11:375:302 – Water and Wastewater Treatment

3 credits; Fall Semester

Catalog Data: 11:375:302 –Water and Wastewater Treatment
This lecture course covers fundamental and emerging aspects of chemical, physical and biological processes used in the treatment of water and wastewater. Unit operations and processes utilized in water and wastewater treatment and methods for their analyses, design and optimization will be presented.

Textbook: *Water Supply and Pollution Control*, any edition, Viessman, W., Jr. and Hammer, M.J., Pearson, Prentice Hall; on reserve in Chang Library

Website: Class members will be given access to a Sakai site—you should have gotten an email with the link. The course website should be available to all registered students upon login to sakai.rutgers.edu. If you do not get access or have problems, send me an email.

Instructor: Donna E. Fennell, fennell@envsci.rutgers.edu; (848) 932-5748 (email is best!)

Office Hours: Open door policy; specific hours announced; and/or email to make an appointment

Lecture Schedule

Day/Date	Topic	Reference Materials	HW #
1	Introduction: o Hydrologic Cycle o Major Legislation o Overview of Water and Wastewater Treatment	**Note Set 1** Chapters 1, 2 and 9	0, 1
2	Water Quality Parameters: o Primary and Secondary Drinking Water Standards o Maximum Contaminant Levels	**Note Set 2** Chapter 8	0, 1
3	Water Quality Parameters: o Chemical Contaminants o Ethics: The Washington DC Pb Story	**Note Set 3** Chapter 8	0, 1
4	Water Quality Parameters: o Biological Contaminants	**Note Set 4** Chapter 8	2
5	Water Quality Parameters: o Most Probable Number (MPN)	**Note Set 5** Chapter 8	2
6 7	Water Quality Parameters: o Biochemical Oxygen Demand	**Note Set 6** Chapter 8	2
8	Drinking Water o Sources; Characteristics; Intake design	**Note Set 7** Chapters 3.1-3.6; 3.16-3.19; 3.25-3.27; 4.1-4.6; 6.10	3
9	Reactors and Reactor Design	**Note Set 8** Chapter 10	3
10	Reaction Kinetics and Reactor Models	**Note Set 9** Chapters 11; 13.11-13.12	3
11	**Exam I**	**Note Sets 1 – 6**	**HW 0-2**
12	Reaction Kinetics and Reactor Models	**Note Set 9** Chapters 11; 13.11-13.12	3
13	Water Treatment o Coagulation-flocculation	**Note Set 10** Chapter 11	4
14 15	Water Treatment o Water Softening	**Note Set 11** Chapter 11	4
16	****No class****	See Sakai posting	Report

	Virtual treatment plant tours and report		
Day/Date	**Topic**	**Reference Materials**	
17	Water Treatment o Iron and Manganese Removal	**Note Set 12**	4
18	Water Treatment o Disinfection	**Note Set 13**	4
19	Wastewater Treatment o Treatment Trains o Design Guidelines	**Note Set 14**	5
20	Wastewater Treatment o Microbial Growth Kinetics and Stoichiometry	**Note Set 15** Chapter 12	5
21	**Exam II**	**Note Sets 7-13**	**HW 3-4 Report**
22	Wastewater Treatment o The Activated Sludge Process	**Note Set 15** Chapter 12	5
23	Wastewater Treatment o Biological Nutrient Removal	**Note Set 16** Chapter 12	5
24	Graduate Lectures on Global and Societal Issues in Water and Wastewater Treatment	Sakai Posting	6
25	Advanced Wastewater Treatment	**Note Set 17** Chapter 14	6
26	In class Exercise Treatment Plant Data Analysis	Handouts	6
27	Anaerobic Digestion	**Note Set 18** Chapter 13	6
Final Exam 8 – 11 am	**Exam III**	**Note Sets 13-18; Graduate Lectures; Field Trip**	**HW 5-6**

Grading:
1. Exams I, II, III: 60 percent (weighted equally)
2. Group Projects: 10 percent
3. Report on Virtual Tours: 10 percent
4. Homework (6 assignments): 20 percent

Group Projects: Points are achieved through attendance and participation in announced and unannounced group projects held during class, and in attending field trips or equivalent activities.

