UNIVERSITY OF NEVADA LAS VEGAS
Civil and Environmental Engineering and Construction Department
CEE 751 Water Reuse Principles and Design

Course Description

Principles and design for a variety of water reuse applications. Topics include emerging chemical and microbial contaminants, nonpotable and potable reuse, advanced treatment trains, and public perception. Case studies of existing reuse systems will be discussed.

Prerequisites

CEE 650 or equivalent or consent of instructor.

Student Learning Outcomes

To acquire an understanding of the drivers, advantages, limitations, and hurdles facing the implementation of water reuse throughout the world. Case studies of existing water reuse systems will be discussed. Students will learn the basis behind existing reuse guidelines and regulations and how water and wastewater treatment processes can be integrated to satisfy these requirements and address a wide range of chemical and microbial contaminants. Specific outcomes include the following:

You will be aware of the various water crises throughout the world and how water is managed under extreme scarcity and uncertainty.

- You will know the critical chemical/microbial contaminants and the corresponding level of removal/inactivation that must be achieved in the design of water reuse systems.
- You will know which international guidelines and regulations are pertinent to water reuse.
- You will demonstrate comprehension of relevant design issues by assembling appropriate treatment trains for various water reuse applications.
- You will learn how to use surveys and statistical tools to assess public perception of water reuse and implement strategies to facilitate its implementation.
- You will complete assignments to improve your written and oral communication skills in relation to environmental engineering, water resources, and public policy aspects of water reuse.

Organization and Delivery

Students will have to work in teams of **3-5** students per group. It is up to students to decide on group compositions. Students are required to maintain the same group members throughout the course. The project will be a company (client) project or a research project identified by faculty

or the students. Each group will identify a tenured/tenure track faculty to be their primary advisor.

All proposed capstone projects will need to be approved by the MSQF program director to ensure that learning objectives will be met. The faculty advisor and MSQF program director will be the main points of contact for each group. Groups are mandated to periodically meet with their faculty advisor and MSQF program director and report about work in progress and/or seek necessary guidance. It is the responsibility of each of the groups to set up these meetings.

Furthermore, groups are invited to seek advice from Finance faculty members and Lee Business School faculty members as specific needs arise. There is no formal class meeting schedule for this course. The primary advisor, MSQF director, and 1-2 other tenured/tenure track faculty members will serve as readers of the final reports. The oral presentation of the capstone project will be made to the same group of 3-4 faculty members.

Course Materials

- NWRI (2016a). ***Evaluation of the Feasibility of Developing Uniform Water Recycling Criteria for Direct Potable Reuse.*** Expert Panel Final Report. National Water Research Institute. Fountain Valley, CA.
- USEPA (2012). ***Guidelines for Water Reuse***. EPA/600/R-12/618. United States Environmental Protection Agency.
- NWRI (2016b). ***Potable Reuse Research Compilation: Synthesis of Findings.*** National Water Research Institute. Water Environment & Reuse Foundation: Alexandria, VA.
- Implementation Of Direct Potable Reuse A Guide For California Water Utilities Draft | July 2019. National Water Research Institute and Carollo Engineers https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/rw_d pr_criteria/app_a_ep_rpt.pdf
- Evaluation of the Feasibility of Developing Uniform Water Recycling Criteria for Direct Potable Reuse. California State Water Resources Control Board. August 2016

Supplemental Text Materials

- Asano, T., Burton, F.L., Leverenz, H.L., Tsuchihashi, R., Tchobanoglous, G. (2007) ***Water Reuse: Issues, Technologies, and Applications***. Metcalf & Eddy | AECOM, McGraw-Hill: New York.
- Crittenden, J.C., Trussell, R.R., Hand, D.W., Howe, K.J., Tchobanoglous, G. (2012) ***MWH Water Treatment: Principles and Design***. 3rd Edition. John Wiley & Sons, Inc.: Hoboken, NJ.
- Tchobanoglous, G., Burton, F.L., Stensel, H.D. (2003) ***Wastewater Engineering: Treatment and Reuse***. Metcalf and Eddy. 4th Edition. McGraw-Hill Higher Education: New York, NY.
- Additional sources will be identified throughout the semester.

