School of Chemistry
Faculty of Science
University of the Punjab, Lahore
Course Outline

BS Chemistry Semester-V					
Programme	**BS Chemistry**	**Course Code**	**Chem-346**	**Credit Hours**	**2**
Course Title	**Chromatographic Techniques-I**	**Course Type**		**Major (Elective)**	

Course Introduction

This course will help the students in understanding chromatographic techniques, involving separation of complex mixture. The students will be able to understand ion exchange methods. The students will also learn about the basic concepts of chromatography.
Chromatographic techniques:
Basic principle of chromatography, classifications of chromatographic techniques, theory of column, paper and thin layer chromatographic techniques; their instrumentation, applications and limitations
Ion exchange chromatography:
Cation exchange resin, anion exchange resin, cross-linkage, effect of pH on amino acids, separation of metal ions by anions/cations exchange columns, applications of ion exchange chromatography.

Learning Outcomes

On the completion of the course, the students will:

1. Explain the basic principles and classifications of chromatography.
2. Implement practical applications of column, paper, and thin layer chromatography.
3. Explain the principles and applications of ion exchange chromatography.
4. Understand the effect of pH on amino acids and its significance in ion exchange chromatography.
5. Perform separations of metal ions using anion and cation exchange columns.

	Course Content	Assignments/Readings
Week 1	Introduction to Chromatography Basic principles of chromatography Importance and applications in analytical chemistry	Collect the material from recommended books and read as per lecture
Week 2	Classifications of Chromatographic Techniques Overview of different types of chromatography Comparison between various chromatographic techniques	Read and understand the lecture and make possible question for discussion
	Class Discussion	
Week 3	Theory of Column Chromatography Principles of column chromatography Instrumentation and setup	Read and understand the lecture and make possible question for discussion
Week 4	Applications and Limitations of Column Chromatography Practical applications of column chromatography Limitations and troubleshooting	Read and understand the lecture and make possible question for discussion
	Quiz	

Week 5	Theory of Paper Chromatography Principles of paper chromatography Instrumentation and setup	Read and understand the lecture and make possible question for discussion
	Class discussion	
Week 6	Applications and Limitations of Paper Chromatography Practical applications of paper chromatography Limitations and troubleshooting	Read and understand the lecture and make possible question for discussion
Week 7	Theory of Thin Layer Chromatography (TLC) Principles of TLC Instrumentation and setup Practical applications of TLC Limitations and troubleshooting	Read and understand the lecture and make possible question for discussion
Week 8	Mid-term assessment	
Week 9	Introduction to Ion Exchange Chromatography Basic principles of ion exchange chromatography Importance and applications in analytical chemistry	Read and understand the lecture and make possible question for discussion
Week 10	Principles of Chromatography Basic principles of separation techniques Understanding retention, selectivity, and resolution	Read and understand the lecture and make possible question for discussion
	Class discussion	
Week 11	Cation Exchange Resin Properties and functions of cation exchange resins Practical applications	Read and understand the lecture and make possible question for discussion
Week 12	Anion Exchange Resin Properties and functions of anion exchange resins Practical applications	Read and understand the lecture and make possible question for discussion
Week 13	Quiz	
	Cross-Linkage in Ion Exchange Resins Understanding cross-linkage and its significance Practical applications	Read and understand the lecture and make possible question for discussion
Week 14	Effect of pH on Amino Acids How pH affects amino acids in ion exchange chromatography Practical examples and experiments	Read and understand the lecture and make possible question for discussion
Week 15	Separation of Metal Ions by Anion/Cation Exchange Columns Techniques for separating metal ions Practical applications and examples	Read and understand the lecture and make possible question for discussion
Week 16	Final assessment	

