CE 451
Course Syllabus
Spring 2014
Part I Course Organization
CE 451 Water Resources Engineering (3 units)  
Spring Semester 2014

Catalog Description: Discussion of broad perspective on control and utilization of water, quantitative hydrology, ground water, probability concepts, economic study, hydraulic structures, multiple purposes water resources projects

Prerequisite: CE 309 Fluid Mechanics


by Linsley, Franzini, Freyberg, Tchobanoglous  
McGraw Hill Book Co.

Instructors: J. J. Lee, Professor of Civil and Environmental Engineering  
KAP 224A, jilee@usc.edu, 213-740-7865 or 213-740-2032

Topics covered:

Week 1  Review of fluid mechanics principles: continuity equation, momentum principle, energy principle, head losses; general classification of problems in water resources engineering. Hydrologic Cycle, Precipitation, Spatial and Temporal Variations.

CE 309 Review  
Reading-- Chapter 7 of May’s Textbook.  
Homework #1

Week 2  Theoretical models for rainfall, runoff, evaporation & transpiration; spatial, temporal variations of hydrological data; Surface Runoff collecting hydrological data; possible errors in hydrological data. Rating Curve, Slope-Stage-Discharge relationship. Hydrograph analysis; rainfall-runoff models; runoff coefficients; infiltration index; antecedent precipitation index; coaxial curves.

Reading – Chapter 8 of May’s Textbook  
Homework #2

Week 3  Unit hydrograph, synthetic unit hydrograph, S-Hydrograph, Rational formula, flood routing, routing through controlled and uncontrolled reservoirs, river routing, Muskingum routing procedure; stochastic hydrology.  
Reading-- Chapters 9 of May’s Textbook
Homework #3

Week 4  Groundwater Engineering: Darcy's law, hydraulic conductivity, aquifer characteristics, well hydraulics, groundwater protection and remediation.
    Reading -- Chapter 6 of May’s Textbook
    Homework #4

Week 5  Steady and unsteady pumping tests, aquifer analysis, groundwater development, artificial recharge and conjunctive use of surface and groundwater.
    Reading—Supplemental notes
    Homework #5

Week 6  Mid-term examination,
        Probability concepts in water resources planning, time series analysis, frequency curves, partial duration series.
        Reading- Chapter 10 of May’s Textbook

Week 7  Extreme events: two-parameter distribution function, three-parameter distribution function, probable maximum flood, synthetic stream-flows.
        Homework #6

Week 8 & 9  Urban Storm Water Management
        Flood control, Floodplain management, collection system, detention facilities, water quality
        Reading- Chapter 14, 15, and 16 of May’s Textbook
        Homework #7

Week 10 & 11  Reservoir Engineering: physical characteristics of reservoirs, determination of required storage capacity, safe yield and secondary yield, sediment transport in rivers and channels, reservoir sediment control, wind waves, determination of significant wave heights. Analysis and design of Dams: types of dams, advantages and disadvantages of different types of dams, analysis and design of different types of dams, seepage analysis Advantages and disadvantages of different spillways, gates and outlet works; energy dissipaters, hydraulic jump, design of energy dissipaters, scour control.
        Reading-- Chapter 17 and 18 May’s Textbook
        Homework #8
Week 12  Analysis and design of open channels: uniform and non-uniform flows, normal depth and critical depth, hydraulic efficiency of channels, design of channel transitions, field measurement of flow rate, culvert, flume and inverted siphons.

   Reading--- Chapter 5 of May’s Textbook
   Homework #9

Week 13  Analysis and design of pressure conduits: major and minor losses, forces acting on pipes, water hammers and surge protections, selection of pumps.

   Reading—Chapters 4 and 12 of May’s Textbook
   Homework #10

Week 14  Water Resources System Analysis, Issues associated with multiple-purpose water projects: flood management, water supply, recreations, environmental preservations. engineering economic analysis in water resources planning: cost of capital, cost of operation, cost of risk; transfer of risk, various methods of economic comparison.

   Reading—Chapter 19 of May’s Textbook

Grading Policy:

1. One mid-term examination: 30%
2. Final examination: 40%
3. Home work weekly: 15%
4. Report of hydrologic records at 3 chosen stations: 5%
5. Term paper on water resources project or review of technical papers on the chosen topic (10%) 

Note: Any students requesting academic accommodation based on disability is required to register with Disability Services and Program (DSP) each semester. A letter of verification for approved accommodation can be obtained from DSP. Please be sure the letter is delivered to the instructor (or the TA) in the semester as early as possible. DSP is located in STU 301 and is open 8:30am – 5:00pm, Monday through Friday. The phone number for DSP is 213-740-0776.
Part II  Detailed Course Objectives
Course Information, Textbook, and Supplementary Materials

Course Description: Discussion of broad perspectives on control and utilization of water, quantitative hydrology, ground water, probability concept, economic study, hydraulic structures, multi-purpose water resources projects.

