Course Specification
(Bachelor)

Course Title:	**Chemical Separation Methods**
Course Code:	**CHM 1438**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammed Ibn Saud Islamic University**
Version:	2024 V **1**
Last Revision Date:	13 October 2024

Table of Contents

A. General information about the course: 3

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods 4

C. Course Content 6

D. Students Assessment Activities 7

E. Learning Resources and Facilities 7

F. Assessment of Course Quality 9

G. Specification Approval 10

A. General information about the course:

-1. Course Identification

1. Credit hours: 4 (3Lectures, 0Tutorials, 3Labs)					
4 (3Lectures, 0Tutorials, 3Labs)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: Level 7/Year 4					
4. Course general Description:					
Classical separation methods, extraction, chromatography (TLC, GC, HPLC, Column chromatography), detectors, ion exchange and electrophoresis.					
5. Pre-requirements for this course (if any)**:**					
Volumetric and Gravimetric Analysis – CHM 1236					
6. Co-requisites for this course (if any)**:**					
None					
7. Course Main Objective(s):					
This course is intended: • **The main objective of this course is to familiarize students with the fundamental of separation processes used in analytical chemistry such as various extraction techniques, gas and liquid chromatography, size and ion chromatography and electrophoresis.** • **By completion of this course, students, are expected to gain independent laboratory skills in certain separation techniques and will have the ability to interpret data from analytical separation methods.**					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**90**	**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**	**45**
2.	**Laboratory/Studio**	**45**
3.	**Field**	**0**
4.	**Tutorial**	**0**
5.	**Others (specify)**	**0**
Total		90

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 outline principles of chemical separations and construction of relevant instrumentation.**	**K1, K2, K3**	• Six hours are weekly, containing lectures and laboratory activities. • A Private study including home exam.	▪ Quizzes Assignments ▪ Discussions. ▪ Participation.
1.2	**To name factors that affect performance of chemical separation methods especially GC and HPLC and optimize respective operating conditions.**	**K2, K3**	• six hours weekly containing lectures and Laboratory activities • Group discussion	• Quizzes • Assignments. • Oral Discussion • Laboratory Reports
1.3	**To describe experimental methods to separate plant extract components**	**K1, K2**	• Six hours are weekly for lectures and laboratory activities • Think, talk, and review appropriate methods to separate plant extract components	▪ Quizzes ▪ Home exam ▪ Oral Discussions. ▪ Laboratory Reports
1.4	**To define the principles of safety, list**	**K4**	• laboratory experiments.	• Participation, • Quizzes and

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
	of emergency responses and outline the routes of exposures to hazards, the minimization, and controlling and laboratory management.		• Laboratory preformance	MCQs, laboratory reports
2.0	**Skills**			
2.1	**To operate and calibrate separative techniques and use the appropriate types of detectors such as ECD, FID, NPD, Diode-Array and mass-spectrometer.**	**S1**	• Lecturing, • Group discussion • Laboratory experiments	• Questions in Lectures. • Short Quizzes and Exams. • Participation • Oral Discussion, • Laboratory Reports • Home Exam.
2.2	**To differentiate the scientific separation methods employed in multidisciplinary fields such as environmental and pharmaceutical analysis.**	**S1, S3**	• Lectures • laboratory sessions	• Questions in Lectures. • Laboratory Reports • Short Quizzes and Exams. • Oral Discussion
2.3	**To design experimental setup for separation of compounds with different properties such as polarity and solubility.**	**S1; S4**	• Lecturing • oral discussion	• Questions in Lectures. • Short Quizzes • Exams.
2.4	**To demonstrate oral communication skills by presenting seminars before his class mates and teaching staff, to write reports about real pollution cases in his community and operate electronic mail and Network skills in**	**S2, S3**	• Oral participation • Group discussions • Lab experiment and reports • Encourage students to use electronic mail to submit homework and assignments.	• Assignments • Laboratory Report.

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
	communicating with others.			
3.0	Values, autonomy, and responsibility			
3.1	To appraise effectively the collaboration and inter-professionalism in class discussions or teamwork, as well as independently.	V1, V2	• Group discussion, assignments and homework • Virtual labs and demonstrations	• Oral tests, • lab performance, • Group work sheets • Assignments and homework marks

C. Course Content

No	List of Topics	Contact Hours
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	6
2.	Extraction techniques: theory and applications in liquid-liquid, liquid–solid, soild-pahse micro extractions and stir-bar sorptive extraction techniques, Comparison of the efficiency of various techniques, and methods improvement, Applications in various fields	6
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, layer chromatography (TLC) and paper chromatography and their applications	6
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)	6
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

6	Ion chromatography, cation and anion exchange: resin, and size exclusion chromatography, Electrophoresis, its principle and capillary electrophoresis.	9
7	Mass spectrometer: instrumental design, theory of operation, basic specifications, advantages and disadvantages as chromatography detector.	6
Total		45

No	List of Experiments	Contact hours
1	Separation of a Solid Mixture	3
2	Determination of distribution coefficient	3
3	Single and Multiple extraction	3
4	Separation of organic mixture by acid-base extraction	3
5	Separation of analegisic ingredients via TLC	3
6	Separation of metal ions by paper chromatography	3
7	Separation of Mn^{7+} and Cr^{6+} via Column chromatography:	3
8	Cation exchange chromatography	3
9	HPLC as stability indicator (Qualitatine analysis)	3
10	Determination of acetaminophenein Panadol tablets via standard calibration curve	3
11	Analysis of Panadol extra via internal standard method	3
12	GC as stability indicator (Qualitatine analysis)	3
13	Determination of chlorohexdine gluconate in anticeptic products	3
14	Revision	6
Total		45

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm 1	6th/ 7th week	10 %
2.	Midterm 2	11th/ 12th week	10 %
3.	Quizzes, Home Works, class participation, and mini projects	During the semester	10 %
4.	Laboratory	All the semester	30 %
5.	Final Exam	16- 17th week	40 %

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
6.	Total	0	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	**Quantitative Chemical Analysis**, Daniel C. Harris, 8th Ed., 2010, W. H. Freeman & Co., New York, ISBN: 9781429218153.
Supportive References	**Modern Analytical Chemistry**, David Harvey, McGraw-Hill, 1st Ed, 2000, ISBN: 0–07–237547–7 **Chemical Analysis: Modern Instrumentation Methods and Techniques**, Francis Rouessac, Annick Rouessac, John Wiley & Sons, 2nd, 2007.ISBN: 0470859040, 9780470859049. **Principles of Instrumental Analysis**, D. A. Skoog, F. J. Holler, S.R. Crouch, Brooks Cole; sixth edition (2006), ISBN: 0495012017, 978-0495012016. **Chromatography: Fundamentals and applications of chromatography and related differential migration methods**, Heftmann ،E , 6th Ed, Elsevier Science, 2004., ISBN: 0444511067, 978-0444511065.
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 cyliders, dishes, funnels) • Appropriate fine chemicals and solvents (raw materials to isolate active materials,,diethyl ether, copper sulphate, HCl, NaOH) • Separating funnul, TLC, Paper chromatography, Column chromatography, Cation exchange chromatography, HPLC.

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.
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.

Assessment Areas/Issues	Assessor	Assessment Methods
	Program Leaders	**Indirect:** Observations - Accreditation review. **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.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.

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.	**7 (NO. 2/3)**
DATE	**29/3/1446 - 2/10/2024**