CITY COLLEGES of CHICAGO
Harry S Truman
Education that Works

Master Syllabus
Chemistry 217 Introduction to Scientific Instrumentation

1. Title, Number, and Classification
Introduction to Scientific Instrumentation
073-0217

2. Course Term
16 week Semester or 8 week summer term

3. Credit and Contact Hours
Credit hours: 4
Contact hours: 2 hr lecture, 4 hr laboratory

4. Prerequisites
Grade of C or better in Chem 205 or consent of the department chairperson

5. Catalog Description
Use of modern optical and electrical methods in chemical analysis; filter photometers; visible, ltraviolet and infrared spectrophotometer; gas chromatographs, radioactive counters, pH meters; potentiometers; refractometers; polarimeters; and polarographs. Writing assignments, as appropriate to the discipline, are part of the course.

6. Students for whom the course is intended
This course is designed for any student intending to work in a laboratory with scientific instrumentation, including students wishing to conduct undergraduate research, students preparing for a four year degree, students preparing for employment as a chemical technician, and students preparing for health professions where experience with sample preparation and analysis is valuable. In addition this course is designed for faculty at high schools and colleges who wish to conduct research with students.

7. Course objectives
This laboratory course provides practical experience with modern chemical instrumentation, including sample preparation, operation, limitations, and data analysis. Additionally, the course provides introduction to ChemSketch and techniques for including data and chemical drawings into MS Word.

8. Learning outcomes
Upon successful completion of this course, the student will be able to:

1. Perform simple chemical tests to **evaluate** a sample before instrumental analysis.
2. **Prepare** chemical samples for analysis by including derivatization where necessary.
3. **Operate** the instrument independently.
4. **Rectify** simple problems with sample preparation or data acquisition.
5. Demonstrate proficiency in chemical laboratory **techniques**. (e.g. calculations, dilutions.)
6. Create laboratory **reports** including data from the instruments and chemical structures.
7. Draft a section of a résumé to include hands on **experience** with specific instruments

The following instruments will be covered in depth: sample preparation, operation, troubleshooting, advanced techniques
Infrared (IR) including DRIFT, ATR, KBr pellets, thin films, and gas accessories
Fourier transform nuclear magnetic resonance (FT-NMR) of ^{1}H, ^{13}C, and other nuclei
Other NMR pulse sequences (T1, DEPT)
Two dimensional NMR (COSY, HETCOR)
Gas chromatography – mass spectrometry (GC-MS) including headspace, SPME, and derivative formation
Direct Inlet mass spectrometry (MS)

Ultraviolet-visible (UV-VIS) spectrometry
High pressure liquid chromatography (HPLC)
Optical polarimetry
Atomic absorption spectroscopy (AA) with flame ionization

Specific Student Learning Outcomes and the General Education Goals They Satisfy:
The course addresses three of the general education goals of the College:
Goal 2: Students demonstrate the ability to gather, interpret, and analyze data;
Goal 4: Students demonstrate the ability to perform effectively in the workplace; and
Goal 6: Students demonstrate the ability to learn independently.

9. Topical Course Outline (suggested)
Lab techniques: Rotovap, Schlenck, video melting point, pH meter,
Lab techniques: ChemSketch, importing data and images into Word
IR part I: KBr, thin film, ATR sample preparation and theory, C
IR part II: DRIFT, gas sampling.
Polarimetry, polarizing filters, Infrared camera
NMR part I: FT NMR theory, sample preparation, ^{1}H and ^{13}C NMR
NMR part II: DEPT, COSY, HETCOR
NMR part III: Heteronuclear NMR
GCMS part I: Operation, theory, method development
GCMS part II: sampling techniques
GCMS part III: Direct Inlet, EI, CI and advanced techniques
AA part I: sampling techniques, operation
AA part I: operation
HPLC part I: Theory, operation
HPLC part II: method development
UV/VIS: Theory, sampling techniques

10. Texts and Materials (suggested)
Laboratory notebook with duplicate numbered pages
ChemSketch, a free chemistry drawing program
Spectrometric Identif. of Org. Cmpds, 7th ed. Silverstein, et. al. ISBN 0-471-39362-2
User Manuals from each instrument covered (distributed online as PDFs)
Colored pens or pencils for taking notes (three colors plus black)
Molecular modeling kit

11. Method of Instruction:
The course will consist of mini-lectures and demonstrations, and extensive laboratory work with the instruments. Students will work in small groups or independently, with assistance as needed from the instructor. The laboratory experiments require group work, data sharing, and immediate discussion of laboratory results, fostering a continuous cycle of observation, reasoning, and experimentation that is the hallmark of the scientific method.