

## SOIL QUALITY (SWS 6134)

3 Credits- Fall 2016

- INSTRUCTOR:** Dr. Zhenli L. He, Professor  
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- COURSE OBJECTIVES:** To acquaint students with basic concepts, principles, components, measurements, and evaluation of **soil quality** and its management for sustainable agriculture. Soil quality is the capacity of the soil to function within the ecosystem boundaries to sustain biological productivity, maintain environmental quality, and promote plant and animal health. In this course, state-of-the-art studies on soil quality and the principles, assessment and management of soil quality are examined with respect to biological production, plant and animal health, food security, and environmental quality. After studying this course, the students should be able to understand basic principles of soil quality and to analyze and evaluate soil quality related to agricultural production and environmental quality.
- DELIVERY METHOD:** E-Learning System/Canvas and Audio lectures (with powerpoint presentations and reading materials)
- FREQUENCY:** Fall semester, every even year
- TARGET STUDENTS:** Graduate students who wish to become specialists in the management of nutrients, soils, agroecosystems, and environmental quality.
- CLASS ATTENDANCE:** **Attendance of chat sessions is mandatory.** There is 5% grade for chat room participation.
- CHAT ROOM SESSION:** Chat room session is scheduled 5-7 PM every Thursday except for public holidays.
- GRADING:**
- |                       |     |
|-----------------------|-----|
| Homework:             | 30% |
| Chat room attendance  | 5%  |
| Mid-term Examination: | 20% |
| Review or research    |     |
| Paper / presentation  | 20% |
| Final Examination     | 25% |

Total 100%

There will be no make-up homework and exams. Late submission of assignments will result in reduced credit (10% per assignment) if it is not agreed upon in advance.

A 94 – 100%  
A- 90 – 93%  
B+ 87 – 89%  
B 83 – 86%  
B- 80 – 82%  
C+ 77 – 79%  
C 73 – 76%  
C- 70 – 72%  
D+ 67 – 69%  
D 63 – 66%  
D- 60 – 62%  
E < 60%

ASSIGNMENTS/  
EXAMS/PROJECTS  
/LECTURES

Soil quality is one of the rapidly-developing frontiers in soil and environmental sciences, with emphasis on soil's functions in plant and animal production, food safety, and environmental quality. This course involves many new concepts, principles, evaluation expertise, and test methods. It is important that the students have a good understanding of the concepts and principles. Therefore, in addition to lectures, the students will be also provided with supplementary course materials to read and homework to do at the end of each chapter. The students are required to submit homework report timely in order to obtain scores. The mid-term examination is designed to check the study progresses of each student so that some adjustment can be made based on student's performance. In addition, each student is required to conduct an independent soil quality evaluation project. For this project, students will select one of the soil quality related study areas (crop production-, animal production-, food safety-, environmental quality (water quality/air quality)-oriented soil quality issue), conduct a literature review based on journal articles, textbook chapters, and/or proceeding papers, discuss the characteristics of the concept/approach, its limitations, and benefits, submit a report, and present results of their independent study.

- REFERENCES:** Reference books, journal articles, and related information links are provided on course website and in disk (some references are listed at the end of this syllabus).
- PREREQUISITES:** Soil Science for Environmental Professionals (SWS 5050).
- OFFICE HOURS**
- INSTRUCTOR:** Open for e-mail and phone call at any time or chat room by appointment.

### **COURSE MODULES**

1. Concepts, principles, and components of soil quality
  - 1.1. Definition and concepts of soil quality
  - 1.2. Soil components and basic soil quality properties
  - 1.3. Soil quality indicators
2. Methods of soil quality evaluation
  - 2.1. Soil quality assessment
  - 2.2. Measurements of soil quality indicators
3. Management of soil quality for agriculture and environmental quality
  - 3.1. Soil quality management for plant production
    - 3.1.1. Soil quality factors
    - 3.1.2. Processes and management
  - 3.2. Management of soil quality for the environment
    - 3.2.1. Water quality
    - 3.2.2. Air quality
4. Management of soil quality for health and food security
  - 4.1. Soil quality management for plant health
  - 4.2. Soil quality management for animal health
  - 4.3. Soil quality management for human health and food security

### **GRADES AND GRADE POINTS**

For information on current UF policies for assigning grade points, see <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

### **ABSENCES AND MAKE-UP WORK**

Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at: <https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

**ACADEMIC HONESTY:** In 1995 the UF student body enacted an [honor code](https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/) (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) and voluntarily committed itself to the highest standards of honesty and integrity. When students enroll at the university, they commit themselves to the standard drafted and enacted by students.

