



**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani**  
**Pilani Campus**  
**AUGS/ AGSR Division**

**SECOND SEMESTER 2020-21**  
**COURSE HANDOUT**

**Date: 20.01.21**

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 F313  
**Course Title** : Foundation Engineering  
**Instructor-in-Charge** : Ravi Kant Mittal ([ravimittal@pilani.bits-pilani.ac.in](mailto:ravimittal@pilani.bits-pilani.ac.in)) Mb.9887692025  
**Instructor(s)** : -  
**Tutorial/Practical Instructors:** Ravi Kant Mittal

**1. Course Description:** General requirement for satisfactory performance of shallow foundations, general, local and punching shear failures, bearing capacity, settlement, tilt and rotation of foundations, proportioning of Shallow Foundations, footings on layered soils and slopes, Deep foundations, capacity of single and group Piles, laterally loaded pile, Earth Pressure theories, Retaining structures, design and checks for stability, Stability of slopes, Introduction to Ground Improvement Techniques and geosynthetics with applications, Introduction to machine foundations for different type of machines, Introduction to geotechnical earthquake engineering and liquefaction of soils, computer applications in foundation design.

**2. Scope and Objective of the Course:** The main goal of this course is to provide an in-depth understanding regarding different types of foundations. Complete analysis of foundations and retaining structures (Shallow foundations, pile foundations, machine foundations, retaining walls, slope stability etc.) considering all geotechnical aspects is included. Emphasis will be given on complete coverage of code of practices for various types of foundations and retaining structures. Geotechnical earthquake engineering, Ground improvement techniques, reinforced earth walls, geosynthetics applications increased tremendously therefore given due consideration.

**3. Text Books:** TB1. Murthy, V. N. S. (2010) "Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering", CRC Press, Taylor & Francis Group, First Indian Reprint, 2010.

TB2. Das B M and Sivakugan, N. (2019) Principles of Foundation engineering, Cengage Learning, 9<sup>th</sup> edition.

**4. Reference Books:**

R1. Gopal Ranjan, and A. S. R. Rao, "Basic and Applied Soil Mechanics", New Age Int. Publishers, 3rd edition, 2015

R2. Kaniraj, S.R. "Design Aids in Soil Mechanics and Foundation Engineering", Tata McGraw Hill, 1988.

R3. Gulhati, SK, and Datta, M. "Geotechnical Engineering", Tata McGraw-Hill Publishing Company Ltd, 2005.

R4. McCarthy (2014) Essential of Soil Mechanics and Foundations, 7<sup>th</sup> edition, Pearson

R5. Relevant BIS, IRC codes and International code of practice

**5. Course Plan:**

Module	Lecture Session	Lec.	Reference to Ch	Learning Outcome
General requirement for shallow foundations	General principles, concepts, requirement for satisfactory performance of foundations, Types of foundations, selection and their specific applications. Interpretation of geotechnical testing, selecting foundation design parameters from laboratory and field tests	3	Chapter 2, 3 T2, NBC (National Building Code)-2016, IS 1904, R1, R2	Selection and design requirement for shallow foundations
Bearing capacity and allowable bearing pressure of	Failure mechanism, generalized bearing capacity equation, local and punching shear failures, corrections for size, shape, depth, water table, compressibility, Effect of load eccentricity and inclination etc., Selection of shear strength parameters, Bearing	4	6, 7, T2, 12T1, IS6403, IS8009-part1,	Learning to find Bearing capacity of shallow foundations in different cases



