| Devi Ahilya Vishwavidyalaya, Indore, India<br>Institute of Engineering & Technology | | | | | III Year B.Tech.<br>(Civil Engineering) | |
|---|---|---|---|---|---|---|
| **Course Code & Name** | **Instructions Hours per Semester and Credits** | | | | | |
| **5RVPE1**<br><br>**Geotechnical Engineering - I** | **Classroom Instruction (CI)** | **Lab Instruction (LI)** | | **Term Work (TW) and Self Learning (SL)** | **Total no. of Hours Per semester** | **Total Credits (Total Hours/30)** |
| | **L** | **T** | **P** | **TW+SL** | **120** | **4** |
| | **20** | **10** | **20** | **70** | | |

**Course Learning Objectives:**

1. Understand the fundamental principles of soil mechanics and their applications in geotechnical engineering.
2. Describe soil properties.
3. Discuss seepage analysis and flow nets.
4. Know the components of settlement and behavior of soils.
5. Define shear strength and pore pressure parameters.
6. Understand stress analysis and failure mechanisms.

**Prerequisites:** Mathematics, Mechanics of Materials, Physics, Chemistry

## COURSE CONTENTS

**Unit I**

Definition and scope of soil mechanics, soil origin and composition, influence of clay minerals on engineering behavior. Soil texture and structure. Three-phase system, index properties and their determination. Classification systems based on particle size, texture, consistency limits – Unified and AASHTO systems with detailed classification.

**Unit II**

Soil properties: density, void ratio, porosity, moisture content, grain size analysis. Dry and wet sieve analysis, sedimentation, soil consistency. Atterberg limits and explanation of indices such as flow index, plasticity index, toughness index, liquid index, and activity ratio.

**Unit III**

Capillary and gravitational water. Permeability of soil, Darcy's law, laboratory determination of permeability and influencing factors. Seepage and flow nets, effective/neutral/total pressure, quicksand phenomenon. Compaction characteristics of soil, moisture-density relationship, factors affecting compaction and control. Compressibility and consolidation of soil, Terzaghi's one-dimensional consolidation theory, pressure-void ratio relationship.

**Unit IV**

Strength of soils. Stress distribution beneath loaded areas using Boussinesq and Westergaard's analysis, Newmark's influence chart, contact pressure distribution. Mohr-Coulomb's theory of shear failure of soils. Measurement of shear strength: shear box test,

triaxial test, unconfined compression test, vane shear test. Measurement of pore pressure parameters, critical void ratio, liquefaction.

**Unit V**

Stability of slopes: infinite and finite slopes, types of slope failures, rotational slips, stability number, effect of groundwater. Selection of shear strength parameters in slope stability analysis. Analytical and graphical methods of stability analysis, stability of earth dams.

**COURSE OUTCOME:**

| CO. No. | CO | PO |
|---|---|---|
| CO1 | Apply soil classification systems. | PO1, PO8 |
| CO2 | List soil properties. | PO2, PO3, PO12 |
| CO3 | Confess about the seepage analysis and static pressure in water. | PO1, PO2, PO3 |
| CO4 | Determine the components of settlements and behavior of soils. | PO1, PO2, PO3 |
| CO5 | Understand the concept of shear strength and its measurements. | PO1, PO2 |
| CO6 | Analyze total stress for slope failure mechanisms. | PO1, PO2, PO8 |

**Books recommended:**


1. Soil Mechanics & Foundations – Dr. B.C. Punmia; Laxmi Publications, Delhi
2. Modern Geotechnical Engineering – Dr. I. Aram Singh; IBT Publishers, Delhi
3. Geotechnical Engineering – C. Venkatramaiah; New Age International Publishers, Delhi
4. Soil Testing for Engineering – T.W. Lambe; John Wiley & Sons, Inc.
5. Soil Mechanics & Foundations – S.K. Garg; Khanna Publishers, Delhi
6. Geotechnical Engineering – Shashi K. Gulhati & Manoj Datta; McGraw Hill Education (India) Pvt. Ltd., New Delhi


**CO-PO Relationship**

| CO | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **5RVPE1.** CO1 | 2 | | | | | | | 1 | | | | |
| **5RVPE1.** CO2 | 1 | 2 | 2 | 1 | 1 | | | | | | | 1 |
| **5RVPE1.** CO3 | 2 | 2 | 2 | 1 | 1 | | | | | | | 1 |
| **5RVPE1.** CO4 | 2 | 2 | 2 | 1 | 1 | | | | | | | 1 |
| **5RVPE1.** CO5 | 2 | 2 | 2 | 1 | 1 | | | | | | | 1 |
| **5RVPE1.** CO6 | 2 | 2 | 2 | 1 | 1 | | | 1 | | | | 1 |

**List of Practical Assignment:**

1. Determination of moisture content of soil.
2. Determination of specific gravity of soil.
3. Determination of field density by sand replacement method.
4. Determination of field density by core cutter method.
5. Sieve analysis of soil and sedimentation analysis.
6. Determination of liquid limit of soil by Casagrande method and cone penetrometer.
7. Determination of plastic limit and shrinkage limit of soil.
8. Determination of permeability of soil by:
9. (a) Constant head method
10. (b) Variable head method
11. Determination of Optimum Moisture Content (OMC) of soil by Standard Proctor Compaction Test.