Course Specification
(Bachelor)

Course Title:	Chromatographical Separation Methods
Course Code:	CHM 1232
Program:	Bachelor of Science in Chemical Laboratories
Department:	Chemistry
College:	Science
Institution:	Imam Mohammed Ibn Saud Islamic University
Version:	2024-V 1
Last Revision Date:	17 September 2024

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A. General information about the course:

-1. Course Identification

1. Credit hours: 3 (2, 3, 0)					
3 (2 Lectures, 3 Lab, 0 Tutorials)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: Level 4/ Second year					
4. Course general Description:					
• **This course is designed to relate the chromatography lectures with the laboratory experiments and allow the undergraduate students to practice the basic principles of chromatographic separation methods.** • **This course covers several chromatographic separation methods of analysis.**					
5. Pre-requirements for this course (if any)**:**					
Chemical Separation Methods – CHM 1231					
6. Co-requisites for this course (if any)**:**					
None					
7. Course Main Objective(s):					
At the end of this course the student will be able to: ✓ Work independently and in a group. ✓ Communicate ideas to other students in the laboratory. ✓ Use standard laboratory equipment and modern instrumentation. ✓ Justify the proper separation tool for specific compounds. ✓ Interpret and evaluate chromatograms resulting from the separation technique. ✓ Calculate the most important parameters extracted from separation process.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**75**	**100%**
2	E-learning	**0**	**0**
3	Hybrid • Traditional classroom • E-learning	**0**	**0**
4	Distance learning	**0**	**0**

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	**30**
2.	**Laboratory/Studio**	**45**
3.	**Field**	**0**
4.	**Tutorial**	**0**
5.	**Others (specify)**	**0**
Total		75

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**To recognize the basic knowledge of the fundamental aspects of the chromatographic techniques**	**K1; K2**	• Five hours weekly, containing lectures and laboratory activities • A Private study, including a Homework	**Direct:** • exams, Quizzes • Homework Laboratory Reports • Participation
1.2	**To name the most suitable Chromatography method for specific compounds and matrices**	**K2; K4**	• Two hours weekly, containing lectures • A Private study, including a Homework	**Direct:** • exams, Quizzes • Oral Discussion • Laboratory Reports • Participation
1.3	**To describe the mechanism of separation and elution modes**	**K2; K4**	• Lectures • laboratory experiments.	**Direct:** • Participation, • Quizzes and MCQs, • laboratory reports
1.4	**To define and describe the most important parameters in the chromatograms resulted from the separation technique**	**K2; K4**	• Lectures • laboratory experiments. • A Private study, including a Homework	**Direct:** • Participation, • Quizzes and MCQs, laboratory reports

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
2.0	**Skills**			
2.1	**Compare and differentiate between separation techniques.**	**S3, S4**	• Lecturing, • group discussion • Laboratory experiments performance	**Direct;** • Short quizzes Exams, • Solved problems marks • Homework assignment laboratory reports
2.2	**To interpret and evaluate chromatograms resulted from the separation technique**	**S1; S2**	• Lecturing, • group discussion • Laboratory experiments performance	**Direct;** • Short quizzes Exams, • Solved problems marks • Homework assignment • laboratory reports
2.3	**To Justify the proper separation tool for specific compounds**	**S1; S2**	• Brain storming • self-study	**Direct;** • Quizzes laboratory reports
2.4	**To calculate the most important parameters extracted from separation process.**	**S3**	• Group discussion • laboratory experiments.	**Direct;** • Homework assignment, • Examination • Laboratory report
3.0	**Values, autonomy, and responsibility**			
3.1	**Appraise teamwork , exchange ideas and create awareness to maintain scientific integrity during assessments, projects, and mini-projects.**	**V2**	• Group discussion, assignments, and homework • Lab-reports • Virtual labs and demonstrations	**Direct;** • Oral tests, lab performance, Reports and sheets of Marks • Assignments and homework marks
3.2	**Show personal values and attributes such as honesty, empathy and respect for others**	**V1, V2**	• Teamwork and class discussions	**Direct** • lab reports • Mini projects

