Birla Institute of Technology & Science, Pilani
Hyderabad Campus

SECOND SEMESTER 2022-2023

Course Handout Part II

Date: 16-01-2023

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : CE F243
Course Title : Soil Mechanics
Instructor-in-Charge : Prof. Anasua GuhaRay
Instructor : Prof. Anasua GuhaRay
Instructors- Lab Component : Mr. Ankur Abhishek, Ms. Meenu Krishnan

Scopes and Objective of the Course:

This course aims to provide comprehensive scientific insight of soil as construction material, its behavior and its engineering properties under stress. This course explains the most essential aspects of soil as an engineering material and the application of principles derived (from the study of soil under stress), while introducing the experimental aspects in form of laboratory experiments. Concept of soil exploration is briefly covered to introduce this very important aspect of civil engineering in general and soil mechanics in particular.

Learning Objectives: At the end of this course, the students will develop:

1. An ability to classify any type of soil and identify its index and engineering properties.
2. An ability to identify the compaction and consolidation characteristics of soil and apply them in practice.
3. An ability to compute vertical and horizontal stresses on soil and shear strength parameters.
4. An ability to design earth retaining structures and slopes.
5. An ability to apply the knowledge in modern construction practices.

Student Learning Outcomes (SLOs) assessed in this course – **(a), (b), (c),(d), (e), (f), (h), (j),** and **(k).**

Textbooks:
T1. Gopal Ranjan and A. S. R. Rao, “Basic and Applied Soil Mechanics”, New Age International Publishers, 2016.

Reference books
R1.VNS Murthy, “Geotechnical Engineering – Principles and Practices of Soil Mechanics and Foundation Engineering”, Marcel Dekker Incorporation, New York, 2013.
R2. B.M. Das, “Principles of Geotechnical Engineering”, Cenage Learning, 2014.

R3. K R Arora, "Soil Mechanics and Foundation Engineering", Standard Publishers Distributors, 5th Edition, 2000.
R4. R.F. Craig. "Craig's Soil Mechanics", Taylor and Francis Group, 7th Edition, 2004.
R5. BC Punmia, Ashok Kumar Jain and Arun Kumar Jain, "Soil Mechanics and Foundations", Laxmi Publications Pvt. Limited, 16th Edition, 2005.
R6. Indian Standard Codes of Practices

Course Plan:

Lecture No.	Topics to be covered	Learning objectives	Chapter in the Text Book / Reference Book	SLO
1-2	Soil Terminology	● Enumerate the types, formation, and composition of soil ● Identify the regional soil deposits of India	Ch1/T1	(a), (j)
3-4	Index Properties	● Study the phase diagrams, and important relationships among different soil properties ● Compute water content, specific gravity, and index properties of soils ● Analyze grain size distribution, consistency of clay (Atterberg's Limits)	Ch2/T1	(a)
5-7	Classification of Soils	● Study the Unified Soil Classification System, AASHTO Soil Classification System and Indian Standard Soil Classification System ● Identify classification of different types of soil by these systems	Ch3/T1	(a)
8-10	Soil Structure & Clay Minerals	● Study the structure of clay	Ch4/T1	(a)

		minerals		
11-13	Soil Compaction	● Study the theory of compaction ● Study the relevant laboratory tests and factors affecting compaction ● Study the engineering behavior of compacted soils ● Study field compaction and machines used for compaction	Ch5/T1	(a)
14-19	Effective Stress, Capillarity & Permeability	● Study effective stress principle, Capillary rise of water in soils, Permeability of Soil ● Study Darcy's law, constant head & falling head test ● Study the factors affecting permeability, Permeability of Stratified Soils	Ch6/T1	(a)
20-21	Seepage Through Soil	● Study seepage forces, Quick sand condition ● Study construction of flow nets	Ch7/T1	(a), (d)
22-25	Shear Strength of Soil	● Study stress at a point: Mohr Circle of Stresses, Mohr Coulomb Failure Criterion ● Study procedures to measure shear strength by - Direct Shear, Triaxial, UCS, Vane Shear Test	Ch10/T1	(a)
26-28	Vertical Stresses in Soil	● Analyse stresses within the	Ch8/T1	(e)

	due to Applied Load	soil mass by - Boussinesq equations, Newmark's Chart, Approximate stress distribution methods for loaded areas ● Westergaard's equations		
29-32	Consolidation	● Study components of total settlement, compressibility, void ratio- effective stress relationships ● Study mechanics of consolidation, Terzaghi's theory of consolidation, Consolidation tests ● Compute Settlement	Ch9/T1	(a), (e)
33-35	Soil Exploration Techniques	● Study different methods of soil exploration, Methods of boring, Methods of collection of soil samples ● Study field tests: SPT, CPT, DCPT ● Identify suitable tests for different types of soil	Ch19/T1	(a), (e), (h)
36-40	Lateral Earth Pressure	● Study earth pressure at rest, Active and passive earth pressures, Introduction to Rankine's earth pressures ● Analyse earth pressures of cohesionless soil by Rankine's theory	Ch12/T1	(a), (c), (e)
41-42	Stability of Slopes	● Study Infinite and Finite Slopes	Ch11/T1	(a), (c), (e)

		● Analyse stability of infinite slopes in cohesionless soil		

List of Experiments:

Serial No.	Experiments	SLO
	PHASE 1	(b), (f), (k)
1	Determination of Specific Gravity by Density Bottle	
2	Determination of Specific Gravity by Pycnometer	
3	Determination of dry unit weight by core cutter method	
4	Determination of dry unit weight by sand replacement method	
5	Determination of Atterberg Limits: (i) Liquid Limit, (ii) Plastic Limit	
6	Determination of Atterberg Limits: (iii) Shrinkage Limit	
7	Grain Size Analysis by Sieving	
	PHASE 2	
8	Determination of Permeability by Falling Head Method	
9	Proctor's Test for determination of OMC - MDD	
10	CBR for soil subgrade	
11	Determination of Shear Strength by Direct Shear Test	
12	Determination of Shear Strength by Unconfined Compression Test	

***Student Learning Outcomes (SLOs):**

SLOs are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

(a), (b), (c), (d), (e), (f), (h), (j), and **(k).**

Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Mid-semester Examination	90 mins.	30	13/03 11.30 - 1.00PM	Closed Book
Surprise Quiz (minimum 5 nos.)	-	10	Throughout the semester	Open Book
Laboratory Experiments	-	20	Throughout the semester	Open Book
Comprehensive Examination	3 hours	40	08/05 AN	Closed Book

Chamber Consultation Hour: W and Th 10-11 AM, or by prior appointment based on urgency through BITS email only.

Notices: All notices concerning the course will be conveyed through Google Classroom.

1. **Makeup Policy:** Make-up will be granted only on genuine reasons (medical emergencies). For medical cases, a certificate from the concerned physician must be produced.
2. For the skill tests, surprise tests, lab demo sessions and tour case study (if any), make-ups are not possible.

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

INSTRUCTOR-IN-CHARGE
CE F243