

ENV 6438: Physical & Chemical Processes for Drinking Water Treatment
Department of Civil & Environmental Engineering
University of South Florida

Cunningham

Spring 2020

Course Description

Analysis and design of physical and chemical processes typically used for treatment of US public water supply. Water quality requirements; rate processes and reactor design; particulate removal; disinfection; removal of dissolved organic contaminants; treatment process combinations; cost analysis. Emphasis on applications to water supply.

Course Objectives

During this semester, students should learn:

- how the quality of our municipal drinking water affects public health;
- the physical, chemical, and biological conditions and standards required for “safe” public water supply;
- which physical and chemical processes are commonly used to treat municipal drinking water to acceptable quality;
- the scientific bases and engineering principles that govern the effectiveness of common drinking-water treatment processes; and
- the nature of some of the most important challenges currently facing public drinking-water utilities.

Learning Outcomes

The work completed by students in this course should help those students to attain:

- an ability to apply physical and chemical principles of environmental engineering;
- an ability to design physical and chemical processes for large-scale centralized treatment of municipal drinking water;
- an ability to function on teams;
- an ability to identify, formulate, and solve environmental engineering problems; and
- an ability to communicate effectively.

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Lectures: Mondays and Wednesdays, 11:00–12:15, room ENG 201

Credit: 3 units, letter grade

Instructor: Professor J A Cunningham ENC (Engineering Bldg III), room 3215
cunning@usf.edu (813) 974-9540

Office hours: About 2–3 hrs/wk will be allocated for ENV 6438 office hours.
Times will be announced during the first or second week of class.

Text book: Crittenden JC, Trussell RR, Hand DW, Howe KJ, Tchobanoglous G, *Water Treatment: Principles and Design*, 3rd edition. John Wiley & Sons, 2012.

Pre-requisites: If you have already taken ENV 6002, and/or if you have a bachelor's degree in chemical engineering, you will probably be better prepared than students who have neither of these. If you have neither of these, but you have taken at least 1 rigorous class in Environmental Engineering and you are willing to work hard, you will likely be fine. If you have *none* of these qualifications, I do not recommend ENV 6438 for you at this time.

E-mail: Outside of class, I will use e-mail to disseminate information. This will be done through the Canvas program so I can reach all students at once. Make sure that Canvas delivers to an active e-mail account.

Grading: 25% homework, 16.7% midterm exam, 25% project, 33.3% final exam

Web site: Course documents – including homework assignments – will be posted on Canvas. I will also attempt to maintain a course web site:
<http://www.eng.usf.edu/~cunning/ENV6438-DrinkingWater/ENV6438-DrinkingWater.htm>

Reserves: As the semester goes along, I might place on course reserve some books and articles that I think will be helpful to you. If you have suggestions, please let me know. Electronic resources can be placed on reserve and accessed via Canvas; print resources can be placed on reserve in the library.

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Course Schedule

The course schedule below should be pretty accurate, but there may be some slight variations, depending on how quickly we progress. Please consider the schedule below to be my *best guess* at how the semester will proceed. In the unlikely event that exam dates need to change, students will be given plenty of advance warning.

Week #	Dates	Topics Covered	Assignment
Week 1	January 13 January 15	Course introduction Water quality and public health	
Week 2	January 20 January 22	<i>Martin Luther King, Jr., holiday – no class</i> Chemical reactions	Homework 1 due
Week 3	January 27 January 29	Reactor theory: ideal reactors Reactor theory: residence time distribution	Project stage 1 due
Week 4	February 3 February 5	Reactor theory: residence time distribution Particles in water	Homework 2 due
Week 5	February 10 February 12	Particles, coagulation, & flocculation Coagulation & flocculation	Homework 3 due
Week 6	February 17 February 19	Coagulation & flocculation Sedimentation	Project stage 2 due
Week 7	February 24 February 26	Sedimentation Granular filtration	Homework 4 due
Week 8	March 2 March 4	Granular filtration Granular filtration	Homework 5 due
Week 9	March 9 March 11	Disinfection <i>Midterm examination</i>	Midterm exam
Week 10	March 16 March 18	<i>spring break</i>	
Week 11	March 23 March 25	Disinfection Disinfection	Project stage 3 due
Week 12	March 30 April 1	Advanced topic (softening?) Advanced topic (ion exchange?)	Homework 6 due
Week 13	April 6 April 8	Advanced topic (membranes?) Advanced topic (other topic?)	Project stage 4 due
Week 14	April 13 April 15	<i>guest lecture or field trip</i> Treatment process combinations	Homework 7 due
Week 15	April 20 April 22	Economics of drinking water treatment Course wrap-up and course evaluation	Project stage 5 due
Week 16	April 27 April 29	Student presentations Student presentations	Homework 8 due
Week 17	May 4 May 6	<i>Final exam, Monday, May 4, 10:00-12:00</i>	Final exam Project reports due

