Course Specification

(Postgraduate Programs)

Course Title:	**Analytical Separation Methods**
Course Code:	**CHM 6133**
Program:	**Master of science in chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	*Course Specification Version Number*
Last Revision Date:	*Pick Revision Date.*

Table of Contents

A. General information about the course:

1. Course Identification:

1. Credit hours: 3 (3 Lectures, 0 Lab, 0 Tutorials)				
2. Course type				
A.	☐University	☐College	☐Department	☐Track
B.	☐Required		☒Elective	
3. Level/year at which this course is offered: Level 2/Year 1				
4. Course General Description:				
The course will focus mainly on the sophisticated separation techniques involved in chemistry. The basic principles of the chromatographic theory will be covered. Gas Chromatography and High-Performance Liquid chromatography instrumentation, columns and applications are described in details. The theory, principles and applications of mass spectrometry and the application of it as a detector for gas and HPLC are described, in addition to Supercritical Fluid Chromatography and its applications.				
5. Pre-requirements for this course (if any)**:**				
Advanced Analytical Chemistry - CHM 6131				
6. Pre-requirements for this course (if any)**:**				
7. Course Main Objective(s):				
• **Familiarize with the fundamental principles of the chromatographic theory.** • **Recognize the basic principles and instrumentation of gas and high-performance liquid chromatography.** • **Specify the optimum conditions for separation of analytes.** • **Understand the fundamentals of mass spectrometry technique.** • **Be familiar with interfacing between GC and HPLC and mass spectrometer as a detector.** • **Identify the basic principles of Supercritical Fluid Chromatography and its applications.**				

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**45**	**100 %**
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		

No	Mode of Instruction	Contact Hours	Percentage
4	Distance learning		

3. Contact Hours: (based on the academic semester)

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

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

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**To list the principles and Chromatography theory for Modern Analytical Methods of Separation.**	**K1. Anal.; K2. Anal.; K4. Anal.**	▪ **Five hours/week lectures.** ▪ **Self-study Home-exam.**	▪ **Regular Exams** ▪ **Assignments** ▪ **Short Quizzes** ▪ **Oral Discussion Participation.**
1.2	**To recognize basic principles and instrumentation of gas and High-Performance Liquid Chromatography.**	**K2. Anal.; K3. Anal.; K4. Anal.**	▪ **Five hours/week lectures.** **Think to justify the instrumentation of Gas and High-Performance Liquid Chromatography principles using available references (SDL) online. Open discussion.**	▪ **Oral Discussion marks** ▪ **Literatures Survey** ▪ **Mini-seminar.** ▪ **Participation .**

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.3	To define the strengths and limitations of different separation techniques	K1. Anal.; K2. Anal.;	Five hours/week lectures. Group Discussion with mini-reports to justify strengths and limitations of different separation techniques using available references (SDL) online. Open Discussion.	Midterm. Assignments. Group Discussions. Literatures Survey Mini-seminar. Participation.
1.4	To state the basic principles of Supercritical Fluid Chromatography and its applications.	K1. Anal.; K2. Anal.; K4. Anal.	Five hours/week lectures. Group Discussion using available references (SDL).	Assignments Open Discussions. Literatures Survey Mini-seminar. Participation.
2.0	**Skills**			
2.1	To analyze data and interpret results for complex samples with different matrix constituents.	S1. Anal.; S2. Anal.; S3. Anal.	Lectures. activity Self-study. Deep discussion on analyzing and interpreting results of different matrices used.	Questions in Lectures. Short Quizzes and Exams. Open Discussions. Participation Mini -seminar.
2.2	To design experimental setup for separation of compounds with different chemical properties	S2. Anal.; S3. Anal.	Practice some examples for experimental setup for analytical separation of specific mixtures. Brainstorming. Self-study.	Questions in Lectures. Participation Oral Discussion Short Quizzes.
2.3	To justify the selection of proper analytical separation techniques for various samples to	S1. Anal.; S2. Anal.	Lectures Oral Discussions. Brainstorming. Self-study	Questions in Lectures. Short Quizzes and Exams. Oral Discussion.

