BIOL 28: INTRODUCTION TO BIOENGINEERING

Foothill College Course Outline of Record

Heading	Value
Effective Term:	Summer 2023
Units:	4
Hours:	4 lecture per week (48 total per quarter)
Advisory:	Not open to students with credit in ENGR 28.
Degree & Credit Status:	Degree-Applicable Credit Course
Foothill GE:	Non-GE
Transferable:	CSU/UC
Grade Type:	Letter Grade (Request for Pass/No Pass)
Repeatability:	Not Repeatable
Cross-Listed:	ENGR 28

Student Learning Outcomes

- The student will be able to recognize and discuss current applications of bioengineering and the relevant steps of the bioengineering design process in medicine, agriculture, and technology.
- The student will be able to define and describe the fundamentals of molecular biology as they pertain to bioengineering including, but not limited to, nucleic acid and protein structure, the human genome, and cell biology.
- The student will be able to describe the bioengineering industry and identify the available career opportunities applicable to their personal career goals.
- The student will be able to analyze the physical processes associated with common biological systems and demonstrate how conservation laws (including conservation of mass and energy, momentum, and charge) apply to biological and medical systems.

Description

Introduction to the field of bioengineering. Topics covered will include an overview of basic biological systems and biochemistry for non-biology majors, how the basic principles of engineering and physics can be applied to problems in biological science, and an overview of current trends in bioengineering, including: medical devices, biomaterials, bioinstrumentation, computational biology, and agricultural biotechnology.

Course Objectives

The student will be able to:

1. Describe the bioengineering industry and identify the available career opportunities
2. Define and describe the fundamentals of molecular biology as they pertain to bioengineering, including, but not limited to, nucleic acid and protein structure, the human genome, and cell biology
3. List and describe the steps of the bioengineering design process
4. Analyze the physical processes associated with common biological systems
5. Recognize and compare current imaging and microscopy instrumentation
6. Demonstrate how conservation laws (including conservation of mass and energy, momentum, and charge) apply to biological and medical systems
7. Recognize and discuss current applications of bioengineering to medicine
8. Recognize and discuss current applications of bioengineering to agriculture
9. Recognize and discuss current applications of bioengineering to technology

Course Content

1. Describe the bioengineering industry and identify the available career opportunities
   a. Defining bioengineering
   b. Careers in bioengineering
   c. History
2. Define and describe the fundamentals of molecular biology as they pertain to bioengineering, including, but not limited to, nucleic acid and protein structure, the human genome, and cell biology
   a. Nucleic acid structure
   b. DNA replication
   c. The human genome
      i. Defining genes and genomes
      ii. Mutations and consequences
      iii. Biomarkers
   d. Cell biology
   e. Proteins
3. List and describe the steps of the bioengineering design process
   a. The scientific method
      i. Steps in the scientific method
      ii. Limitations
   b. Case studies in bioengineering design
   c. Quality assurance
      i. Testing procedures and analysis
      ii. Risk assessment
   d. Bioethics
4. Analyze the physical processes associated with common biological systems
   a. Problem definitions
   b. Systems biology
   c. Statistical methods
5. Recognize and compare current instrumentation used in bioengineering
   a. Microscopy and imaging techniques
   b. Biomechanics
   c. Robotics
6. Demonstrate how conservation laws (including conservation of mass and energy, momentum, and charge) apply to biological and medical systems
   a. Units and calculations
   b. Energy and momentum conservation
   c. Newton's Laws
   d. Circuits, electricity, and conservation of charge

7. Recognize and discuss current applications of bioengineering to medicine
    a. Medical devices
    b. Cell and tissue engineering
    c. Gene therapy
    d. Targeted cancer treatments
    e. Regenerative medicine
        i. Stem cells and cellular techniques
8. Recognize and discuss current applications of bioengineering to agriculture
    a. Bioremediation
    b. Engineering plants and animals
    c. Controversies and ethics
    d. Biofuels
9. Recognize and discuss current applications of bioengineering to technology
    a. Computational applications
        i. Bioinformatics
        ii. Molecular dynamics
    b. Nanobiotechnology and nanobiomaterials
    c. Biomimicry

Lab Content

Not applicable.

Special Facilities and/or Equipment

None required.

Method(s) of Evaluation

Methods of Evaluation may include but are not limited to the following:

Midterm exams comprised of objective and/or written sections and which require critical thinking and analysis of course readings
Final exam requiring knowledge and analysis of all information gathered during the course
Oral expression in discussions and/or presentations
Written expression in evaluating course topics and which require integration of scientific principles with societal/personal views

Method(s) of Instruction

Methods of Instruction may include but are not limited to the following:

Lecture
Group discussion

Representative Text(s) and Other Materials

Bronzino, Joseph D., and Donald R. Peterson. Biomedical Engineering Fundamentals (The Biomedical Engineering Handbook), 4th ed.. 2018.

Types and/or Examples of Required Reading, Writing, and Outside of Class Assignments

1. Reading assignments
    a. Weekly reading assignments from text and outside sources
    b. Suggested supplemental readings from articles relevant to course material
    c. Suggested supplemental readings from web searches relevant to course material
    d. Weekly discussions based on reading assignments and which require knowledge and integration of course material
2. Writing assignments
    a. Question sets based upon assigned reading on current research topics
    b. Poster preparation for oral presentation on subject relevant to course material
    c. Weekly computational problem sets

Discipline(s)

Engineering or Biological Sciences