Field Trip: A field trip to a treatment plant will be scheduled.

Policies:
Late homework will be **marked down 10% for each day** after the due date it is received (to a maximum of -50%). NO HOMEWORK may be turned in after the solutions have been distributed.
No make-up exams will be given unless you or someone in your immediate family is ill.

11:375:302
Elements of Water and Wastewater Treatment
Environmental Sciences Undergraduate Curriculum
Learning Goals and Assessment

Elements of Water and Wastewater Treatment 11:375:302 is a technical elective for the Environmental Sciences Option and a required course for the Applied Environmental Sciences and Environmental Health Options.

Students completing this course will be able to:

Goal 1. Apply knowledge from the sciences and mathematics to water and wastewater treatment problems and solutions;

Instructional Activities
Lectures, assigned readings, homework problems, exams, in-class group homework solutions and revisions, exam review sessions

Assessment Method
Specific homework and exam problems will be scored that required incorporation of math and science knowledge to (1) identify and characterize water quality issues or (2) to provide specific solutions in water and wastewater treatment.

Goal 2. Use skills and modern environmental science techniques and tools necessary for a successful career in the field of water and wastewater treatment;

Instructional Activities
Lectures, assigned readings, homework problems, exams, in-class group homework solutions and revisions, exam review sessions

Assessment Method
Specific homework and exam problems will be scored where students utilized analytical or experimental data (e.g., biochemical oxygen demand, most probable number, treatability tests) to characterize a water or waste water source or to assess treatment effectiveness; or use mass balances coupled to reactor models to design a specific solution (e.g., design of a system or system components).

Goal 4. Function effectively on multidisciplinary teams;

Instructional Activities
Lectures, field trips, virtual field trips, lectures, homework problems, class discussion

Assessment Method
Students complete in-class directed projects in assigned interdisciplinary teams (the course includes engineering students and graduate students from different fields) to (1) identify, establish or design a characterization approach or a system design and (2) utilize treatment facility schematics to characterize a treatment train and the chemical/physical/biological principles used at a specific facility. Assessment will be quantified through scores from individual worksheets completed with the group.

Goal 5. Communicate technical information effectively (orally, in writing, and through electronic media).

Instructional Activities
Lectures, field trips, virtual field trips, class discussions

Assessment Method

Students prepare a written comparative assessment report of specific water or wastewater treatment facilities that are visited via virtual tours on the web. Students will compare treatment trains and discuss relative scientific principles as utilized under site specific conditions. A grading rubric will be provided to explain expectations with respect to style in addition to factual information.

Goal 6. Understand professional ethical responsibilities in the field of water and wastewater treatment; and

Instructional Activities

Lectures, readings, class discussions

Assessment Method

Specific homework and exam problems will be scored where students answer questions or write a short essay regarding professional ethical responsibilities in practice as a water and wastewater specialist.

Goal 7. Understand contemporary environmental science issues and the impact of environmental science in a global and societal context especially as it pertains to water quality and water and wastewater treatment.

Instructional Activities

Graduate students (3-5 students) give short directed lectures on global or societal issues in water and wastewater treatment.

Assessment Method

Specific homework and exam problems will be scored where students answer questions and write a short essay regarding the global and societal issues of concern in practice as a water and wastewater specialist.

Example Assessment Scoring Table

Goal #	No. of students assessed	Un-satisfactory (<70%)	Satisfactory (70-79%)	Good (80-89%)	Outstanding (>90%)	Summary of Assessment
Summary of Assessment Goal						
HW #1						
HW #2						
HW #3						
HW #4						
HW #5						
HW #6						
Exam I						
Exam II						
Exam III						
In-class group projects						
Individual project Virtual Tours						

Bioenvironmental Engineering Undergraduate Curriculum

Elements of Water and Wastewater Treatment 11:375:302 is a technical elective for the Bioenvironmental Engineering Undergraduate Curriculum.

Prepared by: Donna E. Fennell 3 September 2012