Instructor: Byron Hempel   Office Hours: By appointment
                 byronhempel@email.arizona.edu   Harshbarger 105D

Class time: Day(s)/Time   Location: TBD

Zoom link: https://arizona.zoom.us/j/92759393185

Credits: 3

Course Description and Objective:

This course focuses on the application of theory and engineering experience to the design of unit operations for the treatment of wastewater. It covers characteristics of wastewater; wastewater regulations; primary, secondary & tertiary treatment processes; selected topics on advanced treatment and resource recovery; sludge disposal; and design of water and wastewater treatment plants. At the end of the course, the students will have a working knowledge of the wastewater industry and have the skills to perform a preliminary design of a treatment plant.

Student learning outcomes:

On successful completion of this course students will be able to:
- To discuss wastewater quality data.
- To identify specific pollution problems associated with wastewater discharge and sludge disposal.
- To describe the main physical, chemical and biological unit operations applied in municipal and industrial wastewater treatment systems.
- To identify laws and regulations that apply to water and/or wastewater treatment.
- To explain the principles of wastewater treatment, understand the main design criteria and operational parameters for wastewater treatment processes, and apply the knowledge in the process design.
- To understand the principles of excess sludge treatment and apply the knowledge in the process design.
- To formulate a preliminary design of a wastewater treatment plant.
- To reflect on the importance of practical wastewater design considerations as well as sustainability issues

Prerequisites:
CHEE 477R or CHEE 377 or with instructor permission

Graduate-level requirements:
Graduate-level requirements include additional homework problems, a presentation, a course paper, and additional exam questions.

Textbooks:
Required:

Metcalf & Eddy, 2013. Wastewater Engineering: Treatment and Resource Recovery, 5th Ed, McGraw-Hill. ISBN-13: 978-0073401188

<u>Supplemental (free from the U of A libraries online):</u>
M. L. Davis. 2017. Water and Wastewater Engineering. 7th Ed. McGraw-Hill, ISBN: 978-1259064838
Free access to this E-book: via D2L or using the link below
https://ebookcentral.proquest.com/lib/uaz/detail.action?docID=4658082

Grading:

Grades Overview - Undergrad

Item	Points	Description
attendance	10	Includes Perusal
Midterms	38	2 midterms, at 20% each
Final Exam or Semester Long Project	25	Cumulative Final
Homework	25	2 exams over content that are a combination of group and individual
Project term paper and presentation	0	Graduate students only
Review Presentation(s)	2	Peer Practice and Review Content of Course
Total	100	

Grades Overview - Graduate

Item	Points	Description
attendance	10	Includes Perusal
Midterms	38	2 midterms, at 20% each
Final Exam or Semester Long Project	25	Cumulative Final
Homework	25	2 exams over content that are a combination of group and individual
Project term paper and presentation	15	Graduate students only
Review Presentation(s)	2	Peer Practice and Review Content of Course
Total	115	

Project term paper and presentation	Points	Graduate students only
Choose Term Topic	0.25	
1st Draft	0.75	
Submit to Peer Review	0.75	
Peer Review	0.75	
Submission	10	
Presentation	2.5	
Total	15	

Attendance/Participation/Perusall

Student who are not limited by time zone issues are required to attend class each time it is scheduled. While in class, students need to demonstrate engagement in the material to gain credit for the day. Students who are unable to attend class need to demonstrate they viewed the content for the day and write a summary statement to gain attendance points. Before class, student will need to complete the Perusall assigned reading.

Wastewater Treatment Plant Design

One skill engineers need to have is a firm grasp of the design process. We will be moving through different stages of a wastewater treatment plant during the semester. Students are encouraged to continue to work on their design on a rolling basis. See design statement and rubric for more details.

Exam Guidelines and Policy

Exams will have two main portions: an individual portion and a group portion.

