**17CE2204 - SOIL MECHANICS**

**(Civil Engineering)**

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| **Course Category** | Professional Core | **Credits** | 4 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3-2-0 |
| **Prerequisite** | Engineering Geology, Engineering Mechanics and Hydraulics | **Sessional Evaluation** | 40 |
| **Semester End Exam. Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Objectives** | 1. To study the physical properties and their relations and various classifications. 2. To understand the plasticity characteristics of the soil and classification of soil by different systems. 3. To study the hydraulic properties of soils and understand the concept of total stress and effective stress. 4. To understand the stress distribution in soils due to external loads. 5. To study the strength characteristics of soil under load. 6. To understand the deformation characteristics of soil. | |
| **Course Outcomes** | CO1 | Understand basic concepts, determine basic soil properties as per relevant IS codes. |
| CO2 | Determine plasticity characteristics of soil and classify the soil. Be able to perform complete grain size analysis and plot combined GSD curve. |
| CO3 | Determine the permeability of soils. Sketch flownets under different hydraulic structures and compute flow parameters. |
| CO4 | Calculate effective stress under different flow conditions and plot stress distribution diagrams. Determine OMC and MDD for Light and Heavy compaction using relevant methods. Calculate vertical stresses at any point in the soil for various types of loadings. Understand the concept of pressure bulb. |
| 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 | Understand 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**  **INTRODUCTION:** Definitions: soils, soil mechanics, soil engineering, rock mechanics, geotechnical engineering – Scope of soil engineering. Comparison between soil and rock – Basic definitions and relationships-Soil as three-phase system in terms of weight, volume, voids ratio, and porosity.  Definitions: Moisture content, unit weights, degree of saturation, void ratio, porosity, specific gravity, mass specific gravity, etc – Relationship between volume weight, void ratio, moisture content, and unit weight- percent air voids saturation– moisture content– specific gravity, etc – Determination of various parameters such as: Moisture content by oven dry method, pycnometer, sand bath method, torsional balance method radioactivity method, and alcohol method – Specific gravity by density bottle method, pycnometer method, measuring flask method – Unit weight by water displacement method, submerged weight method, Core cutter method, sands replacement method.  **UNIT - II**  **PLASTICITY CHARACTERISTICS OF SOIL:** Introduction to definitions of: plasticity of soil, consistency limits-liquid limit, plastic limit, shrinkage limit, plasticity, liquidity and consistency indices, flow & toughness indices, definitions of activity and sensitivity – Determination of: liquid limit, plastic limit and shrinkage limit – Use of consistency limits – Classification of Soils-Introduction of soil classification: particle size classification, textural classification, unified soil classification, Indian standard soil classification system – Identification: field identification of soils, general characteristics of soil in different groups.  **UNIT - III**  **PERMEABILITY OF SOIL:** Introduction to hydraulic head, Darcy’s law, validity of Darcy’s law – Determination of coefficient of permeability: Laboratory method: constant head method, falling head method – Field method: pumping-in test, pumping-out test – Permeability aspects: permeability of stratified soils, factors affecting permeability of soil – Seepage Analysis - Introduction, Laplace equation, characteristics of flow nets, Uses of flow nets: Determination of discharge, total head, pressure head, uplift pressure and hydraulic gradient, critical hydraulic gradient, types of piping failure, prevention of piping failure – Flow net in earth dams with and without horizontal filters,  **UNIT - IV**  **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 – 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 - 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, reconsolidation pressure, final settlement of soil deposits, consolidation settlement: one- dimensional method, secondary consolidation.  **UNIT - VI**  **SHEAR STRENGTH:** Principal planes parallel to the coordinate axes, Mohr’s circle, important characteristics of Mohr’s circle, Mohr-Coulomb theory, types of shear test: direct shear test, merits of direct shear test, triaxial compression tests, test behavior of UU, CU and CD tests, relation between major and minor principal stresses, unconfined compression test, vane shear test, pore pressure parameters. | |
| **Textbooks and Reference Books** | **TEXTBOOKS:**   1. Soil Mechanics and Foundation Engineering by K.R. Arora. 2. Geotechnical Engineering by C. Venkatramaiah. 3. Soil Mechanics and Foundation Engineering by B.C. Punmia, A. K. Jain & Jain.   **REFERENCE BOOKS:**   1. Basic and applied soil mechanics by A.S. Rao & Gopal Ranjan. 2. Geo Technical engineering by V.N.S. Murthy. 3. Soil Mechanics by Robert V. Whitman and T. William Lambe. | |