ENE 486
Course Syllabus

Fall 2012
Part I Course Organization
# ENE 486 Design of Hazardous & Solid Wastes Engineering System
## Fall 2012 Course Syllabus

<table>
<thead>
<tr>
<th>Class</th>
<th>Thursday</th>
<th>6:30-9:10pm</th>
<th>KAP 137</th>
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<tbody>
<tr>
<td>Professor</td>
<td>Rezvan Ramezani</td>
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<tr>
<td>Office</td>
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<tr>
<td>Phone</td>
<td>(909) 396-2701 Work — (310) 932-8341 Cell</td>
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<tr>
<td>Email</td>
<td><a href="mailto:rezvanra@usc.edu">rezvanra@usc.edu</a></td>
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<tr>
<td>Office Hours</td>
<td>Thursday 5:30-6:30 or by Appointment</td>
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<tr>
<td>Teaching Assistant</td>
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<td>Email</td>
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<tr>
<td>Prerequisites</td>
<td>ENE 400 (Environmental Engineering Principles)</td>
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<tr>
<td>Textbooks</td>
<td></td>
<td>1. HAZARDOUS WASTES: Sources Pathways Receptors by Richard J. WATTS ISBN: 9780471002383</td>
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<tr>
<td></td>
<td></td>
<td>Additional Supplemental material on weekly basis</td>
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<tr>
<td>Course Objectives</td>
<td>This course is designed to provide students with the necessary background and knowledge pertaining to the engineering design of solid and hazardous waste facilities.</td>
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<tr>
<td>Learning Objectives</td>
<td>The course consists of three major components. The first component of the class includes three main parts which are devoted to the following: (1) the description of waste generation, effects of improper management, and management options, (2) related legislation and regulations for facility design, and design criteria, and (3) future trends in waste management. The second component is devoted to solid waste engineering, consisting of engineering principles and actual design cases for major solid waste management facilities, such as transfer stations, sanitary landfills, incinerators, material and energy facilities, etc. The third component will be devoted to hazardous engineering, covering related engineering principles and actual design cases for major hazardous management facilities, such as waste minimization, secured landfills, thermal, chemical, physical, and biological treatment facilities, site remediation facilities, and radioactive waste treatment/remediation facilities, etc.</td>
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**Synopsis:**

In ENE 4846, the course realizes that owing to the fact that there are wide varieties of solid and hazardous waste management facilities available; therefore, the course will focus on major facilities which are widely used currently, and give a general discussions on other relatively less practiced technologies. Type of facilities will include treatment, storage and disposal facilities for both solid and hazardous wastes. For hazardous waste engineering, the "uncontrolled hazardous waste site” remediation facilities will be also included. For major facilities, the theories, parameters, and procedures associated with the design will be presented in detail.
Field trips and evaluation of actual design cases will be provided so students can gain practical knowledge on the subject.

Course Outline and Schedule

PART I. INTRODUCTION

Week (8-30-12)

1. Introduction
   - Syllabus review
   - Use of Black Board (BB)
   - Statement on Academic Integrity
   - Waste Definition, Generation, Effects, Management Options and Future Trends (1.5 week)
     i. General and legal definitions
     ii. Waste Compositions and classifications
     iii. Waste generation
     iv. Effects of in-proper management
     v. Management options
     vi. Future Trends

Week (9-6-12)

2. General Siting and Design Criteria (1.5 week)
   - RCRA-C and D siting and design requirements
   - CERCLA/SARA siting and design requirements
   - Other federal and state legislation and regulation siting and design requirements
   - Summary: Siting criteria
   - Summary: Design criteria

PART II. SOLID WASTE ENGINEERING

Week (9-13-12)

3. Principles and Design of Transfer and Transport Facilities (1/2 week)
   - Objective of transfer stations
   - Types, siting and design criteria of transfer stations
   - Design cases

Week (9-20-12)

4. Principles and Design of Sanitary Landfills (2 weeks)
   - Landfilling methods
   - Design goals, basis, and variables
   - Design of landfill cover and drainage/liner systems
   - Design of landfill gas migration control and recovery systems
• Design of leachate control and treatment systems
• Other design variables
• Design cases

Week (9-27-12)

5. Principles and Design of Material Recovery Facilities (1 week)
   • Types and objectives of material recovery systems
   • Principles, functions, equipment selection and comparisons, design criteria, and operation of different material recycling processes
   • Integrated and specific recycling plants
   • Design cases

Week (10-4-12)

6. Principles and Design of Energy Recovery Facilities (1 week)
   • Types and principles of energy conversion processes
   • Incinerator design
   • Design of other thermal energy conversion systems
   • Design cases

PART III. HAZARDOUS WASTE ENGINEERING

Week (10-11-12)

7. Principles and Design of Waste Minimization Facilities (1 week)
   • Principles and techniques of Waste minimization
   • Examples of waste types and phase separation processes
   • Design criteria and examples

Week (10-14-10)

8. Principles and Design of Hazardous Waste Landfills (1 week)
   • Design configurations and site selection
   • Design of final cover, intermediate cover and drain/liner systems
   • Design of gas and leachate control and treatment systems
   • Design cases