The individual portion of the examination is closed notes. You are encouraged to have a calculator and any type will work. You will have 15 (+ or - 5) minutes to complete this portion of the exam. The individual exam is a general conceptual exam that is meant to test to see if you have conceptualized the essentials of wastewater treatment.

The group examination is open notes and open book and begins after the individual exam has completed. You will need a calculator. You will have the remainder of class to complete the exam.

Review Presentation

Students will give a review presentation at the end of every other Thursday for the last 15 minutes of class. This presentation is meant to be a review of the content from the previous two weeks. Students are encouraged to make these presentations highly interactive rather than a simple recap lecture. Both undergraduate and graduate students will benefit from presenting. See D2L for a schedule of when you present.

Homework

There will be five homework assignments throughout the semester. You are encouraged to work in groups but may submit homework individually.

Semester Schedule Overview

Topic	Week	Description	Homework	Exam	Presentation	Graduate Report
Preparation to Wastewater Treatment Design	1	Intro / Wastewater Gen				
	2	Wastewater Characteristic - Physical and Chem and Biological	HW1		Summary Pres 1	
	3	Microbiology and Litigation				
	4	Kinetics and Reactors	HW2		Summary Pres 2	Choose Topic
	5	Reactors and Micro				
	6	Microbial Kinetcs			Summary Pres 3	
Exam and Guest Lecture	7	Exam and Overview		Midterm I		
Wastewater Treatment	8	Activated Sludge	HW3		Summary Pres 4	First draft
	9	Activated Sludge (cont)				
	10	Trickling Filters and Nitrogen Treatment	HW 4		Summary Pres 5	
	11	Phosphorous Treatment				Peer review draft
	12	Anaerobic wastewater treatment			Summary Pres 6	Return peer review
Exam and Guest Lecture	13	Anaerobic Biosolids treatment and exam		Midterm II		
Post Treatment Considerations	14	Sludge handling and industrial wastewater	HW 5		Summary Pres 7	Turn in paper
	15	Designing a Wastewater Treatment Plant				Grad Pres
	16	Grad Presentations			Summary Pres 8	Grad Pres

Course Lectures

Date	Topic
Class 1	Introduction to Course
Class 2	Wastewater Introduction and Generation
Class 3	Wastewater Characteristics - Physical and Chemical
Class 4	Wastewater Characteristics - Biological
Class 5	Wastewater Flows
Class 6	Environmental Legislation / Permitting
Class 7	Reactors I
Class 8	Reactors II
Class 9	Reactors III
Class 10	Wastewater Microbiology I
Class 11	Microbial Kinetics
Class 12	Preliminary and Primary Treatment Equalization Basins
Class 13	Midterm I
Class 14	Lagoons or Waste Stabilization Ponds
Class 15	TOrCs in wastewater effluent
Class 16	Activated Sludge Processes I
Class 17	Activated Sludge Processes II
Class 18	Activated Sludge Processes III
Class 19	Trickling Filters
Class 20	Nitrification and denitrification I
Class 21	Nitrification and denitrification II
Class 22	Phosphorous Removal
Class 23	Anaerobic Wastewater Treatment Processes I
Class 24	Anaerobic Wastewater Treatment Processes II
Class 25	Midterm II
Class 26	Anaerobic Wastewater Treatment Biosolids
Class 27	Designing a Wastewater Treatment Plant & Disinfection
Class 28	Thanksgiving Break
Class 29	Site visit
Class 30	Grad Presentations or Guest Lecture
Class 31	Grad Presentations or Guest Lecture

Paper Guidelines and Policy (576B Only)

See D2L for a more information and resources.

Overview
This course can only describe the major topics in wastewater treatment. As graduate students, you all will choose a topic to go in depth and have a greater understanding. The topic should concern a wastewater treatment process or problem and MUST be checked for acceptability with the instructor by the deadlines listed in D2L. You are required to prepare a term paper and will give an oral presentation to the class at the end of the semester for the last two sessions of class.