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Class Policies: 1, Homework Policy

- There will be about 8 homework sets to be performed during the semester.
- Depending on how many students are enrolled in the class, I might require assignments to be completed in groups. All students in the group will receive the same score on the assignment. We will decide about group size during the first week of class, once the enrollment is set.
- Even if assignments are completed by a group, it is recommended that *all* students work industriously to complete the homework assignments to maximize their mastery of the material covered this semester. If you do a good job on the homework assignments, you are likely to perform well on the exams. If you don't spend the time on the homework, then you are likely to have difficulty on the exams.
- I will be available at least one hour each week, and probably more, to assist with homework problems. (...most likely about 2–3 hours per week.)
- Students may discuss the homework with each other. However, whatever work is submitted by a group should represent work actually completed by that group. You must conduct the actual computations and write up your own work without referring to the solutions of people outside your group. Copying the work of others (including text, computations, figures, tables, sections of computer programs, spreadsheets, or sections of lab reports) will be considered cheating.
- You may not refer to a previous year's solution sets when completing the homework. That constitutes referral to somebody else's work and is therefore considered cheating.
- Assignments will usually be distributed at least one week before the due date.
- Assignments are due in class on their due date unless otherwise noted. Occasionally, assignments will be due on a non-class day. In those cases, I will provide instructions on how to submit the completed work.
- Homework solutions will be provided to students, usually after the next class following the due date.
- Each group is allowed one late homework submittal during the semester -- no questions asked. Late assignments must be submitted *by the beginning of the next class after the original due date*. After one late submittal, no late homework will be accepted from that group *regardless of reason or excuse*. You get one "freebie," and then that is it!
- Homework should be neat and legible, on standard 8.5-by-11-inch or A4 paper, stapled.
- Report numerical answers to a reasonable number of significant digits. The point of this is that you should consider the level of uncertainty associated with your reported answer.
- Your homework solutions must include at least enough detail that I can follow your reasoning and calculations. An answer provided without this level of detail will be considered insufficient.
- Helpful hint: when performing calculations, be careful of your units. You will catch about 90% of your mistakes (yes, really) if you take proper care of your units.

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Class Policies: 2, Exam Policy

- There will be a midterm exam given in class and a final exam given at the time set by the registrar.
- The midterm exam will probably be on either Monday, March 9, or Wednesday, March 11. The date could be changed if there is a compelling reason. I will announce a firm date in plenty of time for you to prepare.
- The final exam will be on Monday, May 4, from 10:00-12:00, as determined by the registrar.
- Exam questions will be primarily quantitative (problem-solving), but there may be qualitative (definition, discussion) questions as well.
- Exams will be closed-book, but students are permitted to use a *personal note sheet*: one double-sided 8.5-by-11-inch sheet for the midterm, two for the final. On these sheets students may write whatever they like. Sheets must be hand-written – no laser printing, scanning, photocopying, etc. Retrieval of information by other means during the examination will be considered cheating.
- Students who will not be available for an exam should inform me far enough *before* the exam to make alternate arrangements.
- Students who miss the exam unexpectedly (e.g., due to sudden illness, family emergency, or other unforeseen circumstances) must provide documentation or evidence of the reason for missing the exam. It will then be *up to my discretion* whether a “make-up” exam will be offered.
- My intention is to design exam questions such that students who have attended the class and who have diligently completed the homework assignments will be familiar with all the material needed to answer the questions. It will not be my intention to surprise you, only to challenge you.
- Generally, exam questions are intended to test the most important concepts of the class. A good exam should require the students to demonstrate their mastery of the material by synthesizing and applying the most important concepts of the course. Exam questions are not likely to test students on their recall of minutiae.
- Helpful hint: when performing calculations, be careful of your units!! You will catch about 90% of your mistakes (yes, really) if you take proper care of your units.

Class Policies: 3, Field Trips

I would love for our class to take a field trip to a drinking-water treatment plant (or maybe more than one) some time during the semester. So far, I don't have any firm plans for this, but I will likely be able to arrange it pretty early in the semester. The field trip(s) will be optional (not required), but highly recommended to complement class lectures and the assignments that you complete.

