

## CE 5345 – Advanced Physical-Chemical Water Treatment Processes

The University of Texas at El Paso  
Department of Civil Engineering  
Class: Mon & Wed 4:30-5:50 pm, CRBL 304  
CRN: 28471. Cross-listed courses:

- CE 4375 Adv. Topics in CE – 24535
- CE 4376 Adv. Topics in CE II– 23465
- CE 4377 Adv. Topics in CE III – 25071

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### NOTICE:

**Class meetings and Exams will be IN-PERSON according to the schedule provided at the end of this syllabus.** Homework assignments will be administered asynchronously online, and communication will be sent by email through Blackboard (<https://my.utep.edu/>).

### COVID-19 PRECAUTIONS

Please stay home if you have been diagnosed with COVID-19 or are experiencing COVID-19 symptoms. If you are feeling unwell, please let me know as soon as possible, so that we can work on appropriate accommodations. If you have tested positive for COVID-19, you are encouraged to report your results to [covidaction@utep.edu](mailto:covidaction@utep.edu), so that the Dean of Students Office can provide you with support and help with communication with your professors. The Student Health Center is equipped to provide COVID 19 testing.

The Center for Disease Control and Prevention recommends that people in areas of substantial or high COVID-19 transmission wear face masks when indoors in groups of people. The best way that Miners can take care of Miners is to get the vaccine. If you still need the vaccine, it is widely available in the El Paso area and will be available periodically at no charge on campus. For more information about the current rates, testing, and vaccinations, please visit [epstrong.org](http://epstrong.org).

### Philosophy

I believe that *teaching* and *learning* are interdependent; you cannot have one without the other. You and I are partners and colleagues, working together to help you become a knowledgeable, curious, intrinsically motivated, and confident engineer. I want to help you become a critical thinker with sharpened skills in analysis, evaluation, and synthesis. I incorporate team-based, hands-on projects in all of my courses to help prepare you for professional practice and to help you develop as a more robust and intrinsically-motivated engineer. I have also realized that it is important to provide weekly homework assignments and quizzes, which help students keep up with understanding and applying concepts. Thus, I have implemented a combination of homework assignments, quizzes, and exams.

### Required Text:

MWH (2012) **Water Treatment: Principles and Design, 3rd Ed., Wiley;**

Supplemental Texts:

- Benjamin and Lawler (2013) Water Quality Engineering: Physical & Chemical Treat. Proc., Wiley;
- Davis (2020) Water and Wastewater Engineering (2<sup>nd</sup> Ed), McGraw Hill;  
<https://www.accessengineeringlibrary.com/content/book/9781260132274>
- AWWA (2011) Water Quality & Treatment, 6<sup>th</sup> Ed., Edzwald (ed), McGraw Hill,  
<https://accessengineeringlibrary.com/browse/water-quality-and-treatment-a-handbook-on-drinking-water-sixth-edition;>
- Green and Perry (2008) Perry's Chemical Engineers' Handbook, 8<sup>th</sup> Ed.,  
<https://accessengineeringlibrary.com/browse/perrys-chemical-engineers-handbook-eighth-edition>

- Viessman et al (2009) Water Supply & Pollution Control, 8<sup>th</sup> Ed., Pearson Prentice Hall.
- Droste (1997) Theory and Practice of Water and Wastewater Treatment, Wiley

### Description and Objectives

This course involves an advanced study of theory and design of physical-chemical water treatment processes, in greater detail than the introduction provided in CE 3342 (Water & Wastewater Engineering), and complementary with CE 5409 (Environmental Engineering Chemistry), CE 5349 (Membrane Filtration and Desalination), and CE 5344 (Biological Unit Operations). Topics include mass-flow balances, reactor models, coagulation/flocculation, settling, adsorption, disinfection, and AOPs.

### 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.

Preparedness: I recommend that you bring the textbook, a personal course notebook, a pen or pencil, a calculator, completed homework assignments, and questions from the homework and assigned reading.

Punctuality: You are expected to be on time to class, laboratory exercises, and plant tours. 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 development<sup>3</sup> 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

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. 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/students/collegiate-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 (28471).

## Quizzes

I will be using a cloud-based student response software by iClicker in class this semester for quizzing and polling. You will need to download the “iClicker Reef (REEF Polling)” app ([Android](#), [Apple](#)) create an iClicker Reef Student account to participate in class using your laptop, smart phone, or tablet connected to the university’s Wi-Fi (UTEPSecure) or to your mobile data plan. If you have not used iClicker Reef before, then you can see these instructions: <https://www.utep.edu/technologysupport/Files/docs/iClicker-Reef-Student-Signup-Instructions.pdf> **When creating your account, use your university email address** (username@miners.utep.edu). You will NOT need to purchase a subscription to use iClicker REEF this semester because it is provided to you for FREE. After logging in to Blackboard, click the link to iClicker REEF, and complete the registration process. Note: submitting votes for a fellow student is considered cheating and a violation of the University Honor Code and the Civil Engineering Honor Code. If you are caught voting for another student or have votes in a class that you did not attend, you will be referred to OSCCR for disciplinary action.

## 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](mailto:help@packback.co) prompting you to finish registration and payment (\$29). 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, in case you don’t find the email in your primary inbox. If you have ANY questions or concerns regarding Packback throughout the semester, please contact the customer support team at [help@packback.co](mailto:help@packback.co).

