GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3130606
Semester – III
Subject Name: Geotechnical Engineering

Type of course: Core

Prerequisite: Knowledge of Basic Sciences, Strength of Materials, Basic Geology, Fluid Mechanics

Rationale:
Geotechnical engineering is very fundamental subject to study for determination of various soil parameters theoretically and experimentally based on laws of mechanics. Any civil engineering structure needs strong and stable foundation which depends on proper understanding of soil properties and its behavior, determination of stresses and settlements in soil etc. The thorough understanding and implications of geotechnical engineering will play a vital role in strong and economic design of any foundation system for any infrastructural projects. Knowledge of the geotechnical engineering will prepare students to enter into mutli-disciplinary folds of this subject into various other civil engineering schemes.

Teaching and Examination Scheme:

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

Content:

Sr. No.	Content	Total Hrs
1	**Type of Soils, Index Properties, Inter-relationships and Soil Characterization** Types of soil and soil formation, Geological cycle, Phase diagrams, Basic terms, Functional relationships based on index properties, Physical characterization of soil-Dry and Wet sieve analysis, Atterberg's Indices, Soil Structures, Soil Water and its types, Standard nomenclature & IS Soil Classification, Numericals. Problems/Numericals/Codes/Lab and Field Tests.	**10**
2	**Permeability and Seepage:** Darcy's law and its validity, Factors affecting permeability, Laboratory permeability tests, Permeability of stratified soil masses, Seepage pressure, Quick condition, Flow nets.	**05**
3	**Compaction & Consolidation of soil:** Definitions, Differentiate between compaction and consolidation, Compaction mechanism and proctor tests, field compactions methods, factors affecting compaction, Consolidation mechanism through spring analogy, fundamental definitions, Terzaghi's one dimensional consolidation theory (only formula), Time factor, pre-consolidation pressure, consolidation	**09**

	settlement, Numericals. Tests will be covered in lab sessions.	
4	**Stress Distribution:** Causes of stresses in soil, Boussinesque's and Westergard's equation, Pressure Bulb, Stress distribution on horizontal and vertical planes, Stresses due to different shapes of footings, New-mark's influence chart, Numericals.	**05**
5	**Shear Strength of Soil :** Mohr's strength theory, Mohr- coulomb's strength theory, Modified Mohr coulomb's theory, shears parameters through lab and field tests based on drainage conditions, Numericals. Tests will be covered in lab sessions.	**08**
6	**Earth Pressure & Stability of Slopes:** Types of lateral earth pressure, Rankine's and Coulomb's earth pressure, Rebhann's/Culmann's Graphical methods, Infinite and finite slopes, Factor of safety, Type of slope failure, Limit equilibrium method, C-analysis-method of slices, Taylor's stability number, Numericals.	**09**
7	**Introduction to Foundations and Bearing Capacity:** Shallow Foundations; Types, Basic terms, SBC computation using IS and Terzaghi methods. Deep Foundations; Pile and Pile capacity, Numericals.	**10**

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
5	**15**	**25**	**15**	**5**	**5**

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

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. B.C. Punamia; Soil Mechanics & Foundation Engineering; Laxmi Pub. Pvt. Ltd., New Delhi
2. Alamsingh; Soil Mechanics & Foundation Engineering; CBS Publishers & Distributors, Delhi
3. Das Braja M; Principles of Geotechnical Engineering; Thomson Asia Pvt. Ltd.
4. Gopal Ranjan, Rao A.S.R.; Basic and applied soil mechanics; New age int. (p) ltd
5. Arora K.R.; Soil Mechanics & Foundation Engineering; Standard Pub., Delhi
6. Taylor D.W.; Fundamentals of Soil Mechanics; Asia Publishing House, Mumbai
7. Bowles, J.E., "Foundation Analysis and Design, 5th Edition, McGraw Hill, New York, 1995.
8. Relevant IS Codes

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Course Outcomes: Students will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Classify the soil and will be able to understand its behaviour and will be able to compute/estimate index parameters.	25
CO-2	Interpret soil behaviour through learning soil compaction, consolidation, and analyise various theories and calculate parameters needed in design.	20
CO-3	Compute earth pressure, stress distributions and FOS for slopes using various graphical and analytical tools for various engineering projects/site.	25
CO-4	Differentiate, compare, formulate, and evaluate soil parameters through performing various tests as per site conditions or project needs ethically and professionally.	15
CO-5	Suggest suitable type of foundation as per soil type, estimate bearing capacity and demonstrate its socio-economic feasibility.	15

List of Experiments:

- In-situ Density Tests
- Sieve analysis
- Atterberg's Limit Test
- Permeability Tests
- Proctor Compaction Test
- Consolidation /Oedometer test
- Direct Box Shear Test
- Unconfined Compression Test
- Triaxial Compression Tests
- Laboratory Vane Shear Test
- SPT
- CBR Test

Major Equipment: Triaxial Compression Test-setup, Standard Penetration Test -setup

Design based Problems (DP)/Open Ended Problem:

Apart from above tutorials/experiments a group of students has to undertake one open ended problem/design problem. Few examples of the same are given below:

List of Open Source Software/learning website:

http://nptel.ac.in/

http://ocw.mit.edu/courses/civil-and-environmental-engineering/