Winter 2020

ENE 661-101: Environmental Microbiology

Wen Zhang

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EN661 – Environmental Microbiology – Fall 2020 Syllabus

1. Instructor and office time:
Wen Zhang, Ph.D., P.E., BCEE
Associate Professor.
Office: Colton Hall, Room 211
Email: wen.zhang@njit.edu
Office phone: 973-596-5520

2. Lecture time/place: Monday from 6 to 8:50 pm/ WebEx virtual online class

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

4. Course Description:
This course is a core course required for Environmental Engineering concentration. I 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, Biomedical Engineering are welcome to taking this course.
c. Senior undergraduate students from these above majors are possibly allowed to take if they have course works taken related to chemistry, thermodynamics and biochemistry, and biology.

6. Textbook and Other Material:
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:

You will read papers from relevant journals, which include (but are not limited to):
Ecology, and Applied Biochemistry and Biotechnology. The following list provides other valuable written resources for this class and your career:

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

<table>
<thead>
<tr>
<th>Time</th>
<th>Class date</th>
<th>Topic</th>
<th>Reading Assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>09/07</td>
<td>Introduction to microbiology- prokaryotic cells and microorganisms, bacterial stability and properties</td>
<td>Ch. 1 (Maier) Ch. 2 Ch. 20</td>
</tr>
<tr>
<td>1</td>
<td>09/14</td>
<td>Continued topic as last week on viruses, Indicator microorganisms Introduction to Endnote for term paper writing</td>
<td>Ch.8 Ch. 19</td>
</tr>
<tr>
<td>2</td>
<td>09/21</td>
<td>Water sampling/Waterborne and Water-related transmission of microbial pathogens</td>
<td>Ch. 24</td>
</tr>
<tr>
<td>3</td>
<td>09/28</td>
<td>Quantitative microbial risk assessment Disinfection theories and approaches</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>10/05</td>
<td>Examination of negative impacts from harmful algal bloom (HAB) on water quality and water treatment process</td>
<td>Ch.23</td>
</tr>
<tr>
<td>5</td>
<td>10/12</td>
<td>Bacterial growth and kinetics; bacterial energetics MFC systems</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>10/19</td>
<td>Biofilm characteristics and Aquasim applications</td>
<td>Ch.3</td>
</tr>
<tr>
<td>7</td>
<td>10/26</td>
<td>Mid-term exam</td>
<td></td>
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<tr>
<td>8</td>
<td>11/02</td>
<td>Microbiology in wastewater treatment-energetics calculation; yield coefficient; biomass production; Activated sludge process-Monod equation; CSTR with/without sludge return; biokinetic coefficient estimation;</td>
<td>Bruce Rittmann’s book Ch.6, 7</td>
</tr>
<tr>
<td>9</td>
<td>11/09</td>
<td>Aquasim simulation presentation by students/student groups</td>
<td>Bruce Rittmann’s book Ch.9</td>
</tr>
<tr>
<td>10</td>
<td>11/16</td>
<td>Nitrification/Denitrification principles and applications in wastewater treatment plants</td>
<td>Bruce Rittmann’s book Ch.9 and 10</td>
</tr>
<tr>
<td>11</td>
<td>11/23</td>
<td>Phosphorus removal; enhanced biological nutrient removal</td>
<td>Bruce Rittmann’s book Ch.11</td>
</tr>
<tr>
<td>12</td>
<td>11/30</td>
<td>Anaerobic treatment by methanogenesis Or emerging microbiology topics such as microplastics degradation by microbes in the nature</td>
<td>Bruce Rittmann’s book Ch.13</td>
</tr>
</tbody>
</table>
Last Class and lecture content review/student presentation on homework papers

Final exam or TBA by NJIT

8. Grading:
Midterm 30%
Final Exam 30%
Aquasim Simulation 20%
Homework/Projects 20%

9. Term Projects.
In the first two weeks of the term, we will organize into teams of two or three, depending on how many students are registered for the class. We also will choose a topic for each team at that time. I will provide a list of potential topics at the beginning of the term, and teams may also suggest other topics, subject to my approval. A wide variety of topics in environmental pollution, including persistent organic pollutants, oil spills, eutrophication, and heavy metals, with a focus on the underlying chemistry and roles of microbiology and biotechnology in solving these environmental problems will be covered. Each team will have a unique topic. I will provide a schedule with completion milestones to be met by each team during the term. Incremental progress in your term paper will be checked as a regular homework you turn in upon my request, and/or every week you may be requested randomly in advance to orally report with/without PPT about your progress in your research areas and term paper writing. Students are also required to come up with novel or new approaches to solve problems and interpret environmental forensics data as team-based problem-solving activities. These class participations will be graded and recorded as homework or class participation.

I will evaluate each team’s work according to the technical quality of its final product, the quality of the written work against the standard of being suitable for publication in a top-rank journal, and the quality of the oral presentation against the standard of being suitable for presentation at a top-rank technical conference. The quality of the report and oral presentation includes the effectiveness of the communication.

The basic information and logics that your review paper should deliver are as follows (just fill in with your best answers based on your reading)
1. What are the current knowledge gaps in this topic?
2. What are the challenges in filling in the knowledge gaps such as techniques deficiency and inadequate attention?
3. What are the unique contributions and findings from this review work?

10. Contribution to Meet Professional Component:
• The course is one of the courses that make up the one and one-half years of engineering topics in the civil engineering curriculum.
The course is one of the courses that provide engineering design experience in the civil engineering curriculum.

11. Course Objective and Curriculum Outcomes:
The course will help engineering students in their new designs aimed at ensuring public and environmental health.
1) Graduates will be able to conduct laboratory experiments and analyze data
2) Graduates will be able to apply basic mathematics and science fundamentals to analyze and design engineering systems
3) Graduates will develop the ability to think inductively as well as deductively – able to acquire and interpret information and develop logical conclusions
4) Graduates will have the knowledge to locate technical references and complete research
5) Graduates will be able to work in teams
6) Graduates will be comfortable in communicating technical information to technical and non-technical audiences
7) Graduates will be conversant with the variety of tools and equipment used in the industry to analyze, design and build civil engineering systems
8) Graduates will be able to use the tools to analyze and design components

12. Laboratory session and selective topics:

<table>
<thead>
<tr>
<th>Lab #</th>
<th>Potential Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Electrical chemical membrane filtration of bacterial suspension</td>
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<tr>
<td>2</td>
<td>Nanobubbles and bacterial inactivation</td>
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<tr>
<td>3</td>
<td>Microwave disinfection with/without catalytic membranes</td>
</tr>
<tr>
<td>4</td>
<td>Viral inactivation by electrochemical oxidation</td>
</tr>
</tbody>
</table>

13. 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 coordinate reasonable accommodations for students with documented disabilities. The NJIT web site below provides additional information: http://www.njit.edu/counseling/services/disabilities.php

14. Participation:
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 come to class to learn and no extra assistance on lecture content could be offered through e-mailing, text messaging, or phone calling. Cell phones should also be completely turned off or placed in vibrate mode.

15. Thinking critically and independently:
It is my sincere hope that as a graduate of Engineering, each student will be a thoughtful citizen as well as a fundamentally sound engineer. Your questions, thoughts, and comments are valuable and encouraged throughout this course.
16. 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