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Class Policies: 4, Project

- A major component of the course this semester will be the completion of a project.
- Information about the semester project will be made available to students as early as possible – hopefully in the first or second week of the semester – so that you can think about the project as the semester progresses.
- The general idea of the project is to pose, research, and answer a question related to drinking-water treatment.
- Depending on how many students are enrolled in the class, it may be necessary to complete the projects in groups. Once we know how many students are taking the class, I can decide if projects will be completed individually or in groups.
- At or near the end of the semester, each person or group will submit a written report, and will also make a brief presentation to the class about his/her/their project. Requirements for the report and the presentation will be given in more detail later in the semester. Presentations to the class will probably be about 20 minutes in duration, depending on how many students/groups we have.
- Please try to attend class on the days in which students deliver their presentations. The presentations can be fun (yes, really), and you want to support your classmates.
- Students will be graded on the quality of their written reports (both technical soundness and quality of the writing) and on the quality of their presentations. Additional details about grading of the projects will be provided later.
- If projects are completed by groups, then all members within a group will by default earn the same grade on the project. However, students will have some input into the grades of their group-mates. I will ask each group member to indicate (privately) how much each of their group-mates contributed to the project. Students who obviously contributed very little to the project will be marked down appropriately. Students who “went an extra mile” for their groups will be marked up appropriately.
- Additional details about the project will be given throughout the semester.

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Class Policies: 5, Copyrights and Academic Honesty

- Any handouts used in this course are copyrighted. “Handouts” means all materials generated for this class, which include, but are not limited to: syllabi, notes, quizzes, exams, in-class materials, review sheets, and additional problem sets. This includes materials that are posted on the web as well as materials distributed in class. Because these materials are copyrighted, you do not have the right to copy the handouts unless the instructor (or other copyright holder) expressly grants permission.
- Students may audio tape lectures for their own private, personal use, or for a classmate who is registered in the class during this semester. Audio tapes may not be sold or distributed to anybody who is not registered in the class this semester.
- No form of scholastic dishonesty (cheating, plagiarism, etc.) will be tolerated. As commonly defined, plagiarism consists of passing off as one’s own the ideas, words, writings, etc., which belong to another. In accordance with this definition, you are committing plagiarism if you copy the work of another person and turn it in as your own, even if you have permission of that person. This includes copying material from books, reports, journals, pamphlets, handouts, other publications, web sites, etc., without giving appropriate credit for those ideas and/or without identifying material as quotations when taken directly from another source.
- Cheating on homework and exams will not be tolerated. Cheating will be dealt with according to university policy.
- ***It is the responsibility of each student to understand what constitutes plagiarism.***
- ***Students who cheat or plagiarize will be assigned a semester grade of FF.***
- You may discuss homework assignments with students who are not in your homework group. However, when you perform your computations and/or write-ups, you must do so without referring to the work of students who are not in your group. Copying homework from a student outside your group is considered plagiarism. See Class Policy 1, above.
- You may not copy homework solutions from a previous year’s solution set. That will be considered plagiarism because you are copying somebody else’s work.
- Violation of these rules can result in disciplinary action including a grade penalty, up to and including an F or FF in the course, suspension, dismissal, and expulsion from USF. If you have any questions regarding plagiarism or other forms of scholastic dishonesty, please consult the relevant sections of the USF student catalogs, and/or ask the instructor.

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Class Policies: 6, Attendance

- Attendance in class lectures is recommended but not required. It is likely that diligent attendance in class lectures will improve your understanding of the course material, and, hence, improve your semester grade.
- Attendance in class does not factor into your semester grade other than helping you to perform well on assignments and exams (i.e., there are no “class attendance points” awarded).
- If you miss class, there is no need to inform me or to provide me with documentation for your absence. (I don’t take it personally, really.) However, I do recommend that you acquire the lecture notes from a classmate.
- If you choose to attend class, I require that you do not engage in behavior that distracts me or that disrupts the class for others in attendance:
 - Please make sure mobile phones are turned off. **NO TEXTING DURING CLASS!**
 - Laptop computers should be used only for taking notes, not for e-mail, web browsing, or any other activity that might distract your classmates or your instructor.
 - Please do not chat with your classmates, read the newspaper, work on homework for other courses, or engage in any other behavior that is distracting to your classmates or to your instructor.
 - If you need to do something other than participate in the class lectures, then please do so outside the classroom.
 - Students who are engaged in such activities in class will be asked to leave.

Class Policies: 7, Grading

- Your overall grade will be a weighted average of your homework grade (25%), your midterm exam grade (16.67%), your project grade (25%), and your final exam grade (33.33%).
- This class does *not* use a fixed grading scale (e.g., 90=A, 80=B, etc.). The grading scale will be set depending on student performances on the exams and the homework assignments. That way, if the exams are particularly difficult or particularly easy this year, the grading scale will take that into account. However, based on past experience, an *approximate* grading scale is as follows.

