CIV ENGR 416: Water Resource Systems Analysis

Tuesday and Thursday 11:00 – 12:15. 3 credits

Instructor: Dr. Paul Block
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Office Hours: by appointment

Course Description:
This course presents a variety of systems analysis techniques for water resources planning and management. Deterministic and stochastic optimization and simulation models will be developed and applied. Problems addressed include water supply, water quality, and river basin development.

Course Learning Outcomes:
By the conclusion of the course, students should be able to:

a) characterize planning, design, and management objectives in water systems
b) understand optimization and simulation concepts and modeling
c) formulate, design and solve optimization models of water systems
d) integrate systems outputs into decision-making
e) understand the fundamentals of economic theory as applied to water resources
f) understand current issues in water resource management

Additionally, graduate students should also be able to:

g) proficiently write software codes to perform analyses
h) determine multiple performance metrics and subsequently draw suitable conclusions
i) rigorously address and account for uncertainty and probabilistic outcomes

Pre-requisites: Hydrology and Statistics (preferred)

Texts:
Water Resource Systems Planning and Management: An Introduction to Methods, Models and Applications, Loucks and van Beek. Free online at:
http://hdl.handle.net/1813/2804

Practical Optimization: A Gentle Introduction, Chinneck. Free online at:
http://www.sce.carleton.ca/faculty/chinneck/po.html

Water Resources Economics: The analysis of scarcity, policies and projects, Griffin. Available through UW library: http://search.library.wisc.edu/catalog/ocm68176078

Notes:
Lecture power-points will be posted to the course website.

Evaluation:		**Expected Grade Breaks:**	
Participation:	5%	A: 100-92	AB: 92-88
Homework:	35%	B: 88-82	BC: 82-78
Reflections:	10%	C: 78-70	
Final Project:	50%	D: 69-60	
		F: 59-0	

Graduate students will be evaluated separately from undergraduate students on Homework and Final Projects, as detailed below.

Participation:
Parts of the course will include group work, class discussion, and role-playing, thus participation will be critical to advance the learning objectives. All students are expected to regularly participate, in a reasonable manner, during each session. Clearly, attendance is required for full participation.

Homework:
Homework will be assigned throughout the course and typically due 2 weeks later. It will be posted on the course website, and will include creative problem solving, computer modeling, and critical thinking. *For each Homework assignment, graduate students may be required to complete additional problems of a critically challenging nature. Typically this will be an extension of the questions assigned to all students, requiring additional code writing and/or modeling, analyses, and interpretation.*

Reflections:
Students are expected to come to class having completed the assigned readings, ready for discussion. In addition to this, each student must complete reflections for three (3) readings as assigned, and submit a one-half to one page document reflecting and commenting on the reading. This should *not* be a summary of the reading but rather your impressions and conclusions. Reflections are due on the assigned day of the reading. Readings or links to readings will be posted on the course website.

Final Project:
Students will complete a final project in small groups (~3 students), culminating in a presentation. Projects must encompass aspects of the course materials presented. Topic ideas and project expectations will be posted on the course webpage early in the term. Other topics may be selected with the instructor's consent. Various deadlines (topic selection, prospectus, etc.) will need to be met. More details will be given in class. *Graduate students will be required to add at least one additional component to the Final Project, as will be detailed in class, and perform in-depth development and analysis beyond that expected at the undergraduate level.*

Course Outline:

Date	*Topic*	*Reading*		*Assign. Due*
Jan 17	Introduction to Systems & Models	1		
Jan 19	Problem formulation	2	1	
Jan 24	Simulation modeling	3,7		
Jan 26	Optimization concepts & Linear Programming (LP)	3	2	
Jan 31	LP - simplex	4.5	3-6	HW1
Feb 2	LP - modeling tools	5.5	3-7	
Feb 7	LP - modeling tools	6.5	3-8	Reflection1
Feb 9	LP - multiobjective	7.5	3-9	
Feb 14	LP - case study	8.5	3-10	
Feb 16	Integer Programming	4.3	16-19	
Feb 21	Non-linear Programming	4.3	16-19	HW2
Feb 23	*no class*			
Feb 28	Non-linear programming	4.3	16-19	Reflection2
Mar 2	Dynamic programming	4.4	15	
Mar 7	Dynamic programming	4.4	15	
Mar 9	Dynamic programming	4.4	15	HW3
Mar 14	Stochastic optimization	8.4,8.5		
Mar 16	Decision analysis	10		Reflection3, Project Idea
Mar 19, 21	*spring break*			
Mar 28	Decision analysis	10		HW4
Mar 30	Performance measures	10		Prospectus
Apr 4	Performance measures, negotiation	10		
Apr 6	HydroEconomics	HO		
Apr 11	Wicked problems	HO		
Apr 13	Wicked problems	HO		HW5
Apr 18	*no class*			
Apr 20	Guest Lecture			
Apr 25	*no class*			
Apr 27	Guest Lecture			
May 2	Final presentations			
May 4	Final presentations			Project Rpts

* First *Reading* column = Loucks book; second *Reading* column – Chinneck book.
** Readings for *Reflections* will be provided in advance of the due date.

Academic Policies:

Class Attendance:
You are expected to attend all lectures and lab sessions. In the event that you will be absent, please email me *in advance* as a courtesy. You will also be responsible for obtaining notes, etc. from a classmate.

Non-discriminating Environment:
The UW-Madison is committed to creating a dynamic, diverse, and welcoming learning environment for all students and has a non-discrimination policy that reflects this philosophy. Disrespectful behavior or comments addressed toward any group or individual, regardless of race/ethnicity, sexuality, gender, religion, ability, or any other difference is deemed unacceptable in this class, and will be addressed by the professor.

Academic Integrity*:*
As a UW-Madison student, you have the right to expect that you and other students will be graded fairly. You also have an obligation to conduct your academic work with honesty and integrity according to University standards. Academic honesty requires that the coursework you present to the professor honestly and accurately represent you own academic efforts. Work submitted under a student's name must be solely the work of that student and be carried out as prescribed by the professor. Additional information from the Dean of Students is available online: http://students.wisc.edu/doso/acadintegrity.html

Students with Disabilities*:*
If you need accommodations for a physical or learning disability, please see me. The McBurney Disability Resource Center (http://www.mcburney.wisc.edu) is available for consultation, diagnosis, and assistance.

The instructor reserves the right to modify this syllabus as circumstances warrant.