GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING
SOIL MECHANICS
SUBJECT CODE: 2150609
B.E. 5thSEMESTER

Type of course:Core

Pre-requisites: Geotechniques & Applied Geology (GTAG) and Strength of Materials and Fluid Mechanics

Rationale: Soil Mechanics is very fundamental subject consisting of 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 behaviour, determination and interpretation of soil parameters, determination of stresses in soil. The design of any foundation system is based on understanding of soil parameters and its implication based on through interaction with type of structure. The course on *Soil Mechanics* provides the students basic knowledge on soil properties, testing procedures, suitability of test and analytical solutions necessary for design and behaviour of soil.

Content:

Sr. No.	Topics	Total hours	Module Weightage
1	**Compaction:** Definition, Theory of compaction, Factors affecting compaction, Laboratory compaction tests, Effect of compaction on soil properties, Placement water content, Placement layer thickness, Field control of compaction, Proctor's needle, Methods of compaction used in field.	06	10
2	**Shear Strength of Soil :** Mohr's strength theory, Mohr- coulomb's strength theory, Modified Mohrcoulomb's theory, Shear parameters tests: Direct shear test, Unconfined compression test, lab. Vane shear test, Triaxial compression test, Shear tests based on drainage conditions.	07	20
3	**Consolidation of Soils :** **C**ompressibility of soils, Definitions and mechanism of consolidation, Spring analogy, Void ratio and effective stress relation, Related indices, Assumptions of Terzaghi's one dimensional consolidation theory, Time factor, One dimensional consolidation tests, Laboratory and theoretical time curves, Determination of pre-consolidation pressure, Estimation of consolidation settlement and rate of settlement for uniform pressure increment in a clay layer.	07	15
4	**Stability of Slopes:**	06	15

	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., Bishop's method.		
5	**Earth Pressure:** Types of lateral earth pressure, Rankine's and Coulomb's earth pressure, Theory and their application for determination of lateral earth pressure under different conditions,Rebhann's and Culmann's Graphical methods of determination of lateral earth pressures.	07	20
6	**Stress Distribution of Soils:** Causes of stress in soil, geostatic stress,Boussinesque's equation, stress distribution diagrams, New-mark's influence chart Westergard's equation, contact pressure, stresses due to triangular and circular, strip and rectangular loadings.	07	15
7	**Basics of foundation:** Types of foundation, Factors affecting the selection of type of foundations, steps in choosing types of foundation.	02	05

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**20**	**20**	**25**	**15**	**0**

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) P. Purushothama Raj; Soil Mechanics and Foundation Engineering; Pearson
2) Education.
3) B.C. Punamia; Soil Mechanics & Foundation Engineering; Laxmi Pub. Pvt. Ltd.,
4) Delhi.
5) Alamsingh; Soil Mechanics & Foundation Engineering; CBS Publishers &
6) Distributors, Delhi
7) Taylor D.W.; Fundamentals of Soil Mechanics; Asia Publishing House, Mumbai
8) V. N. S. Murthy; Soil Mechanics & Foundation Engineering; Sai Kripa Technical
9) Consultants, Banglore
10) Gopal Ranjan, Rao A.S.R.; Basic and applied soil mechanics; New age int. (p) ltd.
11) Arora K.R.; Soil Mechanics & Foundation Engineering; Standard Pub., Delhi
12) Das Braja M; Principles of Geotechnical Engineering; Thomson Asia Pvt. Ltd.

Course Outcome:

After learning the course the students should be able to:

1. This course will provide good understanding of various index (preliminary) and engineering properties of soil, its determination through various methodology and application for design of shallow and deep foundation systems for various civil engineering structures.
2. The course covers various topics like compaction, shear strength, consolidation, earth pressure, stress distribution which gives insight to students to analyise soil parameters based on application and need of project site.
3. The course will also develop understanding about soil testing procedures, experimentation techniques and related issues. Simulation of mechanics on soil as a material to understand its behaviour before failure and estimating its permissible values.
4. The course also discusses details of foundations, its selection procedures as per soil conditions and various modifications available for various degrees of loads.

List of Experiments/Tutorials:

1. Proctor Compaction Test
2. CBR Test
3. Consolidation /Oedometer test
4. Direct Shear Test
5. Unconfined Compression Test
6. Demonstration of Triaxial test
7. Auger boring/sampling
8. Free swill and swell potential

Open Ended Problems:

Apart from above tutorials/experiments a 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 spread sheets/computer programmes for the determination of shear parameters using Mohr circle.
2. Power point presentation on any one of the above topic supported with one field application/case study.

List of Open Source Software/learning website:
http://nptel.ac.in/
http://ocw.mit.edu/courses/civil-and-environmental-engineering/

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the

students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.