

## Approval: 9<sup>th</sup> Senate Meeting

**Course Number:** CE 302

**Course Name:** Geotechnical Engineering

**Credits:** 3-0-2-4

**Prerequisites:** None

**Intended for:** UG

**Distribution:** Discipline Core

**Semester:** Odd/Even

**Preamble:** Any civil engineering structure needs a proper foundation to stand. This course provides an understanding to the student about the tests for ascertaining the strength in soil and later introduces the concepts for designing the foundation for the given soil and ambient conditions. The course also highlights the criteria for selecting shallow and deep foundations.

The laboratory exercises aim at providing the required standard test procedures discussed in geotechnical engineering course. The students would be exposed to the hands on experience on the various tests on soil and provides a scope of extending them to various materials as possible.

**Course Outline:** The course introduces the concept of effective stress and stress distribution in the soils. Further, it covers the importance, experiments and concepts of the shear strength in soils. The relevance of the earth pressure of soils is also added to provide the requirements to compute the bearing capacity of the soils. Later, based on the bearing capacity of the soils, the design of shallow and deep foundations considering the various factors is explored. This course also includes the various methods and requirements of soil exploration.

The experiments start with the basic physical property and classification of soils and extends to the determination of geotechnical properties of soil i.e. permeability, compaction and consistency limits. Further, the tests on shear strength, CBR and consolidation, leads to the understanding of the engineering behavior of soils.

### **Modules:**

1. **Stress Distribution in Soils:** Effective stress concept, water table, seepage and capillarity effects and failure of structures by piping. Boussinesq theory-pressure distribution diagram on a horizontal and vertical plane, pressure bulb. **(5 contact hours)**
2. **Shear Strength of Soil:** Stress strain curve, stress at a point-Mohr circle of stress, Mohr-coulomb failure criteria, pore pressure, total and effective stress. Peak and residual shear strength. Factors affecting shear strength, Laboratory measurement of shear strength by box shear, unconfined, Vane shear test and triaxial tests under different drainage conditions. Shear strength characteristics of sands and clays. **(7 contact hours)**
3. **Subsoil Exploration:** Methods of subsoil exploration Direct, semi direct and indirect methods, Soundings by Standard, Dynamic cone and static cone penetration tests, Types of Boring, Types of

- samples, Criteria for undisturbed samples, Transport and preservation of samples, Borelogs, planning of exploration programmes, report writing. **(6 contact hours)**
4. **Earth Pressure:** Types of Earth pressure. Rankines and Coulomb's Active and passive earth pressure in soils. **(4 contact hours)**
  5. **Bearing Capacity:** Safe bearing capacity and allowable bearing pressure, General and local shear failure conditions, Terzaghi's bearing capacity equations its modifications for square, rectangular and circular foundation, Factors affecting bearing capacity of Soil.  
**Shallow Foundations:** Factors effecting locations of foundation and design considerations of shallow foundations, choice of type of foundations, Foundations on expansive soils. **(9 contact hours)**
  6. **Settlement analysis:** Causes of settlement, Computation of settlement, allowable settlement. Measures to reduce settlement. **(3 contact hours)**
  7. **Pile Foundations:** Types, Construction, load carrying capacity of single pile – Dynamic Formula, Static formula, Pile load tests, Load carrying capacity of pile groups, settlement of pile groups, Negative skin friction. **(8 contact hours)**

#### **List of experiments:**

1. Determination of Specific Gravity
2. Grain Size Analysis
  - A. Sieve Analysis
  - B. Hydrometer Analysis
3. Determination of Consistency Limits
4. Permeability Test
  - A. Constant Head Method
  - B. Falling Head Method
5. Proctor Light And Heavy Compaction Test
6. Direct Shear Test
7. Unconfined Compression Test
8. Unconsolidated and Undrained Triaxial Test
9. Vane Shear Test
10. CBR Test
11. Field Density Test
12. Free swell and consolidation test

#### **Text books:**

- a) Shamsheer Prakash, Gopal Ranjan and Swami Saran, 'Analysis, Design of foundations and Earth retaining structures', IBH Publishers, 1979.
- b) Braja M. Das, 'Principles of Foundation Engineering', Cengage Learning, 2015.
- c) V.N.S. Murty, 'Geotechnical Engineering', Book World Enterprises, 2002.

#### **Reference books:**

- a) W.C Teng, 'Foundation Design ', Prentice Hall Publishers, 1962.
- b) J. E. Bowles, 'Foundation Analysis and Design', TataMc-Graw Hill Publishers, 1997.