C. Course Content

No	List of Topics	Contact Hours
1.	Introduction (definitions, theory, classifications of chromatography, planar chromatography, column chromatography)	2
2.	Paper chromatography (stationary phase and mobile phase, mechanism, and applications)	4
3.	Thin layer chromatography (types of stationary phase and mobile phase, mechanism, visualization of spots, applications)	4
4.	Gas chromatography (Instrumentation for gas-liquid chromatography, gas chromatography column and stationary phases, applications of gas -liquid chromatography, gas-solid chromatography)	8
5.	High performance liquid chromatography (HPLC) (stationary phases, equipment's, partition chromatography, adsorption chromatography, ion chromatography, affinity chromatography, method development, important applications, comparison to gas chromatography)	8
6.	Supercritical fluid chromatography (properties of supercritical fluid, instrumentation and operating variables, difference with other types, applications)	4
	Sub-total	30
No	**Topics of practical**	
1	Instructions for students	3
2&3	Separation of pigments in writing utensils by means of paper chromatography	6
4&5	Separation of metal ions by Paper Chromatography	6
6&7	Separation and identification of plant pigments using TLC	6
8&9	Separation and identification of pain killers using TLC	6
10	Separation of plant pigments by means of column chromatography	3
11	Separation of organic mixture by means of column chromatography	3
12	Determination of the Exchange Capacity of a Cation Ion---Exchange Resin	3
13	Separation of Chromium complexes by means of Cation exchanger (Resin).	3
14	Separation and quantification of Caffeine in soft drinks using HPLC technique	3
15	Revision and Lab. Reports overview	3
	Sub-total	45
Total		75

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quizzes, Attendance, Participation, Homework	All the semester	10%
2	Laboratory	All the semester	30%
3	Midterm Exam 1	Around 6th -7th week	10%
4	Midterm Exam 2	Around 11th -12th week	10%
5	Final Exam	Around 15th – 16th week	40%
6	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	• Daniel C. Harris, **Quantitative Chemical Analysis**, W. H. Freeman; Eighth edition (April 30, 2010), ISBN-10 : 1429218150, ISBN-13 : 978-1429218153
Supportive References	1. David T Harvey , **Modern Analytical Chemistry**, McGraw-Hill; 1st edition (October 14, 1999), ISBN-10 : 0072375477, ISBN-13 : 978-0072375473 2. Francis Rouessac, Annick Rouessac, **Chemical Analysis: Modern Instrumentation Methods and Techniques**, Wiley; 3rd edition (April 4, 2022), ISBN-10 : 1119701333, ISBN-13 : 978-1119701330 3. Douglas A. Skoog, F. James Holler, Stanley R. Crouch, **Principles of Instrumental Analysis**, Cengage Learning; 6th edition (December 6, 2006), ISBN-10 : 0495012017, ISBN-13 : 978-0495012016 4. E. Heftmann , **Chromatography: Fundamentals and applications of chromatography and related differential migration methods - Part A: Fundamentals and techniques of Chromatography Library, Volume 69A)** , Elsevier Science; 6th edition (April 30, 2004), ISBN-10 : 0444511075, ISBN-13 : 978-0444511072
Electronic Materials	• **Blackboard** • **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
Other Learning Materials	Journal of chromatography. Encyclopedia of chemistry

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Each of the class room should be equipped with a whiteboard and a projector, with a maximum of 20 students. • In each laboratory, a list of safety and precautions are provided. • In each lab has proper ventilation, and well equipped with instruments. • In each lab, containers for solid waste, liquid waste, and crushed glasses. • Each lab has a small pharmacy for first aid in case of an accident • In each lab, the rules, conditions, and safety mechanism as well list of Risk, Safety precautions according to Merck Catalogue are hanging in the labs
Technology equipment (projector, smart board, software)	The rooms are equipped with data show, Smart Board, WI-FI access.
Other equipment (depending on the nature of the specialty)	• Appropriate Glasswares for carrying the requested experiments (conical flasks, beakers, measuring cylinders) • Appropriate fine chemicals and solvents (distilled Water ammonium nitrate) • Analytical balance (3 digits), Set gas laws with the glass jacket Data acquisition set for gas laws with glass jacket, PC, Windows® 95 or higher, calorimeter, thermometer, Filter papers , clamps, stands

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of Students assessment	**Program Leaders**	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Quality of learning resources	**Students**	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
The extent to which CLOs have been achieved	**Course Responsible**	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**COUNCIL OF DEPARTMENT OF CHEMISTRY**
REFERENCE NO.	**3 (NO. 1/3)**
DATE	**5/3/1446- 8/09/2024**