**20CE2103 – GEOTECHNICAL ENGINEERING-I**

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| **Course Category**  | Professional Core | **Credits**  | 3 |
| **Course Type**  | Theory | **Lecture - Tutorial - Practical**  | 2-1-0 |
| **Prerequisite**  | Engineering Geology, Engineering Mechanics and Fluid Mechanics | **Sessional Evaluation**  | 40 |
| **Semester End Exam. Evaluation**  | 60 |
| **Total Marks**  | 100 |

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| **Course Objectives** | 1. To study the physical properties of soil and their relations. To demonstrate the plasticity characteristics of the soil and classification of soil by different systems.
2. To study the compaction characteristics of the soils. To understand the stress distribution in soils due to external loads.
3. To illustrate the concept of total stress and effective stress and to study the hydraulic properties of soils
4. To study flownets under different hydraulic structures
5. To describe the deformation characteristics of soil.
6. To study the strength characteristics of soil under load.
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| **Course Outcomes** | CO1 | Determine basic soil properties and classify the soil as per relevant IS codes. |
| CO2 | Determine OMC and MDD for Light and Heavy compaction. Calculate vertical stresses at any point in the soil for various types of loadings.  |
| CO3 | Evaluate effective stress under different flow conditions and plot stress distribution diagrams. Determine the permeability of soils. |
| CO4 | Sketch flownets under different hydraulic structures and compute flow parameters. |
| CO5 | Understand the basics of soil consolidation and be able to derive Terzaghi’s 1D equation. Be able to calculate consolidation stresses and settlements. |
| CO6 | Evaluate Mohr-Coulomb failure criteria for shear strength and calculate the shear parameters from different types of tests and under different drainage conditions. |
| **Course Content** | **UNIT - I****PHYSICAL PROPERTIES OF SOILS:** Introduction **-**Soil as a 3-phase system –Fundamental relationships by volume and weight - Index properties of soils – Sieve analysis – Sedimentation analysis – Atterberg limits and density index.**IDENTIFICATION AND CLASSIFICATION OF SOILS**: Tests for field identification and classification of soils – Textural classification, Unified soil classification and Indian Standard classification systems.**UNIT - II****COMPACTION OF SOIL:** Introduction, theory of compaction, laboratory determination of optimum moisture content and maximum dry density - Compaction in field, compaction specifications and field control. **STRESS DISTRIBUTION IN SOILS:** Boussinesq’s equation – Vertical stress due to line load, strip load, and uniformly loaded circular area – Newmark’s chart – Westergard’s approach – Pressure bulb concept – Approximate methods. **UNIT - III****EFFECTIVE STRESS PRINCIPLE:** Introduction - effective stress principle, nature of effective stress, effect of water table – Fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure and quick sand condition.**PERMEABILITY OF SOIL:** Introduction - Darcy’s law, validity of Darcy’s law – Determination of coefficient of permeability - constant head, falling head method – pumping-in test, pumping - out test – Permeability aspects - permeability of stratified soils, factors affecting permeability of soil.**UNIT - IV****SEEPAGE ANALYSIS:** Introduction, Laplace equation, characteristics of flow nets, uses of flow nets - Determination of discharge, total head, pressure head, uplift pressure, hydraulic gradient and critical hydraulic gradient, types of piping failure, prevention of piping failure – Flow net in earth dams with and without horizontal filters.**UNIT - V****CONSOLIDATION OF SOIL:** Introduction, comparison between compaction and consolidation, initial, primary & secondary consolidation, spring analogy for primary consolidation, consolidation test results, basic definitions - Terzaghi’s theory of consolidation, coefficient of consolidation - square root of time method and logarithm of time method - preconsolidation pressure - final settlement of soil deposits - consolidation settlement - one-dimensional method, secondary consolidation. **UNIT - VI****SHEAR STRENGTH:** Mohr-Coulomb theory, types of shear test - direct shear test, triaxial compression tests, UU, CU and CD tests, relation between major and minor principal stresses, unconfined compression test, vane shear test, skemptons pore pressure parameters. |
| **Textbooks and Reference Books** | **TEXTBOOKS:**1. A.S. Rao & Gopal Ranjan, *Basic and applied soil mechanics*, New Age International publishers, 3rd edition, 2016.
2. K.R. Arora, *Soil Mechanics and Foundation Engineering*, Standard publisher’s distributions, 6th edition, 2017.
3. B.C. Punmia, A. K. Jain & A. K. Jain, *Soil Mechanics and Foundation Engineering*, Laksmi publications, 17th edition, 2017.

**REFERENCE BOOKS:**1. B. M. Das, *Principles of Geotechnical Engineering*, Cengage learning, 9th edition, 2017.
2. V.N.S. Murthy, *Soil Mechanics and Foundation Engineering*, CBS Publishers, 4th edition, 2018.
3. C. Venkatramaiah, *Geotechnical Engineering*, New Age International Private Limited, 5th edition, 2017.
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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 | 3 | - | 1 | 1 | - | - | - | - | - | 1 | 2 |
| **CO2** | 2 | 3 | - | 2 | 2 | - | - | - | - | - | 1 | 2 |
| **CO3** | 2 | 2 | 1 | 1 | 1 | - | - | - | - | - | 1 | 1 |
| **CO4** | 3 | 2 | 1 | 2 | - | - | - | - | - | - | 1 | 1 |
| **CO5** | 3 | 2 | 1 | 2 | 1 | - | - | - | - | - | 1 | 2 |
| **CO6** | 3 | 2 | 1 | 2 | 1 | - | - | - | - | - | 1 | 2 |