

**B.E. Semester: V**  
**Department of Civil Engineering**  
**Subject Name: Geotechnical Engineering – I (CV505-N)**  
**Course Category: Program Course Core (PCC)**

**A. Objectives of the Course:**

- To understand the soil behaviours before and after application of loads
- To be able to design various foundations
- To be aware of various reinforced techniques to enhance soil bearing Capacity of poor soils
- To study and identify different types natural materials like rocks & minerals and soil
- To know about ‘shear strength’ of soil, describe the direct shear test method and interpret direct shear test results
- To understand the various natural dynamic processes their influence on the surface features, natural material and their consequences
- To know the physical properties of rocks & minerals

**B. Teaching & Evaluation Scheme:**

Teaching Scheme				Credit	Evaluation Scheme					Total Marks
L	T	P	Total		Theory		IE	CIA	Pra/Viva	
hrs	hrs	hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	
3	0	2	5	4	3	70	30	20	30	150

**C. Detailed Syllabus:**

**1. Introduction:**

Definition, Brief history, Scope and limitations of Geo techniques

**2. Geological Origin and Nature of Soil:**

Branches and Scope Of Geology; Surface Processes and Landforms: Weathering and Erosion; Introduction to Geological Agents (River, Wind, Oceans, Glaciers, Groundwater) and their Actions (Erosion, Transport and Deposition), Land Slide and Mass Movement: Introduction, Types, Mitigation and Preservation of Landslide

and Mass Movement, General Characteristics of Different Types of Soils, Overview of Different Types of Soils In Gujarat / India

**3. Index Properties, Relationships and Tests:**

Phase Diagram, Basic Terms and Definitions, Functional Relationships, Determination of Index Properties, Relative Density for Granular Soil

**4. Particle Size Analysis:**

Size and Nomenclature of Soil Particles as per IS Sieve Analysis, Sedimentation Analysis, Particle Size Distribution Curve and its Uses

**5. Soil Structure:**

Shape of The Particles, Texture and Structure of the Soil, Types of The Structure, Properties, Conditions for The Formation of Different Structures

**6. Soil Consistency:**

Consistency Limits and its Determination, Different Indices, Field Moisture Equivalent, Activity, Sensitivity & Thixotropy of soil

**7. Soil Classification:**

Objectives, Basis, Textural, Unified Soil Classification, IS Classification Method, Group Index, Field Identification and General Characteristics of the Soil

**8. Soil Water:**

Free Water and Held Water, Structural Water and Absorbed Water, Capillary

**9. Permeability and Seepage:**

Darcy's Law and Its Validity, Factors Affecting Permeability, Laboratory Permeability Tests, Introduction to Field Permeability Test, Permeability of Stratified Soil Masses, Laplace Equation (2-D), Seepage Pressure, Quick Condition

**10. 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

**11. Shear Strength:**

Mohr Circle and its Characteristics, Principal Planes, Relation between Major and Minor Principal Stresses, Mohr-Coulomb Theory, Types of Shear Tests: Direct Shear Test, Merits of Direct Shear Test, Tri Axial Compression Tests, Test Behaviour of UU, CU And CD Tests, Pore-Pressure Measurement, Computation of Effective Shear Strength Parameters. Unconfined Compression Test, Vane Shear Test

**D. Lesson Planning:**

Unit No	Title of the Unit	Minimum Hours	Weightage (%)
1	Introduction	02	03
2	Geological Origin and Nature of Soil	05	06
3	Index Properties, Relationships and Tests	05	10
4	Particle Size Analysis	04	10
5	Soil Structure	03	07
6	Soil Consistency	03	07
7	Soil Classification	03	07
8	Soil Water	03	07
9	Permeability and Seepage	07	14
10	Compaction	05	14
11	Shear Strength	05	15
<b>Total:</b>		<b>45</b>	<b>100</b>

**E. List of Practical/Assignments:**

Unit No	Title of the Unit
1	Fundamental of Geology
2	Sieve Analysis
3	Moisture Content
4	Liquid Limit Test
5	Plastic Limit Test
6	Proctor Compaction Test
7	In site Density by Sand Replacement method
8	In site Density by Core Cutter Method

9	Permeability Test: Constant Head
10	Permeability Test: Variable Head
11	Box Shear Test

**F. Instructional method and pedagogy (Continuous Internal Assessment Scheme CIA):**

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed
- Lecture may be conducted with the aid of multi-media projector, black board, OHP etc
- Attendance is compulsory in lectures and practical which carries marks
- At regular intervals assignments will be given. Students should submit all assignments during given period
- Classroom participation and involvement in solving the problems in tutorial rooms Carries marks
- Internal exam of 30 marks will be conducted as a part of mid semester evaluation.
- Experiments shall be performed in the field related to course contents.
- The course includes a practical, where students have an opportunity to build an appreciation for the concept being taught in lectures

**G. Students Learning Outcomes:**

On the successful completion of this course

- The students will gain an experience in the implementation of Geotechnical Engineering on engineering concepts which are applied in field Geotechnical Engineering.
- The students will get a diverse knowledge of geotechnical engineering practices applied to real life problems of designing of structures.
- The students will learn to understand the theoretical and practical aspects of geotechnical engineering along with the design and management applications.
- The students will get the basic knowledge about natural material like rocks and minerals and their usage as well as their availability.
- The students will get acquainted with natural dynamic processes and their actions.

