

CE 5349 – Design of Filtration and Membrane Desalination Proc.– Fall 2020

The University of Texas at El Paso
Civil Engineering
Lecture: ONLINE (asynchronous)
CRN: 19647 (CE 4375 - 19648; CE 4376 – 19649;
CE 4377 -19650)
Prerequisites: CE 3342 Water & Wastewater Engr.

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Required Text: MWH (2012) Water Treatment: Principles and Design, 3rd Ed. (9780470405390)

Supplemental Texts:

- AWWA & ASCE (2012) Water Treatment Plant Design, 5th Ed, McGraw Hill, <https://www.accessengineeringlibrary.com/content/book/9780071745727>
- AWWA (2011) Water Quality & Treatment, 6th Ed, McGraw Hill <https://www.accessengineeringlibrary.com/content/book/9780071630115/>
- Benjamin and Lawler (2013) Water Quality Engineering: Physical & Chemical Trt. Proc., Wiley
- Davis (2020) Water and Wastewater Engineering (Second Edition), McGraw Hill
- Green and Southard (2019), Perry's Chemical Engineer's Handbook, 9th Ed., McGraw Hill <https://www.accessengineeringlibrary.com/content/book/9780071834087/>

Description and Objectives

This course involves a study of theory and preliminary design of pretreatment, process, and posttreatment for membrane filtration and desalination systems. The objectives of this course are to develop:

1. design background required to solve problems dealing with water quality, water treatment, and water regulation.
2. the ability to work in teams on complex design problems.
3. an awareness of the environment in which we, as a society, live and the significance of the local, state, national and global problems that face the engineering community.
4. preliminary design of membrane filtration (microfiltration or ultrafiltration) systems for drinking water treatment
5. preliminary design of membrane desalination (reverse osmosis, nanofiltration, or electrodialysis) systems for drinking water treatment

Expectations

Participation: More than simply attending class, you are invited to *think*, and *participate* in the lectures and discussions. I encourage you to be curious and inquisitive during lectures and discussions.

Punctuality: Assignments submitted late will receive half credit.

Ethics: In engineering, personal integrity is of utmost importance, especially in the assessment and reporting of environmental conditions. Also, in most cases, it is necessary to work in teams to develop and design optimal solutions to problems and challenges, and it is essential that each team member contribute to the productivity of the team. In this course, I strongly recommend that you complete homework assignments in teams; in many cases, you will help each other through the solution of difficult problems. My goal for the homework is for you to develop proficiency in the basic application and calculations in design. Thus, every student is accountable for *understanding* the concepts, analysis, and solution. My goal for the projects is for you to have opportunity to apply this theory in a deeper and more meaningful way than homework. Each student is accountable for understanding and *contributing* (equitably) to the team projects. Any student committing plagiarism (*e.g.*, copying another's work without understanding) or any other form of academic dishonesty will be reported to the Dean of Students for disciplinary action (which may include expulsion from the University). For a concise summary of engineering ethics, I have provided here the Fundamental Canons within the [Code of Ethics](#) of the American Society of Civil Engineers (ASCE):

1. *Engineers shall hold paramount the safety, health and welfare of the public and shall strive to comply with the principles of sustainable development³ in the performance of their professional duties.*
2. *Engineers shall perform services only in areas of their competence.*
3. *Engineers shall issue public statements only in an objective and truthful manner.*
4. *Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.*
5. *Engineers shall build their professional reputation on the merit of their services and shall not compete unfairly with others.*
6. *Engineers shall act in such a manner as to uphold and enhance the honor, integrity, and dignity of the engineering profession and shall act with zero-tolerance for bribery, fraud, and corruption.*
7. *Engineers shall continue their professional development throughout their careers, and shall provide opportunities for the professional development of those engineers under their supervision.*

Homework

Some of the homework assignments will be completed through the UTEP Blackboard website (available through <https://my.utep.edu/>), and some homework assignments will be completed through Quest Learning and Assessment (<https://quest.cns.utexas.edu>), a web-based content and homework delivery system maintained by The University of Texas at Austin. Please go to <https://wikis.utexas.edu/display/questla/Obtaining+a+University+of+Texas+EID> for instructions on how to sign up for the Quest system for this class. During the beginning of this course, when you log into Quest, you will be asked to pay \$30 via credit card on a secure payment site (<https://getquest.cns.utexas.edu/subscriptions/>), which goes toward the maintenance and operation of the resource. You can enroll in the homework portal for this course by searching for the CRN (19647) or by clicking this link: <https://quest.cns.utexas.edu/student/elements?courseuser=2967409>

Homework assignments will typically be open two to seven days before the due date, and students will be notified by email when assignments are posted on Quest.

