**The University of Jordan**

**Faculty of Agriculture,**

**Department of Land, Water and Environment**

**2013-2014/First semester**

**Applied Hydraulics (0644211)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Credit hours** | 3 | **Level** | Third year | **Pre-requisite** |  |
| **Coordinator/ Lecturer** | Dr. Muhammad Shatanawi | **Office number** | 279 | **Office phone** | 22441 |
| **E-mail** | shatanaw@ju.edu.jo | **Place** | 188 |  |  |
| **Course website** | http://www2.ju.edu.jo/sites/academic/shatanaw/default.aspx |
| **Time** | 9:30-11:00 a.m. Mon, Wed |  |  |  |  |

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| --- |
| **Office hours** |
| **Day/Time** | **Sunday** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** |
| **Day** | - | \* | - | \* | - |
| **Time** | - | 11:00 -12:00 | - | 11:00 -12:00 | - |

**Course Description**

This course is designed to be given to non engineering students in the field of land and water, soils and irrigation, natural resources and water resources. It combines fluid mechanics and hydraulic engineering courses in a simple applied course. This course covers basic fluid mechanics and hydraulics, including the physical proprieties of fluid, the calculation of pressures and forces exerted by static fluids and the principles of conservation of mass, energy and momentum. In addition, it covers Bernoulli’s principle and the use of various energy loss equations. The hydraulic principles will applied to understanding and solving problems related to: flow in pipes and pipe networks, characteristics and selection of pumps, uniform and non-uniform flow in open channel and flow measurement. Topics such as hydraulics of groundwater and dimensionless analysis will be covered if time permits

**Learning Objectives**

* Provide students with the basic knowledge needed for understanding other courses such as irrigation system design, watershed management and flow in open channels.
* Qualify student to design water system, pipe networks and small hydraulic structure used in the agricultural production.
* Make student aware of the pipe materials, pumps and other fittings available in the markets and used for the design of irrigation delivery systems and wells.
* Calculate water surface profile for gradually varied flow and rapidly varied flow like hydraulic jump, weirs etc.
* Create imaginative thinking and innovation by using mathematic and physics in solving basic conservation equations and dimensionless analysis.
* Qualify students to design reservoirs and other hydraulic structure under static conditions.

**Intended Learning Outcomes (ILOs):**

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

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

**A1.** Be familiar with the units commonly used in Hydraulics

**A2.** Understand the physical properties of fluids

**A3.** Differentiate between absolute and gauge pressures.

**A4.** Understand how to calculate pressure using manometers.

**A5.** Describe the terms in the energy equation.

**A6.** Describe the principles of friction and local head loss in pipes

**A7.** Understand the parameters used in the design of open channels..

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

**B1.** Explain the interaction between properties of fluid.

**B2.** Explain the changes in pressure with elevation

**B3.**  Describe the forces associated with pressures under static conditions.

**B4.** Understand head loss in pipes and relate it to the energy equation.

**B5.** Solve open channels problems using iterative methods and spread sheet.

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

**C1**. Determine the magnitude and location of pressure forces on surfaces.

**C2.** Determine the pressure in a pipe system using manometers

**C3.** Understand and sketch the energy and hydraulic grade lines.

**C4.** Carry out basic calculations such as friction factor, pipe diameter, head loss and discharge.

**C5.**  Select the appropriate pump based on the characteristics curve.

**C6.** Determine the dimensions of open channels based on friction, slope and flow rate

**C7.** Derive the specific energy principles in open channels

**C8.**  Calculate the water surface profile and determine their types.

**C8**. Construct a synthetic unit hydrograph

**C9.** Differentiate between gradually and rapidly varied flow.

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

**D1.** Subjectively select the appropriate friction loss factor using Moody diagram..

**D2.** Determine pipe sizes in branching and parallel systems

**D3.**  Select the appropriate location of pumps based net positive suction head,

**D4.** Identify the value of Manning n based on the canal surfaces.

**D5**. Identify the type of the water surface profile.

# ILOs: Learning and Evaluation Methods

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| --- | --- | --- |
| **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** |
| **2 / 1stwk** | Properties of Fluids* Units used in Hydraulics
* Physical properties of fluids
* Surface tension and capillarity
* Forces in a fluid field
 | Houghtalen, R. J, 2010 (Chapter 1) | **A1,A2, B1, C1** |
| **4/ 2nd, 3rdwk** | Water pressure and pressure forces* Absolute and gauge pressure
* Manometers
* Hydrostatic forces on flat surfaces
* Buoyancy and flotation
 | Houghtalen, R. J, 2010 (Chapter 2) | **A2, A7, B4, C9,D3** |
| **4/4thand 6thwk** | Fluids in motion * Velocity and flow rate
* Classification of fluid flow
* Conservation of energy
* Bernoulli and energy equations
* Conservation of momentum
 | Evett and Liu, 1988 (Chapter 5) | **A2,A3,B2,C3,D4** |
| **5thwk** | El Eid Holiday | 18/11/2013 |  |
|  | First Exam |  |  |
| **8/7th 8th 9th and 10th**  | Water flow in pipes* Description of pipe flow
* Flow regimes
* Energy in pipe flow
* Friction head loss in pipes.
* Equations for friction head loss.
* Local loss in pipe system.
* Branching of pipe systems
* Solving pipeline problems
* Introduction to water hammer.
 | Houghtalen, R. J, 2010 (Chapter 3) | **A2,A5,A6,C5,D3** |
| **4/11thand 12thwk** | Water pumps* Classification of pumps
* Centrifugal pumps
* Pump characteristics curves.
* Pumps in parallel or in series
* Pumps and pipe systems.
* Cavitations in water pumps.
* Pump selection
 | Houghtalen, R. J, 2010 (Chapter 4) | **A1,A2,A4,B1,C4,D1** |
|  | Second Exam | 25/12/2013 |  |
| **8/13,14 and 15thwk** | Water flow in open channels* Classification of flow
* Uniform flow in open channels
* Open channels flow formulas
* Energy in open channels
* Hydraulic jump.
* Nonuniform flow in open channels.
* Classification of gradually varied flow.
* Computation of water surface profiles.
 | Houghtalen, R. J, 2010 (Chapter 6) | **A1,A2,A4,B1,B3,C2,C6,C7,C8,D1,D2** |
| **16thwk** | 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

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| --- | --- | --- |
| **Evaluation** | **Point %** | **Date** |
| **First Exam**  | 15 | 11/11/2013 |
| **Second Exam** | 15 | 11/12/2013 |
| **Class room participation** | 5 | Throughout the semester |
|  **homework** | 15 | Homeworks will be assigned after each topic. |
| **Final Exam**  | 50 | Exam week |

**References:**

* Houghtalen, R. J., Hwang N. H.C. and Akan A. O.; 2010, Fundamentals of Hydraulic Engineering systems, 4th edition; Pearson. (text book)
* Evett J.B. and Liu Ch. , Fundamental of Fluid Mechanics; McGraw-Hill

# Other references:

* Street, R., G. Watters and J. Vennard; 1997, Fundamental of Fluid Mechanics; 7th edition, Wiley

**Grading Scale**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 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 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
* Zero tolerance for cheating and plagiarism
* For more details on University regulations please visit: <http://www.ju.edu.jo/rules/index.htm>