Introduction to Instrumental Analysis

CHMC11H3

Syllabus

'Introduction to Instrumental Analysis' is designed to present the basic principles, ideas and methodologies behind modern instruments used in chemical analysis. After this course you should be familiar with:

- the basics of instrument design
- specific uses for each technique
- advantages and weaknesses for each technique covered
- designing the experiments and analysis of collected data.

The major emphasis is on instruments and methods. Detailed analyses of data collected (for example, the interpretation of NMR or UV/Vis spectra) are outside the scope of this course and are covered in other chemistry courses. (You are likely already familiar with the basics of collected data interpretation for some of these techniques as well as physical principles behind them.) The idea is not to overwhelm you with the equations and electronic principles inside the machines. Rather, the course should leave you with an idea as to the main types of instrumentation used in modern chemistry laboratory and what each one is useful for!

Unfortunately, the course does not have a laboratory component so you will not have a hands-on experience during the course. Every attempt will be made to compensate for this weakness using in-class demonstrations (videos, photographs and alike). The lectures are 3 hours long in one block. Nobody can concentrate for 3 hours so we'll have one short break during every lecture session.

Below is a list of topics to be covered:

1. **Atomic spectroscopy**
    a. Introduction to atomic spectroscopy
    b. Instruments for atomic spectroscopy
    c. Techniques:
        i. Absorption spectroscopy and its applications
        ii. Emission spectroscopy and its applications
        iii. X-ray spectroscopy and its applications
    d. Which technique to choose(?): comparison of absorption, emission and x-ray spectroscopes
2. **Molecular spectroscopy**
    a. Introduction to molecular spectroscopy
    b. Ultra-violet (UV-Vis) spectroscopy
        i. Instrument design
        ii. Techniques and applications
    c. Infrared and Raman spectroscopy
        i. Instrument design
        ii. Techniques and applications
3. **Resonance techniques**
    a. Nuclear magnetic resonance
        i. Instrument design
        ii. Techniques and applications
    b. Introduction to electron resonance spectroscopy
4. **Chromatographic separation techniques**
    a. Introduction to chromatography
    b. Gas chromatography
        i. Instrument design
        ii. Experimental set-up
    c. High Performance Liquid Chromatography
        i. Instrument design
        ii. Experiment set-up
5. **Introduction to electroanalytical chemistry**
6. **Miscellaneous techniques and combination of techniques**

The suggested textbook for this course:
Skoog, D. A., F. James Holler, and Stanley R. Crouch. (2007). "Principles of Instrumental Analysis." 6th ed. Brooks/Cole.

The textbook should be available in the UTSC bookstore.

The other important source will be the lecture notes. The lecture notes will be available on CHMC11 intranet site in pdf format. Occasionally, attritional material will also be available (for example, some sample problems and further explanations) so check the intranet frequently. It is also advisable to review the material from other courses (CHMC10, CHMB16 and CHMB21) if you need to refresh your knowledge of physical principles behind the techniques (for example, electronic structure of the atom for atomic spectroscopy).

Marking Scheme

2 problem sets (assignments) 20% each =	40%
Term tests	20%
Final exam	40%

Problem sets are non-cumulative. You will find them on CHMC11 intranet site as pdf files. Each is due in 7 days in class according to the following schedule:

Problem set	**Distributed**	**Due Date**
1	Thurs. Sept. 30	Thurs. Oct. 7 in class
2	Thurs. Nov. 18	Thurs. Nov. 25 in class

The first term test is going to be in late October (date/place TBA) and will cover all material from lecture 1 up to the week of the test.

The final exam is going to be cumulative placing emphasis on the material after the term test: about 1/3 of the questions on the final will cover the material before term test while 2/3 will concentrate on the material covered in the lectures after term test.

In each case (problem sets, term test and final exam) the questions will be combination of calculations and theory. The questions will be based on both the assigned readings from the textbook and material from the lectures.

Good Luck to all and see you soon!