**The University of Jordan**

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

**Program: 2015-2016/First semester**

**Hydrology (0604212)**

**-----------------------------------------------------------------------------------------------------------**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Credit hours** | 3 | **Level** | Third or Fourth year | **Pre-requisite** |  |
| **Coordinator/ Lecturer** | Dr. Michel Rahbeh | **Office number** |  | **Office phone** | 22442 |
| **Course website** | http://www2.ju.edu.jo/sites/academic/m.rahbeh/default.aspx | **E-mail** | m.rahbeh@ju.edu.jo | **Place** |  |
| **Time** | 8:00 – 9:30 pm Mon, Wed |  |  |  |  |

|  |
| --- |
| **Office hours** |
| **Day/Time** | **Sunday** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** |
| **Day** | - | \* | - | \* | - |
| **Time** | - | 10:00 a.m. -12 p.m | - | 10:00 a.m. -12 p.m | - |

**Course Description**

This course focuses on the measurement and quantification of the major components of the hydrological cycle and the basic understanding of the related physical processes and their interactions. The water cycle will be introduced and then the student will follow the water movement from the lower atmosphere to upper altitudes where it condenses and return back to the earth surface as precipitation. Quantification of precipitation intensities and areal precipitation averages will be discussed, followed by a discussion of the solar energy balance in the context of evapotranspiration. During the course students will learn how to estimate the infiltration, canopy and other abstraction on a watershed scale. The learning activities also includes the isolation of base flow from streamflow , derivation of unit hydrograph and determination of runoff using unit hydrograph and synthetic unit hydrograph. If time permits GIS based hydrological model will be introduced.

**Learning Objectives**

1. This course provides the students with the necessary knowledge to describe the hydrological cycle and the interaction between its components.
2. Quantification of the major components of the hydrological cycle

**Intended Learning Outcomes (ILOs):**

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

**A. Knowledge and Understanding:** Student is expected to

**A1.** Describe the water cycle

**A2.**Befamiliar with the terminology commonly used in the hydrology literature

**A3.**Differentiate and characterize the different types of the precipitation

**A4.**Describe the runoff generation processes

**A5.**Describe the solar energy balance and its role in hydrology

**A6.**Describe the principles behind the evapotranspiration equations

**A7.**Understand the parameters used in description and quantification of water vapour.

**B. Intellectual Analytical and Cognitive Skills:** Student is expected to

**B1.**Explain the interaction between the different components of the hydrological cycle

**B2.**Explain the reasons for spatial variability of rainfall

**B3.** Understand the methods used for the isolation of baseflow from streamflow

**B4.**Understand how air density and atmospheric pressure respond to altitude and temperature changes.

**C. Subject- Specific Skills:** Student is expected to

**C1**.Formulate a simple water balance equation

**C2.**Carry out basic calculations such as water volumes, rates and discharges

**C3.**Determine the average areal rainfall

**C4.** Determine infiltration depth and canopy and other abstractions

**C5.**Determine the evapotranspiration rates.

**C6.** Derive a unit hydrograph

**C7.** Change the time interval of the unit hydrograph

**C8**. Construct a synthetic unit hydrograph

**C9.**Determine the air density, saturated and actual vapour pressure.

**D. Transferable Key Skills:** Students is expected to

**D1.**Subjectively select the appropriate coefficients (SCS-CN) for the determination of runoff.

**D2.**Determine runoff at ungauged catchments

**D3.**  Select the appropriate parameters from a meteorological record for the determination of evapotranspiration.

**D4.**Determine missing precipitation values

# ILOs: Learning and EvaluationMethods

|  |  |  |
| --- | --- | --- |
| **ILO/s** | **Learning Methods** | **Evaluation Methods** |
| **A**. Knowledge and Understanding (**A1-A6**) | Lectures, discussions and homeworks | Exams |
| **B**. Intellectual Analytical and Cognitive Skills (**B1-B4**) | Lectures, discussion and homeworks | Exams |
| **C**. Subject Specific Skills (**C1-C8**) | Lectures, discussion and home works | Exams |
| **D**.Transferable Key Skills (**D1-D3**) | Lectures, discussion and homeworks | Exams |

