CEE 6490: Integrated River Basin / Watershed Planning and Management -- Spring 2016

Class Times and Locations: T/Th 10:30 - 11:45 am (DE 012)
These times are synchronized with CVEEN 7470 (Systems Analysis in Water and Environmental Engineering) taught by Dr. Steve Burian at U of U.

Instructor: David Rosenberg
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Class Website: https://usu.instructure.com/courses/393387

Course Overview

Course Description: This course will introduce students to the basics to plan for and manage U.S. and International river basins considering engineering, economic, environmental, stakeholder, institutional, and legal concerns. Topics include planning approaches, water demand forecasting, water supply and storage alternatives, reservoir management and operations, river basin modeling, and multi-criteria decision analysis. The course has an open, project-type format where students will work in a small group over the semester to identify key management problems and concerns in the Bear River/Great Salt Lake basin, delineate stakeholders and stakeholder goals, choose a stakeholder and define one or more quantitative metrics that represent that stakeholder's satisfaction, and identify potential management alternatives that can improve the stakeholder's satisfaction. Students will also use a river basin systems model to evaluate alternatives according to their defined metric for the stakeholder as well as metrics defined by other groups, characterize tradeoffs, and use results to recommend improved management. Class time will include lectures focused on skills for planning and management, applications of techniques in various river basins, class discussion, an online water management game, joint activities with students in CVEEN 7470 taught by Dr. Steven Burian at the University of Utah, and student presentations of their group project work.

Learning Objectives:

Upon successfully completing this course, you will be able to:

a. Describe and compare the development history, principal water uses, key infrastructure, and major problems of the river basins introduced in lectures and student presentations.
b. Identify + recommend suitable structural and non-structural approaches to manage water supply, flood protection, and environmental water-related problems.
c. Describe and complete at least one iteration of a rational approach to planning.
d. Use Excel, Irrigania, Water Evaluation and Planning (WEAP), multi-objective visualization, and other software to quantitatively and programmatically analyze natural resources management problems.

   i. Forecast water demands
   ii. Calculate water supply metrics from time series data
   iii. Apply principles of game theory and decide how much water to use to irrigate
   iv. Recommend reservoir operations and release policies when given a time-series of historical inflows, water uses, delivery targets, and economic consequences of deliveries and shortages, and
   v. Identify pareto optimal alternatives to water management problems.

e. Identify potential management options, select appropriate quantitative metrics, and quantitatively and qualitatively evaluate identified options against stated metrics.
f. Integrate multiple disciplines including engineering, economics, hydrology, law, social, and environmental considerations as part of river basin management activities.
g. Present work and findings in a variety of formats required of practicing river basin managers, including technical oral presentations, written reports, and webpages/sites.
h. Provide constructive feedback to colleagues on ways to improve the technical content and presentation of their natural resources management work.
i. Work effectively both individually and in small groups.
j. Actively participate in your learning by further identifying, exploring, and characterizing a stakeholder in the Bear River/Great Salt Lake basin, defining a quantitative metric to represent the satisfaction of the selected stakeholder, and evaluating potential alternatives according to the identified quantitative metrics.

Pre-requisites:

- Required: graduate student standing and Microsoft Excel proficiency.
- Recommended: concurrent or prior enrolment in CEE 6410 (Systems Analysis), undergraduate hydrology and microeconomics.

Texts:

- Loucks et al. (2005). *Water Resources Systems Planning and Management: An Introduction to Methods, Models and Applications*. UNESCO [WRSPM, Available free online at http://ecommons.library.cornell.edu/handle/1813/2804]
- Additional required readings to be posted on the class website or distributed in class.

Approximate Grading:

Individual Learning Opportunities (6)		45%
Group Project		50%
Progress report	10%	
Peer review	5%	
Demo of modeling work	5%	
Final report	20%	
Final oral presentation	10%	
Class Participation		5%

CEE 6490 Class Schedule (updated regularly on class webpage)