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	support a reasonable arguments			**Participation.**
2.4	**To operate communication to the basic principles of analytical separation techniques and its applications, accompanying writing of mini-Reports, operating electronic mail, and Network in communicating with others.**	**S1. Anal.; S3. Anal. S4. Anal.**	**Group Discussion and Assignments. Suggest several examples of chemical separation techniques used to study, which will require reading, writing, and oral presentation in groups. Encourage students to use electronic mail to submit Home Exams and Assignments.**	**Oral Discussion. Quizzes, and Exams. Giving marks for Oral Discussion in Lectures. Marks given for Assignments.**
3.0	**Values, autonomy, and responsibility**			
3.1	**To perform a scientific presentation, research, and work independently and integrate with a collaborated group, Using IT to acquire, analyze, and communicate information.**	**V1. Anal.**	**Brain Storms Exercises Group Discussion**	**Oral Discussion. Group Discussion Assignments**
3.2	**To demonstrate his ability to the effectively collaboration and inter-professionalism in class discussions or team works, as well as independently.**	**V1. Anal.; V2. Anal.**	**Small Group tasks Open discussion at classroom. Office hour guiding. Group Presentation of mini-projects**	**Participation Homework's Mini-project(s).**
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C. Course Content:

No	List of Topics	Contact Hours
1.	***Chromatographic Theory:*** The Theoretical Plate Model of Chromatography, The Rate Theory of Chromatography, Retention and equilibrium in Chromatography, Detection and quantification.	**7**
2.	***Gas Chromatography (GC):*** Introduction to instrumentation and operation of GC. Gas –solid chromatography, Instrumentation, Sample preparation and introduction by pyrolysis, Detectors of GC, two dimensional GC, Head space analysis, Purge and trap unit connected to GC.	**7**
3.	***High Performance Liquid chromatography:*** Introduction to instrumentation and operation of HPLC, Liquid-Liquid Chromatography, Chiral Chromatography, Ion exchange Chromatography: with conductivity suppression, Ion Pairing chromatography, Size exclusion Chromatography: Gel filtration and permeation chromatography**.**	**10**
4.	***Mass spectrometry:*** Mass spectrometry, Sample introduction, Methods of ionization: Electron ionization, Chemical ionization, atmospheric pressure photo ionization and field ionization, Electrospray ionization, Matrix-assisted laser desorption ionization (MALDI), Fast-atom bombardment (FAB) ionization, Ion bombardment or secondary ion mass spectrometry (SIMS), Field desorption (FD) ionization, Plasma desorption (PD) ionization, Mass analyzer: Quadruple mass filter and Time-of-flight (linear and reflection, Ion Trap.	**10**
5.	***Chromatographic- Mass spectrometry:*** Application of MS as a detector for GC and HPLC. Connection of GC-MS, Connection of LC-MSS, Tandem mass spectrometry (MS/MS**.**	**5**
	Supercritical Fluid Chromatography (SFC): Supercritical Fluids as Mobile Phase, Instrumentation in SFC, SFC in Chromatographic techniques, Applications of SFC.	**6**
Total		**45**

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Class Activities (Open Discussion, Mini-reports, Oral Presentation, solving questions)**	**weekly**	**30 %**
2.	**Midterm Exams**	**9th and week**	**30 %**
3.	**Final Exam**	**Around 12th–17th week**	**40 %**
4.	**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	***Gas chromatography and mass spectrometry:*** A practical guide, Sparkman, O. D.; .Penton, Z.; Kitson, F. G., 2nd Edition, Academic Press, 2011. ISBN: 978-0123736284. ***Chromatography: Principles and Instrumentation ,*** Vitha, M. F., 1st ed, Wiley, 2016. ISBN: 978-1-119-27088-1 ***Introduction to Modern Liquid Chromatography ,*** Snyder, L. R.; Kirkland, J. J.; Dolan, J.W., 3rd Edition, Wiley, 2009.ISBN-13: 978-0470167540. ***Comprehensive chromatography in combination with mass spectrometry,*** Mondello, L.,1st Ed, Wiley, 2011.ISBN: 978-0-470-43407-9
Supportive References	**NONE**
Electronic Materials	• Saudi Digital Library
Other Learning Materials	• Blackboard. • Multimedia associated with the text book and the relevant websites

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**Each of the classroom should be equipped with a whiteboard and a projector, with a maximum of 20 students.**
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)	**None**

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.

Assessment Areas/Issues	Assessor	Assessment Methods
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory-GCC)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio.
	Course Responsible	**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		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	**Council of Chemistry Department**
REFERENCE NO.	**10 (No. 2/10)**
DATE	21/04/1444- 15/11/2022