



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Civil and Infrastructure Engineering

Subject Code: 3154007

Semester – V

Subject Name: Geotechnical Engineering

Type of course: Core Subject

Prerequisite: Mechanics of Solids and Fluid mechanics

Rationale:

Geotechnical Engineering is a fundamental subject consisting of determination of various soil parameters theoretically and experimentally based on laws of mechanics and hydraulics. It also deals with the application of strength parameters and stress states in slope stability analysis and earth retaining structures.

The objective of this course is to provide the basic understanding of geotechnical engineering to students. Some of the important topics that students will learn during the course are: grain size distribution; identification and classification of soils for engineering purposes; physical and engineering properties of soils; fundamental behaviour of soils subjected to various forces; groundwater and seepage through soils; compaction; consolidation; shear strength.

Students will get acquainted with several geotechnical problems and documentation of geotechnical observations. Upon successful completion of the course, students should be able to apply the fundamentals of soil mechanics and principles of geotechnical engineering in the analysis, design, and construction of civil engineering projects.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Hours
1	Properties of soil Origin of soil and soil formation, three-phase soil system, particle size and shape, weight volume relationships, index properties of soil, I.S. classification of soil, unified classification of soils, plasticity chart.	10
2	Permeability and Seepage Determination of coefficient of permeability, laboratory method: constant head method, falling head method, permeability of stratified soils, seepage analysis, characteristics of flow nets, graphical method to plot flow nets.	6



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3	Stress distribution and Compaction Boussinesq's and Westergaard's theory and its applications for different loads, Newmark's chart, its preparation and uses. Theory of compaction, laboratory (Proctor test) determination of optimum moisture content and maximum dry density, compaction in the field	6
4	Consolidation of soil Theory of consolidation, initial primary consolidation, spring analogy for primary consolidation test results. Terzaghi's theory of consolidation, consolidation settlement: one-dimensional consolidation.	6
5	Shear strength of soil Mohr's circle, Mohr-coulomb theory, types of shear test: direct shear test, merits and demerits of the direct shear test, tri-axial compression tests, and behavior of soil under different drainage conditions, unconfined compression test, vane shear test.	8
6	Earth pressure theories and Applications Different earth pressures, Rankine's and Coulomb's earth pressure theories, different factors of safety, types of slope failure, various methods to determine slope stability, Introduction of bearing capacity theories.	12

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	30	30	10	10	00

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

Course Outcomes:

At the end of the course students will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Understand various index and engineering properties of soil, its determination through various methodology	30
CO-2	Analyse compaction intensity, shear strength, consolidation, earth pressure, stress distribution	30
CO-3	Perform experiments of a variety of soils to judge the soil parameters	30



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	and its behaviour under various loading conditions	
CO-4	Estimate slope stability for civil engineering applications like railways, highway and earth dams	10

List of Experiments:

- Determination of field Moisture Content and density
- Determination of Specific Gravity
- Grain Size Analysis
- Determination of Consistency Limits
- Density/Relative Density Index
- Permeability Test
- Proctor Test
- Vane Shear Test
- Direct Shear Test
- Unconfined Compression Test
- Consolidation Test

Major Equipment:

- Casagrande's apparatus
- Consolidometer
- Direct shear test
- Direct shear test
- Permeameter
- Proctor mould
- Sieve set and sieve shaker
- Unconfined compression strength apparatus

Open-Ended Problems: Each group of students has to undertake one open-ended problem using sub-soil profile of their local city. Few examples of the same are given below: 1. Development of spreadsheets/computer programmes for the determination of shear parameters using the Mohr's circle. 2. Powerpoint presentation on any one of the above topic supported with one field application/case study.

List of Open Source Software/learning website:

<https://nptel.ac.in/courses/105/103/105103097/>

<https://nptel.ac.in/courses/105105168/>

<https://nptel.ac.in/courses/105101084/>

<https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-361-advanced-soil-mechanics-fall-2004/lecture-notes/>