



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Civil Engineering

Subject Code: BE04006021

Subject Name: Geotechnical Engineering

w. e. f. Academic Year:	2024-25
Semester:	4
Category of the Course:	Professional Core Course

Prerequisite:	Knowledge of Basic Sciences, Strength of Materials, Basic Geology
Rationale:	Geotechnical engineering provides the essential analysis 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 behaviour, 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 multi-disciplinary folds of this subject into various other civil engineering schemes

Course Outcomes:

Sr. No.	CO statement	Marks% weightage
CO-1	Classify and identify the soil and will be able to understand its behaviour and compute /estimate index parameters	25
CO-2	Interpret soil behaviour through learning soil compaction, consolidation, and analyse various theories and calculate parameters needed in design.	20
CO-3	Compute stress distribution, shear strength, earth pressure, 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

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits	Assessment Pattern and Marks					Total Marks
L	T	P	PBL*	Total no of hours per semester		Theory		Tutorial / Practical			
						ESE (E)	PA / CA (M)	PA/ CA (I)	TW/S L (I)	ESE (V)	
45	0	30	45	120	4	70	30	20	30	50	200



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* Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.

Content:

Sr. No.	Content	Total Hrs
1	Introduction: Need and scope of Geotechnical Engineering, role and application of geology, geological cycle. Types of soils, Index Properties, Inter-relationships and Soil Characterization: Types of soil and soil formation, 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/Codes/Lab and Field Tests.	8
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	4
3	Compaction & Consolidation of soil: Definitions and difference 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 settlement, Numerical. Tests will be covered in lab sessions.	8
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 shape of footings, New-mark's influence chart, Numericals.	4
5	Shear Strength of Soil: Mohr- coulomb's strength theory, Modified Mohr-Coulomb's theory, shears parameters through lab and field tests based on drainage conditions Numerical, Tests will be covered in lab sessions.	6
6.	Earth Pressure & Stability of Slopes: Types of lateral earth pressure, Rankine's and Coulomb's earth pressure, Rehmann's / Culmann's Graphical methods, Infinite and finite slopes, Factor of safety, Type of slope failure, Friction circle and Swedish circle methods-Taylor's stability number, Numericals.	9



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7.	Introduction to Soil Exploration, Types of Foundation and Bearing Capacity: Objectives and methods of explorations – Sampling. Shallow and Deep Foundations; Types, Basic terms, SBC computation using IS and Terzaghi methods. Pile and Pile capacity, Numericals.	6
TOTAL		45

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	15	20	15	05	05

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:

Sr. No.	Title	Author/s	Publication
1	Soil Mechanics and Foundation Engineering (Geotechnical Engineering)	Dr. K. R.Arora	Standard Publishers Distributors, New Delhi
2	Soil Mechanics and Foundation Engineering	B. C. Punmia	Laxmi Publications, New Delhi
3	Basic and Applied Soil Mechanics	Gopal Ranjan, Rao A.S.R	New age int.(p) Ltd
4	Soil Mechanics and Foundation Engineering	Alam singh	CBS Publishers & Distributors, New Delhi
5	Principles of Geotechnical Engineering	Das Braja M	Thomson Asia Pvt. Ltd.
6	Foundation Analysis and Design	Bowles, J.E.	5th Edition, McGraw Hill, New York, 1995
7	Relevant IS Codes		



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List of Experiments:

1. In-situ Density Tests
2. Sieve analysis
3. Atterberg's Limit Test
4. Permeability Tests
5. Proctor Compaction Test
6. Consolidation /Oedometer test
7. Direct Box Shear Test
8. Unconfined Compression Test
9. Triaxial Compression Tests
10. Laboratory Vane Shear Test
11. Standard Penetration Test

Major Equipment/Software:

1. Sieve shaker,
2. Proctor compaction test apparatus,
3. Consolidation test apparatus,
4. Box shear test apparatus

List of Open Source Software/learning website:

1. <http://nptel.ac.in/>

• List of suggested activities for Problem Based Learning:

Sr.No	Name of the activity	No. of hours	Evaluation Criteria
1.	Technical video-based learning on usefulness of Structural Geology for Dams, Tunnels, Roads, Bridge foundations etc.	Duration of video = 5h Report preparation = 5h Total = 10h	Report /presentation based on the video learning outcomes.
2.	Industry visit – visit of foundation site of residential / industrial civil engineering projects.	Visit = 5h Report preparation = 5h Total = 10h	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
3.	Technical Video based learning related to topics of the geotechnical engineering- soil classification, compaction, consolidation, earth pressure etc.	Duration of video = 5h Report preparation = 5h Total = 10h	Report /presentation based on the video learning outcomes.
4.	Assignment writing. Numerical based	6 assignments of 2h	Based on the assignment



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	assignment related to topics of the geotechnical course.	each. Total = 12h	submitted.
5.	Self-learning on-line courses related to geotechnical field testing for civil engineering projects.	Minimum duration of the course should be 10h.	Examination based assessment at the end of course. Based on the certificate produced.
6.	Videos on safety aspects of workers working for different types of foundation at every stage	Duration of video = 5h Report preparation = 5h Total = 10h	Based on quiz/report submitted
7.	Poster/chart/power point presentation on topics related to advanced geotechnical techniques and tools	Duration = 6 h	Based on poster/chart preparation and presentation skills
8.	Group Discussion on emerging/trending technical topics related to geotechnical techniques and tools	Duration = 02 h each	Based on performance in group discussion, technical depth, knowledge etc.
9.	Real world case studies-based learning for state-of-the-art/new technology in geotechnical engineering	Duration of data collection / study = 5h Report preparation = 5h Total = 10h	Based on in-depth study, technical depth, data collected, fact finding, etc.

Note:

1. All the suggested activity should be related to the subject.
2. The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
3. Minimum 03 activities shall be covered per subject.
4. Rubrics for the evaluation can be prepared by the faculty.
