

BIO 5501

Analytical Biotechnology

Fall 2015

Department of Biology

Temple University

Description

The detection, purification, and characterization of biomolecules (proteins, nucleic acids, carbohydrates, and lipids) are major goals in biotechnological research and development. Specific biomolecules serve as markers for the accurate and sensitive diagnosis of disease, and afford drug targets for disease treatment. Biomolecules also can be indicators of harmful (or beneficial) environmental agents and conditions. New, highly sensitive and accurate analytical methods are now available for the detection of diverse biomolecules. Some of these methods have sensitivities that approach the single-molecule (single-cell) detection level, and are providing the basis for the rapidly developing field of nanobiotechnology, and single-cell genomic analyses. From a basic science standpoint, next-generation analytical biotechnologies offer new approaches to allow a better understanding of the immense complexity of cellular processes. BIO 5501 provides a comprehensive introduction to current approaches to the analysis of biomolecules, with a special focus on proteins and nucleic acids. This course requires a basic background in biochemistry and chemistry (through organic chemistry); a familiarity with basic mathematics (algebra) and basic physical and inorganic chemistry. By successfully accomplishing this course, the student will have a current background on the basic principles of key analytic biotechnologies, and how these technologies allow sensitive and accurate detection, purification, and characterization of biomolecules.

There is no formal textbook for this course. Students will receive relevant handouts as reading assignments. Lecture slides will be an information source, and select references also may be provided.

Course: Biology 5501, "Analytical Biotechnology" (3 cr hr lecture)

Time: Tuesdays & Thursdays, 5:30 – 6:50 PM

Place: Room 237, Biology-Life Sciences Building

Instructors: **Allen W. Nicholson**, Ph.D., Professor, Department of Biology

401A Biology-Life Sciences Building

email: anichol@temple.edu **Office hours:** Wed – Thurs 2:30-4:30 PM

Frank Chang, Ph.D., Professor, Department of Biology

301 Biology-Life Sciences Building

email: fchang@temple.edu **Office hours:** Tues-Thurs 3:30-5:00 PM. Other times by email appointment

Alla Arzumanyan, Ph.D., Assistant Professor (Research), Department of Biology

419 Biology-Life Sciences Building

email: areg@temple.edu **Office hours:** by email appointment

Tests and Grading: There will be three mid-term examinations, and a final examination. The three mid-term examinations will be in-class. Each exam represents 20% of the total points possible. The final exam will be 30% of the grade. Homework problems will be provided for each part of the course, and collectively will count towards 10% of the grade. Grading will essentially be based on straight-scale, but some curving may be applied as appropriate.

Midterm 1: **Sept. 22**; Midterm 2: **Oct. 27**; Midterm 3: **Dec. 1**; Final Exam: **Dec. 10 or 15**, 5:45-7:45 PM.

BIO 5501 Lecture Schedule & Topics *(may be subject to change)*

Part I. Introduction; Biochemical reactions and equilibria (8 lectures, Frank Chang)

- Overview; Water; biochemical interactions and equilibria; pH and buffer calculations - 08.25
- Ion-selective electrodes: principles and use; Ligand-receptor binding and applications - 08.27

Part II. Protein separation and detection technologies

- Biochemical techniques: Centrifugation (preparative, analytical): principles and application. Spectroscopy (UV, visible, and fluorescence) - 09.01
- Electrophoresis - 09.03
- Proteomics; ELISA - 09.08
- Mass spectrometry (MALDI-MS, ESI-MS, LC-MS/MS, LC-MRM-MS): Principles and technologies - 09.10
- Applications of mass spectrometry for disease biomarker detection; Targeted mass spectrometry - 09.15
- Metabolomics and applications; Protein complexes: identification, separation and detection – 09.17

1st Midterm – 09.22 (Parts I and II)

Part III. Proteins & Polypeptides (9 lectures, Alla Arzumanyan)

- Protein structure & properties - 09.24 & 09.29
- Chromatography (affinity, ion-exchange, gel filtration, HPLC) – 10.01
- Protein post-translational modifications, applications in biotechnology – 10.06
- Protein & peptide functions, applications in biotechnology – 10.08; 10.13; 10.15

Part IV. Peptide synthesis and analysis

- Solid phase peptide synthesis - 10.20
- HPLC method development – 10.22

2nd Midterm – 10.27 (Parts III and IV)

Part V. Nucleic Acids (8 lectures, Allen Nicholson)

- Nucleic acids (review): structures, properties, functions -10.29; 11.03
- Synthesis and purification of DNA and RNA -11.05
- Nucleic Acid Detection methods -11.10, 11.12
- Nucleic Acid Amplification: PCR and related methodologies -11.17
- Nucleic Acid Sequencing methods -11.19
- Nucleic Acid Sequencing methods (continued) – 12.1

3rd Midterm – 12.03 (Part V)

Final Examination – 12.10 or 12.15 (Comprehensive)