



# WISCONSIN

## UNIVERSITY OF WISCONSIN-MADISON

University of Wisconsin - Madison  
College of Engineering [EGR]  
Last Offered: 2015 Spring [1154]  
Direct Link to this Syllabus :

<http://aefis.engr.wisc.edu/index.cfm/page/CourseAdmin.ViewABET?coursecatalogid=410&pdf=True>

1. **GLE 732, Unsaturated Soil Geoen지니어ing**
2. **Credits : 3 Contact Hours :**
3. **Textbook and Materials :**
4. **Specific Course Information :**

- a. **Brief description of the content of the course (Course Catalog Description) :** Engineering principles of unsaturated soils as they apply to geotechnical and geoenvironmental systems. Effect of soil water suction and stress on hydraulic conductivity, shear strength, and compressibility of soils in the context of geoen지니어ing problems of flow and stability.
- b. **Pre-requisites or Co-requisites :** Grad st & Civ Engr/GLE 330 or cons inst
- c. **This is a Elective course.**

- **Specific Goals for the Course :**

- a. **Course Outcomes :**

1. The purpose of this course is to teach students the fundamental aspects of geoen지니어ing for unsaturated soils. In this course, unsaturated soils are defined as soils where some or all of the voids are filled with gas. Environmental and traditional aspects of geoen지니어ing for unsaturated soils will be covered. Students completing this course will have a fundamental understanding of unsaturated soil behavior and methods to measure the properties unsaturated soils.

- **ABET Student Learning Outcomes :**

- (a) Ability to apply mathematics, science and engineering principles.
- (b) Ability to design and conduct experiments, analyze and interpret data.
- (e) Ability to identify, formulate and solve engineering problems.
- (k) Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

- **Brief List of Topics to be Covered :** I. Introduction:

review of nomenclature;  
vadose zone vs. unsaturated zone;  
fundamental differences between hydraulic and mechanical properties of saturated and unsaturated soils;  
examples of geo engineering problems requiring unsaturated soil analysis.

II. Stress-State Variables:

definition of stress states and stress state variables for unsaturated soils;  
stress state equations for unsaturated soil;  
continuum between stress state in unsaturated soils and effective stress in saturated soils;  
axis translation.

III. Soil Water Suction and Soil-Water Characteristic Curves:  
total, osmotic, and matric suction;  
measuring soil suction and the soil-water characteristic curve;  
effect of stress state on the soil-water characteristic curve.

IV. Unsaturated Flow:  
Darcy's law for unsaturated soil;  
estimating and measuring unsaturated hydraulic conductivity;  
Richard's equation;  
applications to geo engineering of waste containment systems.

V. Shear Strength and Physical Stability:  
Mohr's circles for unsaturated soil;  
shear strength of unsaturated soil;  
shear strength constitutive surfaces;  
measuring shear strength of unsaturated soil;  
applications to geo engineering of foundations and slopes;

VII. Compressibility and Volume Change:  
compressibility of air-water-solid mixtures;  
constitutive relationships and volume change indices;  
testing methods;  
applications to geo engineering of embankments