**Preamble:** In adopting this honor code, the students of the University of Florida recognize that academic honesty and integrity are fundamental values of the university community. Students who enroll at the university commit to holding themselves and their

peers to the high standard of honor required by the honor code. Any individual who becomes aware of a violation of the honor code is bound by honor to take corrective action. The quality of a University of Florida education is dependent upon community acceptance and enforcement of the honor code.

**The Honor Pledge: We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.** On all work submitted for credit by students at the university, the following pledge is either required or implied: **"On my honor, I have neither given nor received unauthorized aid in doing this assignment."**

The university requires all members of its community to be honest in all endeavors. A fundamental principle is that the whole process of learning and pursuit of knowledge is diminished by cheating, plagiarism and other acts of academic dishonesty. In addition, every dishonest act in the academic environment affects other students adversely, from the skewing of the grading curve to giving unfair advantage for honors or for professional or graduate school admission. Therefore, the university will take severe action against dishonest students. Similarly, measures will be taken against faculty, staff and administrators who practice dishonest or demeaning behavior.

### **STUDENT RESPONSIBILITIES**

Students should report any condition that facilitates dishonesty to the instructor, department chair, college dean or Student Honor Court.

More information about student responsibilities is available online at:

<http://cals.ufl.edu/faculty-staff/docs/cc/forms/Syllabus%20Statements%2013-14.pdf>

### **STUDENT COMPLAINTS**

Each online distance learning program has a process for, and will make every attempt to resolve, student complaints within its academic and administrative departments at the program level. See <http://distance.ufl.edu/student-complaints> for more details.

**UF COUNSELING SERVICES:** Resources are available on-campus for students having personal problems or lacking clear career and academic goals which interfere with their academic performance. These resources include: 1) University Counseling & Wellness Center – 3190 Radio Road,, 352-392-1575, or [www.counseling.ufl.edu/cwe/](http://www.counseling.ufl.edu/cwe/) for personal and career counseling; 2) Student Mental Health, Student health Care Center, 352-392-1171, personal counseling, 3) Sexual Assault Recovery Services (SARS), Student Health Care Center, 352-392-1161, sexual assault counseling, and 4) Career Resource Center, Reitz Union, 352-392-1601, career development assistance and counseling.

**SOFTWARE USE:** All faculty, staff, and students of the University of Florida are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

**STUDENTS WITH DISABILITIES:** The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation

0001 Reid Hall, 352-392-8565, [www.dso.ufl.edu/drc/](http://www.dso.ufl.edu/drc/)

## TOPIC OUTLINE OF SOIL QUALITY

### Chapter 1. Definition and Concepts

#### 1.1. What is soil quality?

Soil quality is the capacity of the soil to function within the ecosystem boundaries to sustain biological productivity, maintain environmental quality, and promote plant and animal health (Soil Sci. Soc. Am, 1997). Soil quality is a measure of the conditions of soil relative to the requirement of one or more species and /or to any human need or purpose (Johnson et al., 1997; Lal, 1997; Doran et al., 1998). Soil quality consists of physical, chemical, and biological components.

#### 1.2. Why do we need soil quality concept?

The importance of developing the concept of soil quality was enhanced because of the need to apply soil science to address the problems of nonagricultural uses of soil (e.g., mineland restoration, urban uses and disposal of urban wastes, soil contamination and pollution by industrial activities, athletic and recreational uses of soil, and environmental regulatory functions with particular reference to water quality and the greenhouse effect). A strong need, therefore, arose to develop appropriate indicators of soil quality in relation to specific soil function (e.g., agricultural, urban, industrial, recreational, athletic, environmental, and waste disposal).

