EEL 5934 Nano Biotechnology

Credits: 3 credits

Text book, title, author, and year: Mauro Ferrari Ph.D., Abraham P. Lee, L. James Lee: *BioMEMS and Biomedical Nanotechnology,* ISBN: 978-0-387-25563-7 (Print) 978-0-387-25842-3 (Online) Iqbal, Samir M., Bashir, Rashid (Eds.): *Nanopores Sensing and Fundamental Biological Interactions*. ISBN 978-1-4419-8252-0

Reference materials: Research papers will be given at the end of lectures to read and understand

Specific course information:

Catalog description: The sensing and characterization of biological entities, processes and events, with novel nanoscale devices and nano-object mediated modalities, will have immediate and far reaching impacts. This course will cover the fundamentals of nanotechnology in biological and biomedical research. The course work is approached from an engineering perspective offering insights on the details of nano-scale fabrication processes as well as cell biology. The basics of biology and chemistry, with focus on how to engineer the behavior of molecules at the nano-scale, are also introduced and analyzed. Concepts and processes related to BioMEMS and microfluidics will also be explained.

Prerequisites: Graduate level engineering and/or physical/biological sciences. Senior undergrads can also take this course with instructor's permission

Specific goals for the course: To introduce the students to the concepts of nanobiotechnology and its applications in biological and biomedical engineering, pharmaceuticals, diagnostics, and public health. Students will also learn material properties of natural and synthetic materials and their applications in biomedical engineering

Brief list of topics to be covered:

→ Introduction to solid-state fabrication
- Standard fabrication processes and modules
- Methods: Photolithography, Evaporation, Etching, Diffusion, Implantation, Deposition
- Current status of these processes

→ Nanofabrication processes
- Limits of current technology
- Synthesis of
  - Nano objects: Nanorods, Nanochannels, Quantum Dots, Nanoparticles, Scaffolds
  - Nanodevies: Nanotubes, Nanowires, Nanocapacitors, Nanogaps, Nanopores, Cantileverls
- Top down and bottom up approaches
- Advances in lithography: DUV, E-beam, Nanoimprint Lithography
- E-beam nanostructuring
- Self-assembly of biomolecules

→ Biology and chemistry fundamental (concepts and structures)
- DNA (human genome project)
- Gene expression and proteins
- Blood-on-chip

→ Electronic properties of biomaterials
- Ion-channels

- Neurons
- Charge transfer through DNA
- Gel electrophoresis

→ Nanobio interface

- Biocompatibility
- Surface functionalization of devices: Techniques, methods and issues
- Why and how?
- Characterization

→ Molecular recognition and biospecificity

- Applications for specific detection

Correlation between engineering and biology