Required: BSCE BS  Elective: All other CE / ENE programs

Prerequisites: CE 309 Fluid Mechanics  --or--  ENE 410 Environmental Fluid Mechanics

Co-Requisites: None


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<thead>
<tr>
<th>Topics Covered</th>
<th>Learning Outcomes</th>
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<tr>
<td>• Review of fluid mechanics and general discussion of water resources eng.</td>
<td>Students will understand the topics and their attendant problems and risks, as follows:</td>
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<tr>
<td>• Groundwater hydraulics and hydrology of groundwater flow</td>
<td>1. General classification of problems in water resources engineering</td>
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<tr>
<td>• Hydrology - descriptive and quantitative hydrology methods for</td>
<td>2. Hydrologic cycles, rainfall, runoff, evaporation &amp; transpiration</td>
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<td>hydrological analysis</td>
<td>3. Quantitative hydrology, hydrograph analysis, rainfall-runoff relation</td>
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<td>• Probability concepts in water resources engineering</td>
<td>4. Unit hydrograph, rational formula, flood routing, river routing</td>
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<td>• Probability distribution function, stochastic hydrology</td>
<td>5. Ground water hydrology, well hydraulics, aquifer characteristics</td>
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<td>• Economical analysis for water resources system</td>
<td>6. Probability concepts in water resources planning – extreme events</td>
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<td>• Flood control problems</td>
<td>7. Reservoir Engineering – storage, yield, sediments control, wind waves,</td>
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<td></td>
<td>reservoir oscillations</td>
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<td>8. Dam types, analysis and design criteria, adv./disadvantages of earth/concrete</td>
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<td>dams, environmental issues</td>
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<td>9. Spillways, gates and outlet works, energy dissipater, scour control</td>
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<td></td>
<td>10. Analyze flow in open channels, hydraulic jumps, critical and subcritical flows</td>
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<td>11. Water related issues worldwide - floods, landslides, tsunamis</td>
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<td>12. Describe issues involved faced in hydrological cycles, precipitation, runoffs,</td>
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<td></td>
<td>and floods.</td>
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<td>13. Perform groundwater well hydraulics analysis.</td>
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<td>• Reservoirs, dams, spillways, gates and outlet works</td>
<td>14. Determine the capacity needed in reservoir design, safe water yield,</td>
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<td>• Analysis and design of open channels</td>
<td>sediment control</td>
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<td>• Analysis and design of pressure conduit systems</td>
<td>15. Design dams, hydraulic jumps, energy dissipaters</td>
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<td>• Hydraulic machinery and hydroelectric power</td>
<td>16. Understand uncertainty in water resources projects worldwide</td>
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<td>• Examples of problems combining hydrology, risk, hydraulic engineering and</td>
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<td>economic analysis</td>
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Lecture and Lab Schedule

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<tr>
<th></th>
<th>Lecture</th>
<th>Lab</th>
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<tbody>
<tr>
<td>Sessions per Week</td>
<td>2</td>
<td>1</td>
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<tr>
<td>Duration per Session</td>
<td>1.5 hours</td>
<td>1.5 hours</td>
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Contribution of Course to Meeting the Professional Component

**Engineering Topics | Design**

Students will understand the design process and learn approaches used to solve various engineering problems that are representative of those found in a professional environment.

In this course, students will learn criteria for dam design, analysis and design of open channels, analysis and design of pressure conduit systems, determine the capacity needed in reservoir design, and will design dams, hydraulic jumps, and energy dissipaters.

**Engineering Topics | Other**

Constraints and Considerations. Students will understand the diverse constraints and considerations that are representative of what they will encounter in an engineering practice. This course covers the following topics:

- Environmental
- Manufacturability
- Health and Safety
- Energy

Relation of Course Objectives to Program Outcomes

The Civil Engineering program is designed to teach beyond the technical content of the curriculum and prepare the students to utilize what they learn in a professional setting.

This course contributes to the program outcomes as outlined in the adjacent table.

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<tr>
<th>Course Contribution to Program Outcomes (a-k)</th>
<th>Key</th>
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<tbody>
<tr>
<td>a. An ability to apply knowledge of mathematics, science, and engineering.</td>
<td>✔</td>
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<td>e. An ability to identify, formulate and solve engineering problems.</td>
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<td>h. The broad education necessary to understand the impact of engineering solutions in a global economic and environmental and societal context.</td>
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Prepared by: Dr. JJ Lee
Professor of Civil and Environmental Engineering

Date: Spring 2014