Supplemental Documentaries:

- Last Call at the Oasis. Documentary.
- Killing the Colorado. Discovery Channel Documentary.

Class Expectations

Class Rules

- Except for special circumstances, cell phones must be turned off and put away during class. You are encouraged to use laptops, iPads, etc. during the lectures as long as it is related to class.
- No food or drink is to be brought into the classroom if it will cause a distraction.
- Behavior towards fellow students and the instructor must be respectful at all times.

Class Absences

- Students are expected to attend all lectures. Material presented in lecture may not always be found in the text references. Students are responsible for knowing material covered in class as well as the material found in the assigned readings.
- Please inform the instructor prior to missing class in order to make any necessary arrangements. In the event that you miss class, you should obtain class notes, handouts, and deadlines from a classmate.
- Excused absences include official university activities, valid medical conditions, and observance of religious holidays (see Religious Holidays policy below).

Participation

Your participation in this class is encouraged. Expect to be called on every class period. You will also be required to work in groups and present material in front of the class. Questions and participation will greatly improve the class and make it more enjoyable.

Assigned Reading

Assigned reading will be announced in class. Keeping up with the assigned reading will help prepare you for the class lectures and prevent you from "cramming" for the tests. Some material covered in the assigned readings will not be covered in lecture and may be included on the exams.

Class Assignments

Homework Assignments

- The homework assignments given in this course are designed to reinforce the material presented in class and to help you learn and improve your critical thinking skills. Students may also be expected to present/discuss their solutions to certain problems.
- Some homework problems may relate to material that has not yet been presented in

class. These problems are intended for the students to become familiar with new material prior to the lecture and to offer the students the opportunity to find information by themselves.

- ***Be neat!*** If it can't be read, it can't be graded!
- Students are encouraged to work together, but cheating/copying will not be tolerated (see Academic Misconduct policy below). All students are expected to understand the course material.

Exams

- There are no excused absences from an exam other than a valid, verified medical condition that prevents attendance.
- If you are unable to take a test and know in advance, please make arrangements with the instructor ***prior to the exam***.
- Make-up exams will be given at the discretion of the instructor and generally will be more difficult than the regular exam.
- Final answers for exam problems should be clearly identified (i.e., boxed), and the solution approach (i.e., the calculations) should be shown. A straight edge is preferred for relevant diagrams. Partial credit ***may*** be awarded if the solution approach is correct regardless of whether the final answer is accurate.
- The exams will be closed-book, closed-notes unless otherwise stated by the instructor.

Contaminant Project (Individual Project) and Reuse Design Project (Group Project)

Students are expected to write one term paper related to water reuse contaminants. The term paper will integrate a variety of water reuse concepts presented in the course, and the format of the paper will follow the guidelines required of an environmental engineering journal identified by the student. For the reuse design project, students will be placed in consultant teams, and each team will be responsible for making a proposal to a city agency. The teams will be responsible for identifying a water reuse application relevant to the city and preparing a conceptual-level design for a water reuse facility capable of meeting applicable regulations and guidelines.

Grading

The weight on each component of the overall course grade are as follows:

Assignments and In-Class Participation/Presentations	30%
Conceptual Design Progress Report (Group Project)	10%
Conceptual Design Proposal (Group Project)	30%
Midterm Exam	15%
Final Exam	15%

