



## Tentative Class outline:

### *Introduction to Mass Spectrometry (2 classes)*

- The mass spectrum
- Formation of ions
- Multiple Charged Species
- Isotopes
- Metastable Ions
- Elemental composition of Ions
- Appearance of the mass spectrum

### *Theory of Mass Spectrometry (3 classes)*

- Energy States and Ionization
- Formation of Ions
- Theories of fragmentation rates
- Ions lifetimes
- Qualitative Theories

### *Methods of ionization (4-5 classes)*

- Gas-Phase Ionization
- Electron Ionization (EI)
- Chemical Ionization (CI)
- Desorption Chemical Ionization (DCI)
- Negative-ion chemical ionization
- Field Desorption and Ionization
- Field Desorption (FD)
- Field Ionization (FI)
- Particle Bombardment
- Fast Atom Bombardment (FAB)
- Secondary Ion Mass Spectrometry (SIMS)
- Atmospheric Pressure Ionization
- Electrospray Ionization (ESI)
- Atmospheric Pressure Chemical Ionization (APCI)
- Laser Desorption
- Matrix-Assisted Laser Desorption Ionization (MALDI)

### *Instrumental Design (2-3 classes)*

- Inlet systems
- Ion sources
- Mass analyzers basics (ion separators)
- Detection and recording of spectra
- Complete systems

### *Combined chromatography and mass spectrometry (3 classes)*

- Gas Chromatography/mass spectrometry (GC/MS)
- Liquid chromatography/mass spectrometry (LC/MS)
- Capillary electrophoresis/mass spectrometry (CE/MS)
- Supercritical fluid chromatography/mass spectrometry (SFC/MS)
- Thin-layer chromatography/mass spectrometry (TLC/MS)
- Other applications of mass spectrometry

*Quantitative Mass Spectrometry (2 classes)*

- Introduction and principles
- Specificity
- Sensitivity and limits of detection
- Calibration and standards
- Selected ion monitoring (SIM)
- Selected reaction monitoring (SRM)
- Isotope dilution
- High-resolution vs. low-resolution
- Accurate mass measurements
- Derivatization

*Non traditional Mass analyzers and tandem mass spectrometry (4-5 classes)*

- Unimolecular ion dissociation: Metastable ions
- Collision-induced Dissociation (CID)
- Double focusing magnetic sector instruments
- Triple Quadrupole instruments
- Three- and Four-sector instruments
- Hybrid instruments
- Time of flight instruments
- Ion traps
- Fourier transform instruments
- Tandem MS ( $MS^n$ )
- Applications of  $MS^n$

*Student presentations – (2-3 classes)*

**Suggested reading material:**

**Journals**

*Analytical Chemistry*

*Organic Mass Spectrometry*

*International Journal of Mass Spectrometry and Ion Processes*

*Biological Mass Spectrometry*

*Mass Spectrometry Reviews*

*Rapid Communications in Mass Spectrometry*

*Journal of the American Society for Mass Spectrometry*

**Class assignment(s):**

**Students will be assigned a developmental mass spectrometry article to present and lead a class discussion. The presentation will be limited to 5 minutes and followed by 5 minutes for discussion. Student is required to provide, by e-mail, up to 2 power point slides the day before the presentation is due.**

**Final presentation/term paper:**

**Students will be required to make a 10-minute formal presentation or provide a term paper on a current emerging topic on mass spectrometry published in the literature in the last two years. All presentations must be made in Microsoft power point. A presentation schedule will be provided after the first mid-term exam.**

**Grading:**

Midterm Exam	35%	October 11, 2011
Final Exam	35%	December 8 <sup>th</sup> 2011 7:30AM GL272
Paper/Presentation*	25%	
Assignment(s)	5%	

\*Depending on the number of students in the class a term paper/presentation will be required.