

# GEOTECHNICAL ENGINEERING

## Programme Structure

Course Code	Course Title	Lecture (L) Hours Per Week	Tutorial (T) Hours Per Week	Practical (P) Hours Per Week	Total Credits
CIV2351	Engineering Geology	3	-	-	3
CIV2451	Geo informatics	3	-	-	3
CIV2551	Geotechnical Engineering-I	3	-	-	3
CIV2651	Geotechnical Engineering-II	3	-	-	3
CIV2751	Project (Geotechnical Engineering)	3	-	-	3
CIV2851	Seminar (Geotechnical Engineering)	3	-	-	3
	<b>TOTAL</b>				<b>18</b>

# GEOTECHNICAL ENGINEERING

## Syllabus

### ENGINEERING GEOLOGY

Course Code: CIV2351

Credit Units: 03

**Course Objective:**

The student is given an introduction to basics of Geology genesis and characteristic of rocks: Geological structure and other effects of civil engineering structures. Geology of India is introduced.

**Course Contents:**

**Module I: Branches and scope of geology**

**Physical geology**

Geological agents and their action, weathering, volcanism, earthquake and plate tectonics

**Module II: Elements of crystallography and mineralogy**

**Petrology**

Types of rocks, genesis and physical and chemical characters, Building stones

**Module III: Structural geology**

Types of structures and classification and their effect on civil engineering projects and Geological mapping

**Hydrogeology**

Groundwater and occurrence, investigations, quality, artificial recharge

**Module IV: Geology in Civil Engineering**

Tunnels, dams, reservoirs, bridges, Runways, Roads and Buildings.

Slope failures and landslides. Investigations, Remote sensing and GIS applications

**Geology of India**

Types, age and occurrence of rock formations and economic importance

**Examination Scheme:**

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

**Text & References:**

- Parbin Singh, Engineering & General Geology, S.K. Kataria & Sons, New Delhi (2008)
- Bangar, K.M., Principles of Engineering Geology, Standard Publishers Distributors, Delhi (2009)
- Billings, Marland P., Structural Geology, 3<sup>rd</sup> ed., Prentice-Hall India, New Delhi.
- Todd, D.K., Ground Water Hydrology, 2<sup>nd</sup> ed., Wiley India, New Delhi (2008)

# GEOINFORMATICS

**Course Code: CIV2451**

**Credit Units: 03**

## **Course Objective:**

Geoinformatics is an important data system for all civil engineering activities including construction of structures, dams, water systems etc. Correct and reliable information and geographical data are a requirement today. The course thus addresses this issue.

## **Course Contents:**

### **Module I**

Triangulation - principle - reconnaissance - selection of site for base line - selection of stations - orders of triangulation - triangulation figures - scaffolds and signals - marking of stations - intervisibility and heights of stations - satellite stations - base line measurement - equipment and corrections - adjustment of observations.

### **Module II**

Survey adjustments and theory of errors – introduction – laws of accidental errors – probability curve – principle of least squares – laws of weights – probable error – normal equation – most probable value – method of correlates – angle adjustment – station adjustment – figure adjustment – adjustment of triangles – adjustment of a geodetic quadrilateral.

### **Module III**

Curves - types of curves - elements of a curve - simple curves - different methods of setting out – introduction to compound curves - reverse curves, transition curves, vertical curves -hydrographic survey - scope - shoreline survey - river survey - soundings – sounding equipment - methods - ranges - locating sounding - plotting - three point problem.

### **Module IV**

Photogrammetry – terrestrial and aerial photogrammetry – heights and distances from Photographs – flight planning – elements of stereoscopy – photo mosaic – photo interpretation – applications of photogrammetry. GNSS – GPS – differential GPS.

## **Examination Scheme:**

<b>Components</b>	<b>A</b>	<b>CT</b>	<b>S/V/Q</b>	<b>HA</b>	<b>EE</b>
<b>Weightage (%)</b>	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

## **Texts & References:**

- S.K Duggal, Sruveying Vol. I and II, 2<sup>nd</sup> ed., Tata McGraw Hill, New Delhi (2004).
- Arora K.R., Surveying Vol. I & II, Standard Book House, New Delhi (2008)
- Punmia B.C., Ashok Kr. Jain, Arun Kr. Jain, Surveying Vol. I &II, Laxmi Pub, New Delhi (2004)

# GEOTECHNICAL ENGINEERING-I

Course Code: CIV2551

Credit Units: 04

## Course Objective:

Soil mechanics and related topics are important areas in Civil Engineering and the first part of Geotechnical Engineering deals with soils and their characteristics.

