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<tr><td colspan="5">School of Civil & Environmental Engineering, AAiT, AAU</td></tr>
<tr><td>Course Code</td><td>CEng 2142</td><td>Course Name</td><td colspan="2">Fundamentals of Geotechnical Engineering – II [Physical Properties of Soils]</td></tr>
<tr><td>ECTS Credits</td><td>5</td><td>Program</td><td colspan="2">B. Sc. in Civil Engineering</td></tr>
<tr><td>Module</td><td colspan="2">Fundamentals of Geotechnical Engineering</td><td>Module Coordinator</td><td>Tewodros Gemechu</td></tr>
<tr><td>Course Team</td><td colspan="4">Lecturers: Bethlehem Worku, Tewodros Gemechu
Laboratory Managers: Alemayehu B., Tenaw W.</td></tr>
<tr><td>Target Group</td><td colspan="4">Second Year Civil Engineering Students</td></tr>
<tr><td>Objectives</td><td colspan="4">The objectives of this course are to introduce soil mechanics to civil engineering undergraduate students and to familiarize students with geotechnical terminology and concepts commonly encountered in engineering practice. Furthermore, it is designed to introduce civil engineering students to the properties and behavior of soil as an engineering material, characterization, the process & aspects of compaction, the state of stress in a soil mass, seepage and flow theory in a soil media.</td></tr>
<tr><td>General Competency</td><td colspan="4">Knowledge
✓ Demonstrate fundamental knowledge of soil formation process, parent materials and mineral properties of different soils.
✓ Articulate the peculiar features of soil as an engineering material and the phase relationships developed as a result of these.
✓ Exhibit a working knowledge of simple soil characterization schemes.
✓ Distinguish between the various soil classification schemes.
✓ Outline the sources of stress in & on a soil mass and be able perform computations to quantify geostatic & additional stresses
✓ Describe conduction phenomenon in soil medium, methods to quantify permeability, the application in aquifers.
✓ Articulate principle of seepage through porous media and be able to determine rate of flow, effective stresses, gradients, etc
✓ Demonstrate fundamental knowledge of soil compaction, its uses, applications, field implementations etc

Skill
✓ Develop the basic skill of identifying soils in the field for preliminary characterization purposes.
✓ Model practical engineering problems and solve them in a systematic manner using basic software tools (especially spreadsheets).
✓ Follow laboratory testing procedures and standard methods, collect and analyze data and write professional engineering laboratory reports.
✓ Able to make quick estimates enabling the student to frame the basic problems at hand and to see them in a greater engineering perspective
✓ Able to communicate with other engineering professions in a design process facilitated through a simple platform describing complex geotechnical conditions.</td></tr>
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	Attitude ✓ Demonstrate individual and team work ethics, professionalism and respectful interaction with both instructors and students during the course work & laboratory experiments. ✓ Reflect upon the geotechnical engineering sub-discipline and its central position in the world of civil engineering.	
Course Content	1. Genesis of Soils & Soil Mechanics 1.1 Introduction 1.2 A recap of properties of rocks 1.3 Weathering 1.4 Soils 1.4.1 Peculiar features 1.4.2 Broad classifications 1.4.3 Clay mineralogy 1.5 Soil Mechanics: An Introduction 2. Simple Soil Properties 2.1 Introduction 2.2 Phase relationships 2.2.1 Weight relations 2.2.2 Volume relations 2.2.3 Weight-Volume relations 2.3 Grain Size Distribution 2.3.1 Introduction 2.3.2 GSD analysis 2.3.3 GSD curves 2.4 Soil Consistency 2.4.1 Introduction 2.4.2 Atterberg limits 2.4.3 Indices 3. Classification and Field Identification of Soils 3.1 Introduction 3.2 Soil Classification 3.2.1 Grainsize classifications 3.2.2 Textural classification 3.2.3 USCS	4. Soil Water, Permeability and Seepage 4.1 Soil water 4.1.1 Adsorbed water 4.1.2 Capillary water 4.1.3 Gravitational water 4.2 Permeability 4.2.1 Introduction 4.2.2 Factors affecting permeability of soils 4.2.3 Hydraulic gradient 4.2.4 Darcy's law 4.2.5 Determination of permeability 4.2.6 Permeability in stratified soils 4.2.7 Acquifers 4.3 Seepage 4.3.1 Introduction 4.3.2 Equation of continuity 4.3.3 Flow nets 4.3.4 Hydraulic uplift force under a structure 4.3.5 Flow nets in anisotropic soils 4.3.6 Construction of flow nets for hydraulic structures 4.3.7 Directional variation of permeability in anisotropic soils 5. Soil Compaction 5.1 Introduction 5.2 Types of compaction forces 5.3 Laboratory compaction test 5.4 Dry density-water content relationship 5.5 Field compaction and specification 5.6 Compaction of cohesionless soil 5.7 Engineering behavior of compacted soils 5.8 Factors affecting compaction 5.9 Compaction quality control 6. Stress in a Soil Mass 6.1 Introduction 6.2 Basics of stress-strain relations 6.2.1 Definitions 6.2.2 Idealized stress-strain response & yielding 6.2.3 Hooke's law 6.2.4 Plane strain & axisymmetric conditions 6.3 Stress and strain states

