GROUND IMPROVEMENT TECHNIQUES
(SYLLABUS)

Course Code	23CE4601A	Year	III	Semester	II
Course Category	Professional Elective-II	Branch	CIVIL	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	-
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks:	100

Course Objectives:

The objective of this course is to:

- To make the student appreciate the need for different ground improvement methods adopted for improving the properties of remolded and in-situ soils by adopting different techniques such as in situ densification and dewatering methods.
- To make the student understand how the reinforced earth technology and soil nailing can obviate the problems posed by the conventional retaining walls.
- To enable the students to know how geotextiles and geo synthetics can be used to improve the engineering performance of soils.
- To make the student learn the concepts, purpose and effects of grouting.

Course Outcomes:

Course will enable the student to:

CO	Statement	BL
CO1	Explain and analyze the need for ground improvement and soil modification techniques for geotechnical engineering applications.	**L3**
CO2	Explain various densification, dewatering techniques and their suitability based on site conditions.	**L3**
CO3	Describe soil stabilization and grouting techniques including use of waste materials.	**L3**
CO4	Apply design principles for reinforced earth walls and assess their stability.	**L3**
CO5	Select and apply geosynthetics and modern improvement methods for sustainable ground engineering practices.	**L3**

Course Articulation Matrix:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	-	2	-	1	1	-	1	2	1
CO2	3	2	2	2	-	2	-	1	1	-	1	2	1
CO3	3	2	2	2	-	2	-	1	1	-	1	2	2
CO4	3	2	2	2	1	2	-	1	1	-	1	2	2
CO5	2	2	2	1	1	2	-	1	1	-	1	2	2

Scale: 3 = Strong, 2 = Moderate, 1 = Low

Syllabus

Unit No	Content	Mapped COs
I	**Introduction and Mechanical Modification--**Typical situations where ground improvement becomes necessary- in situ densification methods- in situ densification of granular soils- vibration at ground surface and at depth, impact at ground and at depth – in situ densification of cohesive soils – pre loading – vertical drains: sand drains and geodrains – stone columns.	**CO1, CO2**
II	**Hydraulic Modification:** Dewatering–sumps and interceptor ditches – single and multi-stage well points–vacuum well points, horizontal wells – criteria for choice of filler material around drains – electro osmosis	**CO1, CO2**
III	**Stabilization of Soil:** Introduction – methods of soil stabilization – mechanical – cement – lime – bitumen and polymer stabilization–use of industrial wastes like fly ash and granulated blast furnace slag. **Grouting:** objectives of grouting – grouts and their applications – methods of grouting – stage of grouting–hydraulic fracturing in soils and rocks –post grout tests. **Liquefaction:** Introduction to liquefaction & its effects & applications.	**CO3, CO4**
IV	**Reinforce earth:** Principles–components of reinforced earth–design principles of reinforced earth walls – stability checks – soil nailing.	**CO4, CO5**
V	**Geosynthetics: G**eotextiles, Geogrids, Geonets, Geomembranes –types– functions, properties and applications –Gabions, Geocomposits	**CO1, CO4, CO5**

Learning Resource(s)

Text Book(s)

1. 'Ground Improvement Techniques' by Purushotham Raj, Laxmi Publications, New Delhi.
2. 'Ground Improvement Techniques' by Nihar Ranjan Patro, Vikas Publishing House(p) limited, New Delhi.
3. 'An introduction to Soil Reinforcement and Geosynthetics' by G.L.Siva Kumar Babu, Universities Press.

Reference Book(s)

1. 'Ground Improvement 'by MP Moseley, Blackie Academic and Professional, USA.
2. 'Designing with Geosynethetics 'by RM Koerner, Prentice Hall

Web Materials:

1. https://archive.nptel.ac.in/courses/105/108/105108075/
2. https://archive.nptel.ac.in/courses/105/105/105105210/

Faculty **HoD-CE**