

Chem 868: TOPICS IN ANALYTICAL CHEMISTRY, Winter 2002

(+) Capillary Electrophoresis (-)
Thursday, 5:30-8:20 PM, 219 Stratton Hall (lecture)
optional 1-credit lab, TBA, 207/204 Disque Hall

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Office Hours: Please feel free to see me (i) before class (except for 15 minutes prior to class when I will be collecting my thoughts/handouts for lecture), (ii) immediately after class, or (iii) any time in the afternoons (M-F). With regard to (iii), I will not be available after 3:30 PM on Wednesdays because I'll be attending chemistry department seminars in Disque 919. I am happy to schedule meetings at other mutually agreeable times with any students who can't see me during these regular office hours.

Course objective(s): to teach students about the most relevant aspects of capillary electrophoresis from a separation science/analytical chemistry perspective. Additional objectives are currently being revised or developed and will be announced.

Texts/Resources: Please purchase the *required text* Practical Capillary Electrophoresis, 2nd edition, written by Robert Weinberger and published by Academic Press (2000, ISBN 0-12-742356-7). *The following book is optional but recommended:* Method Development, Optimization, and Troubleshooting for High Performance Capillary Electrophoresis, written by R. Weinberger and R. Lombardi and published by Simon & Schuster (1997, ISBN 0-536-00029-8).

Books on Reserve: The following books are on reserve in the Hagerty library: J. Landers, Handbook of Capillary Electrophoresis, 2nd edition, CRC Press, 1997, ISBN 0-8493-2498-X. P. Camilleri, Capillary Electrophoresis: Theory and Practice, 2nd edition, CRC Press, 1998, ISBN 0-8493-9127-X. M. Khaledi, High Performance Capillary Electrophoresis, John Wiley & Sons, Inc., 1998, ISBN 0-471-14851-2. Dale R. Baker, Capillary Electrophoresis, Wiley, 1995, ISBN 0-471-11763-3.

Other materials on reserve in the Hagerty Library: Handouts, etc., to be arranged. When the length of a relevant document is small, I may distribute it directly to you rather than put it on reserve. If possible, the documents will also be put on the chemistry department's website.

Other resources: The following computer tutorials (electronic textbooks) with dynamic illustrations of various aspects of capillary electrophoresis (CE) have been installed on two PCs in Disque 209 and on at least 4 of the computers in the physical chemistry lab (Disque 404):

CE1: Principles of CE

CE2: FSCE Method Development
CE3: MECC Method Development

In order to gain access to the computers in Disque 209 and/or the P-chem computer lab, students must sign and return a responsibility acknowledgement form for that room.

Grading: Your course grade will be determined as outlined below. The percentages are approximate. At least a third of each exam will be take-home.

Quizzes		3 %
Selected homework (problem sets)/computer tutorials	25 %	
Mid-Term Exam (February ?)	25 %	
Literature Exercise and/or Discussion		12 %
Class participation		5 %
FINAL EXAM (comprehensive)		30 %

Quizzes: Quizzes will not usually be announced in advance. They are given as an incentive for students to keep up with the reading, lectures, and/or homework.

Problem Sets: Two or three problem sets and/or two or three computer exercises will be assigned, collected, and graded during the semester. Problems sets must be submitted in the following format or they will be returned to the student for no credit: (i) 1-2 page summary sheet of the answers to the problems in the order assigned; (ii) detailed solution to each of the problems in the order assigned. Students are strongly encouraged to use a spreadsheet program such as Excel (v. 5.0 or higher) for statistical or other repetitive calculations.

Late problem sets will be penalized ?% per day.

Homework: Problems assigned throughout the semester should be worked as an aid in comprehending the material. They will usually not be collected or graded, but the student should not be surprised to see at least some of them on an exam.

Exams: If you cannot attend a scheduled exam, you must notify me in advance. If no such notification is given before the exam and no acceptable excuse is given afterwards, you will receive a zero for the exam. Similar rules apply for the problem sets.

Literature Exercise and/or Discussion: You will each be assigned 1-3 articles to download and print or otherwise obtain a copy of (interlibrary loan if necessary). Please distribute 1 copy of each article to each remaining student and the instructor no later than 2 weeks before the last class period, and be prepared to lead an oral discussion of your article(s) during the next to the last class period.

**** Attendance at analytical seminars:** The chemistry department's graduate seminar program includes several analytical seminars this winter term as shown on the department website (<http://www.chemistry.drexel.edu/>). Please attend as many of these analytical seminars as possible.

Communication by e-mail: It is VERY important for me to be able to communicate with each member of the class quickly and efficiently. Whenever someone sends me a question via email, I will reply by email and distribute the answer to the entire class.

It is now a university requirement/responsibility of all students at Drexel to either use your official email address directly or, if you choose to use an alias or completely different email address, to make sure that you receive all email sent to your official email address by making any

and all necessary arrangements to have it forwarded automatically to the email address that you regularly use.

Homework Problems (To Be Announced)

Course Outline for Chem 868

- I. Brief overview of separation science
- II. History of electrophoresis and capillary electrophoresis
- III. Basic physics and electrochemistry for CE
 - A. CE as a DC electrical circuit
 - B. Electrical double layers
 - C. Joule heating
- IV. Basic principles of capillary electrophoresis
 - A. Electrophoresis terminology
 - B. Electroosmosis
 - C. Flow dynamics, efficiency, and resolution
 - D. Effects of capillary dimensions
 - E. Sample introduction
 - F. Detection
 - G. Quantitation
- V. Separation modes of capillary electrophoresis, with representative applications
 - A. capillary zone electrophoresis (CZE)
 - B. electrokinetic chromatography (EKC)
 - C. capillary electrochromatography (CEC)
- VI. "hot topics": Chiral separations, DNA separations, CE on a chip
- VII. Separation modes of capillary electrophoresis, with representative applications
 - A. capillary gel electrophoresis (CGE)
 - B. capillary isoelectric focusing (CIEF)
 - C. capillary isotachopheresis (CITP)
- VIII. Interfacing CE with mass spectrometry
- IX. Selecting the appropriate mode of CE for a given application
- X. Approaches to methods development for CZE and micellar EKC
- XI. Topics requested by students
- XII. Discussions and presentations