JOHN A. REIF, JR. DEPARTMENT OF
CIVIL AND ENVIRONMENTAL ENGINEERING
NJIT New Jersey Institute of Technology

ENE 661 – Environmental Microbiology Fall 2025

1. Instructor and office hours:
Professor Wen Zhang, Ph.D., P.E., BCEE
Office: Colton Hall, Room 211
Email: wen.zhang@njit.edu
Office phone: 973-596-5520
Office Hour: Monday 4:30 pm-6 pm in the office and Thursday 11 am-12:30 pm
via Zoom or in-person by appointment

2. Lecture time/place:
Monday from 6 to 8:30 pm in-person (TIER 107)

3. Designation:
Core (Required for Environmental Engineering Concentration)

4. Course Description:
This course is a core course required for Environmental Engineering concentration. The instructor will provide an overview of the microbiology of natural and human impacted environment, fundamental microbiology in water treatment engineering, microbial detection methodologies, waterborne disease outbreaks, microbial risk assessment, biotechnologies for renewable energy, and other emerging topics that help enhance your problem-solving skills and increase your knowledge base.

5. Prerequisite:
a. Prerequisite courses: Calculus I, Chemistry, Biochemistry, Biology or permission of the instructor.
b. Graduate students from Civil/Environmental Engineering, Environmental Science, Chemistry, Biochemistry, Chemical Engineering, and Biomedical Engineering are welcome to take this course.
c. Senior undergraduate students from these above majors are possibly allowed to take if they have taken courses related to chemistry, thermodynamics and biochemistry, and biology.

6. Textbook and Other Materials:
Primary reference: Handouts and supplemental reading materials provided in the class and will be accessible on Canvas and Dropbox prior to the class.
Secondary references:
1) Bruce Rittmann, et al., Environmental Biotechnology: Principles and Applications. Second edition. Publication Date: February 11, 2020. ISBN: 978-1260441604.
2) Maier et al., Environmental Microbiology. Second edition. Publication Date: October 3, 2008. ISBN: 978-0123705198.

You may read papers from relevant journals, which include (but are not limited to): *Applied and Environmental Microbiology, Biodegradation, Environmental Science & Technology, Water Research, Water Science & Technology, Biotechnology and Bioengineering, Water Environment Research, J. Environmental Engineering, Microbial Ecology,* and *Applied Biochemistry and Biotechnology*. The following list provides other valuable resources on scientific and professional writing for this class and your career:

- Strunk, W., Jr. and E.B. White, The Elements of Style, latest edition, MacMillan Publishing Co., Inc., New York.
- Glasman-Deal, H., Science Research Writing, Imperial College Press, 2010.

7. Tentative weekly schedule for the topics (subject to minor changes):

Week	Class date	Topic
1	09/08	1. Introduction to microbiology: importance to society 2. Bioaerosol and engineering treatment 3. Research opportunities (1-2 part-time motivated RA are needed) 4. Microbial pathogen and health risks (e.g., Covid-19 and other legacy infectious disease-causing microbes)
2	09/15	DNA/RNA structures Prokaryotic cells and microorganisms, bacterial stability and properties
3	09/22	Microscopic techniques
4	09/29	Pathogenic microorganisms
5	10/06	First laboratory session: Quartz crystal microbalance method for bacterial deposition quantification
6	10/13	Viruses Indicator organisms and detection Disinfection theories and approaches
7	10/20	Mid-term exam
8	10/27	Algal bloom and treatment practices
9	11/03	Bacterial growth and kinetics; bacterial energetics; yield coefficient; biomass production/yield;
10	11/10	Bacterial growth and kinetics; bacterial energetics; yield coefficient; biomass production/yield;
11	11/17	Second lab session-biofilm removal using nanobubbles with microscope and culture method
12	11/24	Bacterial growth and kinetics; bacterial energetics; yield coefficient; biomass production/yield;
13	12/01	**Guest lecturer speakers: Dr. Hui Mu and Dr. Thu Le** • Biofilm formation and control • Activated sludge process-Monod equation • CSTR with/without sludge return • Biokinetic coefficient estimation • Nitrification/denitrification • Phosphate removal

14	12/08	Emerging microbiology topics such as: • Microplastics degradation by microbes • Microbial fuel cell (MFC) systems • Bioelectrochemistry and applications **Last Class and lecture content review and/or student presentation**
15	12/15	Final exam: 6:00PM - 8:30PM @ Same classroom

8. Grading:

Midterm (a)		30%
Final Exam (b)	30%	
Two group laboratory reports (c)		10%
Homework (d)	30%	

Grades are usually assessed on a basis of 100 points. Your total final grade equals 30%·a+30%·b+10%·c+30%·d

Bonus points to elevate the final grade are available. The assessment is based on active class or laboratory participation, extra work such as sharing class notes and posting responses to other students' questions on canvas.

