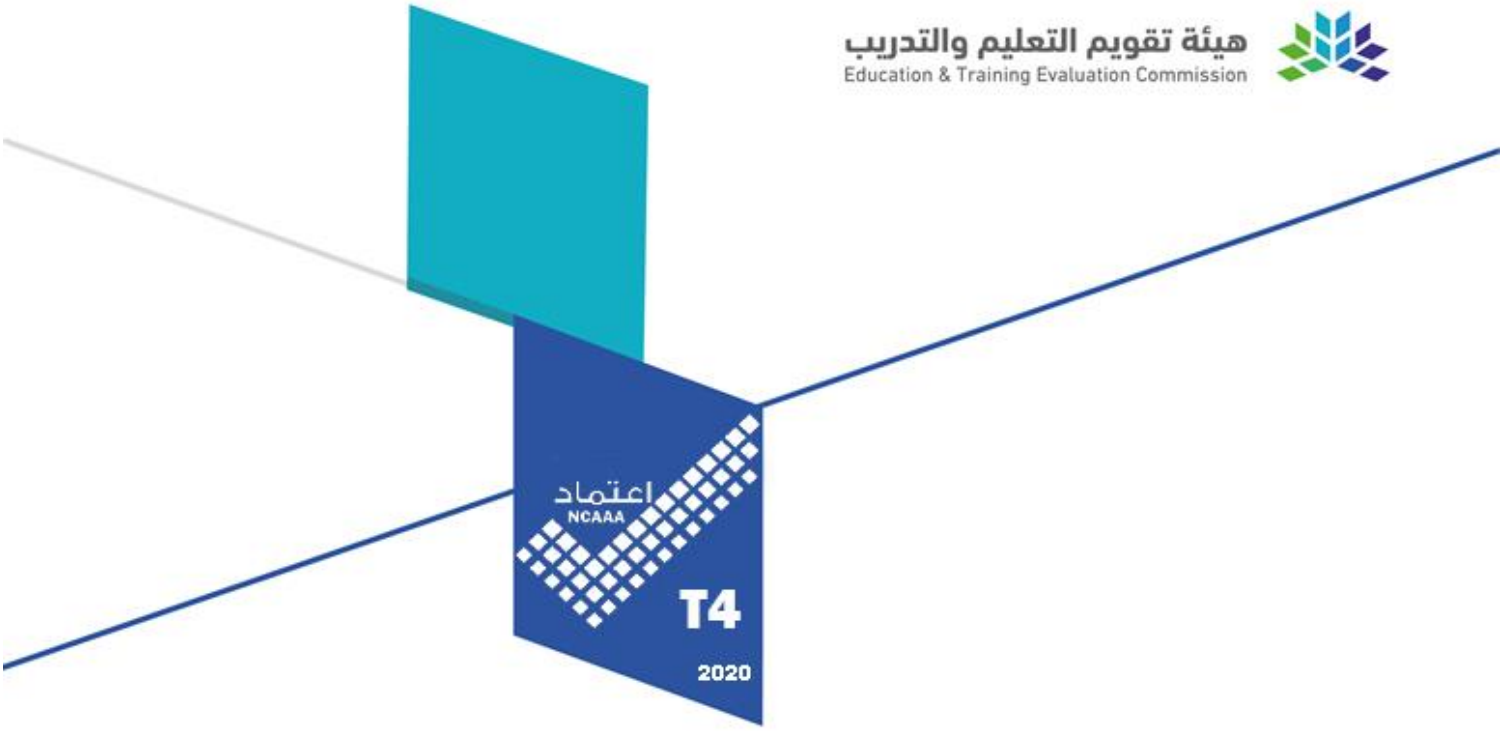
هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission



Course Specifications

Course Title:	**Chromatographic Analysis**
Course Code:	**CHEM 313**
Program:	**Bachelor in Chemistry**
Department:	***Chemistry Department***
College:	***College of Science***
Institution:	***Jazan University (JU)***

Table of Contents

A. Course Identification

1. Credit hours: 3hs **Workload:** 166 .2 **ECTS:** 5.9	
2. Course type	
a. University ☐ College ☐ Department ☑ Others ☐	
b. Required ☑ Elective ☐	
3. Level/year at which this course is offered: Level 5 Year 3	
4. Pre-requisites for this course (if any)**:**	
none	
5. Co-requisites for this course (if any)**:**	
none	

