**19CE42E4- ADVANCED FOUNDATION ENGINEERING**

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| **Course Category**  | Professional Elective  | **Credits**  | 3 |
| **Course Type**  | Theory | **Lecture-Tutorial-Practical**  | 3-0-0 |
| **Prerequisite**  | Geotechnical Engineering-II | **Sessional Evaluation**  | 40 |
| **External Evaluation**  | 60 |
| **Total Marks**  | 100 |

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| **Course****Objectives** | 1. To analyze the pressure distribution for bulk heads.
2. To understand the design of anchored bulk heads by various methods.
3. To demonstrate the design of various components of bracing.
4. To analyze the design of mat foundation by conventional method.
5. To study the behavior of laterally loaded vertical and batter piles.
6. To impart foundation techniques on problematic soils
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| **Course Outcomes** | CO1 | Estimate the pressure distribution for bulk heads. |
| CO2 | Design anchored bulk head. |
| CO3 | Design various components of bracing.  |
| CO4 | Design of mat foundations by conventional method. |
| CO5 | Analyze laterally loaded pile and batter piles. |
| CO6 | Outline the design of foundation on problematic soils |
| **Course****Content** | **UNIT – I****BULKHEADS:** Uses of sheet piling walls – Common types of sheet piling walls – Common sheet pile sections – Cantilever sheet piling walls in cohesionless soils – cantilever sheet piling walls in cohesive soils (Approximate analysis only).**UNIT – II****ANCHORED BULKHEADS:** Anchored bulkhead design by free earth support method – Anchored bulkhead design by fixed earth support method – Methods of reducing lateral pressure – Types of anchorage.**UNIT – III****BRACED EXCAVATIONS:** Braced cut – Apparent pressure diagrams for cuts in both sands and clays – Types of bracing systems – Design of various components of bracing – Bottom heave of cuts in soft clays – Piping failure of cuts in sands.**UNIT – IV****MAT FOUNDATIONS:** Allowable bearing pressure for mat foundations – conventional design of mat foundations – Modulus of sub-grade reaction. **UNIT – V****BEHAVIOUR OF LATERALLY LOADED VERTICAL AND BATTER PILES:** Introduction – Winkler’s Hypothesis – Differential equation – Non-dimensional solutions for vertical piles subjected to lateral loads – P-Y curves – Broom’s solutions – Behavior of laterally loaded batter piles in sand.**UNIT – VI****FOUNDATION TECHNIQUES FOR PROBLEMATIC SOILS**: **Collapsible soils**: General observations – collapse potential and settlement –computation of collapse settlement – design and treatment methods for collapsible soils.**Expansive soils:** Problems of expansive soils – Tests for identification – methods of determination of swell pressure – Improvement of expansive soils – Foundation techniques in expansive soils – Under reamed piles. |
| **Textbooks****& References**  | **TEXTBOOKS:**1. K.R. Arora, *Soil Mechanics and Foundation Engineering*, Standard publishers distributions, 6th edition, 2017.
2. A.S. Rao & Gopal Ranjan, *Basic and applied soil mechanics*, New Age International publishers, 3rd edition, 2016.
3. V.N.S. Murthy, *Soil Mechanics and Foundation Engineering*, CBS Publishers, 4th edition, 2018.

**REFERENCE BOOKS:**1. B. M. Das, *Principles of Geotechnical Engineering*, Cengage learning, 8th edition, 2017.
2. B.C. Punmia, A. K. Jain & A. K. Jain, *Soil Mechanics and Foundation Engineering,* Laksmi publications, 17th edition, 2018.
3. C. Venkatramaiah, *Geotechnical Engineering*, New Age International Private Limited, 4th edition, 2010.
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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** |
| **CO1** | 3 | - | 2 | 1 | - | - | - | - | - | - | - | 1 |
| **CO2** | 2 | - | 3 | 2 | 1 | - | - | - | - | - | - | 1 |
| **CO3** | 2 | - | 2 | 1 | - | - | - | - | - | - | - | 1 |
| **CO4** | 2 | - | 3 | 2 | 1 | - | - | - | - | - | - | 1 |
| **CO5** | 3 | - | - | 2 | - | - | - | - | - | - | - | 1 |
| **CO6** | 2 | - | 2 | 2 | 1 | - | - | - | - | - | - | 1 |