## Course contents:

### Module I: Nature of soil and functional relationships

Soil type -Concepts of single grained, honey combed and flocculent structure and their effects on the basic soil properties - 3 phase system - void ratio - specific gravity - dry density - porosity - water content - saturated unit weight - submerged unit weight - degree of saturation. Laboratory and field identification of soils: Determination of water content by oven drying -Specific gravity using pycnometer and specific gravity bottle - Grain size analysis by sieve analysis, hydrometer analysis and pipette analysis - Atterberg limits and indices – Visual identification by simple field tests - Field density by core cutter, sand replacement and wax coating methods. Classification of soils: Necessity -Principles of classification - I.S. classification – Plasticity charts - Group index.

### Module II: Soil Water, Permeability and Stress Distribution

Soil water: Types - Effective stress - Total stress - Pore pressure - Pressure diagrams. Permeability: Definition - Darcy's law - Factors affecting permeability – Laboratory determination - Stratified soils: average permeability. Stress distribution: Boussinesq's equations for vertical pressure due to point loads- Assumptions and limitations - pressure bulb – Influence diagram - Vertical pressure due to uniformly distributed loads, line loads and strip loads - Newmark charts and their use - Westergaard's solution.

### Module III: Consolidation and Compaction

Consolidation: Definition - Concepts of coefficient of compressibility - Coefficient of volume change and compression index - e-log p curves - Terzaghi's theory of one dimensional consolidation – Determination of coefficient of consolidation- pre-consolidation pressure difference between consolidation and compaction. Compaction: Definition and objectives of compaction - Proctor test and modified proctor test - Concept of OMC and maximum dry density - Zero air voids line -Factors influencing compaction.- Effect of compaction on soil properties - Field compaction methods - Proctor needle for field control.

### Module IV: Shear Strength and Stability of Slopes

Shear Strength: Definition - Mohr's strength and stress circles - origin of planes - Mohr's envelope - Mohr-Coulomb strength theory -Direct, triaxial and UCC tests - Drainage conditions - Measurement of pore pressure - Vane shear tests -Total and effective stress -strength parameters – Stress path, Liquefaction of sand - Choice of test conditions for field problems. Stability of slopes: Slope failure, base failure and toe failure - Swedish circle method -  $\phi=0$  analysis and  $c=0$  analysis - Friction circle method - Taylor's stability number -Stability charts - Sliding block analysis.

## Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

**Text & References:**

- Terzaghi K. & Peck R.B., Soil Mechanics in Engineering Practice, John Wiley Sons, 1967.
- Alam Singh, Soil Engineering-Theory and Practice, Asia Pub, 1967.
- Punmia B.C., Soil Mechanics and Foundations, Saurabh, 1992.
- Murthy V.N.S., Soil Mechanics and Foundation Engineering, Dhanpat Rai, 1984
- Khan I.H., Text Book of Geotechnical Engineering, Prentice Hall of India

# GEOTECHNICAL ENGINEERING-II

**Course Code: CIV2651**

**Credit Units: 04**

## **Course Objective:**

Advanced topics of soil mechanics and the design of foundations are covered in this course.

## **Course Contents:**

### **Module I: Earth pressure**

Earth pressure at rest. Active and passive earth pressure for cohesionless and cohesive soils. Coulomb's and Rankine's theories. Point of application of earth pressure for cases of with and without surcharge in cohesionless and cohesive soils. Culmann's and Rebhan's graphical construction for active earth pressure. Friction circle method for active earth pressure. Site investigation and soil exploration: Objectives. Planning. Reconnaissance. Depth of exploration. Methods of subsurface exploration. Test pits. Auger borings. Wash boring. Rotary drilling. Percussion drilling. Core drilling. Sampling. Types of soil samples. Splitspoon sampler. Thin walled sampler. Piston sampler. Denison sampler. Hand cut samples. Location of water table. S.P.T. Field vane shear test. Introduction to geophysical methods. Boring log. Soil profile.