Penalty points:

Your participation in this class is important. Occasionally we will have in-class example problems and quizzes. Thus, you should bring a calculator with you to class. In addition, students are expected to pay close attention in class, so cell phones should be turned off or placed in vibrate mode. Questions should be raised in class or during office hours, as timely responses are not guaranteed for e-mails and text messages sent to the instructor.

Many people have reasons for not being able to show up such as family issues or sickness. If you are absent, you need to send me a note in advance and join the class via Zoom if that is possible for you. If you are absent from class and Zoom without any communication in advance, I will take it as an unexcused absence and take one point off per absence directly from final grades.

9. Homework:

There will usually be ten homework assignments throughout the semester. Each homework should be submitted to Canvas electronically on its due date. Handwriting on paper should be clearly scanned and saved as PDF or Word files that should be uploaded to Canvas.

Besides weekly homework, two group lab reports are required following one week of the lab session in Colton Hall 412. Typically, 2-3 people form a group or follow the instructor or TA's specific guidelines. The following are potential topics of lab session experiments:

1) Quartz crystal microbalance method for bacterial deposition kinetics under various conditions (e.g., electrode potential, pH and salinity)
2) Biofilm removal using nanobubbles

10. Course Objective and Curriculum Outcomes:

10.1. **Program Educational Objectives**

The mission of the Department of Civil and Environmental Engineering is:

• to educate a diverse student body to be employed in the engineering profession

• to encourage research and scholarship among our faculty and students
• to promote service to the engineering profession and society

Our **program's educational objectives** are reflected in the achievements of our recent alumni:

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 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.

10.2. **Student Outcomes**

Our **Student Outcomes** are what students are expected to know and be able to do by the time of their 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

Below are the proposed course components and assessment measures that correspond to the specific student outcomes

Strategies, Actions and Assignments	**Program Educational Objectives**	**ABET student outcomes**	**Assessment Measures**
Homework on DNA/RNA structures and microbial cell types	1, 2	1, 7	Homework and examinations
Laboratory session: Quartz crystal microbalance for bacterial deposition	1, 2	5, 6	Lab reports and group discussions
Class discussion and homework on microbial pathogens and disinfection	1	2, 4	Class discussions and homework
Homework and exam on bacterial growth kinetics and energetics	1	1, 2	Homework and examinations

Second lab session: Biofilm removal using nanobubbles	1, 2	5, 6	Lab report and group discussion
Class participation in discussions on microbial fuel cells and bioelectrochemistry	2	7	Class participation and final project/presentation
Written summary on microplastic degradation and activated sludge modeling	2	3, 4	Student paper and class discussion

11. Accessibility:
Any student who has a need for accommodation based on the impact of a disability should contact the instructor privately to discuss the specific situation as soon as possible. Contact Disability Resources and Services to provide reasonable accommodation for students with documented disabilities. The NJIT web site below provides additional information: http://www.njit.edu/counseling/services/disabilities.php

12. Academic integrity and AI use statement:
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 University Policy on Academic Integrity 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 policy on Academic Integrity, please contact the Dean of Students Office at dos@njit.edu

Students are **permitted and encouraged** to use generative AI tools (such as ChatGPT, Copilot, etc.) to support learning and to check or explore specific microbiological concepts. These tools can be helpful for clarifying complex topics, summarizing background knowledge, and enhancing understanding outside of class. However, when completing assignments, especially those involving literature summaries or written reports, students must adhere to the following guidelines:

- **Acceptable Use:**
  - You may use AI to brainstorm, generate outlines, or clarify concepts.
  - You may use AI-generated drafts as starting points only if you critically review, edit, and rephrase the content in your own words.
  - All claims must be properly supported by peer-reviewed references—AI-generated content without citation is not sufficient.
- **Prohibited Use:**
  - Submitting unmodified or lightly edited AI-generated content is considered academic dishonesty and will be subject to penalties.
  - AI tools must not be used to fabricate citations or data.

Reminder: Writing that reflects AI-style language (e.g., vague, hollow, overly formal, or citation-free summaries) without clear understanding or proper sources will be flagged and may receive a grade deduction. The purpose of this policy is to promote active learning, critical thinking, and academic integrity while allowing AI tools to serve as learning aids—not substitutes for original work.