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom** **LAB**	***30*** 30	100%
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	30
2	**Laboratory/Studio**	30
3	**Tutorial**	
4	**Others** (specify)	
	Total	60

B. Course Objectives and Learning Outcomes

1. Course Description

Course Title	Course Number	Contact Hours (CH)		Credit unit (CU)	Year	Level	Pre-requisite
		Lec.	Prac.				
Chromatographic Analysis	CHEM 313	2	2	3	3rd	5th	----------

Course Objectives ; They are to identify the following

[1] Develop basic understanding of chromatography principles and theories.
[2] Recognize the advantages and limitations of the main chromatographic techniques.
[3] Calculate chromatographic factors and constants.
[4] Interpret chromatographic data and results.
[5] Develop basic experimental skills of chromatographic analysis.

Syllabus: A-Theoretical contents

definitions of chromatographic analysis terms and parameters, classifications of chromatographic methods, advantages and disadvantages of the different techniques. It will also cover the main theories of chromatography and calculating and interpreting chromatographic factors and parameters. Applications of chromatographic analysis will also be discussed.

Syllabus: A-Practical contents

Practical applications of different chromatographic separation techniques.

2. Course Main Objective

This course aims to give the student an introduction to the principles and theories of chromatographic analysis as a tool of separation for quantitative analysis and qualitative analysis. The course will also cover the applications of chromatographic analysis.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and Understanding:** *Upon completion of this course, student will be able to*	
1.1	*Demonstrate a broad understanding and critical view of the principal theories, concepts and terminology of chromatographic analysis and its applications (P)*	*K1*
1.2	*Describe the main techniques and instrumentations used in chromatographic analysis and their advantages and limitations and applications (P)*	*K2*
2	**Skills :** *Upon completion of this course, student will be able to*	
2.1	*Demonstrate an ability in critical thinking, numeracy, statistical, analytical reasoning, use of graphs and charts to solve problems in chromatographic analysis. (P)*	*S1*
2.2	*Perform experiments using various chromatographic techniques; record, analyze and interpret the chromatographic data, and write reports (P)*	*S2*

CLOs		Aligned PLOs
2.3	*Knows the proper procedures and regulations for safe handling and use of chemicals and can follow the proper procedures and regulations for safe handling when using chemicals. (P)*	*S3*
2.4	*Make effective use of communication, library searching and information technology about chromatographic analysis. (P)*	*S4*
3	**Values:** *Upon completion of this course, student will be able to*	
3.1	*Working as a group leader in cooperation with other colleagues. (P)*	*V1*

C. Course Content

No	List of Topics	Contact Hours
1	*Course introduction and organization*	*2*
2	*Introduction to separation*	*2*
3	*Introduction to chromatography*	*2*
4	*Basic chromatographic theory, terms and equations*	*4*
5	*Paper chromatography (PC)*	*2*
6	*Thin-layer chromatography (TLC)*	*2*
7	*High Performance Liquid chromatography (HPLC)*	*5*
8	*Gas chromatography (GC)*	*5*
9	*Analysis of real samples*	*2*
10	*Other separation techniques*	*2*
	Exams, quizzes and discussions	*2*
	Practical experiments on different chromatographic separation techniques.	*30*
Total		*60*

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge and Understanding** *Upon completion of this course, student will be able to*		
1.1	*Demonstrate a broad understanding and critical view of the principal theories, concepts and terminology of chromatographic analysis and its applications (P)*	*lecture / discussion Seminars /presentation*	*oral and written examinations laboratory reports*
1.2	*Describe the main techniques and instrumentations used in chromatographic analysis and their advantages and limitations and applications (P)*	*lecture / discussion / Seminars /Individual presentation*	*oral and written examinations laboratory reports*
2.0	**Skills** *Upon completion of this course, student will be able to*		

