

## **Geotechnical Engineering - I**

**Course Code : CV52**  
**L:P:T:S : 3:0:0:0**  
**Exam Hours : 03**  
**Hours/Week : 03**

**Credits : 3**  
**CIE Marks : 50**  
**SEE Marks : 50**  
**Total hours : 40**

### **Course Objectives:**

1. To enable the students to acquire the knowledge of basics of soil mechanics
2. To understand the origin of soil, classification, basic terms and properties of soil
3. To design of civil engineering sub structures

### **Course Outcomes: At the end of the course the students will be able to:**

	Course Outcome
CO 1	Identify and classify the soils
CO 2	Determine various index and engineering properties of soil
CO 3	Compute settlements under footings and loaded areas
CO 4	Analyse the soil parameters which are useful in the design of sub-structures
CO 5	Determine the shear strength and consolidation of soil
CO 6	Analyse the compaction properties of soil.

### **Mapping of Course outcomes to Program outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1		2									
CO2	1	1	2									
CO3		2										
CO4		2	3									
CO5				1								
CO6		2										

Unit	Content	Hours	Co's
1	<p>History of soil mechanics, Definition. Phase Diagram, Voids ratio, Porosity, Percentage Air Voids, Air content, Degree of saturation, Water content, Specific Gravity of soil solids and soil mass, Densities and Unit weights - Bulk, Dry, Saturated &amp; Submerged and their inter relationships.</p> <p><b>INDEX PROPERTIES OF SOIL AND THEIR DETERMINATION:</b> Index Properties of soil- Water content , Specific Gravity, Particle size distribution, Relative Density, Consistency limits and indices, in-situ density,</p> <p>Activity of Clay, Laboratory methods of determination of index properties of soil: Water content (Oven Drying method &amp; Rapid Moisture method), Particle size distribution (Sieve analysis), Liquid Limit- (Casagrande and Cone penetration methods), Plastic limit and shrinkage limit. Particle size distribution (hydrometer)</p>	8	CO1 CO2
2	<p><b>CLASSIFICATION OF SOILS:</b> Purpose of soil classification, Particle size classification – MIT classification and IS classification. IS classification - Plasticity chart and its importance, Field identification of soils.</p> <p><b>CLAY MINERALOGY AND SOIL STRUCTURE:</b> Single grained, honey combed, flocculent and dispersed structures, Valence bonds, Soil-Water system, Electrical diffuse double layer, adsorbed water, base-exchange capacity, Isomorphous substitution. Common clay minerals in soil and their structures- Kaolinite, Illite and Montmorillonite</p>	8	CO1 CO3
3	<p><b>FLOW OF WATER THROUGH SOILS:</b> Darcy's law- assumption and validity, coefficient of permeability and its determination (laboratory and field), factors affecting permeability, permeability of stratified soils, Seepage Velocity, and coefficient of percolation, quick sand phenomena, Capillary Phenomena.</p> <p><b>SHEAR STRENGTH OF SOIL:</b> Concept of shear strength, Mohr-coulomb theory, conventional and modified failure envelopes, Effective stress concept of total stress, Concept of pore pressure, Total and effective shear strength parameters, factors affecting shear strength of soils, Sensitivity and Thixotropy of clay.</p>	8	CO3 CO4
4	<p><b>COMPACTION OF SOIL:</b> Definition, Principle of compaction, Standard and Modified proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties, Field compaction control – compactive effort &amp; method, lift thickness and number of passes, Proctor's needle,</p>	8	CO1 CO5

	<b>CONSOLIDATION OF SOIL:</b> Definition, Mass-spring analogy, Terzaghi's one dimensional consolidation theory-assumption and limitations (no derivation), Normally consolidated, under consolidated and over consolidated soils, pre-consolidation pressure and its determination by Casagrande's method. Consolidation characteristics of soil ( $C_c$ , $a_v$ , $m_v$ and $C_v$ ).		
<b>5</b>	<b>DETERMINATION OF SHEAR STRENGTH AND CONSOLIDATION OF SOIL:</b> Measurement of shear parameters- Direct shear test, unconfined compression test and Triaxial compression test , Test under different drainage conditions. Laboratory one dimensional consolidation test, Determination of consolidation characteristics of soils-compression index and coefficient of consolidation (square root of time fitting method, logarithmic time fitting method).	<b>8</b>	<b>CO1 CO6</b>

**NOTE:**

1. Questions for CIE and SEE not to be set from self-study component.
2. Assignment Questions should be from self-study component only.

<b>Self Study Component</b>		
<b>Unit</b>	<b>Contents of the unit</b>	<b>CO's</b>
<b>1</b>	INDEX PROPERTIES OF SOIL AND THEIR DETERMINATION: Origin of soil and formation of soil, Specific gravity of soil solids (Pycnometer and density bottle method)	<b>CO1,CO2</b>
<b>2</b>	CLAY MINERALOGY AND SOIL STRUCTURE: Textural classification	<b>CO1,CO3</b>
<b>3</b>	COMPACTION OF SOIL: Superficial velocity, effective stress and Neutral stress	<b>CO3,CO4</b>
<b>4</b>	COMPACTION OF SOIL: Compacting equipment	<b>CO1,CO5</b>
<b>5</b>	DETERMINATION OF SHEAR STRENGTH AND CONSOLIDATION OF SOIL: Vane shear test	<b>CO1,CO6</b>

**TEXT BOOKS:**

1. Soil Mechanics and Foundation Engg.-Punmia B.C. (2005), Laxmi Publications Co. , New Delhi.
2. Principles of Soil Mechanics and Foundation Engineering- Murthy V.N.S. (1996), 4th Edition, UBS Publishers and Distributors, New Delhi.

## **REFERENCES BOOKS:**

1. Foundation Analysis and Design- Bowles J.E. (1996), 5th Edition, McGraw Hill Pub. Co. New York.
2. Soil Engineering in Theory and Practice- Alam Singh and Chowdhary G.R. (1994), CBS Publishers and Distributors Ltd., New Delhi.
3. Basic and Applied Soil Mechanics- GopalRanjan and Rao A.S.R. (2000), New Age International (P) Ltd., Newe Delhi.
4. Geotechnical Engineering- Donald P Coduto Phi Learning Private Limited, New Delhi
5. Geotechnical Engineering- Shashi K. Gulathi&ManojDatta. (2009), " TataMcGraw Hill.
6. Text Book of Geotechnical Engineering- Iqbal H. Khan (2005),, 2nd Edition, PHI, India.
7. Numerical Problems, Examples and objective questions in Geotechnical Engineering- NarasimhaRao A. V. &Venkatrahmaiah C. (2000), Universities Press., Hyderabad.

## **Assessment Pattern:**

CIE: Continuous Internal Evaluation Pattern for theory: (50 Marks)

Blooms Category	Tests	Assignments	AAT 1	AAT 2
Marks (out of 50)	30	10	05	05
Remembrance	10	2	1	1
Understand	5	2	1	1
Apply	5	2	1	1
Analyze	5	2	1	1
Evaluate	5	2	1	1
Create				

\*AAT 1– Alternate Assessment Tool 1

AAT 2 - Alternate Assessment Tool 2

SEE – Sem End Examination Theory (50 Marks)

Blooms Category	Theory Marks (50)
Remembrance	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	