Exams

Exams will be administered and proctored (<https://wikis.utexas.edu/display/questla/Proctoring>) asynchronously through Quest over a 24 hour period (12:00 am to 11:59 pm) on the date specified in the [course schedule](#) (near the end of this syllabus). You must complete the exam within 90 minutes of starting the exam. If you have any concern about the stability or reliability of your off-campus internet access, then I recommend that you plan on taking the exams at the UTEP Library.

Exams are open book, open notes, and open homework, and you are allowed to use a calculator. You are NOT allowed to use a cell phone or tablet in any way during the exam. On the date of an exam, you are NOT allowed to communicate in any way with anyone (except the instructor) about the exam. You are required to have a functioning webcam for online proctoring. When you begin the exam, you are required to show a 360° view of your surroundings, and you must show a close up of your calculator so that the brand and model number are readable. If your webcam does not work for part of the exam, your exam grade will be reduced by 10 points per minute that your camera is not working.

Packback Forum

Packback is an online curiosity community where you can be fearlessly curious and ask big questions about how what we're studying relates to life and the real world. Packback will be assisting you with developing writing skills while enhancing your ability to critically analyze the discussions of this course to draw real-world conclusions. For a brief introduction to Packback Questions and why we are using it in class, watch this video: <https://vimeo.com/163888277>. I believe that your life-long learning is more affected by seeking to know WHY than WHAT. In this course, I want you to empower yourself through deep connections between the course materials and your why. Your time in my course will be brief, but your potential to make the most of your life is great. I hope that through this forum you are able to be inspired by your peers to make the most of your learning.

How to Register on Packback: You will receive a welcome email from help@packback.co prompting you to finish registration and payment (\$25). Packback has already created an account for you with your UTEP email address, so all you need to do is reset your password. This email may be directed to spam or filtered out, so make sure you do a thorough scan of your inbox if you can't find the email. But, if you can't find the email, then you may register by following the instructions: First, create an account by navigating to <https://questions.packback.co> and clicking "Sign up for an Account". Or if you already have an account on Packback, then you can log in with your credentials. Second, then enter our class community's lookup key into the "Looking to join a community you don't see here?" section in Packback at the bottom of the homepage (Community Lookup Key: 1c33734f-cc46-44e7-988f-33fc9f8ae6a2). Finally, follow the instructions on your screen to finish your registration. If you have ANY questions or concerns regarding Packback throughout the semester, please contact the customer support team at help@packback.co.

For this course, your participation on Packback will count towards 15% of your overall course grade. Your Packback grade is based on weekly participation: post one Question and two Responses per week, relevant to the assigned chapter that week. By the end of the semester, you should have posted 14 Questions and 28 Responses to other students' Questions (*i.e.*, a total of 42 posts). Part of your Packback grade will be based on your average Curiosity score; an average Curiosity score of 90 will constitute full-credit for the Curiosity score component, and an average Curiosity score of 40 or less will receive no-credit. The Packback Participation Score (*PPS*) for CE 3342 will be calculated according to the following equation:

$$PPS = \left(\frac{N_Q}{14}\right) \left(\frac{N_R}{28}\right) \left(\frac{ACS - 40}{50}\right) \left(1 - \frac{N_{IW} - 1}{14}\right)$$

where N_Q is the number of questions posted, N_R is the number of responses posted, ACS is the Average Curiosity Score of all of your posts for the semester, and N_{IW} is the number of inactive weeks (no posts).

Since this is a graduate-level course, in order to catalyze independent thinking and literature review skills, each week you will harness your curiosity around the course topic for that week, and find a peer-reviewed journal article that addresses your question. When you post your question, be sure to include the complete DOI hyperlink (e.g., <https://doi.org/10.1039/D0EN00194E>). When you post a response on a classmate's question, find a different peer-reviewed journal article that addresses their question, and be sure to include the complete DOI hyperlink.

