**The University of Jordan**

**Faculty of Agriculture Department of Land, Water and Environment**

**Program: 2013-2014/Spring Semester**

**Plant-Soil-Water Relationships (634321)**

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| **Credit hours** | 3 | **Level** | Third or fourth year | **Pre-requisite** |  |
| **Coordinator/ Lecturer** | Prof. Ayman Suleiman | **Office number** | 124 | **Office phone** | 22377 |
| **Course website** |  | **E-mail** | ayman.suleiman @ju.edu.jo | **Place** | Faculty of Agriculture |
| **Time** | 14:00 – 15:00 Sun, Tue &Thur |  |  |  |  |

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| --- | --- | --- | --- | --- | --- |
| **Office hours** | | | | | |
| **Day** | **Sunday** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** |
| **Time** | 10 – 11 am | - | 10 – 11 am | - | 10– 11 am |

**Course Description**

This course is concerned with the movement of water in the soil-plant-atmosphere continuum and the impact of soil water on plant growth. The overall aim of the course is to provide the student with a solid background in the basic concepts of water properties and water dynamics within soil and plant. Water properties and its role in the plant, functions and properties of aqueous solutions, components of water potential, methods of measuring water status, water in soils, roots and root growth, movement of water in the soil-plant-atmosphere continuum, evapotranspiration, water use efficiency and plant response to water deficit.

**Learning Objectives**

1. To enable the student to develop mathematical and quantitative skills needed to solve applied problems in Plant-Soil-Water Relations.
2. To provide the student with required background in soil, water, plant and atmosphere interactions.
3. To enable the student to quantify the main water properties and flow processes within the soil-plant-atmosphere continuum

**Intended Learning Outcomes (ILOs):**

Successful completion of the course should lead to the following outcomes:

## A) Knowledge and Understand in: Student is expected to understand the

A1. Importance of water for plant growth at different spatial scales and the water properties that make water so important.

A2. Mechanisms and flow paths associated with movement of water in the soil-plant-atmosphere continuum.

A3. Soil physical properties that influence water storage in the soil profile.

A4. Importance of roots and their growth

A5. Methods to measure water availability and water potential components.

A6. Different factors that impact actual, crop and reference evapotranspiration.

## B) Intellectual Skills: Student is expected to understand the

B1. Implementation of different approaches for solving mathematical problems related to plant-soil-water relations.

B2. Examination of the different components of water balance within soil-plant-atmosphere continuum

B3. Analysis of fate and transport of mass and energy within soil-plant-atmosphere continuum.

**C) Subject Specific Skills:** Student is expected tounderstand the

C1. Implementation of mathematical and physical background in plant-soil-water relations.

C2. Computation of actual, crop and reference evapotranspiration

C3. Determination of water use efficiency.

**D) Transferable Skills:** Student is expected tounderstand the

D1. Adoption of scientific approach for understanding plant-soil-water relations.

D2. Ability to write scientific reports for some assignments and to work in team to solve scientific problems.

# ILOs: Learning and Evaluation Methods

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| **ILO/s** | **Learning Methods** | **Evaluation Methods** |
| **A**. Knowledge and Understanding (**A1-A6**) | Lectures, discussions and assignments | Quizzes and Exams |
| **B**. Intellectual Analytical and Cognitive Skills (**B1-B3**) | Lectures, discussion and assignments | Quizzes and Exams |
| **C**. Subject Specific Skills (**C1-C3**) | Lectures, discussion and assignments | Quizzes and Exams |
| **D**.Transferable Key Skills (**D1-D2**) | Lectures, discussion and assignments | Quizzes and Exams |

