CE 551 WATER AND WASTEWATER TREATMENT ENGINEERING

Spring 2015 TR 9:30 am - 10:45 am
Location: FPAT 253
Instructor: Dr. Y.T. Wang, Professor, P.E.
365 Raymond Building, Department of Civil Engineering
University of Kentucky, Lexington, KY 40506
Phone: 7-5937, Fax: 7-4404, E-mail: ywang@engr.uky.edu
Web: www.engr.uky.edu/~ywang


Synopsis: This course examines the scientific and engineering aspects of water and wastewater treatment. Conventional water treatment processes such as rapid mixing, flocculation, sedimentation, filtration, and disinfection as well as biological processes for wastewater treatment are analyzed. Sustainable alternative treatment techniques are also discussed.

Goal: To introduce the principles of design and operation of water and wastewater treatment processes.

Prerequisite: CE 341, CE 351, and engineering standing or consent of instructor

Student Learning Outcomes: Upon completion of this course, students should be able to

1. Discuss water quality parameters and testing procedures for common pollution parameters
2. Discuss an overview of water and wastewater treatment processes.
3. Describe the hydraulic characteristics of treatment processes as related to treatment efficiency.
4. Discuss physical principles and physical treatment processes.
5. Describe chemical principles and chemical treatment processes.
6. Understand biological principles and biological treatment processes.
7. Discuss sludge characteristics, processing, and disposal.
8. Discuss sustainable water & wastewater treatment processes.

Topics Required Readings

I. Processes for Treating Water and Wastewater Chapter 9
II. Water Quality Parameters Chapter 8
III. Reaction Kinetics & Reactor Systems Chapter 11 (pp.383-398) & Supplement
IV. Physical Treatment Processes Chapter 10 & Supplement
References


Exams

No comprehensive final exam will be given. Three topic specific, equally weighted exams will be administered over a period of 75 minutes each on the following schedule:

Exam I: February 16
Exam II: March 31
Exam III: May 2 (1:00 pm – 2:15 pm)

Labs (Location: OHR C328)

I. Solids determination, dissolved oxygen determination, biochemical oxygen demand, and fecal coliform. Lab report required.
II. Tracer studies. Lab report required.

Field Trips

Water Treatment Plant. Trip report required
Wastewater Treatment Plant. Trip report required

Grading Policy

Grades will be based on the total points accumulated for exams, homework assignments, lab and field trip reports, and class participation. The weighting scale is:
<table>
<thead>
<tr>
<th></th>
<th>Undergraduate</th>
<th>Graduate</th>
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<tbody>
<tr>
<td>Exam I</td>
<td>25%</td>
<td>25%</td>
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<tr>
<td>Exam II</td>
<td>25%</td>
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<tr>
<td>Exam III</td>
<td>25%</td>
<td>25%</td>
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<tr>
<td>Homework &amp; lab report</td>
<td>15%</td>
<td>10%</td>
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<tr>
<td>Design project (team)</td>
<td>5%</td>
<td>0%</td>
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<tr>
<td>Class participation</td>
<td>5%</td>
<td>5%</td>
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<tr>
<td>Sustainable treatment project</td>
<td>0%</td>
<td>10%</td>
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<tr>
<td>Bonus</td>
<td>5%</td>
<td>0%</td>
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<tr>
<td>Total</td>
<td>105%</td>
<td>100%</td>
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The undergraduate project is to design a small scale flow-through water treatment apparatus to removal phosphorus from water as described at this URL: https://drive.google.com/file/d/0ByjGyp_5jxMEdFQ1MUJ0bDdXcDQ/view?pref=2&pli=1

The report should contain around 5 double-spaced pages with at least 5 references. The report point will be weighted among technical content (60%) and writing (40%) and is due before spring break. A bonus of 5 points will be awarded to the team whose design is selected for construction and participation in the ASCE OVSC Environmental Competition. The graduate project report should be around 20 doubled-spaced pages and contains at least 15 references.

Final grades will be decided from the weighted numerical score according to the following scale:

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<thead>
<tr>
<th>Score</th>
<th>Undergraduate</th>
<th>Graduate</th>
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<tbody>
<tr>
<td>90 - 100</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>80 - 89</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>70 - 79</td>
<td>C</td>
<td>C</td>
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<tr>
<td>60 - 69</td>
<td>D</td>
<td>E</td>
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<td>&lt; 60</td>
<td>E</td>
<td>E</td>
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There is no makeup on missed/late homework assignments. Makeup exams will only be given with valid acceptable excuse. Undergraduate students will be provided with a midterm evaluation of course performance based on the criteria above.

**Homework Policy**

Homework will be assigned on a weekly basis. All assignments are due before class on the due date. The assigned work will require manual calculations. Some problems are also to be solved using programs such as MS Excel and MATLAB. Homework to be submitted must be legible (use a suitably dark pen or pencil). Late homework will be penalized 20% each day after due day. No homework will be accepted after the return of graded work. **It is the student’s responsibility to submit**
homework in time even if with excused absence unless a pre-arrangement is made with the instructor.

