ECE527D/BIOM527D Electrochemical Sensors

Course Description: This is an introductory course covering the fundamentals of electrochemistry and applications of electrochemical methods to detect certain class of chemicals/molecules. Students will study the oxidation-reduction mechanism and the interpretation of electrochemical results. Fundamental design of electrochemical sensor experiments and basic components needed for an electrochemical sensor system will be illustrated using different form of electrodes and potentiostat 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;

Course Grade Mode: Traditional

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	Topics	Objective Level
1	Fundamental concepts of electrochemistry, electron transfer mechanism, oxidation and reduction process (Redox), oxidation potentials and reduction potentials, and electrochemical methods (cyclic voltammetry and amperometry).	Mastery
2	Electrode configurations & materials that facilitate redox process at the electrode surface. The roles reference, counter, and working electrodes play.	Mastery
3	Performance parameters of electrochemical sensors including selectivity, sensitivity, linearity, detection limit, and variations.	Mastery
4	Instrumentation used for electrochemical sensing including	Engagement

	laboratory bench-top potentiostat and highly-integrated electrochemical sensing systems	
5	Hands-on demo sessions to use the bench-top potentiostat to perform neurotransmitter detection using electrochemical methods.	Engagement

Grading Policy

Assessment Components	Percentage of Grade
Final exam	30
Homework, Reading Assignment, and Lab	55
Quizzes, optionally including clicker participation	15

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