Date	Topic	Readings	Course Work
Jan 12	Course intro; River basin planning circa 700 AD		
14	Water planning approaches	WRSPM, Intro & ch. 1; Rational planning paper	
19	Water uses and demand forecasting	Baumann, ch. 2+3	
21	Water demand forecasting and management in Utah (Todd Adams, Candice Hasenyager)	Bear River Basin Report	**Group Topic DUE**
26	Irrigania game	Seibert and Vis paper	**ILO-1 DUE**
28	User competition, game theory, U.S. Water Law (Rosenberg, Burian)	Madani paper	
Feb 2	Reliability, resiliency, and vulnerability	WRSPM, ch. 10.4&10.6	**ILO-2 DUE**
4	Modeling to support planning: Great Salt Lake IWRM (Denbleyer)	WRSPM, ch. 2 & 3; Loucks paper	
9	Water storage, reservoirs, and global reach	World Commission on Dams report; Graf paper	**ILO-3 DUE**
11	Single-purpose reservoir operations (Rosenberg)	Loucks, ch. 11.2.2	
16	**No Class (Monday Schedule)**		
18	Reservoir systems (Burian)	Lund & Guzman paper	**ILO-4 DUE**
23	Managing environmental effects of reservoirs	Dams and Rivers report	
25	Other structural and non-structural approaches for water supply (Rosenberg)	Rosenberg and Lund paper	
Mar 1	River basin simulation software (WEAP)	WEAP user's guide	**Progress Report DUE**
3	River basin simulation software lab	WEAP lab	
8	**No Class (Spring Break)**		
10	**No Class (Spring Break)**		
15	Interactive multi-objective visualization	DecisionVis	**ILO-5 DUE; Peer Review DUE**
17	Interactive multi-objective visualization lab	IMO lab	
22	Dam removal	Dam removal report; Graff report	**ILO-6 DUE**
24	Group demos of modeling work		
29	Ground water and conjunctive use	Coe paper	
31	Example management: Colorado River Basin (Schmidt)		

Date	Topic	Readings	Course Work
Apr 5	Planning for climate change & sustainability	Stakhiv paper; Loucks & Sustainability papers	
7	Example management: Indus River Basin (Burian)		
Apr 12	Planning for resiliency		
14	Example management: Jordan River Basin (Middle East) [Rosenberg]		
19	Example mismanagement: Aral Sea		
21	Example mismanagement: Lake Urmia		
26	Class Wrap-up/Review		
28	Project work time		**Wikis DUE**
May 3	**1:30 to 3:20 pm. Final group presentations****		

* Topics highlighted in yellow will be delivered using Interactive Video Conferencing in a joint classroom environment with UU CVEEN 7930 taught by Dr. Steve Burian

** Date/Time of final presentations will be shifted after consultation with students to allow synchronizing with CVEEN 7470.

Description of Required Course Work

Individual Learning Opportunities (ILOs)

Students will complete 6 individual learning opportunities (ILO). Each ILO will pose a problem related to river basin planning and management and focus on engineering calculations, analysis, and/or use of simulation and visualization software. ILOs will also represent several intermediary steps towards completion of the semester group project:

ILO-1. Forecasting water demands
ILO-2. Irrigania game results
ILO-3. Reliability, resiliency, and vulnerability indicators
ILO-4. Simulation of reservoir operations
ILO-5. River basin simulation lab exercise with WEAP
ILO-6. Multi-objective analysis

Turn in the answer to each ILO as a 1-page engineering report or briefing paper. Each report should be fully self-contained to include an introduction to the problem, methods used, results, analysis, recommendations or conclusions so that a technically-versed reader not familiar with the problem statement can understand the rationale for and results of the work presented. The restriction to 1 page is to help develop clear and succinct writing skills (river basin planners and managers are very busy people!). References, figures, tables, and more detailed explanations can be included in appendixes which do not count towards the 1-page limit. Students not satisfied with their performance on an ILO report may revise and resubmit it up to 1 week after I return the ILO report.

Group Project

A large part of the course work will involve a semester-long group project. Groups of up to 3 students will choose a stakeholder in the Bear River basin. Each group will gather background history and information on the stakeholder, identify a current water management problem the stakeholder is facing, identify the objective the stakeholder is working to meet, and propose one or more metrics to quantify achievement towards that objective. Along the way, groups will perform an institutional analysis, collect data, propose one or more structural and/or non-structural management alternatives or solutions to the problem the stakeholder is facing, and use (or expand) the existing Water Evaluation and Planning (WEAP) model for the Lower Bear River system to evaluate the proposed alternatives against the metric(s) defined for the stakeholder the group is representing. Groups will also identify tradeoffs between the quantitative metric for the stakeholder the group represents and metrics defined by other groups for other basin stakeholders. Group project work will comprise the following components:

1. Topic: a paragraph describing stakeholder, group members, and problem(s) to be explored (not graded).
2. Progress report: Submitted in the form of a GitHub repository that summarizes:
    a. stakeholder's type(s) of water uses, current problem(s), stakeholder objectives, and results of an institutional analysis,
    b. available data on stakeholder water demands in the basin
    c. quantitative metric(s) to be used to evaluate the extent to which a management alternative meets the stakeholder's objective(s)
    d. the proposed management alternative(s), and
    e. major findings to date and future steps (for the remainder of the semester)

    Presenting work in the format of a GitHub repository will help facilitate communication among group members and make group work and results available to the rest of the class, future classes, and others. See the River Basin Planning Class Wiki for examples of student projects for prior classes I have taught.
3. Peer review: provide feedback to another group on their progress report. Identify ways they can improve their study and the write-up of their work
4. Demo of modeling work: A first oral presentation that will overview the stakeholder under study and how objectives and performance metrics for the stakeholder are implemented in the model. Demos should also show audience members how to use the model to calculate developed metrics and evaluate alternatives.
5. Final report: Submitted in the form a GitHub repository that synthesizes all project work for the semester. This final repository will continue and expand upon the progress report to describe the proposed management alternative, model results, tradeoffs among quantitative metrics and stakeholder objectives, management recommendations, and major findings. The final GitHub repository must also include electronic copies of model input data, modeling files, and results so that the reader can replicate the work done.
6. Final oral presentation: Overviews work done for the semester and highlights select, key results and findings.