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
2.1	*Demonstrate an ability in critical thinking, numeracy, statistical, analytical reasoning, use of graphs and charts to solve problems in chromatographic analysis. (P)*	*lecture / discussion / Seminars /Individual presentation*	*oral and written examinations laboratory reports*
2.2	*Perform experiments using various chromatographic techniques; record, analyze and interpret the chromatographic data, and write reports (P)*	*Lab work, group work*	*lab report/ Lab notebook.*
2.3	*Knows the proper procedures and regulations for safe handling and use of chemicals and can follow the proper procedures and regulations for safe handling when using chemicals. (P)*	*lab demonstrations / hands-on student learning activities*	*Observation of practical skills / Safety exam / Practical assignments and laboratory reports*
2.4	*Make effective use of communication, library searching and information technology about chromatographic analysis. (P)*	*research activities / project-based learning / Technology-enabled learning*	*assignments and reports / project / seminar / report*
3.0	*Values Upon completion of this course, student will be able to*		
3.1	*Working as a group leader in cooperation with other colleagues. (P)*	*lab demonstrations / whole group and small group discussion*	*group project reports / Practical assignments and laboratory reports /*

2. Assessment Tasks for Students

#	Assessment task*		Week Due	Percentage of Total Assessment Score
1	**Homework assignment**		2	1.25
2	**Lecture Quiz**		3	1.25
3	**Homework assignment**		3	1.25
4	**Lecture Quiz**		5	1.25
5	**Quiz in Safety**		5	0
	Mid-term exam		9	15
	Presentation session		11	0
6	*LAB*	*Quiz in Safety*	*5*	*0*
7		Lab reports and assignments	2,3,4,5,7,9	15
8		Lab Sheet Exam	15	5
9		Final Practical Exam	15	10
10	*Final Exam*		*16*	*50 %*
			Total	*100 %*

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:

- ***Instructor will be available for academic counseling on daily basis for at 4h/day during office hours.***
- ***The office hours are listed in the instructor time table and delivered to students in the first lecturer in each semester.***
- ***Instructor is available in a WhatsApp group with student.***
- ***E-mail and Telephone number are delivered to student for any help during semesters.***

F. Learning Resources and Facilities

1. Learning Resources

Required Textbooks	1- Skoog, Douglas, Donald West, F. L. Holler, and Stanley Crouch. *Fundamentals of analytical chemistry*. Cengage Learning,9th Edition 2014. 2- سلامة، أحمد خميس محمد. التحليل الكروماتوجرافي (اساسيات وطرق التحليل). جامعة المجمعة، الطبعة الأولى، 2015 . 3- العسود، بسام إبراهيم. التحليل الآلي. دار الفكر، الطبعة الأولى، 2011.
Essential References Materials	• Skoog, Douglas, Donald West, F. L. Holler, and Stanley Crouch. *Fundamentals of analytical chemistry*. Cengage Learning,9th Edition 2014. • Ahuja, Satinder. *Chromatography and separation science*. Vol. 4. Academic Press, 2003. • Miller, James M. *Chromatography: concepts and contrasts*. John Wiley & Sons, 2nd Edition, 2005. • Braithwaite, Alan, and J. F. Smith. *Chromatographic methods*. Springer, 5th Edition, Reprint 1999.
Electronic Materials	• http://www.chromacademy.com/ • www.chromforum.org/ • http://www.lcresources.com/ • http://www.sepscience.com • http://chemwiki.ucdavis.edu/Analytical_Chemistry/Instrumental_Analysis/Chromatography/ • https://chem.libretexts.org/Special:Search?qid=&fpid=230&fpth=&query=chromatography&type=wiki
Other Learning Materials	• ***None***

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	***A Lecture hall for 30 students equipped with modern teaching technology (projector, smart board, computer and internet)***

Item	Resources
	- Laboratory in accordance with the rules of safety and personal protection accessories should be available to all students
Technology Resources (AV, data show, Smart Board, software, etc.)	***- Laptop computer, smart board and internet access in the classroom and laboratory***
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	***- Chemicals and standards used in lab experiments*** ***- Related analytical equipment and instruments such as GC, HPLC, UV lamp for TLC, separation columns and accessories, pH meter, analytical balance, …etc***

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of Teaching and Assessment	***Student***	***Likert-type Survey (CES) Indirect***
Extent of achievement of course learning outcomes	***Instructor & Course coordinator***	***Class room evaluation (direct & indirect)***
Quality of learning resources	***Program coordinator***	***Indirect***
Exam Quality assessment	***Assessment committee***	***Indirect***
Effectiveness of Teaching and Assessment	***Student***	***Likert-type Survey (CES) Indirect***

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	**Chemistry Department Council**
Reference No.	42 / 35 /102 112
Date	17 /09 /1442 Corresponding to 28 / 04 /2021

