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**SECOND SEMESTER 2022-2023**

**Course Handout (Part II)**

**Date: 16/01/2023**

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

Course No. : **CE F426**

Course Title : **Geosynthetics and Reinforced Soil Structures**

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

**Course Description, Scope and Objectives:**

The main goal of this course is to provide an in-depth understanding of different ground improvement techniques with geosynthetics and stability analysis of reinforced earth structures. The course provides an insight into the different guidelines of ground improvement suggested by IS Code, IRC and AASHTO. In addition, the course also provides knowledge about other popular ground improvement techniques such as soil nailing, rock bolting by illustration through case studies. Recent trends in ground improvement with the use of waste materials will also be covered in the course.

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

1. An ability to identify different ground improvement techniques for different soil conditions.
2. An ability to design earth structures with geosynthetics with application to retaining walls, slope stabilization and foundations.
3. An ability to design preloading and surcharge, sand drains, pre-fabricated drains, stone columns by different methods.

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

**Text Book**:

T1. Purushothama Raj P. “Ground Improvement Techniques”, Laxmi-Publications, 2nd Edition, 2016.

**Reference Books:**

R1. G.L. Sivakumar Babu, “An Introduction to Soil Reinforcement and Geosynthetics”, Universities Press, 3rd Edition, 2013.

R2. Manfired R. Hausmann, “Engineering Principles of Ground Modification”, McGraw-Hill Pub, Co., 2013

R3. Koerner, R. M., “Designing with geosynthetics”, Prentice Hall Inc. 1998.

R4. Jie Han, “Principles and Practice of Ground Improvement”, John Wiley & Sons, 2015.

R5. G.V. Rao, “Geosynthetics – An Introduction” SAGES – Bangaluru, 2007

**Course Plan**

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| --- | --- | --- | --- | --- |
| **No. of Lectures** | **Topics to be Covered** | **Learning Objectives** | **Chapter in the Text Book / Reference Book** | **SLO** |
| 1-2 | Introduction | * Study the need for ground improvement * Study different types of problematic soils and their origin, Reclaimed Soils * Study the effect of Temperature, Seepage, Erosion, Vibration on Soil * Study major classifications of ground improvement techniques | TB 1 Ch1 | (a), (j) |
| 3-8 | Mechanical Stabilisation | * Study requirements for shallow and deep compaction, Properties of compacted soil and compaction control, Principles and methods of soil compaction * Study about different types of rollers. * Study dynamic compaction, vibro-compaction, vacuum consolidation, blast densification. | TB 1 Ch2 | (a), (k) |
| 9-17 | Ground Improvement by Geosynthetics | * Study types, properties and applications of Geosynthetics * Study filtration, drainage and seepage control with Geosynthetics * Design Earth Structures with geosynthetics with application to retaining walls, slope stabilization and foundations. | TB 1 Ch 8, R1 Ch 10, 19 | (a), (c), (f), (k) |
| 18-21 | Grouting | Study permeation grouting, compaction grouting, jet grouting, different varieties of grout materials, grouting under difficult conditions, different applications of grouting | TB 1 Ch 6 | (a) |
| 22-25 | Modification by Admixtures/ Chemical Stabilisation | Study cement stabilization and cement columns, Lime stabilization and lime columns, Stabilization using bitumen and emulsions | TB 1 Ch 7 | (a) |
| 26-31 | Accelerated Consolidation Methods for Soft Clay Soils | * Study dewatering methods * Design preloading and surcharge, Sand drains, Pre-fabricated drains, Stone columns according to IS code and other methods. * Design ground improvement techniques by consolidation | TB 1 Ch 4 | (a), (c), (f), (k) |
| 32-35 | In-situ Soil Treatment Method | Study and design soil nailing, rock anchoring, micro-piles, rock bolting. | R2 Ch 20 | (c), (f), (k) |
| 36-38 | Ground Improvement using Waste Materials | Study ground improvement using natural fibers, fly ash, GGBS, shredded rubber chips and other waste materials, LDPE and HDPE. | Class Notes | (a) |
| 39-42 | Ground Improvement by Microbial Activities | Study bio-clogging, bio-cementation | Class Notes | (a) |

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

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

1. an ability to apply knowledge of mathematics, science and engineering
2. an ability to design and conduct experiments, as well as to analyze and interpret data
3. 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
4. an ability to function on multidisciplinary teams
5. an ability to identify, formulate, and solve engineering problems
6. an understanding of professional and ethical responsibility
7. an ability to communicate effectively
8. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
9. a recognition of the need for, and an ability to engage in life-long learning
10. a knowledge of contemporary issues
11. 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. | 30 | 18/03 9.30 - 11.00AM | Closed Book |
| Assignments | - | 15 | Throughout the semester | Open Book |
| Project | - | 15 | Throughout the semester | Open Book |
| Comprehensive Examination | 3 hours | 40 | 19/05 FN | Closed Book |

**Chamber Consultation Hour:** W and Th 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.

**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 F426**