

<b>Course Title: Ground Improvement Techniques</b> As per Choice Based Credit System (CBCS) scheme] SEMESTER:VI			
Subject Code	15CV654	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
<b>CREDITS –03</b>		<b>Total Marks- 100</b>	
<b>Course objectives:</b> This course will enable students to 1. Understand the fundamental concepts of ground improvement techniques 2. Apply knowledge of mathematics, Science and Geotechnical Engineering to solve problems in the field of modification of ground required for construction of civil engineering structures. 3. Understand the concepts of chemical compaction, grouting and other miscellaneous methods. 4. Impart the knowledge of geosynthetics, vibration, grouting and Injection.			
Modules		Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
<b>Module -1</b>			
<b>Formation and Development of Ground :</b> Introduction, Formation of Rock, soil and soil profile, Soil distribution in India, Alterations of ground after formation, Reclaimed soils, Natural offshore deposits; Ground Improvement Potential – Hazardous ground conditions, poor ground conditions, favourable ground conditions, Alternative Approaches, Geotechnical processes. <b>Compaction:</b> Introduction, compaction mechanics, Field procedure, surface compaction, Dynamic Compaction, selection of field compaction procedures, compaction quality control.		8 hours	L1, L2 , L3
<b>Module -2</b>			
<b>Drainage Methods:</b> Introduction, Seepage, filter requirements, ground water and seepage control, methods of dewatering systems, Design of dewatering system including pipe line effects of dewatering. Drains, different types of drains. <b>Pre-compression and Vertical Drains:</b> Importance, Vertical drains, Sand drains, Drainage of slopes, Electro kinetic dewatering, Preloading		8 Hours	L1, L2 , L3
<b>Module -3</b>			
<b>Chemical Modification-I:</b> Definition, cement stabilization, sandwich technique, admixtures. Hydration – effect of cement stabilization on permeability, Swelling and shrinkage and strength and deformation characteristics. Criteria for cement stabilization. Stabilization using Fly ash. <b>Chemical Modification-II:</b> Lime stabilization – suitability, process, criteria for lime stabilization. Other chemicals like chlorides, hydroxides, lignin and hydrofluoric acid. Properties of chemical components, reactions and effects. Bitumen, tar or asphalt in stabilization.		8 Hours	L2, L3 , L4
<b>Module -4</b>			
<b>Vibration Methods:</b> Introduction, Vibro compaction – blasting, vibratory probe, Vibro displacement compaction – displacement piles, vibroflotation, sand compaction piles, stone columns, heavy tamping <b>GROUTING AND INJECTION:</b> Introduction, Effect of grouting. Chemicals and materials used. Types of grouting. Grouting procedure, Applications of grouting		8 Hours	L2 , L3, L5
<b>Module -5</b>			
<b>Geosynthetics:</b> Introduction, Geosynthetic types, properties of Geosynthetics – materials and fibre properties, Geometrical aspects, mechanical properties, Hydraulic properties, Durability ; Applications of Geosynthetics - Separation, Filtration and Fluid Transmission, Reinforcement, <b>Miscellaneous Methods (Only Concepts &amp; Uses):</b> Soil reinforcement, Thermal methods, Ground improvement by confinement – Crib walls, Gabions and Mattresses, Anchors, Rock bolts and soil nailing. Stone Column, Micro piles.		8 Hours	L1 , L3, L5
<b>Course Outcomes:</b> After studying this course, students will be able to: 1. Give solutions to solve various problems associated with soil formations having less strength. 2. Use effectively the various methods of ground improvement techniques depending upon the requirements. 3. utilize properly the locally available materials and techniques for ground improvement so that economy in the design of foundations of various civil engineering structures			

**Program Objectives:**

- Engineering knowledge
- Problem analysis
- Interpretation of data

**Question Paper Pattern:**

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

**Text Books:**

1. Purushothama Raj P, "Ground Improvement Techniques", Laxmi Publications, New Delhi.
2. Koerner R.M, "Construction and Geotechnical Method in Foundation Engineering", Mc Graw Hill Pub. Co.

**Reference Books:**

1. Manfred Hausmann , "Engineering principles of ground modification", Mc Graw Hill Pub. Co.,
2. Bell, F.G., "Methods of treatment of unstable ground", Butterworths, London.
3. Nelson J.D. and Miller D.J, "Expansive soils", John Wiley and Sons.
4. Ingles. C.G. and Metcalf J.B , "Soil Stabilization; Principles and Practice", Butterworths