**19CE32E3 – GROUND IMPROVEMENT TECHNIQUES**

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| **Course Category** | Professional Elective | **Credits**  | 3 |
| **Course Type**  | Theory | **Lecture - Tutorial - Practical**  | 3 - 0 - 0 |
| **Prerequisite**  | Foundation Engineering and Water Resources Engineering. | **Sessional Evaluation**  | 40 |
| **Semester End Exam Evaluation**  | 60 |
| **Total Marks**  | 100 |

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| **Course****Objectives** | 1. To explain the emerging trends in ground improvement and factors affecting the selection of ground improvement techniques.
2. To demonstrate the various methods of compaction by mechanical stabilization.
3. To study the various methods of dewatering and To understand the preloading techniques
4. To study the various methods of grouting under difficult conditions.
5. To explain the concept of reinforced earth soil
6. To discuss the various functions and uses of geotextiles. To study the soil confinement systems
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|  **Course** **Outcomes** | CO1 | Outline the problematic soils and suitability of ground improvement techniques  |
| CO2 | Comprehend various mechanical densification methods of soils. |
| CO3 | Understand dewatering methods and Evaluate the preloading technique along with construction of different types of vertical drains for accelerating consolidation. |
| CO4 | Apply the grouting techniques under different conditions.  |
| CO5 | Analyze the design procedure for reinforced earth wall |
| CO6 | Assess the application geotextiles in various fields and understand the soil confinement systems. |
| **Course****Content** | **UNIT – I****INTRODUCTION:** Need for Ground Improvement – Different types of problematic soils – Emerging trends in ground Improvement – classification of ground improvement techniques – factors affecting the selection of ground improvement techniques – Suitability, feasibility and durability of ground improvement techniques**UNIT – II****METHODS OF STABILIZATION:** introduction – requirements of soil stabilization – mechanical stabilization – Portland cement stabilization – Bituminous stabilization – chemical stabilization – construction methods. **UNIT – III****HYDRAULIC MODIFICATION:** Introduction **–** filter requirements – ground water and seepage control – methods of dewatering – open sumps and ditches, wellpoint systems , deep-well drainage, vacuum dewatering systems and dewatering by Electro-osmosis – Design steps for dewatering systems – Drains – open drains and closed drains – general principle, design of vertical drains, types and construction of vertical drains – efficiency of vertical drains and applications. **UNIT – IV****GROUTING AND INJECTION:** Introduction – aspects of grouting – Different varieties of grout materials - grouting procedure – Grouting under difficult conditions.**UNIT – V****REINFORCED EARTH:** Introduction – mechanism of reinforced soil - components – advantages of reinforced earth structures and other applications of soil reinforcement – procedure for the design of reinforced earth wall **UNIT – VI****GEOTEXTILES**: Introduction – advantages of geotextiles – functions of geotextiles – use of geotextiles in earth dam construction, road works, railway works, erosion control and bearing capacity improvement – storage, handling and placement of geotextiles. **SOIL CONFINEMENT SYSTEMS**: Concept of confinement, Gabion walls - function, application, advantage - Crib walls, Sand bags, Evergreen systems and fabric form work |
| **Textbooks****and****References** | **TEXTBOOKS:**1. Dr. P. Purushothama raj, *Ground improvement techniques*, Laxmi Publications, 2nd edition, 2016.
2. Koerner, R. M, *Designing with Geo-synthetics,* Prentice Hall Inc. 1998.
3. G L Sivakumar Babu, *An introduction to soil reinforcement and geosynthetics*, Universities press, 1st edition, 2019.

**REFERENCE BOOKS:**1. Moseley M.P., *Ground Improvement*, 2nd Edition, Blackie Academic and Professional, Boca Taton, Florida, USA, 2007.
2. Xanthakos P.P, Abramson, L.W and Brucwe, D.A., *Ground Control and Improvement*, 5th Edition, John Wiley and Sons, New York, USA 2000.
3. Manfred R. Haussmann, Engineering principles of ground modification, Pearson Education Inc. New Delhi, 2008
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**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO 1** | 1 | - | 1 | 2 | 1 | - | 2 | - | - | - | - | 1 |
| **CO 2** | 1 | 2 | 1 | - | 1 | - | 1 | - | - | - | - | - |
| **CO 3** | 2 | 2 | 2 | 1 | 1 | - | 1 | - | - | - | - | 2 |
| **CO 4** | 2 | - | - | 1 | 2 | - | 1 | - | - | - | - | - |
| **CO 5** | 2 | 2 | 2 | 2 | 1 | - | 1 | - | - | - | - | 1 |
| **CO 6** | 2 | 1 | 1 | 1 | 1 | - | 2 | - | - | - | - | 1 |