#### 1.3 How do we evaluate soil quality?

#### 1.4 What are the potential applications of soil quality in agriculture, food and environment?

### Chapter 2. Soil Components and Basic Soil Quality Properties

#### 2.1. Soil development and quality changes

#### 2.2. Soil components

##### 2.2.1 Inorganic components

Primary minerals

Clay minerals

Oxides

##### 2.2.2 Organic components

Organic matter

Humus

Soil organisms

#### 2.3. General soil quality attributes

##### 2.3.1 Soil texture

##### 2.3.2 Soil reactions

##### 2.3.3 Soil charges

- 2.3.4 Ion exchange
  - 2.3.5 Buffering capacity
  - 2.3.6 Adsorption-desorption
  - 2.3.7 Microbial turnover
  - 2.3.8 Nutrient cycling
- Chapter 3. Soil Quality Indicators
- 3.1. What are soil quality indicators?
  - 3.2. Physical indicators
  - 3.3. Chemical indicators
  - 3.4. Biological indicators
- Chapter 4. Soil Quality Assessment
- 4.1. The need of soil quality assessment
  - 4.2. Approaches of soil quality assessment
  - 4.3. Procedures of soil quality assessment
  - 4.4. Site selection
  - 4.5. Identification of soil quality attributes
  - 4.6. Soil quality indexing
- Chapter 5. Measurements of Soil Quality Indicators
- 5.1. Soil sampling
  - 5.2. Physical Parameters
    - Soil texture
    - Depth of soil and rooting
    - Soil bulk density and filtration
    - Water holding capacity
    - Water retention characteristics
    - Water content
  - 5.3. Chemical Parameters
    - Total organic C and N
    - pH
    - Electrical conductivity
    - Labile nutrients and metals
    - Labile contaminants
  - 5.4. Microbiological and Biochemical Parameters
    - Microbial biomass C and N
    - Potentially mineralizable N
    - Soil respiration
    - Enzyme activity
    - Microbial quotient
    - Microbial respiration quotient
- Chapter 6. Soil Quality Management for Plant Production: Part I. Soil quality factors
- 6.1 Plant nutrients
  - 6.2 Nutrient availability
  - 6.3 Chemical quality factors
  - 6.4 Biological quality factors

Chapter 6. Soil Quality Management for Plant Production: Part II. Processes and management

- 6.5 Objectives of soil quality management
- 6.6 Management strategies
- 6.7 Management criteria
- 6.8 Land use and soil quality
- 6.9 Soil quality indexing of plant production
- 6.10 Soil erosion
- 6.11 Quality restoration of eroded soils
- 6.12 Soil acidification
- 6.13 Quality improvement of acid soils

Chapter 7. Management of Soil Quality for the Environment: Water Quality

- 7.1 Soil and water quality relationship
- 7.2 Nutrient and contaminant transport and surface water quality
- 7.3 Surface runoff and leaching
- 7.4 Phosphorus cycle
- 7.5 Soil biogeochemistry of phosphorus
- 7.6 Phosphorus management for water quality
- 7.7 Nitrogen cycle
- 7.8 Ammonia volatilization
- 7.9 Nitrate leaching and ground water quality
- 7.10 Nitrogen management for water quality
- 7.11 Heavy metals and pesticides

Chapter 8. Soil Quality Management for Air Quality

- 8.1 Greenhouse effects and soil quality
- 8.2 Soil carbon pools
- 8.3 Soil carbon sequestration
- 8.4 Conservation reserve program and carbon sequestration
- 8.5 Nitrogen emissions
- 8.6 Soil nitrogen losses and soil quality
- 8.7 Soil quality management to reduce nitrogen losses

Chapter 9. Soil Quality Management for Plant Health

- 9.1 Nutrient need for healthy plants
- 9.2 Nutrient deficiencies
- 9.3 Plant toxicity
  - Al, Mn and Fe
  - Heavy metal
- 9.4 Water stresses
  - Water supplying conditions
  - Flooding effects
- 9.5 Other soil constraints for plant Health
- 9.6 Optimal fertilization and irrigation



9.7 Soil quality evaluation for plant health

Chapter 10. Soil Quality Management for Animal Health

- 10.1 Essential elements for animal health and growth
- 10.2 Forage quality and animal production
- 10.3 Nutrient imbalance
- 10.4 Toxic effects of heavy metals
- 10.5 Other contaminants
- 10.6 Soil quality evaluation for animal health

Chapter 11. Soil Quality Management for Food Security

- 11.1 Food chain principles
- 11.2 Human nutrition and food
- 11.3 Food chain contamination: heavy metals and pesticides
- 11.4 Micro-nutrients, from soil to food
- 11.5 Soil quality management of quality food production
- 11.6 Soil quality evaluation for food security

## **BIBLIOGRAPHY**

Soil Quality Websites: <http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>

### **Books**

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