Before you start posting, be sure to read the Community Guidelines found in the tutorial on Packback. If your post doesn't follow the Packback Community Guidelines, there is a chance it will be removed and you won't receive points for that post. **There will be a weekly deadline of Monday at 1:00 am Mountain Time for submitting posts.** Note: it takes 24 hours for the Packback team to moderate a post and send a coaching email. If by any reason your post is moderated because it does not meet the Community Guidelines, you will need to edit and re-publish your post to receive credit for the week. It is important that you complete your Packback questions and responses several days in advance of the deadline in case your post is moderated.

Since this involves weekly professional writing, I encourage you to use this opportunity this semester to improve your technical and professional writing skills. I strongly encourage you to use a grammar check (e.g., <http://www.grammarly.com>) and proofread your questions and responses before posting. Unfortunately, popular culture includes making opinionated statements on social media, but in this platform, we want to postulate questions and make statements based on factual information.

Evaluation

Assessment of your performance in this course will be determined by class attendance and participation, homework quizzes, and exams. (No makeup exams will be offered.) The total course average will be computed by the following:

Evaluation	Contribution (%)
Homework	25
Packback Participation Score	15
Midterm Exams (3)	25
Project 1	10
Project 2	10
Final Exam	15
Total	100

The final course letter grade will be determined according to the following:

Average (%)	Grade
≥ 90	A
80-89	B
70-79	C
60-69	D
< 60	F

I reserve the right to modify or augment this grading scheme for the sake of improving the educational effectiveness of this course.

Topics Covered

The topics covered in this course are:

1. Water Quality
2. Granular Media (Depth) Filtration (e.g., rapid sand filtration)
3. Membrane Filtration (e.g., MF and UF) – Design Project 1
4. Membrane Desalination Systems (e.g., RO, NF, and ED) – Design Project 2
5. Residuals (concentrate) management

Tentative Course Schedule

Class	Date	Topics	Reading Assignment
1	AUG	25 Global context, development	Ch. 1
2		27 Water quality: Phys., Chem., & Microbio.	Ch. 2-3
3	SEP	1 Water treatment overview	Ch. 4
4		3 Granular Media Filtration: principles	Ch. 11.1-3
5		8 Granular Media Filtration: hydraulics	Ch. 11.4
6		10 Granular Media Filtration: particle removal	Ch. 11.5
7		15 Granular Media Filtration: rapid filter design	Ch. 11.6-7
8		17 Granular Media Filtration: other technologies	Ch. 11.8
9		22 Membrane Filtration: principles	Ch. 12.1-3
10		24 Membrane Filtration: particle removal	Ch. 12.4-5
11		29 EXAM 1	Chapters 1-4, 11
12	OCT	1 Membrane Filtration: hydraulics and fouling	Ch. 12.6-7
13		6 Membrane Filtration: design process	Ch. 12.8
14		8 Membrane Filtration: point-of-use	(supplement)
15		13 Reverse Osmosis: principles	Ch. 17.1-4
16		15 Reverse Osmosis: fundamentals	Ch. 17.5a (p. 1348-1367)
17		20 EXAM 2	Chapter 12
18		22 Reverse Osmosis: polarization and scaling	Ch. 17.5b-6
19		27 Reverse Osmosis: design process	Ch. 17.7
20		29 Reverse Osmosis: manufacturer's software	Tbl. 17-5, Commercial Software
21	NOV	3 Electrodialysis: principles	(supplement)
22		5 Electrodialysis: design	(supplement)
23		10 Direct Potable Reuse (DPR)	(supplement)
24		12 Residuals (concentrate) Management	Ch. 21
25		17 Semi-batch RO: CERRO, CCRO, & FRRO	(supplement)
26		19 EXAM 3	Chapters 17, 21
27		24 <i>Thanksgiving Holiday</i>	-
-		26 <i>Thanksgiving Holiday</i>	-
28	DEC	1 Electrodialysis Metathesis	(supplement)
29		3 Membrane distillation and pervaporation	(supplement)
30		10-11 FINAL EXAM	(comprehensive)