Approved in 36th BoA Meeting

Course Number: CE512
Course Name: Advanced Soil Mechanics
Credits: 3-0-0-3
Prerequisites: Geotechnical Engineering I (CE302) or Equivalent

Intended for: UG/PG
Distribution: Discipline Elective

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1. Preamble:

The underlying soil stratum being the basic support system for any civil engineering structure, it becomes imperative to understand the soil behavior in details. Soil being a three-phase complex system, its strength and deformation behavior significantly gets influenced by the flow of water through the soil medium and evolution of pore water pressure under applied loading. Keeping these aspects in focus, the proposed Advanced Soil Mechanics course will discuss steady state and transient flow through soil along with the stress state and stress-strain behavior of soil under different loading conditions. It will also include interpretation of different laboratory tests for estimation of shear strength of soil and various factors influencing its shear strength response.

2. Course Modules with Quantitative Lecture Hours:

Module 1: Steady State Flow through Soil (8 hours)
Laplace's Equation of Continuity; Permeability; Flow net, use and method of obtaining flow net; Numerical solution for 2D steady state flow in soil; Examples of 2D and 3D seepage in soil, seepage in anisotropic soil.

Module 2: Transient Flow in Soil (8 hours)
Compressibility and rate of consolidation; Primary, secondary and tertiary consolidation; Consolidation theories: Terzaghi and Biot's formulation, numerical solution of governing consolidation equation; Laboratory consolidation test and its interpretation.

Module 3: Strength and Deformation Behavior of Soil (11 hours)
Introduction to stress-strain behavior of soils, principal stresses, Mohr diagrams; Shear strength of cohesive and cohesionless soils, various failure criteria, drained and undrained shear strength of soils; Determination of shear strength from various laboratory tests, e.g. direct shear, triaxial, simple shear, true triaxial, hollow cylinder test, interpretation of various triaxial test results, significance of pore pressure parameters; Concept of critical void ratio; Dilation in sands.

Module 4: Stress Path Pertaining to Various Loading Conditions (4 hours)
Stress path, drained and undrained stress path; Stress path with respect to different initial state of the soil; Stress path for different practical situations.

Module 5: Critical State Concept **(11 hours)**

Critical state soil mechanics, concept of soil yielding, critical state parameters; Critical state for normally consolidated and over consolidated soil; Significance of Roscoe and Hvorslev state boundary surface, drained and undrained plane, complete state boundary surface.

3. Text Book:

(i) Muni Budhu, Soil Mechanics and Foundations, John Wiley & Sons, Inc., 2010.
(ii) T.W. Lambe and R.V. Whitman, Soil Mechanics, John Wiley & Sons, 1991.

4. References:

(i) Jonathan Knappett and R.F. Craig, Craig's Soil Mechanics, CRC Press, 2012.
(ii) B.M. Das, Advanced Soil Mechanics, CRC Press, 2013.
(iii) James K. Mitchell, Kenichi Soga, Fundamentals of Soil Behavior, John Wiley & Sons, 2005.
(iv) J.H. Atkinson, The Mechanics of Soils and Foundations, CRC Press, 2007.
(v) Holtz, R. D., and Kovacs, W. D., An Introduction of Geotechnical Engineering, Prentice Hall, 1981.
(vi) Parry, R. H. G., Mohr Circles, Stress Paths and Geotechnics, CRC Press, 2004.
(vii) David Muir Wood, Soil Behaviour and Critical State Soil Mechanics, Cambridge University Press, 1991.
(viii) Andrew Schofield and Peter Wroth, Critical State Soil Mechanics, McGraw Hill, 1968.
(ix) Potts, D.M. and Zdravkovic, L., Finite Element Analysis in Geotechnical Engineering: Theory, Thomas Telford, USA, 1999.

5. Similarity Content Declaration with Existing Courses:

Sl. No.	Course Code	Similarity Content	Approximate % of Content
1	CE301 Geotechnical Engineering	Introductory concepts of Seepage, Consolidation and Shear Strength	<20%
2	CE606 Constitutive Modeling of Frictional Material	Concepts of stress-strain behavior of soils	<5%

6. Justification for new course proposal if cumulative similarity content is > 30%:

Not Applicable.

Approvals:

Other faculty interested in teaching this course: Dr. Kala Venkata Uday and Dr. Ashutosh Kumar.

Proposed by: Dr. Mousumi Mukherjee School: School of Engineering (SE)

Signature: Mousumi Mukherjee Date: 30/09/2020

Recommended / Not Recommended, with comments:

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Chairman, CPC Date:

Approved / Not Approved

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Chairman, Senate Date: