

## **CIVE 425: SOIL AND WATER ENGINEERING**

**Meeting time:** 8-8.50 am Monday and Wednesday in Engineering Bldg. D102 for classroom instruction; 3-6 pm Monday for lab exercises in Geo-tech Lab, Glover Bldg. 140.

### **Course Objectives**

The course is designed for students in Civil and Environmental Engineering majors and for students interested in getting introduction to the theory and practice of irrigated agriculture. The students will learn principles of soil-water and soil-water-plant relationships and their field applications to support useful plant life, with minimum degradation of land and water resources. Agriculture is essential for food production and security, but it can be a large source of non-point pollution. A good understanding and application of engineering fundamentals relating water to soil and plant can help produce food and fiber with minimum degradation of our natural resources (soil and water).

### **Instructor**

Dr. Ramchand Oad, 203 Glover Building (491-7682), e-mail: [oad@engr.colostate.edu](mailto:oad@engr.colostate.edu)

### **Textbook**

Rodney Huffman, Delmar D. Fangmeier, et al. 2013. Soil and Water Conservation Engineering, Seventh Edition. American Society of Biological and Agricultural Engineers. St. Joseph, Michigan.

### **Prerequisites by topic**

Fluid properties, fluid statics, fluid flow concepts and basic equations.  
Physical and chemical properties of soils.

### **Laboratory Exercises**

Lab exercises will be held in the Soil and Water Engineering Lab (part of Geotech Engineering Lab, Glover 140) on Monday 3-6 pm. Graduate student Brandon Barkey will assist as TA for the class. Following lab exercises are tentatively planned. In addition, we usually plan for two field trips.

1. Soil particle size analysis
2. Soil bulk density, particle density and porosity
3. Measurement of soil moisture: standard gravimetric and indirect methods, sensor calibration
4. Pressure plate analysis for soil moisture retention curves
5. Lab measurement of soil hydraulic conductivity
6. Measurement of soil-water salt content
7. Measurement of soil infiltration

### **Grading Policy**

Homework assignments and lab exercises	40 %
Examinations	50 %
Class attendance (including field trips)	10%

## Course Topics

### 1. Soil-Water Relationships

- Soil as a medium for plant growth
- Water storage in soil; Classification and measurement of soil-water
- Soil water storage capacity; Soil water availability for plant growth and water uptake by plants
- Infiltration and water movement within a soil mass (Textbook: chapter 5)

**References:** Notes by Dr. Oad and Textbook: Chapter 15.

### 2. Soil-Water-Plant Relationships

- Crop water requirements: Evapotranspiration and other consumptive uses
- Determination of evapotranspiration (ET)
  - Direct measurement of crop ET: Lysimetry
  - Calculation or estimation of ET
    - Potential and actual (crop) ET: Aerodynamic and Energy balance
    - Combination method (Penman Equation), Crop coefficients
    - Empirical methods (Jensen-Haise, Blaney-Criddle, and Evaporation pan)

**References:** Text: Chapter 4.

### 3. Application of Water to Soil -- Irrigation

- Defining an irrigation system
- Fundamental concerns at the farm level: Irrigation timing or irrigation scheduling
- Irrigation duration and the amount of water to be applied during an irrigation event

**References:** Text: Chapter 15.

- Irrigation methods or water application to land
  - Surface gravity flow irrigation: borders, furrow-and-ridge, and basin methods

**References:** Text, chapter 16.

Surface pressurized irrigation: sprinkler and trickle (drip) methods

**References:** Text: Chapters 17-18.

### 4. Surface Drainage of Agricultural Lands

- Purpose of drainage
- Layout of surface drains
- Design of open channels for surface drains
- Determination of design capacity of open channel drains.

**Reference:** Text: Chapter 13; Chapters 3,5 and 6.

### 5. Subsurface Drainage of Agricultural Lands

- Layout of surface drains
- Design of subsurface pipe drains
  - Depth and spacing of pipe drains
  - Size of pipe drains
  - Bed slope, construction materials etc.

**References:** Text: Chapter 14.