



## SYLLABUS

### A. Course Description

Course Code	Course Num.	Course Name	Credit Hours	Lec.	Lab.	Tut.	Private study	Pre-requisites	Course Level	Language
CHM	333	Chemical Separation Methods	4	2	3	1	8	CHM 332	6	English

Classical separation methods, extraction, chromatography (TLC, GC, HPLC, Column chromatography), detectors, ion exchange and electrophoresis.

At the end of this course the student will be able to:

- To outline principles of chemical separations and construction of relevant instrumentation.
- To state operating conditions to optimize a particular separation technique
- To list different methods for quantitative separation analysis
- To name factors that affect performance of chemical separation methods especially GC and HPLC
- To describe experimental methods to separate plant extract components

### B. References: Required Textbook & Internal Website

I shall use

**Quantitative Chemical Analysis**, Daniel C. Harris, (8<sup>th</sup> Ed.), W. H. Freeman & Co., New York, 2010, ISBN: 9781429218153.

**Students are required to purchase the textbook/materials (it is an obligation).** The book contains the lecture notes as well as activities for the students to take part in; the book serves as a workbook. Other references:

- **Modern Analytical Chemistry**, David Harvey, McGraw-Hill, (1<sup>st</sup> Ed.), 2000, ISBN: 0-07-237547-7
- **Chemical Analysis: Modern Instrumentation Methods and Techniques**, Francis Rouessac, Annick Rouessac, (2<sup>nd</sup> Ed.), John Wiley & Sons, 2007. ISBN: 0470859040, 9780470859049.
- **Principles of Instrumental Analysis**, D. A. Skoog, F. J. Holler, S.R. Crouch, Brooks Cole; (6<sup>th</sup> Ed.) 2006, ISBN: 0495012017, 978-0495012016.
- **Chromatography: Fundamentals and applications of chromatography and related differential migration methods**, Heftmann, E., (6<sup>th</sup> Ed.), Elsevier Science, 2004., ISBN: 0444511067, 978-0444511065.
  - **Journal of chromatography.**
  - **Encyclopedia of chemistry**

Website:

- [http://highered.mcgrawhill.com/classware/ala.do?isbn=0073048518&alaid=ala\\_1136810&protected=true&showSelfStudyTree=true](http://highered.mcgrawhill.com/classware/ala.do?isbn=0073048518&alaid=ala_1136810&protected=true&showSelfStudyTree=true)
- <http://www.chem1.com/acad/webtext/virtualtextbook.html>
- <http://www.shodor.org/UNChem/index.html>



Google Classroom Webpage: <http://www.imamm.org/>

### C. Topics Outline

**Disclaimer:** this is a very fast-paced course. There will be little time-if any-for review. What follows is an approximate outline of the pace of the course. We may go faster or slower, contingent on the class response. The tentative list of topics to cover:

#### a. *Theory:*

1. Introduction to separation: Pre-concentration , quantification, purity and role of separation, Classification of separation methods depending on the basis of separation, Classical separation methods, distillation, re-crystallization, filtration, decantation, and centrifugation, Introduction to the developed method of separation, requirements and specifications
2. Extraction techniques, theory and applications on liquid-liquid, liquid–solid , solid-phase micro extractions and stir-bar sorptive extraction techniques, Comparison of the efficiency of various techniques, and methods improvement, Applications in various fields
3. Chromatographic theory: history of chromatography, classification of chromatographic methods, mechanism of separation, column efficiency, Band broadening and resolution, (HETP) theoretical plates, open column and chromatogram, Thin layer chromatography (TLC) and paper chromatography and their applications
4. Gas chromatography: instrumental design, gas type selection, methods of sample introducing or injection (split, splitless , split-splitless and purge and trap, Types of detectors, (ECD, FID, NPD, PID) and connection to MS Columns (capillary and packed) , chemically bonded and comparing the efficiency, Temperature programmed (oven) and quantitative analysis (applications)
5. High performance Liquid Chromatography (HPLC): theory of operation, instrumental design , function of various parts of the machine , solvent delivery (pumps), types of pumps and requirements, Column specification and polarity, column selection, detectors (UV-Vis., Fluorescence , RI, Diode array,) and connectivity to MS Operational modes of HPLC ( Reverse and Normal phase) quantitative analysis and applications
6. Ion chromatography, cation and anion exchange: resin, and size exclusion chromatography, Electrophoresis, its principle and capillary electrophoresis.

#### b. *Practical:*

Classical Separation of mixture depending on different physical and chemical properties, Separation and purification by Re-crystallization, Determination of Distribution Coefficients of iodine and benzoic acid in organic solvent/water system, Separation of organic mixture by distillation techniques: simple and fractional, Separation of mixture using liquid-liquid extraction technique, Separation of organic mixture and plant pigments by means of column chromatography, Separation and identification of pain killers and plant pigments using TLC, Separation of metal ions by Paper Chromatography, Separation of Chromium complexes by means of Cation exchanger (Resin)., Determination of  $\text{Na}^+$  by Ion-Exchange chromatography, Determination of  $\text{Ca}^{2+}$  by Ion-Exchange chromatography, Separation of organochlorine pesticides by Gas-chromatography, Separation and quantification of Caffeine in soft drinks using HPLC technique.



## D. Exams & Grading System

The semi-official dates of the exams for this course, with all the caveats, that the word “semi-official” entails, can be found here:

- **Midterm 1:** 6<sup>th</sup> or 7<sup>th</sup> week      & **Midterm 2:** 11<sup>th</sup> or 12<sup>th</sup> week
- **Quizzes & Homeworks:** During the semester

Your course grade will be based on Final Exam, Midterms, Homework, Quizzes, Participation, Attendance and Project.

Midterm 1: 10 %	Midterm 2: 10 %	Final Exam: 40 %
Laboratory: 30 %	Quizzes; Homework & Attendance & Participation: 10 %	

### Grading distribution:

A+: [95, 100], A: [90, 95), B+: [85, 90), B: [80, 85), C+: [75, 80), C: [70, 75), D+: [65, 70), D: [60, 65), F: [0, 60).

## E. Student Attendance/Absence

Only three situations will be considered as possible excused absences:

- Occurrence of a birth or death in the immediate family will be excused. (“Immediate family” is defined by the University as spouse, grandparents, parents, brother, or sister).
- Severe illness in which a student is under the care of a doctor and physically unable to attend class will be excused. Students are not excused for a doctor's appointment. Do not make appointments that conflict with rehearsals. Notes from the University Health Center will be accepted.

[Executive Rules for Study Regulations and Examsgoo.gl/ykm7t3](http://Examsgoo.gl/ykm7t3)

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