Description of the Course. This course covers the economics and engineering dimensions of water resources and water systems. It is intended to prepare the participants for practice as a water resources engineer or as an economic consultant. For those pursuing the MA/MS or Ph.D. degrees, it is a prerequisite for the research seminar Economics 8555 and/or for writing a thesis/dissertation in the field.

Interdisciplinary courses always pose the problem of finding the right level for each discipline without losing or boring people from other disciplines. For this reason, you are expected to have or to pick up on your own certain basics from economics and water engineering. These topics should include:

**Economics:** scarcity, broad functioning of a market economy; supply and demand; production functions; cost functions; correcting for price level changes; discounting of future values (compounding of past values); present value of a series of benefits or costs over time. Anyone not having a working knowledge of these topics should consult an introductory or intermediate level micro-economics like:

- Jack Hirshleifer, *Price Theory and Applications*
- Gwartney & Stroup, *Microeconomics: Private and Public Choice*
- Byrns and Stone, *Microeconomics.*

**Water Resources Engineering:** precipitation, evapotranspiration, runoff, aquifers, soil-water hydrographs, reservoirs, basic probability, basic statistics, point and non-point source pollution, BOD, DO, waste and water treatment. Anyone not having a working knowledge of these topics should consult the following texts:

- Chow, *Handbook of Applied Hydrology*
- Leopold, *Water for Environmental Planning*
- Maidment, *Handbook of Hydrology*

or (engineers) buy the optional text.
The course also presumes a knowledge of PC operation for spreadsheets and relatively simple programs that will be provided in class and mathematics through calculus.

Texts.

1. Howe, "Multiple-Objective Evaluation of Water Projects" to be purchased at C.U. bookstore.

2. Linsley, Franzini et al., Water-Resources Engineering @ UMC Bookstore. Optional, expensive but useful for engineers. Will be on reserve at the Geology Library (next to Economics Building)

3. Readings packets will be on reserve at the Geology Library (next to Economics Building) and Engineering Library.

The Class is scheduled to meet Wednesdays, 3:00 p.m. - 5:30 p.m. in Econ. 119. Grading will be based on homework 20%, mid terms (2) @ 20% each, final 30%, team project 10%.

Course Outline.

28 Aug. Global Overview (Howe, Strzepek).
- Global water stress.
- Regional issues.
- Current U.S. issues.

Readings: Reading No. 1, S-1
Linsley, et al Chapters 1 and 2

- The river basin setting.
- Water law and property rights.
- The project evaluation process
  in a river basin setting:
  economic efficiency and equity
  the accounting stance
  measuring direct benefits and costs.

Readings: Howe, Chapters I-VI.
Linsley et al 21
Problems: as assigned. Due next class.
18 Sept. **Surface Water & Ground Water Development**

- Basic hydrology. (Strzepek & Howe)
- Reservoir Modeling.
- Storage-field relationships.
- Structures.
- Ground water hydrology.
- Conjunctive management.
- Economics of surface and ground water development.

**Readings:** 2, 3. S-2
Linsley et al 3.1-3.10, 4.1-4.8, 4.12-4.22

**Problems:** as assigned. Due next class

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25 Sept. **Technology and Economics of Irrigation**

- Methods of irrigation water application.
- Drainage issues.
- Crop response functions (production functions).
- Farm management models (linear programming) and derivation of water demand functions.
- Effects of agricultural and water policies.

**Readings:** 4, 5.
Linsley et al 14

[Take-home exam over materials covered through 18 Sept. Due 30 Sept.]

**Problems as assigned. Due next class.**

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2 Oct. **Municipal & Industrial Water System Design & Management**

- System components.
- Keying system design to demands.
- Incorporating reliability into design.
- Urban demand and pricing

**Readings:** 6, 7, 8. S-3
Linsley, et al 15

**Problems:** as assigned. Due next class.

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9 Oct. **Hydroelectric Generation**

- Place of hydro in the grid.
- Environmental impacts.
- Modification of releases: the Glen Canyon case.
- Peak Period problem.

**Readings:** 9, 9a Linsley et al 16

**Problems:** as assigned. Due next class.
16 Oct.  **Flood Control (Strzepek, Howe).**
   Hydrology of extreme events
   Computing return intervals.
   Flood control alternatives.
   Measuring flood control benefits.

   **Readings:** 10. S-4
   Linsley et al 5.1-5.7, 20.

23 Oct.  **Economics of Instream Flows (Howe).**
   Values of instream flows.
   Non-market values and estimation:
      travel cost methods.
      contingent valuation methods.
   Problem in interstate allocations.

   **Readings:** 11, 12, 13.
   Linsley et al 17.

[Take-home exam over materials from 25 Sept. through 16 Oct.]

30 Oct. **Water Quality Management (Strzepek).**
   Dimensions of WQ.
   Control alternatives.
   Setting WQ standards.
   State implementation plans.
   Minimum cost attainment of standards.

   **Readings:** 14, 15. S-5
   Linsley et al 19

6 Nov.  **River Basin Modeling (Strzepek, Howe)**
   Types of Models.
   Computer applications.
   Combining hydrologic and economic 
      Models: Yates model
   Input - output models (Howe).

   **Readings:** 16 S-6, S-7

13 Nov.  **River Basin Modeling (continued)**
   Computer applications.
20 Nov.  Financial Planning; Water Law & Water Markets (Howe).
Cost allocation and cost sharing.
Financial feasibility.
Repayment experience.
Water law.
Water markets.
Readings: Howe, Ch. VII; Nos. 17, 18
Linsley et al 6

27 Nov.  Role of Water in Economic Development (Howe).
Water as a growth initiator.
Third World problems
Case study of Colorado - Big Thompson Project.
Readings: 19, 20, 21, 22. S-8

4 Dec.  Environmental and Social Impacts;
Summing Up and Ex-Post Analysis;
Team Project Presentations (start).
Readings: Howe, Chapters VIII, IX.

11 Dec.  Team Project Presentations.

16 Dec.  FINAL EXAMINATION: 7:30 - 10:30 p.m.