Grading Scale: A = 90-100%, B = 80-89%, C = 70-79%, D = 60-69%, F = 0-59%

Course Outline

***may be modified as necessary to adjust to course needs**

Week	Topic/Deliverable (due at time of indicated class)	Assignments (due at time of indicated class)
1	Introduction to Wastewater Treatment and Nomenclature of water reuse Peer-Reviewed Publications	Start reading/reviewing
	Introduction to Water Reuse Killing the Colorado Documentary (Prescott)	Jenkins (2015) Mulroy Article Southern Nevada Water Recycling Study
2	Water Rights and Water Use in the Southwest Water Reuse in Las Vegas Splashing the Streets Video	Stave (2003) Las Vegas Water Model Portfolio in class or presentation
	Microbes in Water Reuse Applications	**Homework 1 Due** Chapter 1 of CA DDW DPR Report
3	Last Call at the Oasis Documentary	Chapter 2 of CA DDW DPR Report
	Last Call at the Oasis Documentary	Chapter 3 of CA DDW DPR Report Portfolio in class or presentation
4	Microbial Risk Assessment Case Study	**Homework 2 Due** Amoueyan et al. (2017) QMRA Pecson et al. (2017) QMRA
	Pathogen Monitoring Microbial Community Characterization	Chapter 6 of CA DDW DPR Report Gerrity et al. (2017) Microbial Community Portfolio in class or presentation
5	Chemicals in Water Reuse Applications	Chapter 4 of CA DDW DPR Report Michael Kordatau et al. (2015) dEfOM
	Microbial Contaminant Presentations	**Microbial Contaminant Assignment Due**
6	Chemical Risk Assessment	Bull et al. (2011) Toxicology Portfolio in class or presentation
	Bioanalytical Tools for Water Analyses	Chapter 5 of CA DDW DPR Report Macova et al. (2010) Biotoxicity
7	Public Perception of Water Reuse San Diego Pure Water/Padre Dam Projects Arizona Pure Water Brew Challenge	**Homework 3 Due** 1998 NRC Report (Executive Summary) 2012 NRC Report (Excerpt)
	Chemical Contaminant Presentations	**Chemical Contaminant Assignment Due**
8	Public Perception (cont.) Public Perception Survey **Progress report presentations**	Rock et al. (2012) Public Perception Harris-Lovett et al. (2015) Legitimacy **Progress Report Presentation Due**
	Economic Value of Water in the U.S. Nonpotable Reuse Killing the Colorado Documentary (Ag) MIDTERM EXAM	**Homework 4 Due** EPA (2012): Section 3.0 Gerrity and Snyder (2011) GMP/H_2O Rice et al. (2013) de facto Reuse
9	SPRING BREAK	XXXXXXXXXXXXXXXXX
	SPRING BREAK	XXXXXXXXXXXXXXXXX
10	Potable Reuse Treatment Trains	Chapter 10 of CA DDW DPR Report Gerrity et al. (2013) Reuse Treatment Trains Portfolio in class or presentation
	Advanced Oxidation for Potable Reuse	**Homework 5 Due** Gerrity et al. (2012) Ozone Correlations Gerrity et al. (2016) UV/H_2O_2 Correlations
11	Ozone Biofiltration for Potable Reuse	Lee et al. (2013) Ozone Oxidation Lee et al. (2016) UV/H_2O_2 Oxidation

Week	Topic/Deliverable (due at time of indicated class)	Assignments (due at time of indicated class)
		Portfolio in class or presentation
	Treatment Process Presentations	**Treatment Process Assignment Due**
12	4Rs of Potable Reuse	Chapter 8 of CA DDW DPR Report Pecson et al. (2015) 4Rs Portfolio or class presentation
	Potable Reuse Regulations	Chapter 9 of CA DDW DPR Report CA GW Regulations
13	Potable Reuse Regulations	CA SWA Regulations
	Cost of Potable Reuse	Chapter 7 of CA DDW DPR Report Plumlee et al. (2014) Cost Estimates Portfolio or class presentation
14	**Regulation Presentations**	**Regulation Assignment Due**
	Antibiotic Resistance	Rizzo et al. (2013) AR Review Chang et al. (2017) AR UV Chapter 11 of CA DDW DPR Reportspri
15		
16	**Final Conceptual Design Presentations**	**Final Conceptual Design Project/Presentation Due**
	Final Conceptual Design Presentations	None
17	**Final Exam**	

UNLV Policies

Academic Policies
Student Services & Activities
University Policies
University Community & Libraries