**Course Contents**

|  |  |  |  |
| --- | --- | --- | --- |
| **No. of 1.5 hour lecture (s) /Week** | **Subject** | **Sources** | **ILOs** |
| **3/ 1stwk** | Introduction* Definition of hydrology
* Hydrological cycle
* Water balance equations
 | Chow et al. 1988 (Chapter 1) | **A1,A2, B1, C1** |
| **7/ 2nd, 3rd, 4thwk** | Atmospheric water* Vapor pressure
* Water vapor
* Precipitable water
 | Chow et al. 1988 (Chapter 3) | **A2, A7, B4, C9,D3** |
| **6/5thand 6th wk** | Precipitation* Formation
* Types
* Measurements
* Areal averages
 | Chow et al. 1988 (Chapter 3 and 6) | **A2,A3,B2,C3,D4** |
| **4/7thand 8th wk** | Infiltration and storm abstractions * The process of infiltration
* φ-index
 | Chow et al. 1988 (Chapter 4) | **A1,A2,A4,B1,C4,D1** |
| **1/8th wk** | Midterm Exam  |  |  |
|  |  |  |  |
| **3/9th and 10thwk** | Infiltration and storm abstractions (cont’d)* Soil Conservation Services (SCS) method
 | Chow et al. 1988 (Chapter 4) | **A1,A2,A4,B1,C4,D1** |
| **9/11th,12th,13thand 14thwk** | Streamflow * Sources of streamflow; overland flow, subsurface flow and base flow
* Runoff generation
* Streamflow hydrograph
* Base flow separation
* Derivation of the unit hydrograph
* Construction of the synthetic unit hydrograph
 | Chow et al. 1988 (Chapters 4,5,6,7) | **A1,A2,A4,B1,B3,C2,C6,C7,C8,D1,D2** |
| **3/15th wk** | Evaporation and plant transpiration* Energy balance
* Combination method
* Potential evapotranspiration
 | Chow et al. 1988 (Chapter 3), Allen et al. 1999 | **A2,A5,A6,C5,D3** |
| **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.

# Evaluation

|  |  |  |
| --- | --- | --- |
| **Evaluation** | **Point %** | **Date** |
| **Midterm exam** | 30 | November 18, 2015 |
| **Quizzes and home works** | 20 | Home works will be assigned after each topic.  |
| **Final Exam**  | 50 | Exam week  |

**Main Reference/s:**

Chow, V. T., Maidment, D. R. and Mays, L. W. 1988. *Applied hydrology*. McGraw-Hill

# References:

Allen, R. G.,Pereira, L. S., Raes, D. and Smith, M. 1998. *FAO Irrigation and drainage paper NO. 56: Crop Evapotranspiration (guidelines for computing crop water requirement.* FAO, Water resources, development and management services, Rome Italy.

**Suggested Grading Scale**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| From (%) | To (%) | Scale | Letter Grade | Result |
| 86 | 100 | 4 | A | Excellent |
| 83 | 85 | 3.75 | A- | Excellent |
| 80 | 82 | 3.5 | B+ | Very Good |
| 74 | 79 | 3.0 | B | Very Good |
| 71 | 73 | 2.75 | B- | Very Good |
| 68 | 70 | 2.5 | C+ | Good |
| 62 | 67 | 2.0 | C | Good |
| 59 | 61 | 1.75 | C- | Good |
| 56 | 58 | 1.25 | D+ | Accepted |
| 50 | 55 | 1.00 | D | Accepted |
| 47 | 49 | 0.75 | D- | Fail |
| 0  | 46 | 0 | F | Fail |

**Tips for Success**

* Results from previous semesters showed that successful student are those who attendedthe classes regularly.
* Solve all your homeworks yourself, it’s worth the effort. Consider the following popular saying**: "**Ihear and I forget. I see and I remember. ***I do and I understand***."

**Notes and class room policies**

* Regular and timely attendancesare expected from all students. University regulations concerning class attendance will apply
* The students are expected to submit homeworks in due time, a late submission will result in 20% deduction of the homework grade and will not be accepted once the key answers are provided
* Exams absentees are allowed to write makeup exams only if an acceptable and documented excuse is provided; for example, a medical report. Makeup exams are usually more difficult than regular exams
* Use of cell phone in prohibited
* Zero tolerance for cheating and plagiarism
* For more details on University regulations please visit: <http://www.ju.edu.jo/rules/index.htm>