Attachment:
LAB EXPERMENTS EXP PART

Experiment	Chemicals, Glassware and Equipment	Remarks
Lab. Experiments' organization and manual design	Data Show.	
Safety demonstration	Safety Equipment in the lab.	
Separating food colors using paper chromatography	Goggles; gloves and fume hoods. Chromatography paper; Capillary tube to spot samples; Beaker tall-form 500-mL; Watch glass large (to fit beaker); Scissors; Pencil; Ruler. Commercial food colors; Sodium chloride solution, NaCl, 0.1%.	
Separating Amino Acids by Thin Layer Chromatography	Goggles; gloves and fume hoods. Thin Layer Chromatography Sheet: (20 x 20 cm) covered with 0.20 mm layer of silica gel 60 (MACHEREY-NAGEL ALUGRAM® Xtra SIL G or similar); Capillary tube to spot samples; Beaker, 1000-mL (Developing Chamber); Watch glass, large (to fit beaker); Spraying bottle for the detecting reagent; Scissors to cut the TLC sheet; Pencil; Ruler. Amino Acids STANDARD solutions of: Lysine, β-Alanine, Tryptophan. Developing solvent (Mobile Phase): a mixture of Acetonitrile : water (70:30 vol/vol). Detecting reagent: Ninhydrin solution - 0.3% (w/vol) ninhydrin in n-butyl alcohol containing 3% glacial acetic acid. Drying oven or hair dryer for hot air.	
Separation and Identification of Pain-Killing Drugs by Thin Layer Chromatography	Goggles; gloves; face masks and fume hoods. Thin Layer Chromatography Sheet: (20 x 20 cm) covered with 0.20 mm layer of silica gel 60 (MACHEREY-NAGEL ALUGRAM® Xtra SIL G or similar); Capillary tube to spot samples; Beaker, 1000-mL (Developing Chamber); Watch glass, large (to fit beaker); Scissors to cut the TLC sheet; Pencil; Ruler. STANDARD solutions for Active ingredients: Caffeine (6.5 mg/mL); Paracetamol (50 mg/mL); Acetylsalicylic acid (30 mg/mL); Painkiller tablets; Developing solvent (Mobile Phase): a mixture of Ethyl acetate / Hexane / Acetic acid (60:39:1). UV light box with lamp at short wavelength.	
Separation of dyes by Column Chromatography	Goggles; gloves; face masks and fume hoods. Chromatography column (400 x 22 mm); Beakers (2), 100-mL; Plastic droppers or Pasteur pipettes; Measuring cylinder, 50-mL; Funnel with wide stem; Pencil (for tapping); Long glass rod to position the cotton wool plug.	

	Dyes Mixture: Mixture of Methyl Orange and Methylene Blue solutions (1:1). Single-compound solutions are prepared in 95% ethanol; Mobile Phase (Elution solvents): FIRST elution solvent: 95% (v/v) Ethanol/Water. SECOND elution solvent: Acetonitrile-Water-Acetic Acid (80:15:5 v/v).	
Determination of Caffeine and Benzoic Acid in Soft Drinks by HPLC with UV detector	Goggles; gloves; and fume hoods. HPLC with UV Detector; Ultrasonic bath. Volumetric flasks (2x10 mL); Reagent bottles (1x60 mL); Glass pipette (1x1 mL); Beakers (1x50 mL, 2x25 mL); Syringe Filter (0.2 μm); Plastic syringe (1x2 mL); HPLC glass vial (1x1.5mL). Soft drink sample; Phosphate buffer solution at pH=3 (50 mL); HPLC mobile phase components (Methanol and Phosphate buffer).	
Qualitative Separation of Alcohols by Gas Chromatography	Goggles; gloves; and fume hoods. GC with Thermal Conductivity Detector (TCD). Small Vials for the solvents; 10 uL micro syringe. Single-Standard of Alcohols (Methanol, Ethanol, 2-Propanol and 1-Butanol); Mixture of all the four alcohols to examine the separation conditions; Unknown mixture of the above alcohols.	
Field trip to a chromatography lab	A bus accommodating the total number of students in addition to 3 instructors.	
Experiments review and discussions.	Data show and glassware for demonstration.	
Practical and sheet exams	Depends on the experiments assigned for the exam.	Week 15