

1. ECE 527F (ECE 581B6): Biosensing: Bophotonic Sensors Using Refractive Index
2. 1 credits: 2-80 minute lecture sessions/week – 5 weeks
3. Kevin Lear
4. None - readings and notes provided by instructor
5. Course Information
  - a. Operating principles of optical biosensors based on changes in refractive index, such as thin films, ring-resonators, Mach-Zehnder interferometers, and other evanescent wave sensors. Basic supporting optical concepts, including thin-film interference, optical waveguides and evanescent waves.
  - b. Prerequisites: ECE 527E or BIOM 527E; MATH 340, may be taken concurrently or MATH 345, may be taken concurrently; PH 142
  - c. Selected Elective: Electrical Engineering; Lasers & Optics Engineering ; Computer Engineering
6. Goals for the Course
  - a. Course Learning Outcomes
    - i. Describe the operating principles of primary examples of interferometric and evanescent wave biosensors and discuss relative advantages and disadvantages
    - ii. Calculate changes in optical signals for optical biosensors from the surface concentration of proteins
    - iii. Distinguish between sandwich assays and real-time optical sensors and discuss the utility of the latter for chemical kinetics measurements
  - b. Student Outcomes
    1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
    6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
    7. An ability acquire and apply new knowledge as needed, using appropriate learning strategies
7. Topics Covered
  - Two commercial optical biosensor systems: Biacore and Genalyte
  - Transmission spectra of Fabry-Perot interferometers, dependence on refractive index, associated spectroscopic equipment for readout
  - Inherent optical properties of proteins
  - Optical waveguides
  - The wave equation and boundary conditions, existence of evanescent waves, impact of core and cladding refractive index, confinement factor
  - Mach-Zehnder interferometer
  - Ring-resonator
  - System design considerations

## Alternative biosensor mechanisms