Course Type	Course Code	Name of the course	L	T	P	Credit
DC	NCEC536	Ground Improvement and Geosynthetics	3	1	0	4

Course Objective
To understand various ground improvement techniques along with principles, design and construction procedures for the construction sites which are not suitable for supporting any physical infrastructure.
Learning Outcomes
After studying this course, students should be able to: • learn about various ground improvement techniques, their design and field implementation along with various case studies where ground failures were resolved using ground improvement techniques and the application of geosynthetics for ground improvement and containment purpose.

Unit No.	Topics to be Covered	Contact Hours	Learning Outcome
1	**Introduction:** Need for ground improvement, Different types of problematic soils, Classification of ground improvement techniques, Emerging trends in ground improvement.	**2L**	Introduction to Engineering Ground Modification.
2	**Mechanical Stabilization:** Shallow and Deep Compaction: Conventional and Intelligent compaction, Deep dynamic and Rapid impact compaction, Vibro compaction, Blasting densification. Deep Replacement: Stone Columns, Vibro concrete columns. Design and Construction Methods.	**6L+2T**	Shallow and Deep Ground Improvement by Mechanical Stabilization methods
3	**Hydraulic Modification:** Drainage and Dewatering System: Dewatering methods, Design of dewatering systems, Prefabricated vertical drains, Vacuum consolidation, Electro-kinetic dewatering, Design and construction methods.	**6L+2T**	Ground Improvement by Hydraulic modification methods
4	**Chemical and Thermal Modification:** Modification by Admixtures: Lime and Cement columns, Admixtures in Pavement design, Stabilization of Industrial Waste. Modification by Grouting: Different Types of grouting, Grouting techniques and control. Thermal Modification: Heat Treatment of Soils, Ground Freezing, Design and construction methods	**6L+2T**	Ground Improvement by Physical and Chemical Modification methods
5	**Modification by Inclusions and Confinement:** Soil nailing: Stabilization using soil nailing, Types, design and construction methods. Anchors: Design and construction methods, Soil Confinement by form work.	**6L+2T**	Ground Improvement by inclusions and confinement Techniques
6	**Geosynthetics: Overview of geosynthetics**: Major application areas, Manufacturing and testing, Properties: Physical, Mechanical, Endurance and Degradation properties. Geosynthetics Types: Geotextile, Geogrid, Geonet, Geomembranes, Geocell and GCL etc. Designing for Functions: Reinforcement, Separation, Filtration and Drainage etc. Designing of Geosynthetics in Transportation Infrastructure and Reinforced Soil Structures: Overburden Mine Slopes reinforced with Geosynthetics, Pavements, Embankments etc. Geosynthetics Reinforcement in waste containment Applications: Liquid contaminant Liners (Design with Geomembranes), Solid Containment (Landfill Covers and Liner system), Design with Geocomposites.	**14L+6T**	Geosynthetics application in various reinforced soil structures.

7	**Emerging and Innovative Topics**: Microbial and Nano-Technology in site remediation, Energy Geotechnology, Recent developments and Case studies of ground improvement projects.	**2L**	Exposure to recent development in Ground Improvement Techniques
	Total Contact hours	**42L+14T**	

Text Books:

1. Hausmann, M.R. (1990). Engineering principles of ground modification, McGraw Hill.
2. Koerner, R.M. (2012). Designing with geosynthetics: Vol. 1 & 2, 6thEdition, Xlibris.
3. Babu, G.L.S. (2005). An introduction to soil reinforcement and geosynthetics, 1st Edition, Universities Press, India**.**

References Books:

1. Han, J. (2015). Principles and practice of ground improvement, 1stEdition, Wiley.
2. Van Impe W.F., Soil improvement techniques and their evolution, Balkema, 1989.
3. Moseley, M.P. and Kirsch K. (1993). Ground improvement, Taylor and Francis.
4. Shukla, S.K. and Yin, J.H. (2006). Fundamentals of geosynthetic engineering, Taylor and Francis, UK.