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shallow foundation	capacity analysis of footings on layered soils.			
	Different approaches for determination of allowable soil pressure for cohesionless and cohesive soils from lab and field tests (SPT, CPT, etc.).	4	12T1, IS6403, IS8009-part1, R1, R2	Learning procedures to find allowable bearing pressure for shallow foundation
Proportioning of footings	Load combination, Proportioning of isolated footings, strip, rectangular and trapezoidal combined footings, proportioning of footings subjected to combined vertical, moment and horizontal loads	3	14 T1, 8 T2 Class notes	Learning how to proportion shallow foundations
Deep Foundations-bearing capacity and settlement	Types of deep foundations and their applications, selection, general requirements, driven and bored piles, pre-cast and cast in-situ piles, under-reamed piles, pier and well foundations, Indian case histories.	2	15 T1, IS2911	Learning Deep Foundations classification, selection, and their applicability and construction
	Load carrying capacity of piles by different methods, load tests, settlement for single pile and pile group.	5	15 TB, IS2911	Learning different methods to find Piles capacity and settlement
Laterally loaded Pile	Various methods for laterally loaded pile analysis	2	12T2, 16 T1, IS2911,	Learning procedures to analyses laterally loaded Pile
Earth pressures theories	Various theories for computation of earth pressures, Earth Pressure theories, Coulomb and Rankine approaches, smooth and rough walls, inclined backfill, depth of tension crack, lateral pressure due to surcharge loads	3	11 T1, IRC:6, 7-R1	Learning different approaches of earth pressures theories
Earth retaining structures	Classification and selection of different type of retaining walls. Analysis of different types of retaining walls, stability condition, Advantages and applications of reinforced earth walls, Indian case histories,	3	17T2, 19 T1, R5, 8-R1	Selection and analysis of retaining walls,
Dynamic Properties of Soil	Dynamic properties of soil, using laboratory and field tests. Evaluation and interpretation of geotechnical reports, selecting foundation design parameters from laboratory and field tests. Code of practices.	2	R1, R2, R3, IS 5249	Evaluation of dynamic Properties of Soil
Machine foundation.	General requirements and design criteria - Stiffness and damping parameters, Analysis and design of block foundations for reciprocating machines, Limitations of BIS code of practices	3	R2, R3, IS 2974	Analysis and design of foundations for different type of machines.
Geosynthetic s	Introduction to designing with geosynthetics, for various applications such as foundation, GRS wall & slopes, roads, drainage and filtration.	3	17 T2, R3, IRC codes, notes	Learning Geosynthetics applications and benefits



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Ground improvement techniques	Soil stabilization and ground improvement techniques for difficult or problematic ground conditions, anti-liquefaction measures, Dynamic compaction, Vibro techniques, preloading, vertical drains, PVD, stone columns, grouting, micropile etc., Successful case histories.	3	5T2, Ch 15 R4, 21 T1, 16 R1, 29, 30, 31R3, IRC guidelines, IS 13094, IS 15284: Part 1,2, other IS codes and notes	Learning ground improvement techniques principles, advantages, limitations and selection. repair/strengthening measures for foundations
Introduction to geotechnical earthquake engineering	Basics of soil dynamics, seismic design guidelines for foundations and geotechnical structure, liquefaction of soil, screening criterion, evaluation of liquefaction potential.	3	Class notes, IS1893-part1-2016, code of practices, Ch.12 R4,	Learning basic concepts of geotechnical earthquake engineering and liquefaction of soils
Stability of slopes	Stability of slopes, limit equilibrium methods, methods of slices, highway embankments	2	10 T1, IRC-75	Methods of Stability of slopes
	Total	44		

**6. Evaluation Scheme:**

Component	Duration	Weightage (%)	Date & Time	Nature of component (Close Book/ Open Book)
Mid Sem	90 Min.	30	Will be announced by AUGSD	Open Book
Comprehensive Examination	120 Min.	40	Will be announced by AUGSD	Closed Book
Quiz/Assignments		30	Continuous during class and/ or take home	Open Book

**7. Consultation Hour:** To be announced in the class

**8. Notices:** Notices will be sent to your BITS email id only.

**9. Make-up Policy:** Make-up would be granted only for genuine cases with **prior permission**.

**10. Note (if any):** Reading assignments will be given whenever necessary.

**Instructor-in-charge**  
**Course No.**