

GROUND IMPROVEMENT TECHNIQUES

VII Semester: CE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
ACE509	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45		Tutorial Classes: Nil		Practical Classes: Nil			Total Classes: 45	
<p>COURSE OBJECTIVES: The course should enable the students to:</p> <ol style="list-style-type: none"> I. Identify the types of soils and categorize the problematic soils by in-situ laboratory tests. II. Design dewatering systems to prevent significant groundwater seepage into the excavation and to ensure stability of excavation side slopes. III. Modify the ground by different procedures such as admixtures, shotcrete, grouting and ground freezing. IV. Apply different methods of soil reinforcement like soil anchors, rock bolts and soil nails in cohesive and granular soils. <p>COURSE OUTCOMES (COs):</p> <p>CO 1: Describe different types of soils, In situ and laboratory tests to characterize soils.</p> <p>CO 2: Describe various mechanical modification techniques like blasting, vibro compaction, dynamic tamping and compaction piles.</p> <p>CO 3: Describe various dewatering methods, their choice and various hydraulic ground modification techniques.</p> <p>CO 4: Explore the concept of soil modification by physical and chemical methods.</p> <p>CO 5: Explain soil reinforcement technique, reinforcement with strip, in-situ ground reinforcement, ground anchors and soil nailing.</p> <p>COURSE LEARNING OUTCOMES (CLOs):</p> <ol style="list-style-type: none"> 1. Understand the needs and objectives of ground improvement techniques. 2. Identify soil types by performing In Situ and laboratory tests to characterize problematic soils. 3. Analyze Mechanical, hydraulic, physico-chemical methods of ground improvement techniques. 4. Understand Electrical, Thermal methods, and their applications of ground modification. 5. Understand the need for mechanical modification 6. Analyze Deep Compaction techniques 7. Recognize the need for Blasting vibrocompaction 8. Understand the objectives and techniques of hydraulic modification. 9. Identify traditional dewatering methods and their choice 10. Design of dewatering system and understanding electro-osmosis technique 11. Understand Electro kinetic dewatering technique and Filtration technique used in geosynthetics. 12. Analyze drainage and seepage control with geosynthetics. 13. Identify preloading the vertical drains and understand Physical and Chemical Modification of admixtures. 14. Analyze the importance of shotcreting and guniting Technology. 15. Understand modification at depth by grouting, Crack grouting and compaction grouting 16. Understand Jet grouting technique, Thermal modification, Ground freezing. 								

17. Understand modification by inclusions and confinement. 18. Recognize the need for Soil reinforcement and grid reinforced soil. 19. Analyze the importance of In-situ ground reinforcement. 20. Understand ground anchors. Rock bolting and soil nailing.		
UNIT-I	INTRODUCTION TO GROUND MODIFICATION	Classes: 09
Need and objectives, identification of soil types, in situ and laboratory tests to characterize problematic Soils, mechanical, hydraulic, physical, chemical, electrical, thermal methods and their applications.		
UNIT-II	MECHANICAL MODIFICATION	Classes: 09
Deep compaction techniques, blasting, vibro compaction, dynamic tamping and compaction piles.		
UNIT-III	HYDRAULIC MODIFICATION	Classes: 09
Objective and techniques, traditional dewatering methods and their choice, design of dewatering system, electro-osmosis, electro kinetic dewatering. Filtration, drainage and seepage control with geosynthetics, preloading the vertical drains.		
UNIT-IV	PHYSICAL AND CHEMICAL MODIFICATION	Classes: 09
Modification by admixtures, shotcreting and guniting technology, modification at depth by grouting, crack grouting and compaction grouting. Jet grouting, thermal modification, ground freezing.		
UNIT-V	MODIFICATION BY INCLUSIONS AND CONFINEMENT	Classes: 09
Soil reinforcement, reinforcement with strip, and grid reinforced soil. In-situ ground reinforcement, and ground anchors, rock bolting and soil nailing.		
Text Books:		
1. Hausmann, M.R “Engineering principles of Ground Modifications”, Tata McGraw-Hill publications, 1990.		
Reference Books:		
1. Koener, R.M, “Designing with Geosynthetics”, Prentice Hall, New Jersey, 1994. 2. Jones C.J.P, “Earth Reinforcement and soil structures”, Butterworths, London, 1985.		
Web References:		
1. http://nptel.ac.in/courses/105104034/ 2. http://www.myopencourses.com/subject/ground-improvement-techniques-1		
E-Text Books:		
3. http://www.sciencedirect.com/science/book/9780124080768		