90–100	A+	72–78	B+	< 60	C+ or lower
84–90	A	66–72	B		
78–84	A–	60–66	B–		
- It is my expectation that most or all students who diligently complete their work will earn a grade of A, A–, B+, or B. I call this the “target range”. Students who perform notably better than their peers may possibly earn a grade of A+. Students who perform notably worse than their peers may possibly earn a grade of B–, C+, C, or possibly even lower, but historically the lowest grade assigned (other than to students who cheat or plagiarize) is C. Grades below B are rare for students who are keeping up with the work and making a full effort.
- Students who cheat or plagiarize should expect to receive a grade of F or, more likely, FF.

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Appendix: USF Academic Policies

On the pages that follow are a number of policies that USF has asked instructors to include in their syllabi. Students should read these policies carefully as they apply to *all* classes at USF.

For most of the policies that follow, only an abbreviated form of the official policy or regulation is provided in this syllabus. Complete details are generally available to students on-line. Specifically, USF's official wording for some of these policies is available at the following web sites.

<http://regulationspolicies.usf.edu/policies-and-procedures/>

<https://www.usf.edu/provost/faculty-info/core-syllabus-policy-statements.aspx>

<https://www.usf.edu/undergrad/students/academic-policies.aspx>

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Attendance for the Observance of Religious Days by Students (USF System policy 10-045)

All students, faculty, and staff within the USF System have a right to expect reasonable accommodation of their religious observances, practices and beliefs. The USF System will, at the beginning of each academic term, provide written notice of the class schedule and formal examination periods. The USF System, through its faculty, will make every attempt to schedule required classes and examinations in view of customarily observed religious holidays of those religious groups or communities comprising the USF System's constituency. Students are expected to attend classes and take examinations as determined by the USF System. No student shall be compelled to attend class or sit for an examination at a day or time prohibited by his or her religious belief. However, students should review the course requirements and meeting days and times to avoid foreseeable conflicts, as excessive absences in a given term may prevent a student from completing the academic requirements of a specific course. Students are expected to notify their instructors at the beginning of each academic term if they intend to be absent for a class or announced examination, in accordance with this Policy. Students absent for religious reasons, as noticed to the instructor at the beginning of each academic term, will be given reasonable opportunities to make up any work missed. In the event that a student is absent for religious reasons on a day when the instructor collects work for purposes of grading (homework, pop quiz, etc.), the student shall be given a reasonable opportunity to make up such work or shall not have that work averaged into the student's grade at the discretion of the instructor. Any student who believes that he or she has been treated unfairly with regard to the above may seek review of a complaint through established USF System Academic Grievance Procedures (found in the Graduate and Undergraduate Catalogs) and those provided by the University's Office of Diversity, Inclusion, & Equal Opportunity.

Statement of Academic Continuity (*or, in other words, emergencies*)

In the event of an emergency, it may be necessary for USF to suspend normal operations. During this time, USF may opt to continue delivery of instruction through methods that include, but are not limited to: Learning Management System (i.e., Canvas), online conferencing, e-mail messaging, and/or an alternate schedule. It is the responsibility of the student to monitor the Learning Management System for each class for course-specific communication, and the main USF, College, and Department websites, e-mails, and MoBull messages for important general information (USF System Policy 6-010). For additional guidance on emergency protective actions and hazards that affect the University, please visit www.usf.edu/em (*Instructor's note: examples of "emergency" could be a hurricane, outbreak of contagious disease, etc.*)

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“Incomplete” Grades (<http://ugs.usf.edu/policy/IGradePolicy.pdf>, accessed August 2019)

An “I” grade indicates incomplete coursework and may be awarded to graduate and undergraduate students. (Undergraduate rules apply to non-degree-seeking students.) It may be awarded to an undergraduate student only when a small portion of the student’s work is incomplete and only when the student is otherwise earning a passing grade. The instructor will be required to complete the I-grade contract online when posting the semester grade at the end of the term, identifying the remaining coursework to be completed, the student’s last day of attendance, and the percent of work accomplished to this point. This online contract will be automatically copied to the student’s email and to the Registrar. Until removed, the “I” is not computed in the GPA for either undergraduate or graduate students. The time limit for removing the “I” is to be set by the instructor of the course. For undergraduate students, this time limit may not exceed two academic semesters, whether or not the student is in residence, and/or graduation, whichever comes first. “I” grades not removed by the end of the time limit will be changed to “IF” or “IU,” whichever is appropriate. If an instructor is willing, he or she may accept work from a student after an I grade has changed to an IF or IU grade, and assign the student a final grade in the course, unless the student has graduated. Whether or not the student is in residence, any change to “IF” grades will be calculated in the cumulative GPA and, if applicable, the student will be placed on appropriate probation or academically dismissed. Students are not required to re-register for courses in which they are only completing previous course requirements to change an “I” grade. However, if a student wants to audit a course for review in order to complete course requirements, full fees must be paid.

