Birla Institute of Technology & Science, Pilani
Hyderabad Campus

ACADEMIC GRADUATE STUDIES AND RESEARCH DIVISION
FIRST SEMESTER 2023-2024
Course Handout (Part -II)

Date: 12.08.2023

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

Course No. **: CE G620**

Course Title **: Advanced Foundation Engineering**

Instructor-in-charge **: Prof. Anasua GuhaRay**

Instructors **: Prof. Anasua GuhaRay, Mr. Ankur Abhishek**

Course Description:

Types of foundations, bearing capacity and settlement of foundations, foundations on slopes and layered soils, Analysis and design of shallow foundation, Foundation on Reinforced Soil, analysis and design of deep foundations, Earth retaining structures, Introduction to machine foundations, failure in foundations and retrofit measures.

Scope and Objective of the Course:

This course is aimed understand different types of foundation, estimation of bearing capacity of underlying soil, settlement behavior, design of various types of foundation and case studies in foundation. Complete design of foundation systems considering geotechnical as well structural design of foundation systems (spread footing, combined footing, raft foundation, pile foundations, pile cap, caissons, well foundations, machine foundations, basements walls, retaining structures etc.)

Course Outcomes: At the end of this course, the students will develop:

1. An ability to design unreinforced and reinforced retaining walls, sheet pile walls and braced excavations in different soil conditions.
2. An ability to determine bearing capacities of different types of soil based on different theories and design different types of shallow foundations for bearing and settlement.
3. An ability to design different types of deep foundations for bearing and settlement under different types of loading.
4. An ability to design foundations under dynamic loading conditions.

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

Text Book:

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	Varghese, P.C. (2009) "Design of reinforced concrete foundations" Prentice-Hall of India
R2	Tomlinson, M. (1994). Pile design and construction practice. 4th edition, CRC Press.
R3	Prakash, S., & Sharma, H. D. (1990). Pile foundations in engineering practice. John Wiley & Sons.
R4	Relevant IS codes

Course Plan

No. of Lectures	Topics to be Covered	Learning Objectives	Chapter in the Text Book / Reference Book	SLO
1	Types of Foundation	• Introduce foundation engineering • Study different types of foundation • Study requirements of good foundation	Class Notes	(a), (e)
2-5	Concrete and Mechanically Stabilized Earth Retaining Walls	• Study proportioning of retaining walls: Gravity, Cantilever, and Counterfort. • Design Unreinforced Retaining Walls: External Stability • Design Mechanically Stabilized Retaining Walls: External and Internal Stability • Study different Backfill and Reinforcing Materials (Geosynthetics, Geotextiles etc.)	T1 Ch 19	(a), (e), (f)

6-12	Shallow Foundations I: Ultimate Bearing Capacity	• Study the requirements, location, depth of foundation • Study classification of shallow and deep foundations, isolated, strap and spread footings • Study the principal modes of soil failure: general, local and punching shear failures, • Design shallow foundations by Terzaghi, Skempton, Meyerhof, Hansen, Vesic and IS Code Recommendations by introducing corrections for size, shape, depth, inclination, water table etc., eccentric loading • Analyze ultimate bearing capacity of soils based on SPT and CPT tests • Determine ultimate bearing capacity of footings resting on stratified deposits of soil • Determine bearing capacity of foundations on top of an unreinforced and reinforced slope • Design of shallow foundations on reinforced soil	T1 Ch 12, IS: 1904 (1986), IS: 6403 (1981),	(a), (e), (f)
13-16	Shallow Foundations II: Settlement	• Study Contact Pressure Distribution, Elastic, Consolidation and Creep Settlement • Design shallow foundations for permissible settlement • Analyze bearing capacity and settlement from model and field plate load test	T1 Ch 13, IS: 8009 (Part 2) - 1980	(a), (e)
17-19	Shallow Foundations III: Combined Footings, Mat and Raft Foundations	• Design of Combined Footings by Conventional Method • Design of Mat Foundation by Rigid Method • Design of Floating Foundations	T1 Ch 14	(a), (e)

20-25	Deep Foundations	● Study types of piles according to composition, method of installation (driven and bored piles, pre-cast and cast in-situ piles, under-reamed piles) ● Analyze vertical load bearing capacity of single vertical pile for cohesionless and cohesive soil ● Study Static and Dynamic Pile Load Tests ● Study Negative Skin Friction, uplift capacity of pile group	T1 Ch 15 Part A and Part B, IS 2911 (Part1) – 2010, IS 2911 (Part2) – 2010, IS 2911 (Part3) – 2010, IS 2911 (Part4) – 2010	(a), (e), (f)
26-29	Laterally Loaded Vertical and Batter Piles	● Study Winkler's Hypothesis ● Study p-y curves for solution of laterally loaded single piles ● Study Brom's Solution	T1 Ch 16	(a), (e)
30-33	Pier and Well Foundations	● Study types of drilled piers, methods of construction, ● Study types and components of Well Foundations, Shapes of Well Foundation ● Analyze forces acting on Well Foundation ● Design of Well Foundation by IRC Method	T1 Ch 17 + R1 Ch 17	(a), (e)
34-37	Sheet Pile Walls and Braced Excavations	● Design cantilever and anchored sheet pile walls in cohesionless and cohesive soils ● Design braced excavations in cohesionless and cohesive soils	T1 Ch 20	(a), (e)
38-42	Design of Machine Foundations	● Study Dynamic Properties of Soil and their effect on design of Foundation ● Analyse Single Degree of Freedom System ● Design Block and Framed Foundations	Class Notes IS 2974 (Part 1,2,3,4,5) – 1982 IS1893-part1,2,3,4,5	(a), (e), (f)

***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
Mid-semester Examination	90 mins	25%		Closed Book
Project* (Software oriented)	-	40%	Continuous	Open Book
Comprehensive Examination	3 hours	35%	07/12 FN	Closed Book

*Finite element software (Plaxis) and its application to various geotechnical problems will be taught during the practical hours

Chamber Consultation Hour: W and F 10-11 AM, 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. Make-up will be granted only on genuine reasons (medical emergencies). For medical cases, a certificate from the concerned physician of the Medical Centre must be produced.
2. For the skill tests, surprise tests, lab demo sessions and tour case study (if any), make-ups are not possible.
3. It is mandatory to attend all practical sessions. No makeup will be provided for practical sessions without prior permission.

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 G620