### **Module II: Bearing capacity**

Ultimate and allowable bearing capacity. Terzaghi's equation for bearing capacity for continuous circular and square footings. Types of shear failures. Bearing capacity factors and charts. Effect of water table on bearing capacity. Meyerhoff's bearing capacity theory. Skempton's formulae. Bearing capacity from field tests. Bearing capacity from building codes. Net bearing pressure. Methods of improvement of soil bearing capacity: vibro flotation and sand drains.

Settlement analysis: Distribution of contact pressure. Immediate and consolidation settlement. Estimation of initial and final settlement under building loads. Limitations in settlement computation. Causes of . Permissible, total and differential settlements. Cracks and effects of settlement.

### **Module III: Foundations**

General considerations: Functions of foundations. Requisites of satisfactory foundations. Different types of foundations. Definition of shallow and deep foundation. Selection of type of foundation. Advantages and limitations of various types of foundations. Design considerations . Footings subjected to eccentric loading. Conventional procedure for proportioning footings for equal settlements.

Open excavation: Open foundation excavations with unsupported slopes. Supports for shallow and deep excavations. Stress distribution in sheeting and bracing of shallow and deep excavations. Stability of bottom of excavations. Raft foundations: Bearing capacity equations. Design considerations. Conventional design procedure for rigid mat. Uplift pressures. Methods of resisting uplift. Floating foundations.

### **Module IV: Pile foundations**

Uses of piles. Classification of piles based on purpose and material. Determination of type and length of piles. Determination of bearing capacity of axially loaded. Single vertical pile. Static and dynamic formulae. Determination of bearing capacity by penetration tests and pile load tests (IS methods). Negative skin friction. Group action and pile spacing. Analysis of pile groups. Load distribution by Culmann's method. Caissons and piers: Open (well) caissons. Box (floating) caissons. Pneumatic caissons. Construction details and design considerations of well foundations. Drilled piers and their construction details.

**Examination Scheme:**

<b>Components</b>	<b>A</b>	<b>CT</b>	<b>S/V/Q</b>	<b>HA</b>	<b>EE</b>
<b>Weightage (%)</b>	<b>5</b>	<b>10</b>	<b>8</b>	<b>7</b>	<b>70</b>

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

**Text & References:**

- Joseph E. & Bowles, Foundation Analysis & Design, McGraw Hill
- Leonards G.A., Foundation Engineering, McGraw Hill
- Punmia B.C., Soil Mechanics & Foundations, Laxmi, 1988.
- Tomlinson M.J., Foundation Design & Construction, Pitman, 1963.
- Terzaghi & Peck, Soil Mechanics in Engineering Practice, Asia Publishing
- Arora K.R., Soil Mechanics & Foundation Engg., Standard Publications, 1987.
- Murthy V.N.S., Soil Mechanics & Foundations.

## **PROJECT (Geotechnical Engineering)**

**Course Code: CIV2751**

**Credit Units: 03**

### **Methodology**

The topic for the project work can be a design/experimental/field / analytical/simulation project in any topic of Geotechnical Engineering area. The work can be done individually or by a group of students under the guidance of a faculty of the Department. On completion of the project, the students are to present a report covering various aspects learnt by them and give a presentation on same.

### **Examination Scheme:**

Literature study/ Fabrication/ Experimentation	40
Written Report	20
Viva	15
Presentation	25
<b>Total</b>	<b>100</b>



## **SEMINAR (GEOTECHNICAL ENGINEERING)**

**Course Code: CIV2851**

**Credit Units: 03**

**Objectives:**

To enable the students to acquire knowledge for searching compilation and to  
Develop skills for presentation in the form of the seminar

**Contents:**

The seminar comprises the selection of an appropriate research proposal and developing research proposals. The student is required to organize and analyze the data/ information collected and write a complete document and presenting the document in the form of seminar.

**Text Book:**

Relevant technical/ professional material and references in Geotechnical Engineering courses and journals.