The intent of the paper assignment is:

- to become acquainted with and gain experience using the environmental science and engineering literature
- to obtain a more in-depth knowledge of a particular treatment process or problem
- to improve your writing and critical evaluation skills.

Paper Requirements
Format: 10-12 pages (excluding references, cover page and table of contents). Any appropriate, clearly legible, typeface may be used of 12 point. Lines should be 1.5 spaced.

Structure: The paper will be organized as follows:

- Cover page
- Table of Contents
- Abstract/Summary (maximum 1/2 page)
- Introduction and background
- Objectives (objectives of your literature study)
- Results (what is known from research papers on the topic, design/operation/application of the selected method)
- Discussion (what are the potentials and limitations of the treatment system considered, what research still needs to be done)
- Conclusions and recommendations
- References: References should be cited within the paper, and a list of references should be appended.
- Appendices, if any (not to exceed 5 pages)

Oral Report Presentation
The oral presentations will be conducted over the last two days of class. The following are requirements:

- Plan for a 15 minute presentation with the potential for questions afterwards
- Presentation must cover the main points in the research paper
- Follows good presentation practices

Grading Rubric:
This course will be graded on a straight scale as follows:

Total percentage of points earned	Final Grade
90 - 100 %	A
80 - 89 %	B
70 - 79 %	C
60 - 69 %	D
< 60%	E

Teaching Philosophy
I truly believe in your success as a student and adapting my instruction to ensure your success. Below you will find several different instructional methods to help me accomplish my goal:
1. Everyone has the right and ability to be successful in this course. I provide many chances for low-stakes points for this course. As a future engineer, I want to provide a level of rigor (appropriate for this course!) that will promote you to be the best engineer you can be.
2. I vary my teaching methods to ensure that our courses are accessible to all students. Feel free to give me any feedback onto what works or does not work for you.
3. I believe in transparency and open communication, meaning I wish to be as clear as possible in class and give you insight into my teaching decisions. I want my classroom to be one where you can feel free to express your own ideas and thoughts to contribute to the wider discussions.
4. Foremost, I believe in student-centered active learning. Literature through education-based teaching practices support nearly every aspect and decision in this course. If you have any questions or comments about the theory and practice of different methods, once again, I would love your feedback. Just as I want you all to have a growth mindset, I too want to continuously improve this course to be the best it can be.

Feeling stuck or like you could be studying more effectively?
You're not alone! May students don't fully know their ideal study behaviors until later in their college careers. If you'd like to find additional resources concerning research-proven best study practices, check out the supplemental section in our D2L page. You will find many different resources there to help you get started on your path to your ideal student self!

Course Lectures and Attendance Policies:
This class uses an active learning environment and attendance is critical for you all to be able to engage with the material. Class participation is a requirement. Groups will be assigned on the first day of class and will be reassigned on the 6th and 11th class during the semester.

Scholastic Dishonesty Policy: Integrity is expected of every student in all academic work. Scholastic dishonesty will not be tolerated. Please refer to the UA Code of Academic Integrity for information about procedures and about what constitutes scholastic dishonesty (http://deanofstudents.arizona.edu/academicintegrity).

Plagiarism: Although this course is not writing intensive, plagiarism is strongly discouraged. The plagiarism policies within the Student Code of Academic Integrity will be strictly followed: http://doc.web.arizona.edu/uapolicies.

Threatening Behavior: The general policies against threatening behavior by students will be followed: http://policy.web.arizona.edu/~policy/threaten.shtml.

SALT Center and Disability Resource Center: Students who are able to use the services of the Strategic Alternatives Technology Center or may have other educational needs may see the professor at any time to discuss accommodations for their needs. However, this should be done at least 1 week prior to the first exam to allow for preparations that may be needed. Students who are registered with the Disability Resource Center must submit appropriate documentation to the instructor if they are requesting reasonable accommodations: http://drc.arizona.edu/teach/syllabus-statement.html.

