ME 762 Biosensors
for Fall 2020

Instructor: Pilgyu Kang

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Office Hours: To be deteremined

Suggested Textbooks:
1. **Biosensors: Fundamentals and Applications,** Anthony P. F. Turner, Isao Karube, George S. Wilson, Oxford University Press, 1990
2. **Chemical Sensors and Biosensors: Fundamentals and Applications,** Florinel-Gabriel Banica, John Wiley & Sons, 2012
3. **Introduction to Biosensors: From Electric Circuits to Immunosensors,** Jeong-Yeol Yoon, Springer, 2016
4. **Nanomaterials for Biosensors,** Challa S. S. R. Kumar, John Wiley & Sons, 2007
5. **Biosensors Based on Nanomaterials and Nanodevices,** Jun Li, Nianqiang Wu, CRC Press, 2017

Course Objective:

The objective of this course is to introduce fundamentals and applications of biosensors including concepts of biosensors, physics and mechanisms of sensing signal transduction, device fabrications/engineering principles, system integrations, chemistry and materials science of nanomaterials and biomolecules associated with detection strategies, and various applications. This course discusses a wide range of sensing mechanisms, including fluorescent sensing, nanocantilever oscillators, electrochemical detection, optical and plasmonic sensing, and magnetic detection. This course discusses types of nanomaterials, such as gold nanoparticles, quantum dots, graphene, graphene oxides, magnetic nanoparticles, carbon nanotubes, inorganic nanowires/nanorods, plasmonic nanostructures, and photonic crystals, carbon nanotubes, fullerenes, fluorescent and biological molecules, and nanostructured silicon, and explains how to utilize the unique properties of nanomaterials to develop high performance biosensors. This course also introduces various types of sensors and biosensors. including temperature sensors, strain sensor, light sensors, spectrophotometric sensors, pulse oximeter, optical fiber probes, fluorescence sensors, pH sensor, ion-selective electrodes, piezoelectric sensors, glucose sensors, DNA and immunosensors, microfluidic and paper-based lab-on-a-chip biosensors.

Projects: There will be one term paper project and a presentation associated with the project. For the term paper, each student develops a new biosensor-related idea in the format of research proposal that includes an abstract, literature review, background/significance, preliminary results, and an approach.

Homework: There will be six homework assignments.

Prerequisites: Students must be at the level of advanced undergraduate or graduate students in an engineering or science related field. Students must have completed college level general chemistry, calculus, differential equations and linear algebra.

Grading Policy:

Homework (6):	20%
Project:	20%
In-Class Exams (3)	60% (20% each, Not cumulative)
Grading Scheme:	90–100% (A); 80–89% (B); 70–79% (C); 60–69% (D); 0–59% (F)

ME 762 Lecture Schedule
for Fall 2020

The table below presents a course schedule including tentative topics.
The course schedule is subject to change by the instructor.

Week	Lecture#	Date		Tentative Topics
1	1	Aug 24	Mon	Introduction: Concepts of Biosensors
	2	Aug 26	Wed	Physics and mechanisms of sensing signal transductions: Fluorescent Sensors, Nanomechanical Sensors (Acoustic Wave Sensors and Microcantilever Sensors)
2	3	Aug 31	Mon	Optical and Plasmonic Sensors I: Fundamentals
	4	Sept 2	Wed	Optical and Plasmonic Sensors II: Applications
3	5	Sept 7	Mon	Electrochemical Sensors I: Fundamentals & Applications
	6	Sept 9	Wed	Magnetic Sensors: Fundamentals and Applications
4		Sept 14	Mon	**Exam#1**
	7	Sept 16	Wed	Chemistry and materials science of nanomaterials and biomolecules: Protein Structure and Properties, fluorescent and biological molecules
5	8	Sept 28	Mon	Electrochemical Affinity: Antibody-antigen interactions Nucleic Acid
	9	Sept 30	Wed	Optical Biosensing based on Metal and Semiconductor
6	10	Oct 5	Mon	Biosensors Based on Nanoparticles
	11	Oct 7	Wed	Graphene based Electrochemical Biosensors
7		Oct 12	Mon	**Fall Break – No Class**
		Oct 14	Wed	**Exam#2**
8	12	Oct 19	Mon	Graphene based Optical Biosensors and Imaging
	13	Oct 21	Wed	Photonic Crystal Biosensors
9	14	Oct 26	Mon	Graphene and Nanowire Field Effect Transistor Biosensors
	15	Oct 28	Wed	Nanomaterial based Electrochemiluminescence Biosensors
10	16	Nov 2	Mon	Carbon Nanotube based Electrochemical Biosensors
	17	Nov 4	Wed	Biodetection using Surface Enhanced Raman Spectroscopy (SERS)
11	18	Nov 9	Mon	Device fabrications/engineering principles I: Microfluidic and Lab-on-Chip Technologies for Biosensors
	19	Nov 11	Wed	Device fabrications/engineering principles II: System integrations
12	20	Nov 16	Mon	**Exam#3**
		Nov 18	Wed	Various types of sensors and biosensors I: Wearable Sensors and Technologies including temperature sensors, strain sensor
13	21	Nov 23	Mon	Various types of sensors and biosensors I: Optical sensors & Spectrophotometric sensors, pulse oximeter, optical fiber probes, fluorescence sensors
	22	Nov 25	Wed	**Thanksgiving – No Class**
14	23	Nov 30	Mon	Various types of sensors and biosensors II: pH sensor, ion-selective electrodes, piezoelectric sensors, glucose sensors, DNA and immunosensors, Microfluidic and paper-based lab-on-a-chip biosensors
		Dec 2	Wed	Project Presentations