# *Microscale, Nanoscale and Ultratrace Analysis*

*Scope:*

The course is directed to undergraduate students who would like to specialize in **analytical, forensic, pharmaceutical, clinical, or environmental chemistry, as well as materials science**, and related areas.

The main focus is on characterization of nanoscale and microscale materials, including nanoparticles and biological cells, as well as analysis of low-abundance molecules.

*Contents:*

1. Introduction
2. Microfluidics in analytical chemistry
    a. flow injection analysis
    b. microchip technology
3. Microarrays for the analysis of transcripts and proteins
4. Microreactors in analytical chemistry
5. Single-cell analysis
6. * Mid-term exam I
7. High-resolution microscopy
8. Hydrodynamic techniques for characterization of nanomaterials
    a. field flow fractionation
    b. hydrodynamic chromatography
    c. Taylor dispersion
    d. analytical ultracentrifugation
9. Electrophoretic methods for separation of nanoscale materials

10. * Mid-term exam II

11. Organic residue analysis

12. Trace analysis of heavy metals and radionuclides

    a. electrochemical methods

    b. spectroscopic methods

    c. ionizing particle spectrometry

    d. neutron activation analysis

13. Single-molecule analysis

14. Applications of trace and ultratrace analysis methods

    a. environmental monitoring

    b. drug analysis

    c. personalized medicine

    d. toxicology and forensics

    e. archeology

15. * Final exam

*Evaluation:*

* Final mark will be based on the results of the mid-term exams (2 x 30%) and the result of the final exam (40%). Additional points (up to 15%) can be gained for active participation in the class.

*Requirements:*

Students who have completed the General Chemistry course, and who are currently taking (or have already completed) the introductory course of Analytical Chemistry, are encouraged to participate.

*Study material:*

Handouts and review articles will be provided for selected topics.

*Useful links: (This section will be expanded.)*

DNA Microarray

Fundamental Principles of Förster Resonance Energy Transfer (FRET) Microscopy with Fluorescent Proteins

Fluorescence Resonance Energy Transfer (FRET) Microscopy

FRET Microscopy with Spectral Imaging