Accessibility and Accommodations: It is the University's goal that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, please let me know immediately so that we can discuss options. You are also welcome to contact Disability Resources (520-621-3268) to establish reasonable accommodations. Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.

Useful Websites/Resources:

The Career Resource Library helps with career exploration, resumes, interviewing, graduate school and networking.

The THINK TANK provides math and science tutoring, writing support, weekly course reviews for select courses, one-on-one tutoring, academic skills tutoring, supplemental instruction, and other academic support services to online students. They provide both FREE and fee-based services – hours and availability can be found on their website. Online Services with THINK TANK

The Writing Skills Improvement Program (WSIP) helps students at the University of Arizona improve their writing skills and achieve academic success. Writing coaches work one-on-one with students, staff, and faculty across all majors and degree programs through writing workshops, custom workshops, and summer writing institutes. Tutoring is available online via Skype. They provide both FREE and fee-based services – hours and availability can be found on their website. Tutoring Services with WSIP

The 24/7 IT Support Center (commonly known as 24/7) can help you with troubleshooting hardware, software, and any special course technology you are using and is available 24 hours a day, with the exception of University observed holidays.Phone: (520) 626-TECH (8324); 24/7 Website

If you are looking for a quick answer to a D2L question, D2L Support has created several tool manuals, tutorials and an in-depth FAQ for many of the common issues and questions related to our learning management system, Desire2Learn.Help Pages

Need to talk to someone for more in-depth support? Various aspects of D2L are supported by different groups across campus, so D2L Help has put together a handy resource for finding quick and comprehensive support for any questions and issues that you may have.D2L Help Contacts ; Privacy Statement ; Accessibility Statement

The University of Arizona's UACBT service (Computer-Based Training) offers 24/7 availability of FREE online training to over 1000+ courses and 98,000+ video tutorials, covering a broad range of topics and applications browse titles here. Most tutorials have between five and fifteen hours of content. Each tutorial is divided into lessons from 2-10 minutes long on average. Each lesson is available as a Flash, QuickTime, Adobe Air, or Adobe Air for Linux movie. You can stop, start, rewind, and review each lesson as often as desired.Access UA Computer-Based Training

For scholarship opportunities and two great groups to network with:

http://www.saems.org/
https://www.azwater.org/

Netiquette

Netiquette is an abbreviation for "internet etiquette" – more simply put, guidelines for communicating online to ensure meaningful and polite exchanges. The common standards listed below work well for both the online classroom and beyond in professional online communication:

1. **Behavior**. Maintain the same standard of behavior and ethics that you would follow in a face-to-face context.
2. **Tone**. Treat others with respect. Be mindful of your tone and how that is conveyed in your writing style. DO NOT USE ALL CAPS (wasn't that loud/painful?). It is considered shouting and not appropriate in a classroom. Avoid sarcasm and irony as it is easily misinterpreted in an online environment.
3. **Clarity and Content**. Be succinct. Write, reread, and then post. Carefully consider what you have written. Does it make sense? Is is free from errors? Does is add to the conversation? Is it unnecessarily confrontational or offensive?
4. **Contribute**. Online learning is not passive. It is expected that you will share your knowledge and insight. Be an active contributor to the learning community.
5. **Be forgiving**. If someone makes a mistake or does something inappropriate, address it privately and politely. You can always let the instructor know and ask them to address it as well.

Please note: ALL University of Arizona students have agreed to abide by the standards for behavior set forth by the Arizona Board of Regents. *The* Student Code of Conduct *is in place to create a safe, healthy and responsible environment that allows UA students, faculty, and staff to be successful in their daily endeavors and long term goals. Sanctions may be imposed for acts of misconduct that occur on university property or at any university-sponsored activity (including the online environment). As further prescribed in these rules, off-campus conduct may also be subject to discipline.*

Changes to the Syllabus: The information contained in the course syllabus, other than the grade and absence policies may be subject to change with reasonable advanced notice as deemed appropriate by the instructor.