CHEMISTRY - CHM 6155
SPECTROCHEMICAL METHODS
(Section 6A55)
Spring 2024

Class times: M,W,F 9:35AM-10:25AM(3rdPeriod) -
This course will be given in presence (Flint 109).
Instructor: Prof. Nicoló Omenetto
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Office hours: Tuesday, Thursday: 8th – 9th period (2:00PM – 4:00PM) or by appointment.

1. Course objectives.

This course will lay the foundations of the interaction between electromagnetic radiation and matter, the instrumental aspects of the spectroscopic methods (absorption, emission, fluorescence and scattering) and the optimization of the analytical signal and signal to noise ratio.
The final goal of the course is to provide the student with the *basic knowledge of spectroscopic instrumentation and methodologies*, and with the capability of associating the most appropriate technique to the analytical problem on hand.

2. Textbook.

The course will be organized around the textbook: "*Spectrochemical Analysis*" J.D. Ingle and S.R. Crouch, Prentice Hall, Upper Saddle River, New Jersey (1988). Despite being old, this book is still the *classic reference book* for basic concepts of *signals*, *noise* and *signal-to-noise ratio* in analytical spectroscopy.
Supplementary material on specific topics will be made available by the instructor.

3. Material covered and planned weekly schedule.

Section I. Spectrochemical Information and Measurements. Instrumental Tools. Chapters 1-4 (~ 4 weeks).

The first Section will cover the basic definitions and concepts related to atomic and molecular spectroscopy. Optical systems, associated components (lenses, mirrors, gratings, interferometers) and concepts (wave description, radiation parameters, dispersion, resolution), will be described in detail. *Radiation sources* (including lasers), and different type of *detectors (optical transducers)* will also be discussed.

Section II. Analytical spectroscopy. Signals, Noise and Measurements. Chapters 5 and parts of Chapter 6 (~ 3 weeks)

The second Section will focus on *characterization of Signals, Noise and S/N ratio*. Different *types of noise* (shot, flicker) affecting the various measurements, noise additions and correlation, and the resulting *signal-to-noise ratio and its optimization* will be treated, together with the *definition and use* of analytical figures of merit like *sensitivity* (*calibration* and *analytical*) and *limit of detection*. In my experience, this topic is *fundamental for analytical students*,

Section III. Atomic Spectroscopy. Chapters 7-11. (~4 weeks).

This Section will focus on the *basic theoretical derivation of emission, absorption, and fluorescence signals* and their dependence upon the concentration of the atomic and molecular species sought. Specific topics will include a brief recall of spectroscopic structure and energy levels, *a detailed discussion of spectral line profiles*, and analytical reservoirs, with particular emphasis on plasma sources.

Section IV. Molecular Spectroscopy. Chapters 12-16 (3 weeks)

The fourth Section will deal with the *theory, instrumentation and practical applications of molecular absorption, fluorescence and scattering (Raman) methods*, with emphasis on fluorescence and associated concepts (e.g., *lifetime, quantum yield, polarization, anisotropy*). Topics include: Molecular spectra, UV-visible absorption, infrared absorption and luminescence spectrometry, linear and non-linear Raman scattering, and laser-based analytical methods.

4. Tests and Grading

Selected numerical problems from various book chapers will be given and discussed in class or during office hours. *As a preparation for the tests, typical problems/questions, including their solutions, will also be provided.*
There will be *1 Mid-term Test*, and a *Final Test*. Mid-term Test 1 will include the material covered in Section I and II, and the Final Test will cover Sections III and IV. *Home work tests* will also be given on specific topics.
Tentative dates for the exams are planned as follows:
Mid-term Test: Monday; March 1, Time: TBA.
Final Test: Date, (tentative) time: Monday, April 26; Time:10AM-12PM.
For the *Home work* tests, the dates will be agreed with the students.
Grading will be based on a 200 points total and on a point distribution as follows: 1/2, 1/2. *See Table on page 4* for the correspondence between points and letter grades. Note that, *for the Mid-term Test*, *individual discussions of the results with the students will be organized.*

5. Policy related to class attendance, class demeanor and make-up exams

Students are expected to attend 85% of the course. Punctuality is recommended. Cell phones should be silent during class time.
If justified, *late Mid-term exam can be considered*, with no additional penalty if taken within the next two days of the actual date of the exam. This may not be applicable to the Final test.
Students are expected to provide feedback on the quality of the instruction in this course by completing on-line evaluations at https://evaluations.ufl.edu.
Evaluations are open two or three weeks before the end of the semester.

6. Policy releated to COVID-19

Participation in our class is fundamental, since *improving oral conversation skills* is a key objective of the course. The course is in presence; should the situation with COVID worsening to the point that Remote (Zoom) teaching would be safer, instructions will be given. Oral comments on camera and written comments in the chat box are considered activities for participation. If you have technical issues, please immediatley consult UF IT Help to resolve them and then contact your instructor. Zoom sessions will not be recorded by the instructor and may not be recorded by students. As in all courses, unauthorized recording and unauthorized sharing of recorded material is prohibited.

6. Miscellaneous

Students are referred to the instructions given in the University of Florida website regarding the University's honesty Policy (http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/), as well as phone numbers and contact sites for university counseling and mental health services.

CORRESPONDENCE POINTS - LETTER GRADES

≥170	**A**
160-169	**A-**
150-159	**B+**
140-149	**B**
130-139	**B-**
120-129	**C+**
100-119	**C**
< 100	**C-**

Important Note for the students: *Grading* will *also take into account* the attendance and partecipation of the student to class, including her/his performance in the *Home work* tests given on specific topics.