CHM 6180 Biosensors Syllabus 2017

Lecture hours - Monday/Wednesday/Friday Period 4 (10:40 – 11:30 am)

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Instructor's office - 218 Chemistry Laboratory Building (CLB)

Office hours - TBA

Rationale for Course - The development of biosensors, for example, the commercial blood glucose sensor, is a triumph of modern analytical chemistry. In addition to improving human health, biosensors act as research tools for scientists and engineers in a diversity of fields including chemistry, genetics, biomedical engineering, proteomics, molecular biology, and materials science. For these reasons, understanding biosensing technologies and the basic science and engineering principles behind these technologies is important training for any 21st century STEM student.

Course Description and Objectives - This class will focus on practical, real-world biosensing technologies such as enzyme-based biosensors, gene chips, and ion-selective electrodes. I will review the basic principles behind the operation of these devices and discuss the advantages and disadvantages of each. Just as importantly, I will unify these very different technologies by discussing core issues common to all, such as molecular/ion recognition chemistry and transduction of that chemistry into a measurable electrical signal. This will require reviewing some basic science and engineering issues including solution chemistry, electronics, and mass transport.

My objective for the student is to obtain the knowledge needed to evaluate a proposed new biosensing technology. Put it this way: your boss wants to know if the company should invest in a new type of biosensor and puts you in charge of making that decision. This class will provide the knowledge and tools to make that analysis and make you look smart to your boss.

Reading – There is no formal text, but you will be e-mailed PDF files of important research and review articles.

Grading – There will be a midterm and a final exam, each worth 40% of the grade. The other 20% will be from your presentation at the end of the semester. You will find recent scientific papers that describe a proposed new biosensing strategy. These papers may be from one research group or from different groups, but they must deal with the same technology. Your presentation will describe that technology in terms of the concepts taught in this class. You must also present the strengths and weaknesses of the technology. And finally, answer the bottom line question – will this evolve into a real-world sensing platform, or are these just more biosensor research papers?

Proposed Course Outline – This is my first time teaching this class, so I can only approximate how much time it will take to cover each subject. Given that caveat, here is my proposed outline.

1. Neural cells teach us the principles of biosensing

2. The ubiquitous glass pH electrode illustrates what a sensor physically is

3. A review of solution chemistry and basic concepts in analytical chemistry

4. Electronic signals, signal-to-background ratio, and detection limits

5. Calibration curves, the method of standard addition, and sensitivity

6. Ion-selective electrodes and potentiometry

7. The Clark oxygen electrode and an introduction to electrochemical sensors

8. Enzyme-based biosensors, *e.g.*, the blood glucose sensor

9. Array-based DNA "biochip" sensors with fluorescence detection

10. Student presentations