Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2023-2024

Course Handout Part II

Date: 11-08-2023

Course No. : **CE F313**

Course Title : **Foundation Engineering**

Instructor-in-charge : **Dr. Raghuram Ammavajjala**

Instructor :

Pre-requisite: Soil Mechanics

Scope and Objectives of the Course:

This course aims to provide an in-depth understanding of different types of foundations for geotechnical infrastructure. Comprehensive geotechnical analysis of foundation systems (spread footing, combined footing, raft foundation, pile foundations, retaining structures, slopes etc.) will be covered in this course. Special emphasis will be given to coverage of relevant codes of practice for various types of foundations and retaining structures.

Course Outcomes: At the completion of this course, students will:

1. Be able to Design RE walls and slopes in various soil conditions.
2. Be capable to estimate the bearing capacities of shallow and pile foundations.
3. Be able to identify various ground improvement techniques for problematic soils.
4. Have the capacity to comprehend machine foundations and earthquake engineering fundamentals.

Student Learning Outcomes (SLOs) assessed in this course – **(a), (e), (f), (j), (k).**

Text Books:

T1. Murthy, V. N. S. "Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering", Marcel Dekker Inc., Special Indian Edition, First Indian Reprint, 2013.

Reference Books:

R1. Gopal Ranjan and A. S. R. Rao, "Basic and Applied Soil Mechanics", New Age International Publishers, 2nd Edition, 2007.

R2. Saran, S. "Soil Dynamics and Machine Foundations", 3rd edition, Galgotia, 2016.

R3. B.M. Das. Principles of Foundation Engineering. Cengage Learning, 7th Edn., 2010.
R4. Gulhati, SK, and Datta, M. "Geotechnical Engineering", Tata McGraw-Hill Publishing Company Ltd, 2005.
R5. Knappett, J., Craig, R.F. Craig's Soil Mechanics, Eighth Edition, CRC Press, 2012.

No. of Lectures	Topics to be Covered	Learning Objectives	Chapter in the Text Book / Reference Book	SLO
1-5	Lateral Earth Pressures	● To learn various Earth Pressure conditions (at Rest, Active and Passive) for cohesionless and cohesive soils ● To study earth pressure for submerged backfill, sloping backfill, backfill with surcharge, layered soil, and tension crack by Rankine's Theory	T1 Ch 11, IS: 1893 (Part 3)	(a), (e)
6-9	Concrete and Mechanically Stabilized Earth Retaining Walls	● To study proportioning of retaining walls: Gravity, Cantilever, Counterfort. ● To understand unreinforced Retaining Walls: External Stability ● To learn Mechanically Stabilized Retaining Walls: External and Internal Stability ● To study different Backfill and Reinforcing Materials (Geosynthetics)	T1 Ch 19	(a), (e), (f)
10-15	Shallow Foundations I: Ultimate Bearing Capacity	● To gain an overview of requirements, location, and depth of the foundation ● To understand the classification of shallow and deep foundations, isolated, strap, and spread footings,	T1 Ch 12, IS: 1904 (1986), IS: 6403 (1981),	(a), (e), (f)

		● To learn different terminology related to foundations ● To understand the concepts of Principal modes of soil failure: general, local, and punching shear failures, ● To design shallow foundations by Terzaghi, Skempton, and Meyerhof's Bearing Capacity Theory by introducing corrections for size, shape, depth, inclination, water table etc. ● To learn bearing capacity theories by Hansen, Vesic, and IS Code ● To study the ultimate bearing capacity of soils based on SPT and CPT tests by empirical relationships ● To gain knowledge on the ultimate bearing capacity of footings resting on stratified deposits of soil		
16-17	Shallow Foundations II: Settlement	● To understand the effect of the settlement on the structure and permissible settlement ● To learn the design of shallow foundations for permissible settlement ● To study bearing capacity and settlement from model and field plate load test	T1 Ch 13, IS: 8009 (Part 2) - 1980	(a), (e)
18-23	Deep Foundations	● To understand types of piles according to composition, and method of installation (driven and bored piles, pre-cast and cast in-situ	T1 Ch 15 Part A and Part B, IS 2911 (Part1) – 2010,	(a), (e), (f)

		piles, under-reamed piles) ● To study vertical load-carrying capacity of the single vertical pile for cohesionless and cohesive soil: Static pile formulae, dynamic pile formulae, and pile load test. ● To learn the concepts of Negative Skin Friction, uplift capacity of pile group ● To gain knowledge on the efficiency of pile groups: Individual pile failure criteria, block failure criteria. ● To study the vertical load-carrying capacity of pile groups	IS 2911 (Part2) – 2010, IS 2911 (Part3) – 2010, IS 2911 (Part4) – 2010	
24-27	Laterally Loaded Vertical Piles	● To study Winkler's Hypothesis ● To understand the behavior of laterally loaded batter piles in sand	T1 Ch 16	(a), (e)
28-29	Pier and Well Foundations	● To learn types of drilled piers, methods of construction ● To study types and components of Well Foundations, Shapes of Well Foundation ● To understand the forces acting on Well Foundation	T1 Ch 17 + R1 Ch 17	(a), (e)
30-33	Slope Stability	● To gain knowledge on stability of Infinite Slopes in Sand and Clay ● To study the Finite Slopes by Method of Slices ● To learn General Limit Equilibrium Method	T1 Ch 10	(a), (e), (k)

34-35	Foundations on Collapsible and Expansive Soils	● To understand the concepts of Swelling Potential, Swelling Pressure, Free Swell, Collapse Potential, Treatment methods for collapsible soils	T1 Ch 18	(a), (e), (f)
36-38	Ground Improvement Techniques	● To learn different ground improvement techniques ● To study Deep Compaction, Sand Drains, Stone Columns, Sand Drains, Prefabricated Vertical Drains, Grouting	T1 Ch 21 + R3 Ch 14	(a), (e), (j)
39-42	Introduction to Machine Foundations	● To learn the concepts of Dynamic Properties of Soil ● To study the Single Degree of Freedom System ● To understand Stiffness and Damping ● To study Types and requirements of Machine Foundations ● To learn the concepts of Liquefaction of soil	R2 Ch 2, Ch 9, Ch 10 IS 2974 (Part 1,2,3,4,5) – 1982, IS1893-part1,2,3,4,5	(a)

***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.

Evaluation Scheme:

Component	Duration	Weightage	Date & Time	Nature of Component
Midsemester Examination	90 mins	30%	12/10 - 11.30 - 1.00PM	Closed Book
Home Assignments (minimum 3 nos.)	-	15%	To be announced in the class	Open Book
Surprise Quiz	-	15%	To be announced in the class	Open Book
Comprehensive Examination	3 hrs	40%	14/12 AN	Closed Book

Chamber Consultation Hour: M to Fr 4-5 PM, or by prior appointment based on urgency through BITS email only.

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

Make-up Policy:
1. Makeup will only be provided for genuine cases with prior permission.
2. For the skill tests, surprise tests, lab demo sessions, and tour case studies (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.

Raghuram Ammavajjala
Instructor-in-charge
CE F313