Class Participation

I expect students to read assigned readings ahead of time and come to class and share their impressions of the reading(s) or ask questions on points they did not understand. At times, we

will discuss readings in a seminar format. During lectures or discussions, I pose many questions to the class and will, if needed, call on you individually to ensure everyone participates.

Grading of and Expectations for Submitted Work

Grading will be weighted for course work roughly as listed on page 2.

90 to 100% -- at least some sort of A
80 to 90% -- at least some sort of B
70 to 80% -- at least some sort of C
< 70% -- most probably some sort of F

There is no curve. All submitted work that exceeds standards listed in the grading rubrics will earn an "A".

I will grade all submitted work for technical correctness, organization, presentation, and other criteria according to the Grading Rubric available on the class website for the course work item. I will ask to meet with students who submit low quality work to discuss improvement strategies.

Submitted work must be:

- Original, typed with 1" margins in a standard 12-point font, printed, and stapled (ILOs).
- Have a title page with title, student name(s), date, email address(es), class, and instructor.
- Handed in at the **beginning** of class on the due date listed on the class web page.
- Turned in with duplicate electronic copy and the self-assessment via Canvas.
- Turned in with the self-assessment portion of the Grading Rubric completed.
- Turned in with the Group (and self) Rating Form completed (for group work items).
- For group work, only one paper and Canvas copy need be submitted.
- **I do not accept late assignments.** They will **earn a zero**. In extenuating circumstances (birth/death in the immediate family; grave illness with doctor's note), contact me **prior** to the due date and make alternative arrangements to submit.

Academic Integrity: I expect each student to uphold academic integrity. See http://www.usu.edu/studentservices/studentcode/article6.cfm. For example, USU, the CEE department, and I take plagiarism seriously and I will prosecute offending parties to the full extent of the USU Code. When in doubt, acknowledge sources, cite references, and quote.

Electronic Policies

1. Class Webpage: I will post all class materials to the class webpage including readings, lecture handouts, and descriptions of and grading rubrics for all course work.
2. Canvas: Submit electronic copies of all work and self evaluations to Canvas (to archive).
3. GitHub Repository: Use to post, edit, and communicate content and materials related to group projects. Each student must set up a GitHub account (if do not already have one) and locate the project repository under the group for the class.

4. Email: **Include "CEE 6490" in the subject line** of all email so that I can timely respond to emails. Unless you request otherwise, I may respond to the entire class.

Expectations of Students

- Be on-time to class and ready to learn / participate when class starts.
- Read assigned readings ahead of time and come to class prepared to share your impression(s) of the reading(s) and/or ask questions on points you do not understand.
- Turn off or keep silent all electronic devices that may distract me or other students. I will ask students using phones, pagers, PDAs, music players, etc. to leave class.
- Contribute to class discussions plus be respectful of and listen to other's points of view.
- Turn in all work on time in the required format.
- Bring questions and concerns forward during class, office hours, or by email.
- Put in approximately 2 – 5 hours outside of class for each 1 hour of in-class time.

Expectations of the Instructor

- Start class on time.
- Respect the value of student's time.
- Call equally on all students for class participation.
- Learn student names by some point through the semester.
- Facilitate an environment of inclusivity and non-discrimination.
- Respond to email within 30 hours when I am not traveling out of town.
- Return graded work within 1 week from when work is submitted.

Disability/Special Accommodations

Please talk to me immediately if you require disability or other special accommodations.

Additional Resources for Students

- Partial list of stakeholders in the Bear River Basin (last page of this syllabus)
- List of web sites discussing water conservation and conflict resolution (http://www.engr.usu.edu/cee/faculty/derosenberg/links.htm)
- Class web page: http://www.engr.usu.edu/cee/faculty/derosenberg/cee6490.htm
- Wiki page of current and prior group projects: http://www.engr.usu.edu/wiki/index.php/CEE_6490_River_Basin_Planning
- Instructor's web page: http://rosenberg.usu.edu.

Please direct further questions or concerns about the syllabus or the course to the Instructor by email, in person, or phone

Partial List of Stakeholders in the Bear River Basin to Study for Semester Long Project

(In no particular order)

- Bear River Canal Company
- Box Elder County
- Cache County
- Weber Basin Water Conservancy District
- Jordan Valley Water Conservancy District
- Cache County
- City of Logan
- PacificCorp
- State of Utah
- State of Idaho
- State of Wyoming
- Bear River Commission
- Trout Unlimited
- The Nature Conservancy
- Bear River Migratory Bird Refuge