundation settlement
 - 11.8 In-situ test of bearing capacity
- Tutorial (15 hours)**
- 1. Numerical Problems on three phase diagrams of soils
 - 2. Numerical Problems on soil water and permeability of soils.
 - 3. Numerical Problems on soil compaction
 - 4. Numerical Problems on effective stress
 - 5. Numerical Problems on shear strength of soils
 - 6. Numerical Problems on Press void relationship and settlement due to primary consolidation of soils

7. Numerical Problems on earth pressure and stability analysis of retaining structure
8. Numerical problems on bearing capacity of soils

Practical

(30 hours)

1. Water Content by oven drying and pycnometer methods
2. Specific gravity by pycnometer method
3. Field density by core cutter and sand replacement methods
4. Sieve analysis of coarse grained soil
5. Hydrometer analysis of fine grained soil
6. Liquid limit and plastic limit of fine grained soil
7. Coefficient of permeability by constant head and variable head permeameter methods
8. Standard Proctor compaction test
9. Unconfined compression test
10. Direct shear test

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks distribution*
1 and 2	8	16
3,4 and 5	10	16
6	5	8
7	5	8
8	4	8
9	5	8
10 and 11	8	16
Total	45	80

* There may be minor deviation in marks distribution.

References

1. Murthy, V.N.S. (2017). A Textbook of soil Mechanics and Foundation Engineering. UBS Publishers and Distributors.
2. Rao, G.R. (2016). Basic and Applied Soil Mechanics. New Age International.
3. Punmia, B.C. (2005). Soil Mechanics and Foundation Engineering. Laxmi Publications.
4. Arora, K.R. (2020). Soil Mechanics and Foundation Engineering. New Delhi: Standard Book House.