**20CE41EC – GROUND IMPROVEMENT TECHNIQUES**

**(Civil Engineering)**

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| **Course Category** | Professional Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0 - 0 |
| **Prerequisite** | Geo Technical Engineering- II | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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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. 2005. 3. G L Sivakumar Babu, *An introduction to soil reinforcement and geosynthetics*, Universities press, 1st edition, 2019.   **REFERENCE BOOKS:**   1. Manfred R. Haussmann, *Engineering principles of ground modification,* Pearson Education Inc. New Delhi, 2008. 2. B.C. Punmia, A. K. Jain & A. K. Jain, *Soil Mechanics and Foundation Engineering*, Laksmi publications, 17th edition, 2017. 3. B. M. Das, *Principles of Geotechnical Engineering*, Cengage learning, 9th edition, 2017. | |

**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** | **PSO1** | **PSO2** | **PSO3** |
| **CO 1** | 1 | - | 1 | 2 | 1 | - | 2 | - | - | - | - | 1 | - | 2 | 2 |
| **CO 2** | 1 | 2 | 1 | - | 1 | - | 1 | - | - | - | - | - | - | 2 | 2 |
| **CO 3** | 2 | 2 | 2 | 1 | 1 | - | 1 | - | - | - | - | 2 | - | 2 | 2 |
| **CO 4** | 2 | - | - | 1 | 2 | - | 1 | - | - | - | - | - | - | 2 | 2 |
| **CO 5** | 2 | 2 | 2 | 2 | 1 | - | 1 | - | - | - | - | 1 | - | 2 | 2 |
| **CO 6** | 2 | 1 | 1 | 1 | 1 | - | 2 | - | - | - | - | 1 | - | 2 | 2 |