ECE527E/BIOM527E Affinity Sensors

Course Description: Introduction of DNA/RNA and proteins and their binding mechanisms with complementary DNA/RNA strands and antibodies.
Students will study techniques using optical methods to determine binding events as well as electrical methods using immobilized probe receptors on electrode surface. Fundamental design of affinity sensor experiments and basic components needed for an affinity sensor system will be illustrated using different form of electrodes and bench-top equipment.

Prerequisite Courses BIOM 101 OR LIFE 102 OR instructor permission (in case of H.S. biology); CHEM 111; PH 142; MATH 255 or MATH 261; Concurrent registration in MATH 340 OR MATH 345

Course Learning Objectives

Upon successful completion of this course students will be able to

1. Identify, formulate, and solve engineering problems related to affinity sensors by applying principles of engineering, science, and mathematics
2. Apply the engineering design process to produce solutions that meet specified needs with consideration for public health and safety, and global, cultural, social, environmental, economic, and other factors as appropriate to the discipline
3. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
4. Communicate effectively with a range of audiences
5. 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
6. Recognize the ongoing need to acquire new knowledge, to choose appropriate learning strategies, and to apply this knowledge
7. Function effectively as a member or leader of a team that establishes goals, plans tasks, meets deadlines, and creates a collaborative and inclusive environment

Specifically, the following topics are covered and their learning objective levels are expected.

Week	Content/Topics	Objective Level
1	Review of single and double strand DNA, RNA, protein, antibody, and antigen. Concept of binding affinity.	Mastery
2	Design of affinity sensors: molecule immobilization using covalent bond, enzyme-linked immunoassay (ELISA), capacitive and impedimetric immunoassay	Mastery
3	Performance parameters of affinity sensors including selectivity, sensitivity, linearity, detection limit, and variations.	Mastery
4	Instrumentation used for affinity sensing and laboratory bench-top impedance meters, and highly-integrated impedimetric sensing systems	Engagement

5	Hands-on demo sessions to use the bench-top impedance meter to perform certain DNA detection using the affinity sensing method.	Engagement

Grading Policy

Assessment Components	**Percentage of Grade**
Final exam	30
Homework/Lab	30
Lab and/or project	40

Textbooks and Course Materials: A set of slides and reading materials prepared by the instructor will be distributed.