Rutgers University
Electrical and Computer Engineering Department

14:332:493	Topics in ECE: Biosensing and Bioelectronics
Index Number	16320
Date:	Fall 2014
Credits:	3
Time:	Tuesday and Friday Second Period, 10:20 AM to 11:40AM
Location	CORE 538
Grading	30% HW, 40% Midterm Exams, 30% Final Project
Final Exam	None
Instructor	Mehdi Javanmard, PhD.
Course TA:	TBA
Textbook:	Class slides will contain all necessary material for the course and will be available on the class website.
Prerequisites:	14:332:366 Digital Electronics

Further Reading:

Saliterman, Fundamentals of BioMEMS and Medical Microdevices (2009)
Stryer, Lubert *Biochemistry* 5th Edition (2008)

Description of Course: The course covers state-of-the-art and emerging bio-sensors, biochips, microfluidics, which will be studied in the context of molecular diagnostics. Students will briefly learn the relevant biology, biochemistry, and molecular biology pertinent to molecular diagnostics. Students will also become equipped with a thorough understanding of the interfaces between electronics, optics, and molecular biology. Topics will include microfluidics and mass transfer limits, electrode-electrolyte interfaces, electrochemical noise processes, biosensor system level characterization, determination of performance parameters such as throughput, detection limit, and cost, integration of sensor with microfluidics, and electronic readout circuitry architectures Novel nanobiosensors such as nanopores, nanowire FETS, surface plasmon resonance, surface enhanced Raman scattering, fluorescence and single molecule detection will also be covered. Emphasis will be placed on hands-on in-depth quantitative design of biomolecular sensing platforms.

Course intent
1. To introduce the major biochemical and molecular processes relevant in molecular diagnostics.
2. To introduce and provide an understanding of emerging micro- and nanotechnologies for biomarker based disease diagnosis.
3. To give insight and understanding to participants to quantitatively evaluate and design biosensing solutions in medical diagnostics.
4. To generate an appreciation of the interface of biology and engineering, in particular microfluidics, sample preparation, and biosensing in current and emerging technologies.
5. For students to gain practical experience in design and characterization of biosensors.

Week Number	Topic
Week 1	Intro to Molecular Biology
Week 2	Intro to Cancer Biology, Traditional Diagnostics
Week 3	Microfluidics: Hydrodynamic Physics
Week 4	Mass Transfer Affects and Biosensor Performance Limits
Week 5	Interfacial Electrochemistry/Electrical Biosensing
Week 6	In-vitro and In-vivo Bioelectronic Devices and Interfaces
Week 7	Electronic Biosensors, Noise Analysis, Signal Conditioning
Week 8	Low-Noise Electronic Circuits for Biosensing
Week 9	Electric Field/Fluid Interactions: Electrokinetics
Week 10	Micro/Nanofabrication Techniques
Week 11	Electrokinetics and Sample Preparation
Week 12	Nanoelectronic Biosensing Devices
Week 13	Optical Microscopy and Nanophotonic Biosensing
Week 14	Micromechanical and Magnetic Sensing Techniques
Week 15	Review and Final Project Presentation