CHEM 8823: Special Topics - Analytical Chemistry (Analytical Separations)

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Office hour: any time when I am in office, or by appointment

Time and Location: MWF 9:05 am ~ 9:55 am. CoC room 52.

Textbook: "Unified separation science" by J. Calvin Giddings (1991), ISBN: 0-0471-52089-6, A Wiley – Interscience Publication. "The essence of chromatography", by Colin F. Poole, 2003, Elsevier.

Other reading: "Principles and practices of modern chromatographic methods" by Kevin Robards, P. E. Jackson, Paul R. Haddad, 1 edition (1995), Academic Press. Additional reading materials will be recommended and available during the class.

Requirements: All the students enrolled in CHEM 8823 are expected to conform to the Honor Code.

Course Description/Learning Objectives: Analytical Separations are extensively applied to almost every modern experimental subject, such as chemistry, biology and engineering. The separation process is governed by some fundamental physical parameters including equilibrium, mass transport, flow, diffusion, viscous phenomena, zone formation and band broadening, etc. We will attempt to obtain an in-depth understanding of the separation process, especially the underlying mechanisms, which will aid us design and develop suitable separation methods for our future research. The course will cover theories, instrumentation and applications of a variety of modern separation techniques such as gas chromatography (GC), liquid chromatography (LC), electrophoresis, isoelectric focus (IEF), field-flow fractionation (FFF), immunoprecipitation (IP), sedimentation and membrane separation, etc.

Grading:

10 quizzes at the end session of each week except the first and last weeks (10%),
Two mid-term exam (25% each), Final exam (40%).
The final grade will be converted to a letter grade, based on the mean point grade, according to the following scale: A (100 – 81 points); B (80 – 61 points); C (60 – 40 points); D (39 – 21 points); F (below 20 points).

Lecture Timeline:

Week	Contents
Aug 20 – 24	Syllabus discussion, introduction of analytical separations, equilibrium.
Aug 27 – 31	Transport - separative transport, irreversible thermodynamics and molecular transport
Sep 3 – 7	Flow transport, flow in capillaries and flow in packed bed, viscosity, friction coefficient and separation speed
Sep 10 – 14	Sample distribution, zone formation and broadening, resolution and peak capacity
Sep 17 – 21	Electrophoresis (including CE, SDS-PAGE), IEF
Sep 24 – 28	2D separation, western blotting and immuno-precipitation (IP), Sep 28: **Midterm 1**
Oct 1 – 5	Sedimentation (centrifugation) separation and isopycnic method
Oct 8 – 12	field-flow fractionation and membrane separation
Oct 15 – 19	Chromatography theory
Oct 22 – 26	Chromatography from a molecular viewpoint
Oct 29 – Nov 2	Gas chromatography theory
Nov 5 – 9	Gas chromatography instruments and applications Nov 9: **Midterm 2**
Nov 12 – 16	Supercritical fluid chromatography and thin layer chromatography and applications
Nov 19 – 23	High performance liquid chromatography - normal and reversed phase chromatography, affinity chromatography, size exclusion chromatography, etc.)
Nov 26 – 30	HPLC - ion-exchange chromatography, chiral chromatography and multiple-dimension chromatography, Optimization and method development based on LC
Dec 3 – 7	HPLC applications, especially for biological samples, such as metabolites, DNA, peptides and proteins, etc.
Dec 10 – 14	**Final Exam**
Dec 18	Grades posted, end of term