**University of Rhode Island**

**Department of Chemistry**
**CHM 506, Chemical Analysis, Fall 2015**

## Not a syllabus: See Sakai site for syllabus.

## Professor

Dr. Jason R. Dwyer
Pastore 318

## Lectures

MWF, 13:00-13:50, Pastore 219

## Office Hours:

Drop by (Pastore 318; check 330/332 if I'm not in 318) or by appointment.

## Recommended Text

This course will draw on the literature, but Skoog, Holler and Crouch's *Principles of Instrumental Analysis*, 6th ed. (ISBN 0-495-01201-7, ISBN13 978-0-495-01201-6), is strongly recommended. You will find other textbooks, such as standard physical chemistry textbooks, will be useful from time to time. You may also find these textbooks useful: Quantum Chemistry, 6th ed., Ira N. Levine (ISBN-10: 0136131069, ISBN-13: 9780136131069), and Physical Chemistry, 2nd ed., R. Stephen Berry, Stuart A. Rice and John Ross (ISBN13: 9780195105896, ISBN10: 0195105893).

## Attendance

Attendance in lectures is mandatory. Attendance at several of the chemistry department seminars (Mondays, 3pm, Pastore 234) may be mandatory unless you provide documentation of a legitimate scheduling conflict. These seminars will form part of the material on which you will be tested.

## THEMATIC AREAS

1. **Scientific Development of Chemical Analysis**
    a. Traditional approaches to chemical analysis, to establish basic principles in an accessible framework (e.g. gas-phase electron diffraction, microwave spectroscopy).
    b. Emphasis on application of physical principles in the development of analysis methods.
2. **Physical Principles of Measurement**
    a. Basic electronics, especially limitations of methods (temporal resolution, saturation, linearity, frequency response, gain)
    b. Computer-based data acquisition (Analog-to-digital conversion, bit depth, amplification)
    c. Troubleshooting instrumental methods—common errors (e.g. saturation, nonlinearity) and practical approaches
    d. Methods of detection.
        i. Photon-based (e.g. photoelectric effect, CCDs)
        ii. Particle-based (e.g. particle bombardment)
        iii. Electrochemical
3. **Small Molecule Analysis**. Selected traditional methods to access atomic composition, oxidation state, bond lengths and angles, electronic structure, functional group identification. Representative techniques drawn from, for example:
    a. NMR, EPR
    b. Mass spectrometry (MS)
    c. Cyclic voltammetry
    d. UV/VIS & fluorescence
    e. IR/Raman
    f. X-ray crystallography + related techniques (neutron diffraction, etc.)

4. **Analysis of Extended Structures**. Extension of small molecule analysis to macromolecules, polymers, liquids, nanoparticles, crystals, surfaces and devices. Representative techniques drawn from, for example:
    a. Small molecule techniques
    b. Scanning probe microscopies (AFM, STM, NSOM)
    c. SEM/TEM
    d. XPS
5. **Analysis of Multicomponent/Multiphase Systems**
    a. Immunochemical assays (including electrochemical assays)
    b. Separations

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**Prerequisites:** CHM 412 or permission of the instructor

## Course Description

Fundamental principles governing methods and instrumentation used for chemical analysis. Topics will include selections from signal processing, instrument and method design and selection, and spectroscopic, mass spectrometric, chromatographic and electrochemical techniques.

## Course Goals and Student Learning Objectives

This course is designed to provide a framework for students to develop a complete view of the methods and instrumentation of chemical analysis, grounded in fundamental chemical and physical principles and molded by practical engineering limitations. The course will additionally establish the principles of experimental design, troubleshooting and interpretation in the context of a survey of modern chemical analysis approaches.

## Course Content Learning Outcomes

Upon successful completion of this course, students will:

LO1 Understand the physical principles governing modern chemical analysis.

LO2 Have developed a conceptual framework for understanding the performance capabilities and limitations of chemical analysis methods and instruments

LO3 Have an integrated foundation to be able to develop scientifically sound experiments and to analyse, critique and troubleshoot experiments on the same basis.