Biosensor course, Spring 2010
Examination questions.

1. Structure of a sensor. Types of sensors. Performance factors.
2. Electrochemical cells. Reference electrodes. Nernst equation.
3. Potentiometry. Concentration cell. Selectivity and interference. Nikolskii-Eisenman equation.
4. Potentiometry. Types of ion selective electrodes
5. Charge transfer at an electrode. Butler-Volmer equation. Tafel plot.
6. Mass transport at an electrode. Concentration overpotential.
7. Potential step experiment. Chronoamperometry. Explain Cotrell equation:

$$i(t) = nFAD_O \frac{C_O(b)}{\sqrt{4D_O t}} + nFAD_O \frac{C_O(b)}{r}$$

8. Voltammetry. Explain a typical cyclic voltammetry curve. How kinetic and catalytic effects can influence the shape of voltammetry curve.
9. Glucose biosensors. First, second and third generation of amperometric sensors.
10. Conductivity sensor. ChemFET
11. Impedance spectroscopy
12. Electrochemical cell. Common reference electrodes. Working electrodes. Modified working electrodes.
13. Mechanical and thermal sensors
14. SPR sensors: basic principle. Excitation of surface plasmons.
15. SPR biosensor design. Main optical modulation and coupling schemes.
16. Kinetics of surface bound reactions.
17. Achieving selectivity and sensitivity in SPR biosensors. Immobilization strategies in SPR. Improving signal for small analytes
18. DNA sensors. Hybridization, main detection schemes. DNA arrays.
19. Principles of patch-clamping technique. Planar patch-clamping.
20. Application of carbon nanotubes and nanowires for biosensing.
21. Fluorescence and quenching. Stern-Volmer plot. FRET.
22. Optical sensing with a fiber. Bio-optrode design.
23. Principles of Real-Time PCR.