Textbooks and Reading Material

1. Chromatography by R.K Sharma, Gogel publishing home meerret
2. Introduction to chromatography by Nasir-ud-din, Published by author
3. Modern analytical chemistry by David Harvey, Roohani-art press, Islamabad
4. Principle and Practice of analytical chemistry by Fillfield, Blackwell Science Ltd
5. Fundamentals of Chromatography by H.G. Cassidy, Inter Science Publisher, London, N.Y.
6. Fundamentals of Analytical Chemistry by Doughlas Skoog and Donals M. W. West, Holt Reinchart and Inc, London.
7. Analytical Chemistry by G. D. Christian

Teaching Learning Strategies

1. Lecturing using white/black board/Multimedia
2. Written Assignments
3. Class activities and discussion
4. Quiz about last lecture
5. Presentations

Assignments: Types and Number with Calendar

Assignments, quiz, Tasks, Presentation, etc.

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

BS Chemistry Semester V					
Programme	**BS Chemistry**	**Course Code**	**Chem-347**	**Credit Hour**	**1**
Course Title	**Basic Chromatographic Techniques (Lab-I)**	**Course Title**		**Major (Elective)**	

Course Introduction

Outline of this course covers basic analytical separation techniques involving different types of chromatography. It also finds its applications in various fields regarding organic and in organic separations.
Separation of ink components by paper chromatography
Separation of dyes using thin layer chromatography (TLC)
Separation of various amino acids by thin layer chromatography
Separation of leaf pigments using column chromatography
Determination of the capacity of an ion exchange resin
Separation of metal ions using cation exchange chromatography
Separation of cadmium and zinc using an anion exchange column
Separation of anions using anion exchange chromatography
Recovery of the separated bromophenol blue, congo red and phenol red using TLC/column chromatography
Separation of dyes by column chromatography
Separation of mixture of ink components by circular paper chromatography
Separation of mixture of amino acids by circular paper chromatography

Learning Outcomes

On the completion of the course, the students will:

1. Analyze and interpret the results of paper, TLC, and column chromatography experiments.
2. Separate metal ions and anions using ion exchange chromatography.
3. Analyze and interpret the results of ion exchange chromatography experiments.

	Course Content	**Assignments/Readings**
Week 1	Overview of chromatography principles	Collect the material from recommended books and perform experiments
Week 2	Separation of ink components by paper chromatography	Collect the material from recommended books and perform experiments
Week 3	Separation of dyes using thin layer chromatography	Collect the material from recommended books and perform experiments
Week 4	Separation of various amino acids by thin layer chromatography	Collect the material from recommended books and perform experiments
Week 5	Separation of leaf pigments using column chromatography	Collect the material from recommended books and perform experiments
Week 6	Separation of dyes by column chromatography	Collect the material from recommended books and perform experiments

Week 7	Recovery of the separated Bromophenol blue, congo red and phenol red using TLC/Column chromatography	Collect the material from recommended books and perform experiments
Week 8	Mid-term assessment	
Week 9	Introduction to ion exchange chromatography	Collect the material from recommended books and perform experiments
Week 10	Determination of the capacity of an ion exchange resin	Collect the material from recommended books and perform experiments
Week 11	Separation of metal ions using cation exchange chromatography	Collect the material from recommended books and perform experiments
Week 12	Separation of cadmium and zinc using an anion exchange column	Collect the material from recommended books and perform experiments
Week 13	Separation of anions using anion exchange chromatography	Collect the material from recommended books and perform experiments
Week 14	Separation of mixture of ink components by circular paper chromatography	Collect the material from recommended books and perform experiments
Week 15	Separation of mixture of amino acids by circular paper chromatography	Collect the material from recommended books and perform experiments
Week 16	Final assessment	

Textbooks and Reading Material

1. Vogel's text book of quantitative inorganic analysis by J. Bassett. The English language book Society and Longman
2. Introduction to chromatography by Nasir-ud-din, Published by author
3. Paper chromatography by Dr. Friedrich Cramer, London Macmilian and Co. Ltd
4. Thin-layer chromatography by Marini, Elservier publisher

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