SUMA PS4145 - Science of Sustainable Water

Instructor: Wade McGillis

1. Course Description

This course covers all topics and material about water. It is a comprehensive introductory water resource class that all sustainable-minded professionals should have. The topics and materials studied in the class strikes a balance for management, business, science, and technical specialists. The sustainability of water has become an increasingly critical issue, and over the coming decade, as awareness and resources go into addressing public health, economics, growing development, climate and weather changes, and aging infrastructure. Water resources are affected by changes not only in climate but also in population, economic growth, technological and scientific changes, and other socioeconomic factors. In addition, they serve a dual purpose; water resources are critical to both human society and natural ecosystems. The objective of this course is to provide a fundamental understanding of key hydrological processes in the natural and built environment. We will then use this understanding to explore aspects of sustainable strategies for integrated water resources management. Case studies will be highlighted throughout the course as well as the practical challenges faced by water practitioners (researchers, water and sustainability policy makers and managers, technologists). Basic quantitative and management skills will be used to answer and solve questions related to water sustainable development. The management of water resources is not only essential in itself, its serves as a hot topic for training in sustainability.

This course satisfies the program's physical dimensions requirement. Students are able to identify the connections between environmental inputs (i.e. natural resources) and outputs (i.e. energy and waste), and their effects on the natural environment. The emphasis in this requirement will be on assessing the environmental impacts from organizational activities. The planning, design or architecture courses give students a foundation in planning, design and spatial issues. This is particularly important, as many sustainability initiatives concern land use, buildings and other physical entities.

2. Course Objectives

Students are expected to understand key components of the water cycle and their relevance for water-resource sustainability, including precipitation, evaporation, groundwater, and surface flow. Students are also expected to become familiar with the fundamental principle of the balance and conservation of water, as it is a basic concept needed to manage sustainably. Sustainability issues in water management will be explored for various regions, including those in both developing and developed countries, and at local to global scales. Students should then be prepared to apply strategies for water-resource management to specific cases studies recognizing socioeconomic and scale issues.

3. Course Content

Basics of the natural water system
Human interventions and uses in the water cycle

Built water infrastructure
Water hazards and health concerns
Water resource management and sustainability
Pricing and trade
Weather and climate connections
Water and climate-resilient development

4. Instruction and Method of Evaluation

Course Requirements - Assignments
The major assignments of the course will include homework assignments, one written test, and a final project and presentation. The homework assignments and exam are both designed to reinforce the basic concepts presented in class and to ensure that students are versed with the key concepts. The objective of the final project is to have student apply the concepts that they explore in class to a practical problem, where sustainable management of water resources is needed. Evaluation of the homework, exam, and project will be based on how well the students demonstrate their knowledge of the material covered in the course.

Evaluation and Grading
The relative contribution of course activity to the total grade for the course:
Homework assignments = 40%
End of semester exam = 20%
Final project and presentation = 20%
Class participation = 20%

The final project should consist of a 10 page report on a study related to sustainable management of water resources. These are team projects with 3-4 classmates.

The project also includes an end of semester presentation. Possible topics will be generated during the first part of the course. Students are allowed to propose study projects, but these need to be discussed and approved. The final project should include analyses and discussions that build on ideas discussed in the course.

5. Resources and Software Packages
Canvas will be used for communication of assignments, exams, course material, and other information throughout the course. Students should be familiar with Microsoft Excel or matlab. The Columbia University Libraries will be primary resources for course material.

6. Readings and Textbooks
All readings will be posted on Courseworks in the 'Syllabus' section. Each session will have its own page, so please be sure to check there before each class for relevant readings and other announcements. Students should read this material before each class (i.e. The readings should be done by start of lecture that it is associated with).

Texts:

1 **Fundamentals of Hydrology**, Tim Davie (2008).

2 When the rivers run dry: water, the defining crisis of the twenty-first century, Pearce (2006).

Available Electronically through Columbia Library
Water Resources Systems Planning and Management, D.P.
Loucks, http://ecommons.library.cornell.edu/handle/1813/2804 (Links to an external site) (Links to an external site.)Links to an external site.
Supplemental reading will be provided drawing from the scientific and policy literature.

References

• Aeschbacher, J, et al (2005), River water shortage in a highland-lowland system: A Case study of the impacts of water abstraction in the Mount Kenya region.
• Brauman, KA et al. (2007). The nature and value of ecosystem services: an overview highlighting hydrologic services. Annu. Rev. Environ Resour.32:67-98
• Brown, TC (2000). Projecting US freshwater withdrawals. Journal of Water Resources Research.
• Cane, M. The ENSO Mechanism.
• Chow, VT et al. (1988). Applied hydrology.
• Dinar, A. Water allocation mechanisms-- principles and examples.
• Downs, TJ et al (2000), Sustainability of least cost policies for meeting Mexico City's future water demand. Water Resources Research, vol. 36, no. 8, pages2321-2339.
• Konar, M.et al (2011), Water for food: The global virtual water trade network.
• Hoekstra, AY, and Chapagain, AK (2007) Water footprints of nations: Water use by people as a function of their consumption pattern, Water Resource Management 21:35-48.
• Lall, U. and Jain, S. (2001) Floods in a changing climate: Does the past represent the future? Water Resources Research, vol. 37, no. 812, Pages 3193-3205.
• Loucks, DP (2005). Water Resources Systems Planning and Management.
• Masters, GM(1991). Introduction To environmental engineering and science.
• Mays, L (2007). Water Resources sustainability.
• MacLeod, M, Smith, E (2003) Economic principles for sound water planning: An introduction for regional water planning groups in Texas. Environmental Defense.
• Pearce, F (2006). When the rivers run dry: water, the defining crisis of the twenty-- first century.
• SEI (2009) Rainwater harvesting: a lifeline for human well--being: a report prepared for UNEP by Stockholm Environment Institute.
• Vörösmarty, CJ et al (2000). Global water resources: vulnerability from climate change and population growth. Science 289,284.
• Vörösmarty, CJ and Sahagian D (2000). Anthropogenic Disturbance of the terrestrial water cycle, Vol. 50 No.,BioScience.
• Vörösmarty, CJ Et al.(2010). Global Threats to human water security and river biodiversity. Nature.