Course Title: Unsaturated Soil Mechanics
Course Number: CVEN 646
Instructor Information: R. L. Lytton
Prerequisites: CVEN 365 or equivalent, and should have taken or be taking CVEN 647 in parallel, or should have the approval of the instructor

Course Topics/Calendar:

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Tests: Two take-home tests: one after week five and the second after week ten. One final exam.


An Introduction to Geotechnical Engineering, R. D. Holtz and W. D. Kovaes, Prentice-Hall, 1981
Technical papers, handouts

A more detailed listing of the topics to be covered under each heading follows.
Unsaturated Soil Mechanics (CVEN 646)

Unsaturated Soil Fabric (Fine, Coarse)

Soil Water Potential (Soil Suction)
   Matric Suction
   Osmotic Suction
   Soil Water Characteristic Curve (SWCC)

Hydraulic Conductivity
   Gardner's, Mitchell's
   Formulation w/ Juarez-Badillo Principles
   Estimating Hydraulic Conductivity from SWCC
   Solute Effects
   Equilibrium and Transient Suction Profiles

Stress-State in Unsaturated Soils
   Independent Stress Tensors
   Helmholtz Free Energy Derivation of Lamborn
   Surface Energies and Interparticle/Interpacket Forces

Volume Change
   Granulometry
   Unsaturated Volume Change Formulations
   Large, Medium, and Small Strain
   Unsaturated Poisson's Ratio
   Lateral Earth Pressure
   Effects of Micro- and Macrostructure
   Relation to Critical State Soil Mechanics
   Estimating Field Volume Change Properties
   Coupling Between Moisture Diffusion and Volume/Shear Strain (Mandel-Cryer Effect)
   Prediction of One, Two, and 3-D Volume change, Suction Distributions
   Liquefaction

Shear Strength
   Unsaturated Shear Strength
   Plastic Yield Criteria (Mohr-Coulomb, Lade, Desai, Venneer)
   Plastic Potential Functions
   Bearing Capacity
   Maximum and Minimum Lateral Earth Pressure
   Slope/Dam/Tailings Dam Stability
Viscoelasticity: Creep and Flow
   Soil Constitutive Equations
   The Correspondence Principle
   Viscoelastic Solutions from Elastic Solutions
   Time-Temperature Shift
   Concept and Use of Pseudo-Strain

Fracture and Healing
   Principles of Viscoelastic Fracture and Healing
   Paris-Erdogan Law in Soils; J-Integral
   Microfracture and Healing: Surface Energies
   Crack Propagation: Desiccation

Coupled Heat and Moisture Flow
   Unsaturated Moisture Diffusion in Soils
   Heat Conduction and Convection: Thermal Conductivity
   Coupling of Heat and Moisture Flow
   Effects of Freezing: Latent Heat

Coupled Flow and Volume Change (Transient and Steady State)
   Unsaturated and Saturated Flow - (Use PDEase) - No Volume Change (1-D, 2-D)

Coupled Unsaturated and Saturated Flow (Transient and Steady State)
   (Use FLODEF) → Differences w/uncoupled Flow

Foundation Slab

Drilled Pier - Interface Element

Landfill Liners and Covers

Pavements, Moisture Barriers

Downhill Creep and Shallow Slope Failure

Tailings Dams

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