SYLLABUS

1. **Number and Name: 11:117:414 – UNIT PROCESSES IN BIOENVIRONMENTAL ENGINEERING II**

2. Credits and contact hours: 3 credits, 2-80 min. lecture periods per week

3. Instructor: Donna E. Fennell

4. Text book, title, author, and year: *Environmental Biotechnology: Principles and Applications*, B.E. Rittmann and P.L. McCarty, McGraw-Hill, 2001

a. other supplemental materials, notes, selected current scientific papers

5. Specific Course Information

a. **Catalog Description:** *Biological principles and operations for wastewater treatment, bioremediation, and energy production including: microbial ecology; energetics, stoichiometry, and kinetics of microbial growth; kinetics of pollution degradation; modeling of ideal bioreactors; design criteria for specific wastewater treatment processes; and new developments in use of microorganisms in bioenvironmental engineering.*

b. **Prerequisites:** 11:375:201; 11:117:413; or permission of instructor

c. **Course Type:** Required

6. Course Goals

a. Specific Instructional Outcomes

Students will gain an understanding of the scientific and quantitative principles governing biological unit processes applied to wastewater treatment, bioenergy production and bioremediation. Students will develop analytical skills through problem solving and research and communication skills through a classroom presentation. Students learn cutting edge science and technology developments through attending a seminar and reading research papers.

b. Specific Outcomes are addressed by the course include:

c. Ability to design a system, component, or process to meet desired needs

Instructional Activity: Design methods are included in lectures, homework assignments and exams. Homework assignments are completed individually and then discussed and reworked in class and review sessions. Students perform an individually assigned design project. Successful completion of 5 problem sets, at least 3 of which involve the design of systems for wastewater treatment and bioremediation.

Assessment Activity: Homework assignments are graded and returned. The homework is reviewed in class. Three exams help to ensure all material is mastered. An individual design project is completed and graded.

f. Understanding of professional and ethical responsibility

Instructional Activity: After a lecture in an ethical case study (Washington DC and Flint MI lead crisis) brainstorm on approaches to maintain ethical behavior in a potentially non-supportive environment.

Assessment Activity: An exam question helps to ensure all material is mastered.

g. Ability to communicate effectively

Instructional Activity: Each student submits a request for proposal (RFP) regarding selection and design of a technology to solve a specific waste treatment or bioremediation problem. RFPs are then checked by the instructor and re-distributed randomly, one to each class member. Each student then develops an engineering design in response to her/his assigned RFP. Any clarification questions are

referred to the student who issued the RFP. Each student develops a 15 min presentation of their response to the RFP. The response includes comparisons of suitable technologies, selection of a technology, and an engineering design specific to the RFP.
Assessment Activity: A grading scheme is employed by the instructor to give a points total to each student. The rest of the class uses an evaluation form to give the speaker additional feedback. Effective communication and use of graphics, and proper use of citations are part of the rubric that is used in the evaluation. Students also complete short writing projects related to seminar attendance and a virtual homework assignment.

j. Knowledge of contemporary issues
Instructional Activity: Students will complete a virtual assignment on contemporary issues and will attend a research seminar related to a contemporary issue in environmental engineering, law, or policy, or microbial processes. Students and obtain a signature to certify seminar attendance and turn in a two-page synopsis of the seminar. The individual design project includes a review of scientific papers related to the process.
Assessment Activity: The instructor grades the two-page synopsis of the seminar to evaluate whether students gained an understanding of the seminar topic. The instructor leads a discussion of the virtual assignment in class to facilitate further understanding and awareness. An exam question will further assess the effectiveness of the virtual assignment and discussion. The design project is evaluated.

k. Ability to use techniques, skills and modern engineering tools necessary for engineering practice
Instructional Activity: Techniques, skills and modern engineering tools are presented and discussed in class. Homework problems are completed and discussed. The RFP and design project requires students to perform literature research to obtain models and parameters, carry out an objective evaluation of different technologies (e.g., comparison of costs or potential endpoints), and to carry out a design for a particular process to solve the problem just as they would do as a consulting engineer.
Assessment Activity: The PowerPoint presentation of the RFP/design project is graded based on rubric that gives credit for use of design calculations to recommend a proposed technology to solve the problem.

7. Brief list of topics to be covered:
Redox Reactions
Microbial Bioenergetics
Stoichiometry and Bacterial Energetics
Microbial Growth Kinetics
Reactor Mass Balances and Microbial Growth
The Activated Sludge Process
Biological Nitrogen Removal
Biological Phosphorus Removal
Energy-Production
Bioremediation