Academic Integrity (USF System regulation 3.027)

Academic integrity is the foundation of the University of South Florida System’s commitment to the academic honesty and personal integrity of its university community. Academic integrity is grounded in certain fundamental values, which include honesty, respect, and fairness. Broadly defined, academic honesty is the completion of all academic endeavors and claims of scholarly knowledge as representative of one’s own efforts. Knowledge and maintenance of the academic standards of honesty and integrity as set forth by the university are the responsibility of the entire academic community, including the instructional faculty, staff, and students. The final decision on an academic integrity violation and related academic sanction at any USF System institution shall affect and be applied to the academic status of the student throughout the USF System, unless otherwise determined by the independently accredited institution.

Disruption of Academic Process (USF System regulation 3.025)

Disruptive students in the academic setting hinder the educational process. Disruption of the academic process is defined as the act, words, or general conduct of a student in a classroom or other academic environment which in the reasonable estimation of the instructor: (a) directs attention away

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from the academic matters at hand, such as noisy distractions, persistent, disrespectful or abusive interruption of lecture, exam, academic discussion, or general University operations, or (b) presents a danger to the health, safety, or well-being of self or other persons.

Academic Grievance Procedure (USF System policy 10-002)

The purpose of [these procedures] is to provide all undergraduate and graduate students taking courses within the University of South Florida System an opportunity for objective review of facts and events pertinent to the cause of the academic grievance. An “academic grievance” is a claim that a specific academic decision or action that affects that student’s academic record or status has violated published policies and procedures, or has been applied to the grievant in a manner different from that used for other students.

Disability Access (USF System policy 0-108)

It is the policy of the University of South Florida System (USF System) to comply fully with the requirements of the Americans with Disabilities Act of 1990 as amended by the Americans with Disabilities Act Amendments Act of 2008 and all other federal and state laws and regulations prohibiting discrimination and assuring accessibility on the basis of disability. No qualified individual with a disability shall, by reason of such disability, be excluded from participation in or be denied the benefits of services, programs, or activities of the USF System, or be subjected to discrimination or lack of access by the USF System, as provided by law.

Students with disabilities are responsible for registering with Students with Disabilities Services (SDS) (SVC 1133) in order to receive academic accommodations. SDS encourages students to notify instructors of accommodation needs at least five (5) business days prior to needing the accommodation. A letter from SDS must accompany this request.

(Instructor’s note: The Americans with Disabilities Act is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact SDS as soon as possible.)

Sexual Misconduct / Sexual Harassment (USF System policy 0-004)

USF is committed to providing an environment free from sex discrimination, including sexual harassment and sexual violence (USF System Policy 0-004). The USF Center for Victim Advocacy & Violence Prevention is a confidential resource where you can talk about incidents of sexual harassment and gender-based crimes including sexual assault, stalking, and domestic/relationship violence. This confidential resource can help you without having to report your situation to either the

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Office of Student Rights and Responsibilities (OSSR) or the Office of Diversity, Inclusion, and Equal Opportunity (DIEO), unless you request that they make a report. Please be aware that in compliance with Title IX and under the USF System Policy, educators must report incidents of sexual harassment and gender-based crimes including sexual assault, stalking, and domestic/relationship violence. If you disclose any of these situations in class, in papers, or to me personally, I am required to report it to OSSR or DIEO for investigation. Contact the USF Center for Victim Advocacy and Violence Prevention: (813) 974-5757.

Auditing Privilege (USF System policy 10-006, section III.A.4.)

Accepted students eligible to enroll in courses may register to audit a course strictly on a space-available basis, provided the student:

- a. requests and receives any necessary approval as determined by the instructor or other designated responsible office;
- b. understands that no exams, grades, credit or other academic evaluations may be provided;
- c. officially registers to audit the course by the end of drop/add period and does not attend any class session prior to the official registration without affirmative approval by instructor;
- d. attends the class as a listener which means instructors may limit the auditing student's participation in class including class projects or other interactive graded or ungraded activities;
- e. complies with all University Regulations and Policies of the University;
- f. complies with all conditions of audit registration and any deviation from those conditions will be considered disruptive and a student found to be disruptive to the class or academic process may be removed from the class under USF3.025 Academic Disruption; and
- g. is responsible for all fees for audit which are the same as for full enrollment for credit, except out-of-state tuition is not charged.