Class Participation

Class attendance is strongly recommended and attendance will be taken. Absences will adversely affect the final grade. Forging a classmate's signature to indicate attendance will be considered to be a form of cheating. Late arrival and early departure (unexcused) will be considered as absence. Acceptable reasons for excused absences are consistent with university policy, but are typically:

1) serious illness;
2) illness or death of family member;
3) University-related trips;
4) major religious holidays;
5) other circumstances found to be "reasonable cause for nonattendance by the instructor."

Students anticipating an absence for a major religious holiday are responsible for notifying the instructor in writing of anticipated absences due to their observance of such holidays no later than the last day for adding a class.

Classroom and Learning Accommodations

Students requiring such accommodation should provide documentation of the need during the first week of class. The Disability Resource Center (Room 2, Alumni Gym, 257-2754, email address jkarnes@email.uky.edu) specifies the particular type of such accommodations on a student-by-student basis.

Cheating and Plagiarism

University policy on student conduct, including that regarding academic honesty, plagiarism and cheating will be followed. Use of a cell phone without explicit permission during exams or quizzes is not allowed, and will result in a charge of cheating. Student's work should be individual. For a discussion of the overall issue and guidelines, refer to the document on the website of the Ombud of the University of Kentucky at http://www.uky.edu/Ombud/Plagiarism.pdf. The Ombud web site also includes a link to a Prentice Hall Companion Website “Understanding Plagiarism” http://wps.prenhall.com/hss_understand_plagiarism_1/0,6622,427064,-00.html. All exams will be proctored. The minimum penalty for either of these offenses is an "E" for the assignment or examination, with suspension and dismissal also possibilities.
Student Interaction

Students are expected to maintain communication with the instructor and the TA through personal meetings (by arrangement or during office hours), e-mail or phone. The instructor will normally respond to e-mail or phone calls (received during normal office hours) within four hours of receipt. Students are expected to be familiar with, and have internet access, along with access to software for document creation and editing, and for preparation of presentations. This access is provided at a number of on-campus locations.

Teaching Assistant

Delbert Ji
Email: delbert1989@hotmail.com
Phone: (859) 257-3643 (Office)
Office: 366 Raymond Building
Office hours: M & W: 2:00 pm – 3:00 pm

Instructor Office Hour

Normally available 8:00 AM to 3:00 PM or by appointment. Students may contact the instructor through email or phone calls as described under “Student Interaction”.

Access to Course Material

Course assignments and lecture notes will be available for download from the instructor’s web link: www.engr.uky.edu/~ywang.
Course Schedule

TR (Tuesday Thursday)

14-Jan Thursday Introduction (Chapter 9). HW1
19-Jan Tuesday Water quality parameters (Chapter 8)
21-Jan Thursday **Lab I: Solids, DO, BOD, and FC test**
26-Jan Tuesday Reaction kinetics (Chapter 11 & supplement), HW2
28-Jan Thursday Analysis of experimental data (Chapter 11 & supplement)
02-Feb Tuesday Ideal reactors (Chapter 11 & supplement), HW 3
04-Feb Thursday Non-ideal reactors (Chapter 11 & supplement)
09-Feb Tuesday **Lab II: Tracer study (Lab manual)**
11-Feb Thursday Rapid mixing, flocculation (Chapter 10 & supplement), HW 4
16-Feb Tuesday **Exam I (HW 1-3 & Lab)**
18-Feb Thursday Stock’s law and sedi (Chapter 10 & supplement),
23-Feb Tuesday Sedimentation in water & wastewater treatment (Chapter 10), HW 5
25-Feb Thursday Gravity granular-media filtration (Chapter 10)
01-Mar Tuesday Head losses, filter backwash (Chapter 10), HW 6
03-Mar Thursday Water chemistry, alkalinity & hardness (Chapter 11)
08-Mar Tuesday Coagulation & water softening (Chapter 11), HW 7
10-Mar Thursday Iron & Mn removal, disinfection (Chapter 11), **undergraduate report due**
15-Mar Tuesday Spring Break Day
17-Mar Thursday Spring Break Day
22-Mar Tuesday C.t concept & disinfection (Chapter 11), HW 8
24-Mar Thursday Membrane treatment, adsorption (Chapter 11)
29-Mar Tuesday **Field Trip I: Water Treatment Plant**
31-Mar Thursday **Exam II (HW 4-8)**
05-Apr Tuesday Process microbiology, growth kinetics & nutrient requirement (Ch 12), HW 9
07-Apr Thursday Wastewater characteristics, activated sludge processes (Ch 12)
12-Apr Tuesday Oxidation pond, fixed-film biological processes (Chapter 12), HW 10
14-Apr Thursday Fixed-film biological processes (Chapter 12)
19-Apr Tuesday Characteristics and quantity of sludge (Chapter 13), HW 11
21-Apr Thursday Anaerobic sludge digestion & sludge disposal (Chapter 13)
26-Apr Tuesday **Field Trip II: Wastewater Treatment Plant**
28-Apr Thursday Sustainable treatment proc, student presentation, **graduate report due**
2-May Monday **Exam III (HW 9-11) 1:00 pm – 2:15 pm**