**Course Contents**

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| --- | --- | --- | --- |
| **No. of 1 hour lecture (s) /Week** | **Subject** | **Sources** | **ILOs** |
| **2 / 1st wk** | 1. Introduction  * Historical Review * Early research * The work of Stephen Hales in 1727 * The century after Hales * The second half of the 19th century * The 20th century | Kramer and Boyer 1995 (Chapter 1) | **A1** |
| **5/ 1nd, 2rd 3th wk** | 1. Functions and properties of water  * Ecological Importance * Physiological Importance * Functions of Water in Plants * Properties of pure water * Properties of Aqueous Solution | Kramer and Boyer 1995 (Chapter 2) | **A1, D1, D2** |
| **3/ 3th and 4th wk** | 3. Soil water potential  - Forms of energy  - Total soil water potential and its components | Scott 2000 (Chapter 8) | **A3,A5,B3,D1,D2** |
| **9/4th , 5th 6th and 7th wk** | 4. Soil and Water   * Important characteristics of soils * Soil water terminology * Water movement within soils * Measurements of soil water * Control of soil water | Kramer and Boyer 1995 (Chapter 4) | **A3,A5,B2,B3,D1,D2** |
| **6/7th , 8th and 9th wk** | 5. Cell water relations   * Cell Structure * Osmosis * Water status * Mechanism of osmosis * Changes in water status * Water transport * Rate of dehydration and rehydration * Osmotic adjustment * Water relations of cells in tissues | Kramer and Boyer 1995 (Chapter 3) | **A2,B1,B2,C1,D1,D2** |
| **3/9th and 10th wk** | 6. Roots and root systems   * Functions of roots * Root growth * The absorption zone of roots | Kramer and Boyer 1995 (Chapter 5) | **A4,B1, D1,D2** |
| **3/10th and 11th wk** | 7. The absorption of water   * Absorption mechanisms * Characteristics of root pressure exudation * Factors affecting water absorption through roots | Kramer and Boyer 1995 (Chapter 6) | **A2,A4,B3,D1,D2** |
| **9/11th , 12th , 13th and 14th wk** | 8. Evapotranspiration   * Importance of evapotranspiration * The process of transpiration and evaporation * Other factors affecting transpiration and evaporation * Measurements of transpiration and evaporation * Measurements of transpiration and evaporation | Kramer and Boyer 1995 (Chapter 7) | **A6,B1,B2,C1,D1,D2** |
| **3/14th and 15th wk** | 9. Water use   * Definition of water use efficiency * Crop yield and transpiration * Factors affecting water use efficiency | Scott 2000 (Chapter 12) | **C3,D1,D2** |
| **3/15th and 16th wk** | 10. Plant response to water deficit   * Drought-stresses plants * Effect of water stress on plant productivity | Scott 2000 (Chapter 12) | **C3,D1,D2** |
| **16th wk** | Exam week | Final Exam as scheduled by the University registration |  |

**Learning Methodology**

# Question and answer teaching method will be used in this course; therefore, the students are encouraged to participate in classroom discussions. All study material will be circulated electronically, made available at the instructor’s website. The lectures will focus on comprehensive understanding of the course material and problem solving. The homework problem sets are designed to help the students to widen their understanding of the course material and practice their problem solving skills. The students will have the opportunity to demonstrate their newly acquired knowledge through a series of quizzes.

# Evaluation

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| **Evaluation** | **Point %** | **Date** |
| **Midterm Exam** | 30 | 6/4/2014 |
| **Quizzes and homework** | 20 | Homeworks will be assigned after each topic. Each homework is followed by a quiz |
| **Final Exam** | 50 | Exam week |

**Main Reference/s:**

Kramer, P.J. and J.S. Boyer. 1995. Water Relations of Plants and Soils. Academic Press, New York.

Scott, H. D., 2000, *Soil Physics: Agricultural and Environmental Applications*.

**Grading Scale**

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| --- | --- | --- | --- | --- |
| From (%) | To (%) | Scale | Letter Grade | Result |
| 86 | 100 | 4 | A | Excellent |
| 83 | 85 | 3.75 | A- | Excellent |
| 77 | 82 | 3.5 | B+ | Very Good |
| 74 | 76 | 3.0 | B | Very Good |
| 71 | 73 | 2.75 | B- | Very Good |
| 65 | 70 | 2.5 | C+ | Good |
| 62 | 64 | 2.0 | C | Good |
| 59 | 61 | 1.75 | C- | Good |
| 53 | 58 | 1.25 | D+ | Accepted |
| 50 | 52 | 1.00 | D | Accepted |
| 36 | 49 | 0.75 | D- | Fail |
| 0 | 35 | 0 | F | Fail |

**Notes and class room policies**

* Regular and timely attendances are expected from all students. University regulations concerning class attendance will apply
* The students are expected to submit homework in due time, a late submission will not be accepted
* Exams absentees are allowed to write makeup exams only if an acceptable and documented excuse is provided; for example, a medical report. Makeup exam are usually more difficult than regular exams
* Zero tolerance for cheating and plagiarism
* For more details on University regulations please visit: <http://www.ju.edu.jo/rules/index.htm>