NJIT
CIVIL AND ENVIRONMENTAL ENGINEERING

ENE 360 – WATER AND WASTEWATER ENGINEERING

FALL 2024 - SYLLABUS

Instructor: Prof. Arjun Venkatesan, Ph.D.
Colton Hall, Room 217
E-mail: arjun.venkatesan@njit.edu

Office Hours: By appointment (Webex or In-Person)
Tuesdays and Wednesdays: 10:30 am to 11:30 am

Room: CKB 126 **Day and Time:** Wednesdays 6:00 PM – 8:50 PM

Description:
This course will focus on sustainable design concepts, processes, and practices related to water pollution control and will provide an introduction to the principles of green chemistry and green engineering and their integration in the design of water/wastewater technologies. The course will apply foundational principles of physics, chemistry, biology, and sustainability to creating solutions for managing and mitigating environmental pollution. Topics include the chemical, physical, and biological processes that occur in waste treatment design and in receiving waters; modeling schemes to determine chemical loadings and removals in various bodies of water; and water and wastewater treatment processes used for water pollution control. Additionally, the course will discuss the vulnerability of drinking water/wastewater systems to climate change and discuss ongoing initiatives to ensure resilience in water and sanitation services.

Prerequisites: ENE 262: Introduction to Environmental Engineering; Junior standing

Course Objectives:

1. Students will define sustainable development and sustainable engineering in their own words (and according to others) and relate how sustainability is related to water pollution control.
2. Students will learn to calculate and predict physical, chemical and biological changes that affect water quality and treatment requirements.
3. Students will apply fundamentals mechanisms to unit operations and processes in water and wastewater treatment with emphasis on problem interpretation, formulation and sustainable solution.
4. Students will incorporate engineering tools for problem solving and communication through the application of social, regulatory, and political context to environmental and water quality analysis.

Textbook(s)/Materials Required:

1) Mihelcic, J.R., Zimmerman, J.B., (2014) Environmental Engineering: Fundamentals, Sustainability, Design, 3rd Edition (ISBN: 978-1-119-60445-7) John Wiley and Sons, Inc.
2) Handouts/slides

Grading:

Midterm exam	25%
Final Exam	25%
Homework assignments/quiz	20%
Project and oral presentations	20%
Attendance and class participation (random sign-in sheet)	10%

The final letter grades are computed as follows:
A = > 90.0%, B+ = 85.0% - 89.9%, B = 80.0% - 84.9%, C+ = 75.0% - 79.9%, C = 70.0% - 74.9%, D = 60.0% - 69.9%, F < 60.0%

Tentative class schedule

Week	Topics	Reading Assignments
1	Introduction to water/wastewater engineering and sustainable development/engineering Units/Measurements; Environmental Standards	Chapter 1 Chapter 2
2	Chemical processes: reaction stoichiometry; acid-base reactions; gas-liquid equilibrium; redox; reaction kinetics	Chapter 3
3	Physical processes: Mass and energy balances; reactor design; mass transport	Chapter 4
4	Biological processes: biological reactions and kinetics; oxygen demand (BOD, COD, ThOD); material flow in ecosystems (water, C, N, P biological cycles); design of biological reactors	Chapter 5
5	Environmental risk Green engineering: principles of green chemistry and green engineering	Chapters 6 Articles/slides
6	***Midterm exam***	
7	Water supply, demand, distribution and collection; Water quality, wetlands, groundwater	Chapter 7
8	Water treatment: coagulation, flocculation, hardness removal, sedimentation	Chapter 8
9	Water treatment: filtration, disinfection, adsorption, membrane processes	Chapter 8
10	Wastewater treatment: collection systems; preliminary, primary and secondary treatment	Chapter 9
11	Wastewater treatment: nutrient removal; resource recovery; solid waste management; biosolids	Chapter 9 Articles/slides
12	Alternative wastewater treatment options New technologies: advanced oxidation processes Direct/indirect potable water reuse: climate-resilient water supply and treatment	Chapter 9 Articles/slides
13	***Student project presentations***	
14	***Final exam***	

POLICIES & PROCEDURES

Academic Integrity:
Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at:
http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. **Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university**. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu

Communication: All communications by the instructor will be during the class and via NJIT e-mail. It is your responsibility to check your NJIT e-mail regularly. Expect an e-mail response/reply from the instructor only on Monday - Friday between 9am - 5pm.

