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| Image result for nit meghalaya logo | **National Institute of Technology Meghalaya**An Institute of National Importance | **CURRICULUM** |
| Programme | **Bachelor of Technology in Civil Engineering** | Year of Regulation | **2020-2021** |
| Department | **Civil Engineering** | Semester | **V** |
| CourseCode | Course Name | **Pre requisite** | Credit Structure | Marks Distribution |
| L | T | P | C | INT | MID | END | Total |
| **CE 313** | **Ground Improvement Technique** | **Nil** | **3** | **0** | **0** | **3** | **50** | **50** | **100** | **200** |
| CourseObjectives | 1. To introduce different types problematic soils and to familiarize with different ground improvement techniques for improving these soils.
 | Course Outcomes | CO1 | Identify the type of problems in problematic soils and to suggest different ground improvement techniques to solve these problems.  |
| 1. To impart knowledge of mechanical modification techniques such as deep compaction, blasting, vibrocompaction, dynamic tamping and compaction Piles.
 | CO2 | Understand the importance and suitability of shallow and deep compaction techniques like use of different rollers, dynamic tamping, explosion etc. |
| 1. To apply knowledge on ground improvement techniques such as drainage and dewatering and grouting techniques on stabilization of expansive soils.
 | CO3 | Understand traditional dewatering system methods and design of drainage and dewatering systems for various civil engineering problems. Design the preloading and vertical drain systems for consolidations. |
| 1. To give idea on design of dewatering system which is treated as one of the most widely applicable ground improvement techniques.
 | CO4 | Apply the admixtures like cement and lime for treating expansive soil.  |
| 1. To develop the understanding of the students regarding the concept of reinforced earth, geosynthetics and soil reinforcement in ground improvement.
 | CO5 | Understand the importance and suitability of different grouting techniques and grout materials used frequently for underground and foundation constructions.  |
| CO6 | Understand the in-situ soil improvement techniques such as use of ground anchors, rock bolts, micro-piles, soil nails, various geo-synthetic materials etc. and to introduce the design and construction techniques of those in-situ soil improvement techniques. |
| No. | COs | Mapping with Program Outcomes (POs) | Mapping with PSOs |
| PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | CO1 | 2 | 1 | - | 1 | 1 | 2 | - | - | 3 | - | - | 3 | **0** | **2** | **3** |
| 2 | CO2 | 1 | - | 1 | - | 3 | - | - | - | 3 | - | 1 | 1 | **0** | **2** | **3** |
| 3 | CO3 | 3 | 3 | 3 | - | 2 | - | - | - | 1 | - | 2 | 3 | **0** | **3** | **3** |
| 4 | CO4 | 3 | 1 | - | - | 2 | - | - | - | 2 | - | 2 | 1 | **0** | **2** | **3** |
| 5 | CO5 | 2 | 1 | - | - | 3 | - | - | - | 2 | - | 2 | 1 | **0** | **2** | **3** |
| 6 | CO6 | 3 | 2 | 2 | - | 3 | - | - | - | 3 | - | 2 | 3 | **0** | **2** | **3** |
| SYLLABUS |
| No. | Content | Hours | COs |
| I | **Introduction** Need for Ground Improvement, Different types of problematic soils, Emerging trends in ground Improvement.  | **03** | **CO1** |
| II | **Mechanical Stabilization** Shallow and deep compaction requirements, Principles and methods of soil compaction, Shallow compaction and methods. Properties of compacted soil and compaction control, Deep compaction and Vibratory methods, Dynamic compaction. | **07** | **CO2** |
| II | **Hydraulic Modification** Ground Improvement by drainage, Dewatering methods, Design of dewatering systems, Preloading, Vertical drains, Vacuum consolidation, Electro-kinetic dewatering, design and construction methods.  | **07** | **CO3** |
| III | **Modification by Admixtures** Cement stabilization and cement columns, Lime stabilization and lime columns. Stabilization using bitumen and emulsions, Stabilization using industrial wastes, Construction techniques and applications.  | **07** | **CO4** |
| IV | **Grouting** Permeation grouting, compaction grouting, jet grouting, different varieties of grout materials, grouting under difficult conditions.  | **05** | **CO5** |
| V | **In Situ Soil Treatment Methods** Soil nailing and ground anchors, rock anchoring, micro-piles, design methods, construction techniques, Functions and applications of geosynthetics – geotextiles, geogrids, geomembranes; soil reinforcement using strips, bars and geosynthetics.  | **07** | **CO6** |
| Total Hours | **36** |  |
| **Essential Readings** |
| 1. S. K. Gulhati and M. Datta, "Geotechnical Engineering", Tata McGraw Hill.
 |
| 1. H.R. Hausmann, "Principles of Ground Modification", McGraw-Hill Book Company.
 |
| 1. Purushothama Raj. P, “Ground Improvement Techniques”, Firewall Media.
 |
| **Supplementary Readings** |
| 1. M. R. Hausmann, “Engineering Principles of Ground Modification”, McGraw-Hill Pub, Co.
 |
| 1. P. Nicholson, “Soil Improvement and Ground Modification Methods”, Butterworth-Heinemann Ltd.
 |
| 1. R. M. Koerner, “Designing with Geosynthetics”, Prentice Hall Inc.
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