CIV ENV 202: BIOLOGICAL & ECOLOGICAL PRINCIPLES

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COURSE DESCRIPTION:

Civ Env 202 follows an applications-centered track to discuss biology and ecology as they relate to engineering in general, and environmental engineering specifically, while also discussing the ramifications for society at large. The goal of this course is to provide students with an overview of the fundamentals of biology, including cell biology, genetics, and biochemistry, and ecology, including biological interactions, microbial ecology, and biogeochemical cycling. The bioinformatics tools necessary for analyzing biological and ecological data will also be presented. As each concept is introduced, it is illustrated with examples of emerging or successfully developed technologies, such as biosynthesis of insulin, CRISPR, wastewater treatment, microbial and plant-based biofuel production, and fecal transplants. Special consideration will be given to exploration of fortuitous discoveries, as well as unintended consequences, in biological and ecological engineering. We will also discuss how the public perceives innovations and how these topics are handled by the media. Because of the topical nature of the material, some readings are subject to change. Students are evaluated based on homeworks, quizzes, a final paper and participation.

PREREQUISITES:

- MATH 214-2 or equivalent, CHEM 103 or CHEM 172 or equivalent.

OBJECTIVES:

1. Learn the basics of biotechnology, including possible career paths, through a discussion of real world applications.
    a. The scientific method, correlation vs. causation
    b. Components of a cell, eukaryotes and prokaryotes, the tree of life
    c. Basics of genetics and evolution: structure of DNA, the genetic code, mutation
    d. Basics of biochemistry: enzymes, substrate specificity
    e. Basics of ecology: biological interactions (competition, symbiosis), alpha and beta diversity
    f. Basics of biogeochemistry: the nitrogen cycle, chemical and biological fate and transport
2. Think about challenges and opportunities related both to engineering and ethics in biotechnology.
3. Develop and express an opinion on an aspect or application of biotechnology in the form of an op-ed.
4. Reinforce/integrate learning by drawing connections to other courses in curriculum (particularly Environmental Microbiology, Microbial Ecology).

OUTCOMES* - Upon successful completion of this course, students have:

- an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (ABET 1)
- an ability to communicate effectively with a range of audiences (ABET 3)
- 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 (ABET 4)

* OUTCOMES correspond to Environmental Engineering Outcomes which are adopted from ABET.

TEXT:

- *Biology 2e*, OpenStax
- Course packet of selected readings (links or PDFs on Canvas)

EVALUATION:

- 5 homework assignments (problems, short answer) (40%)
- Two quizzes (20%)
- Participation – Class attendance, discussion (15%)
- Final paper (25%)

Late work will be accepted at the professor's discretion.