Lectures/Class: Some weekly lectures will start with quizzes. During the class, the instructor can often ask you to work on a problem or brainstorm ideas with the people next to you and you will be called on to provide one or more of your answers. The goal of this in-class work and discussion is to get you started on a problem (not necessarily to finish) and improve how you think about the problem which will then be discussed. Lectures will NOT be recorded for subsequent access to students; therefore, students have the burden of making up for missed lectures. Please be respectful to the course instructor and your classmates. You should always bring a pencil and calculator with you to class. Please put your cell phones on silent or turned off during class.

No late homework is accepted (no exceptions): Homework assignments must be handed in or submitted before the beginning of the class. Assignments must be typed; however, hand sketches (as necessary) may be submitted. If plots or calculations are required, either use hand calculations of the problem in your submitted HW solution or you can use Excel program and attach the solution excel files along with pdf homework submissions. Begin each problem on a new page and number all pages; collate all homework pages together and have your name written clearly on the front page. It is your responsibility to make sure you understand how to solve the problems by attending office hours with the instructor/TA and/or asking questions in class. As with many conceptual problems, multiple solutions may be possible. This means that all rational solutions to the assignments may be considered for acceptance. Homework will be due at the beginning of class on the date it is due. Late Homework will NOT be accepted after the due date. The homework should be turned in as instructed before 6 pm.

Exams: There will be two exams held during class time: midterm and final exam. All exams in this course will be in-person. No electronic devices (such as laptops/cellphones/tablets/smart watches, etc.) are allowed during quizzes/exams. No recording devices shall be allowed during class or examinations.

Term Project and Presentation: There will be a term project/assignment for this course that must be carried out as a group. This term project is made up of two parts: (1) term project paper/report, and (2) term project presentation. Necessary background information and knowledge, in addition to the expectations and format of the term project will be provided during class lectures throughout the semester.

Quizzes. There will be short (15 - 25 min.) quizzes given during class. These quizzes primarily cover recent material. Quizzes will require both essay and mathematical proficiency and will be based largely on homework problems and reading. Quizzes are in the closed-book/closed-notes format.

Instructor Commitment: You can expect the instructor to be courteous, punctual, organized, and prepared for lecture and other class activities; to answer questions clearly; to be available during office hours or to notify you beforehand if office hours are moved; to provide a suitable guest lecturer or pre-recorded lecture when they are traveling or unavailable; and to grade uniformly, fairly, and consistently.

Students with Documented Disabilities: NJIT is committed to providing students with documented disabilities equal access to programs and activities. If you have, or believe that you may have, a physical, medical, psychological, or learning disability that may require accommodations, please contact the Coordinator of Student Disability Services located in the Center for Counseling and Psychological Services, in Campbell Hall, Room 205, (973) 596-3414. Further information on disability services related to the self-identification, documentation and accommodation processes can be found on the webpage at: (http://www.njit.edu/counseling/services/disabilities.php).

Outcomes Course Matrix - ENE 360 Water and Wastewater Engineering

Strategies, Actions and Assignments	**ABET Student Outcomes (1-7)**	**Program Educational Objectives**	**Assessment Measures**
Student Learning Outcome 1: Make calculations related to reactor design			
Calculate reactor volume and retention time	1, 2	1, 2	Homework and examinations
Balance chemical reaction	1, 2	1, 2	Homework and examinations.
Student Learning Outcome 2: Discuss state of the art technologies for water and wastewater treatment			
Discuss and review new technologies, advance oxidation, anaerobic treatment, water reuse	4, 7	1, 2	Homework and class discussions.

CEE Mission, Program Educational Objectives and Student Outcomes

The undergraduate program leads to a Bachelor of Science degree in Civil Engineering (CE), producing graduates who will, within 3-5 years:

1. Engineering Practice: Alumni will successfully engage in the practice of civil engineering within industry, government, and private practice, working toward safe, practical, resilient, sustainable solutions in a wide array of technical specialties including construction, environmental, geotechnical, structural, transportation, and water resources

2. Professional Growth: Alumni will advance their technical and interpersonal skills through professional growth and development activities such as graduate study in engineering, research and development, professional registration and continuing education; some graduates will transition into other professional fields such as business and law through further education.

3. Service: Alumni will perform service to society and the engineering profession through membership and participation in professional societies, government, educational institutions, civic organizations, charitable giving and other humanitarian endeavors.

Students from the CE program will attain (by the time of graduation):

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.