

**Texas A&M University – San Antonio**  
**Water Resources Science and Technology**  
**Department of Natural Sciences**

**WATR 5335**

**Desalination and Emerging Technologies** (3 credit hours)

Fall 2024, MW 7:00 – 8:15 pm

**Contact Information: Dr. Walter Den**

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**Office Hours:** SciTech Building (STB), Room 349D (office) or 345 (lab). Hours: MW, 3:00-5:00 pm, or by appointment at other times. You may also call (ext. 2815) or leave a message to me.

**Books:** (note – none of the on-the-shelf books available on the subject of desalination is designed in conventional textbook format due to the evolving nature of the technology. As such, the required book is best suited for the course with introductory nature.)

Required book: Bazargan, A. 2018. *A Multidisciplinary Introduction to Desalination*. The International Water Association/River Publications, Denmark (ISBN: 978-1780409153)

Reference book: Voutchkov, N. 2014. *Desalination Engineering: Operation and Maintenance* McGraw-Hill Education, New York, N.Y. (ISBN-13: 978-0071804219)

**Course Description:** This course will introduce both well-established desalination technologies and developing ones. The first part of the course will focus on membrane-driven systems such as micro- and ultra-filtration, reverse osmosis and forward osmosis. Followed by brief introduction of thermal-driven processes. The second part of the course will discuss developing technologies such as electrodialysis, electrocapacitive de-ionization, solvent extraction, and small-scale desalination solutions known as atmospheric water harvesting. Students will participate in small-group cooperative term projects, including a design project using reverse osmosis process and a humanitarian project from which a scientific report will be written. Results of the research will be orally presented to the class as a scientific report/paper.

**Learning Outcomes:** This course is to familiarize the student with the principles of desalination technologies, as well as the regulatory and economic challenges associated with the existing technologies. Specifically:

- a. Students will demonstrate the ability to communicate scientific information through oral and written formats;
- b. Students will gain a familiarity with brine water characterization, the operating principles and fundamental design component of the introduced desalination processes.

- c. Students will gain experience in conceptual design of desalination system using existing desalination plants as examples; and
- d. Students will be able to use and understand the primary scientific literature associated with new desalination processes and applications.

### **Course Requirements:**

**Lecture Attendance:** Typically, Mondays will be lecture days, while Wednesdays will be partially discussion days. Students are expected to attend all lectures, and come prepared for discussions. Discussions are meant to explore desalination processes or applications that are still in early stage of development and we will discuss papers in which the authors presented new data at the time of publication. All students will be graded on discussion contribution during each discussion, and discussion leading during an assigned discussion. *Attendance during discussions is mandatory*, and attendance is reflected in the grade (see course grading, below).

**Course Grading:** The course grades are broken down as follows: Midterm exam (25%); Final exam (25%), class projects (40%), and contributions to/leading discussions (10%). Grades will be based on the percentage of points earned from the total (90% = A, 80% = B, 70% = C, 60% = D). In principle, grade curving will not be used in this course.

### **Policies:**

- 1) **No make-up exams will be given without approval before a scheduled exam. Unexcused, missed exams, receive a score of zero.**
- 2) **Having more than one unexcused absence for a discussion day will lower the discussion score one full letter grade for each unexcused absence.**
- 3) Use of electronic devices (phones, computers, etc.) is not allowed without permission. Use of such devices for voice, text, or internet applications during a lecture is unprofessional.
- 4) Academic integrity is expected of all students at all times (see current Texas A&M University – San Antonio academic catalog). **Make sure you take care of all personal needs (e.g. bathroom, etc.) before exams. Leaving the room during an exam for any reason ends the exam.**
- 5) **Attitude and perseverance are everything!** Performance is more than just about grades. I am a big proponent of note-taking, because writing notes help you organize your thoughts and focus on lectures. Do not be over-confident of your photographic memory.

## Tentative Outline of Topics

Week	Date	Class Schedule	Notes
1	8/26	Class introduction; Overview of desalination technologies; Water supply technology portfolio	Reading: Ch. 1, 2, 19, 20
	8/28		
2	9/2	Water quality	<ul style="list-style-type: none"> <li>- Intro to class project I</li> <li>- Reading: Ch. 6.1, 6.2, 11.1</li> <li>- Assignment I</li> </ul>
	9/4		
3	9/9	Fundamentals of membrane filtration	<ul style="list-style-type: none"> <li>- Reading: Ch 4</li> <li>- Reading: supplemental material I &amp; II</li> </ul>
	9/11		
4	9/16	RO design criteria	- Reading: SM Sec III
	9/18		Discussion I: RO applications
			Assignment II
5	9/23	RO design process	- Reading: SM Sec III - Design
	9/25		
6	9/30	Forward osmosis	<ul style="list-style-type: none"> <li>- Reading: 3.4, 6.3, 12.4</li> <li>- Reading: SM Sec IV</li> </ul>
	10/2		Discussion II: FO applications Assignment III
7	10/7	Forward osmosis	- Reading: Ch 3.4.1, 5.1-5.4
	10/9		
8	10/14	Review	
	10/16	Midterm Exam	
9	10/21	Fundamentals of electrochemical methods	- Intro to term project II
	10/23		
10	10/28	Electrodialysis	- Reading: Ch 6.4
	10/30		Assignment IV
11	11/4	Capacitive deionization	- Reading: Ch 12.7
	11/6		Discussion: Journal readings Assignment V
12	11/11	Solvent extraction	- Supplementals
	11/13		Discussion: Journal readings
13	11/18	Energy considerations	- Supplementals
	11/20		Discussion: Journal readings
14	11/25	Project presentation	- Reading: Ch 14
	11/27		Thanksgiving
15	12/2	Review and discussion	
	12/4		
16		Final Exam Week	

### Academic Calendar: 2024 Fall

Date	Day	Event
August 26	Monday	First class day
September 2	Monday	Labor Day Holiday
September 3	Tuesday	Last day to register for Fall 16-Week Session
September 11	Wednesday	Census Date
September 12	Thursday	Drop for non-payment
October 7-18	Monday-Friday	Midterm grading period
November 11	Monday	Last day to drop with an automatic grade of “W”
November 19	Tuesday	Last day to withdraw from the university
November 27	Wednesday	Study Day - No classes
November 28-30	Thursday-Saturday	Thanksgiving Holiday
December 5	Thursday	Last day of scheduled weekday classes
December 6	Friday	Study Day - No classes
December 7-13	Saturday-Friday	Final examinations
December 13	Friday	End of Fall Semester
December 16	Monday	All grades due by noon