Your participation on Packback will count towards 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 60 or less will receive no-credit. The Packback Participation Score (*PPS*) for CE 3342 will be calculated according to the following equation:

$$PPS = \left(\frac{N_Q}{14}\right) \left(\frac{N_R}{28}\right) \left(\frac{ACS - 60}{30}\right) \left(1 - \frac{N_{IW} - 1}{14}\right)$$

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 related to your question or response. When you post your question or response, 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 (“http...”).** In addition to searching on [Google Scholar](#), here are a few specific recommended journals related to this course, and you should be able to access these for free through the [UTEP VPN](#):

- Journal of Environmental Engineering (<https://ascelibrary.org/journal/joecedu>)
- Environmental Science & Technology (<https://pubs.acs.org/journal/esthag>)

- Water Research (<https://www.journals.elsevier.com/water-research>)
- Journal of Membrane Science (<https://www.journals.elsevier.com/journal-of-membrane-science>)
- Science of the Total Environment (<https://www.journals.elsevier.com/science-of-the-total-environment>)
- Water Environment Research (<https://onlinelibrary.wiley.com/journal/15547531>)

On Packback, each post (question or response) must cite at least one peer-reviewed journal article. If you find a relevant article that does not have a DOI, then it is probably not peer-reviewed. But just because it has a DOI does not guarantee that it is peer-reviewed. I don't have anything against scientific blogs and such, but in a world of social media that is inundated with people passing off their opinion as fact (which is so nauseating!), as engineers, we need to help guide people with objective truth. Of course, the peer-review process does not guarantee truth or accuracy, but it often helps improve accuracy and prevents well-intentioned knuckleheads or agenda-driven self-professed "scientists" from expressing unfounded opinions as "truth". In other words, the peer-review process is at least one barrier to the propagation of nonsense. As a general rule (though not always the case), journals with a higher impact factor tend to be more selective in their publications, so (theoretically), you are less likely to see a junk paper in their journals. I provided the list of some journals (above) that tend to be more trustworthy.

Also, simply listing a citation at the end of your post is insufficient. You need to reference the citation in the post. For example, "According to [insert lead author's last name here] et al. ([insert year of publication here]), [summarize here what you learned from reading the paper]."

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 Sunday at 11:59 PM 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. **With respect to the weekly question post, please focus on one of the two lesson topics listed for that week in the course schedule (provided at the end of this syllabus). Please try to post your question by Thursday evening so that everyone has time to post responses before the Sunday night deadline.**

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 make-up exams will be offered.) Your total course average will be computed by the following:

Evaluation	Contribution (%)
Homework Avg	30
Quiz Avg	5
Packback Participation Score	10
Midterm Exams	30
Final Exam	25
<i>Total</i>	<i>100</i>

Furthermore, your final course grade will be determined according to the following:

<b>Average (%)</b>	<b>Grade</b>
≥ 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.

**Special Accommodations**

The University of Texas at El Paso provides, upon request, appropriate academic accommodation for students with disabilities. For more information, contact the Center for Accommodations and Support Services (<https://www.utep.edu/student-affairs/cass/>).

**Course Schedule**

Lesson	Date	Topics	Reading
1	JAN	19 Fluid mechanics, flow tracers, turbulence, mixing	-
2		24 Mass balance and ideal reactors: PFR, CMR	6.1-3
3		26 Mass balances in systems	6.2
4		31 Chemical equilibrium and kinetics	5.1-5, 6.4
5	FEB	2 Ideal reactors with reactions	6.5
6		7 Tracer tests to exit age distribution	6.6
7		9 Modeling non-ideal reactors: DFM/TIS	6.7
8		14 Non-ideal reactors with reactions	6.8
9		16 PFRs in parallel, Segregated-Flow Model	6.9
10		21 Mixing, blending	6.10
11		23 Coagulation	9.1-5
12		28 Flocculation	9.6-7
-	MAR	2 Exam 1 review	-
-		7 <b>EXAM 1</b>	<b>Ch. 5-6</b>
-		9 Exam 1 review	
-		14 <i>Spring Break</i>	-
-		16 <i>Spring Break</i>	-
13		21 Adsorption	15.1-6
14		23 Mass transfer: diffusion	7.1-3
15		28 Interfacial transfer	7.4-6
16		30 Operation and enhance. of mass-transfer	7.7-9
17	APR	4 Introduction to air stripping and aeration	14.1-4
18		6 Air stripping design	14.5-8
19		11 Chemical oxidation and photolysis	8.1-4
20		13 Disinfection theory	13.1-4
-		18 Disinfection Documentary <i>How we got to now: clean</i>	-
-		20 <b>EXAM 2</b>	<b>Ch. 9, 15, 7, 14</b>
-		25 -	-
21		27 Disinfection and DBPs	13.5-9, 19.1-5
22	MAY	2 AOPs with O <sub>3</sub> , H <sub>2</sub> O <sub>2</sub> , and UV	18.1-5
-		4 <b>EXAM 3</b>	<b>Ch. 8, 13, 19, 18</b>
-		9 <b>FINAL EXAM, 4:00pm-6:45pm</b>	<b>(comprehensive)</b>