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<tr><td></td><td>3.2.4 AASHTO classification
3.3 Field Identification of Soils
3.3.1 Texture
3.3.2 Plasticity
3.3.3 Color
3.3.4 Odor
3.3.5 Other aspects</td><td>6.3.1 Principal planes & Principal stresses
6.3.2 Mohr's circle
6.4 Stress paths
6.4.1 Stress & strain invariants
6.4.2 Plotting stress paths
6.5 Geostatic stress
6.5.1 Total stress
6.5.2 Neutral stress
6.5.3 Effective stress
6.6 Additional stress
6.6.1 Equations based on elasticity
6.6.2 Newmark's influence chart
6.6.3 Approximate methods for rectangular loads</td></tr>
<tr><td>Pre-requisite(s)</td><td colspan="2">CEng2141 – Engineering Geology
CEng2161 – Civil Engineering Hydraulics</td></tr>
<tr><td>Semester</td><td colspan="2">Year 2, Semester II (2012EC Academic Year)</td></tr>
<tr><td>Evaluation</td><td colspan="2"><table>
<tr><th>Evaluation technic</th><th>Weight</th><th>Due</th></tr>
<tr><td>Quizzes & class activity</td><td>BONUS</td><td>Any session</td></tr>
<tr><td>Test 1</td><td>15%</td><td>End of Chap.3</td></tr>
<tr><td>Test 2</td><td>10%</td><td>End of Chap.4</td></tr>
<tr><td>Test 3</td><td>15%</td><td>End of Chap.6</td></tr>
<tr><td>Assignments</td><td>MANADATORY</td><td>End of each chapter</td></tr>
<tr><td>Attendance</td><td>MANADATORY</td><td>Minimum of 85%</td></tr>
<tr><td>Laboratory practice</td><td>10%</td><td>Two weeks after practice</td></tr>
<tr><td>Mini-project</td><td>10%</td><td>One week after class end</td></tr>
<tr><td>Final exam</td><td>40%</td><td>End of course</td></tr>
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<tr><td>Reference literature</td><td colspan="2">Budhu, M. (2000). Soil mechanics and foundations. New York: Wiley.
Jean Louis Briaud. (2013). Geotechnical Engineering: Unsaturated and Saturated Soils. Hoboken, USA, New Jersy: John Wiley & Sons.
Ian Smith. (2014). Smith's Elements of Soil Mechanics, 9th Edition. Wiley-Blackwell

Atkinson, J.H. (2007). The Mechanics of Soils and Foundations. – 2nd ed. New York, USA. Taylor & Francis.
Alemayehu Teffera and Mesfin Leikun. (1999) Soil Mechanics. Addis Ababa University, Ethiopia.</td></tr>
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