



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3150615
Semester - V
Subject Name: Soil Mechanics

Type of course: Program Elective

Prerequisite: Knowledge of Basic Geotechnical Engineering, Strength of Materials (MOS), Basic Geology

Rationale:

Soil Mechanics is fundamental subject consisting of determination of various soil properties based on soil investigation as per need and type of project in conjunction with building byelaws and construction practices. Thorough understanding of *Soil Mechanics* will help an engineer to decide the most optimum design based on rigorous analysis for any infrastructural projects. Further knowledge will act as a key to enter into multi-disciplinary folds of this subject into various other civil engineering schemes. The course/elective on *Soil Mechanics* provides the students in-depth knowledge of soil parameters and its determination, use of parameters in design and analysis, various numerical/analytical approaches using software, through IS codes and construction practices.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Slope Stability: Infinite and finite slopes, factor of safety, type of slope failure, stability of infinite slopes, finite slopes forms of slip surfaces, limit equilibrium method and critical stage instability analysis, effects of tension crack and submergence, C-analysis-method of slices, Taylor's stability no., use of Bishop's method.	08
2	Stress Distribution of Soils: Causes of stress in soil, geostatic stress, Boussinesque's equation, stress distribution diagrams, Newmark's influence chart, Westergaard's equation, contact pressure, stresses due to triangular and other loadings.	05
3	Subsurface Investigation: Objectives of exploration, planning of exploration program, soil samples and soil samplers, field penetration tests: SPT, SCPT, DCPT., Introduction to geophysical methods, Bore log and report writing. Tests will be covered in lab sessions.	06
4	Shear Strength: Stress-Strain relationship in soil – Failure criteria – Mohr - Coulomb's failure theory – Shear parameters under different drainage conditions – Pore pressure	06



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	parameters, – Analytical predictions of pore water pressure – stress dilatancy theory – results of plain strain shear tests – Forces on shear parameters – Stress path and its applications – Rheological models. Tests will be covered in lab sessions.	
5	Bearing Capacity of Shallow Foundation : Introduction, significant depth, design criteria, modes of shear failures. Detail study of bearing capacity theories (Prandtl, Rankine, Terzaghi, Skempton), bearing capacity determination using IS Code, Presumptive bearing capacity. Settlement, components of settlement & its estimation, permissible settlement, Proportioning of footing for equal settlement, allowable bearing pressure. Bearing capacity by use of penetration test data and by plate load test. Bearing capacity of raft. Factors affecting bearing capacity including Water-Table. Contact pressure under rigid and flexible footings. Floating foundation. Types of pavements & its design. Tests will be covered in lab sessions.	07
6	Pile foundations : Introduction, load transfer mechanism, types of piles according to their composition, their method of installation and their load carrying characteristics, piles subjected to vertical loads- pile load carrying capacity from static formula, dynamic formulae (ENR and Hiley), penetration test data & Pile load test. Pile group: carrying capacity, efficiency and settlement. Negative skin friction. Underreamed pile foundation- its concept, design & field installation.	07
7	Introduction to Geosynthetics : Definition, types of geosynthetics, properties of geosynthetics and various foundation/poor soil/civil engg applications.	03

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
05	10	25	20	05	05

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.



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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
9. V. N. S. Murthy; Soil Mechanics & Foundation Engineering; CRS Press, Taylor & Francis Group, New York

Course Outcomes: Students will be able to

Sr. No.	CO statement	Marks % weightage
	Students will be able to,	
CO-1	Classify the soil, understand its behavior and will be able to compute/estimate index parameters.	25
CO-2	Interpret soil behavior due to compaction, consolidation, and analyze 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, Settlements and demonstrate its socio-economic feasibility.	15

List of Experiments:

1. Auger boring/sampling
2. Standard/dynamic cone penetration test
3. Static cone penetration test
4. In situ permeability test
5. Free swell and swell potential
6. Swelling pressure test
7. Model pile load test.
8. Planning site investigations for a real life problem- project mode tests.SPT

List of Open Source Software/learning website:

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

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