Week (10-18-12)

   • Types and design criteria
   • selection and design of storage facilities
   • Design of containment, run-on/run-off management systems
   • Design examples
   •
Week (10-25-12)

10. Principles and Design of Thermal Treatment Facilities (1 week)
    • Status, types, principles, equipment used, application ranges, and comparisons of different thermal treatment technologies
    • Design of incinerators
    • Design of other thermal systems
    • Design cases

Week (11-1-12)

11. Principles and Design of Chemical/Physical/Biological Treatment Facilities (1 week)
    • Status, types, principles, equipment used, application ranges, and comparisons of different treatment facilities
    • General design criteria and special requirements
    • Design cases

Week (11-8-12)

12. Principles and Design of Site remediation Facilities (1 week)
    • Status, types, principles, equipment used, application ranges, and comparisons of different site remediation technologies
    • Remedial investigations and feasibility studies
    • Soil remediation design examples
    • Groundwater remediation design examples

Week (11-15-12)

13. Principles and Design of Radioactive Waste Treatment/Site Remediation Facilities (1 week)
    • Status, Types, technologies, principles, applications
    • Treatment Technologies
    • Site Remediation Technologies
    • Case Examples

Week (11-22-12) Presentations/Field Trip
Week (11-29-12) Thanksgiving Holiday

Week (12- 6 through 16-10) Finals
TERM PROJECTS
FINAL EXAM

Final Exam: Thursday, December 6, 6:30 – 9:00 PM
Term Project should be around 10 pages and contain at least 5 references and are due on November 18, 2012. The subject of report should be approved by Lecturer. Each student should present his/her report in the class (5 minutes per member presentation). More on that as the time gets close.

GRADING CRITERIA

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<tr>
<th>Item</th>
<th>% of Final Grade</th>
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<tr>
<td>Class Participation</td>
<td>10%</td>
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<tr>
<td>Homework</td>
<td>20%</td>
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<td>Midterm Exam</td>
<td>20%</td>
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<tr>
<td>Final Exam</td>
<td>20%</td>
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<td>Term Projects</td>
<td>30%</td>
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Statement for Students with Disabilities
Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

Statement on Academic Integrity
USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one’s own academic work from misuse by others as well as to avoid using another’s work as one’s own. All students are expected to understand and abide by these principles. Scampus, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: http://www.usc.edu/dept/publications/SCAMPUS/gov/. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/.
REFERENCES

13. Design cases (to be provided in the class).
Part II  Detailed Course Objectives
Course Information, Textbook, and Supplementary Materials

Course Description: Engineering design of solid and hazardous waste facilities such as waste minimization, secured landfill, and hazardous waste treatment.

Design Kernel for: ENE Environmental  Required for: BSENE

Prerequisites: ENE 400 Environmental Engineering Principles and CE 473 Engineering Law, Finance and Ethics

Co-Requisite: None

Required Textbooks:

References:
11. Design cases (provided in the class).

Topics Covered

<table>
<thead>
<tr>
<th>Learning Outcomes</th>
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<tr>
<td>Introduction to engineering design of solid and hazardous waste facilities</td>
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<tr>
<td>Students will understand the components of solid and hazardous waste; and the principles of design:</td>
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<tr>
<td>1. Waste Definition, Generation, Effects, and Management Options</td>
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<td>2. Legislation and Regulations</td>
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<td>3. General Siting and Design Criteria</td>
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<td>4. Future Trends</td>
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<td>Solid Waste Engineering</td>
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<td>5. Principles and Design of Transfer and Transport Facilities</td>
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<td>6. Principles and Design of Sanitary Landfills</td>
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<td>7. Principles and Design of Material Recovery Facilities</td>
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<td>8. Types and principles of energy conversion processes</td>
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<td>9. Principles and Design of Waste Minimization Facilities</td>
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<td>12. Principles and Design of Thermal Treatment Facilities</td>
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<td>13. Principles and Design of Chemical/Physical/Biological Treatment Facilities</td>
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<td>14. Principles and Design of Site Remediation Facilities</td>
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<td>15. Principles and Design of Radioactive Waste Treatment/Site Remediation Facilities</td>
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Lecture and Lab Schedule

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<tr>
<th>Lecture</th>
<th>Lab</th>
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<tr>
<td>Sessions per Week</td>
<td>Duration per Session</td>
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<tr>
<td>1</td>
<td>3 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. They will practice decision-making skills as they apply their knowledge of basic sciences, mathematics, and the engineering sciences to convert resources optimally to meet the stated needs of a project.

This course is designed to provide students with the necessary background and knowledge pertaining to the engineering design of solid and hazardous waste facilities. Two field trips give the students the opportunity to tour both a solid and hazardous waste engineering facility.

**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:

- Economic
- Environmental
- Sustainability
- Ethical
- Health and Safety
- Social
- Political
- 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.

<table>
<thead>
<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>
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<tr>
<td>c. An ability to design a system component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.</td>
<td>✓</td>
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<tr>
<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. Rezvan Ramezani
Professor of Civil and Environmental Engineering

Date: Fall 2012