- The students will understand the influence of natural processes and geological factors on civil structures and help them to take decision while planning, design and execution stage of the structures in their professional life.
- The students will know the significance of geological investigations for civil engineering projects and site selection as well as for the preparation of feasibility reports and others.

## **H. Recommended Study Materials:**

### **a. Text book & Reference Books:**

1. Arora K. R., Soil Mechanics & Foundation Engineering, Standard Publications
2. Punamia B. C., Soil Mechanics & Foundations, Laxmi Publications
3. Murthy V. N. S., Soil Mechanics & Foundation Engineering, Dhanpat Rai, Engineering
4. Alamsingh; Soil Mechanics & Foundation Engineering; CBS Publishers & Distributors, Delhi
5. Gopal Ranjan & Rao A. S. R., Basic & Applied Soil Mechanics, New Age International Publishers
6. Das Braja M; Principles of Geotechnical Engineering; Thomson Asia Pvt. Ltd.
7. F. G. Bell, Engineering Geology Second Edition, Elsevier Ltd, 2007
8. Parbin Singh, Engineering and General Geology, S. K. Kataria & Sons 2010
9. Shroff A. V., Shah D. L., "Soil Mechanics & Geotechnical Engineering", Oxford-IBH New Delhi

### **b. Indian Standards:**

1. IS 2720-1 1983, Methods of test for soils, Part 1: Preparation of dry soil samples for various tests
2. IS 2720-2 1973, Methods of test for soils, Part 2: Determination of water content
3. S 2720-3-1 1980 Methods of test for soils, Part 3: Determination of specific gravity, Section 1: Fine grained soils
4. IS 2720-3-2 1980 Methods of test for soils, Part 3: Determination of specific gravity, Section 2: Fine, medium and coarse grained soils
5. IS 2720-4 1985, Methods of test for soils, Part 4: Grain size analysis
6. IS 2720-5 1985 Methods of test for soils, Part 5: Determination of liquid and plastic limit

7. IS 2720-6 1972 Methods of test for soils, Part 6: Determination of shrinkage factors
8. IS 2720-7 1980 Methods of test for soils, Part 7: Determination of water content-dry density relation using light compaction
9. IS 2720-8 1983 Methods of test for soils, Part 8: Determination of water content-dry density relation using heavy compaction
10. IS 2720-9 1992 Methods of test for soils, Part 9: Determination of dry density-moisture content relation by constant mass of soil method
11. IS 2720-10 1991 Methods of test for soils, Part 10: Determination of unconfined compressive strength
12. IS 2720-11 1993 Methods of test for soils, Part 11: Determination of the shear strength parameters of a specimen tested in unconsolidated undrained Triaxial compression without the measurement of pore water pressure
13. IS 2720-12 1981 Methods of test for soils, Part 12: Determination of shear strength parameters of soil from consolidated undrained triaxial compression test with measurement of pore water pressure
14. IS 2720-13 1986 Methods of test for soils, Part 13: Direct shear test
15. IS 2720-17 1986 Methods of test for soils, Part 17: Laboratory determination of permeability
16. IS 2720-28 1974 Methods of test for soils, Part 28: Determination of dry density of soils, in-place, by the sand replacement method
17. IS 2720-29 1975 Methods of Test for Soils, Part 29: Determination of Dry Density of Soils In-place by the Core-cutter Method
18. IS 2720-30 1980 Methods of test for soils, Part 30: Laboratory vane shear test
19. IS 11229 1985 shear box for testing of soils
20. IS 11594 1985 mild steel thin walled sampling tubes and sampler heads
21. IS 12287 1988 consolidometer for determination of consolidation properties
22. SP 36-1 1987 Compendium of Indian Standards on Soil Engineering: Part-1 Laboratory Testing of Soils for civil Engineering Purposes
23. SP 36-2 1988 Compendium of Indian Standards on Soil Engineering: Part-2 Field Testing of Soils For Civil Engineering Purposes

**c. Web Materials:**

1. <http://edudel.nic.in>
2. <http://bis.org.in/other/quake.htm>
3. [http://www.vastu-design.com/india\\_homes.htm](http://www.vastu-design.com/india_homes.htm)

4. <http://www.thepeninsulaneighborhood.com/ThePlan.html>
5. [http://www.historytution.com/indus\\_valley\\_civilization/town\\_planning.html](http://www.historytution.com/indus_valley_civilization/town_planning.html)