SHIV NADAR UNIVERSITY

I. **Course Title:** Geotechnical Engineering

II. **Course Code:** CED 302

III. **Course Credits (L:T:P):** (3:0:1)

IV. **Course Type:** Major

V. **Prerequisite/s (If Any):** CED 201

VI. **Course Coordinators/Instructor(s):** Dr. Gyan Vikash

VII. **School:** School of Engineering

VIII. **Department:** Civil Engineering

IX. **Objective:** This course is intended to provide an understanding of the nature of soil and fundamentals of mechanical behavior of soil. It provides basic knowledge of the principles of soil mechanics and its applications to geotechnical engineering problems. This course illustrates how, why, and with what limitations these principles can be applied in practice, and it helps develop the engineering judgment.

X. **Learning Outcomes:** Upon successful completion of the course, student should be able to

- Understand the underlying principles of soil mechanics
- Analyze the flow through the soil medium
- Analyze the stability of a slope
- Perform all important tests to characterize physical and engineering properties of soils
- Interpret the test data obtained from various types of soil tests

XI. **Course Content:**

Module 1: **Origin and Classification of Soils –** Soil Origin, Soil classification, Criteria for classifying soil, classification on the basis of grain size, classification on the basis of plasticity, Symbols and graphic representation, Classified soil and its engineering properties, Three phase system, Weight relationships, Volume relationships, Density and unit weight relationships, Inter-relationships

Module 2: **The Effective Stress Principle –** Measurable stresses, Nature of effective stress, Distribution of effective stress with depth, Influence on effective stress of a shift in the water table, Influence on effective stress of a shift in the ground surface, Preview of the functional relations between engineering properties and effective stress

Module 3:**Permeability-** Permeability – a function of soil type, Permeability – a function of void ratio, Permeability – a function of soil structure, Permeability – a function of the

permeant, Permeability – a function of effective stress, Darcy's law, Constant head permeameter, Falling head permeameter, Laboratory measurement of permeability

Module 4: **Flow Analysis –** One Dimensional Steady State Flow, Flow through Homogeneous deposit, Flow through layered systems, Effective stress under steady state one- dimensional flow, Seepage force, Downward flow, Upward flow, Quick condition, Two-dimensional steady state flow – Laplace equation, Flow nets, confined flow, unconfined flow, determining pore water pressures under two dimensional flow, Radial flow

Module 5: **Compressibility-** Compressibility – a function of effective stress, Compressibility – a function of soil type, Compressibility – a function of stress history, Normally consolidated and Overconsolidated Clay

Module 6: **Consolidation -** Effective stress under transient hydrodynamic conditions, A mechanistic model, Condition of Continuity, Terzaghi's One-dimensional Consolidation theory, Effective stress distribution in a compressible layer during consolidation, Consolidation and settlement, Determining coefficients of compressibility, and consolidation, Limitations in predicting consolidation behavior, Amount of consolidation, time of consolidation

Module 7: Shear Strength of Soils – Measurement of shear strength, Mohr's circle, Types of Triaxial compression tests, Shear stress, shear strength and the Triaxial test, Stress-Strain behavior of sands, Stress-Strain behavior of clays, Concepts of failure, Stress conditions at failure in terms of total stresses, Stress conditions at failure in terms of effective stresses, Relationships among stresses at failure, Cohesion and Friction, Pore Water Pressure Parameters, Shear strength and strength parameters, Effective stress-strength parameters – a function of soil type, Effective stress-strength parameters – a function of stress history and stress range, Behavior of Overconsolidated Clays, Behavior of sands at high stresses, Effective stress analysis, Total stress analysis

Module 8: Slope Stability Analysis – Stability of Infinite Slopes, Stability of finite slopes, Stability numbers, Method of slices, The Swedish method of slices, The critical failure surface, Non-circular failure surfaces, Two-wedge method

XII. Recommended Books:

[1] Shashi K Gulhati, and Manoj Datta, Geotechnical Engineering, McGraw-Hill Companies

[2] Braja M. Das (2010). Principles of Geotechnical Engineering (7th Edition), Cengage

[3] Gopal Ranjan and A. S. R. Rao, Basic and Applied Soil Mechanics, PHI

XIII. Assessment Scheme:

[1] Assignment: 10 %

[2] Quiz: 10%
[3] Mid Semester Exam: 20 %
[4] Final Exam: 30 %
[5] Soil Mech Lab: 30%