Course Syllabus

1	**Course title**	Applied Chromatography
2	**Course number**	1201524
3	**Credit hours**	2 credits
	Contact hours (theory, practical)	2 theory hr per week (1:30-2:30 ST; 2:30-3:30 MW) and no practical course.
	Course Level /Hours according to Jordan National Qualifications Framework (JNQF) Standards	7^{th}/75 hr
4	**Prerequisites/corequisites**	1201315
5	**Program title**	B.sc in Pharmacy/Pharm D
6	**Program code**	----
7	**Awarding institution**	The University of Jordan
8	**School**	Pharmacy
9	**Department**	Pharmaceutical Sciences
10	**Course level**	Undergraduate
11	**Year of study and semester (s)**	First/second semester of the 4th and 5th year (Elective)
12	**Other department (s) involved in teaching the course**	N/A
13	**Main teaching language**	English
14	**Delivery method**	☐ Face to face learning ☑ Blended ☐ Fully online
15	**Online platforms(s)**	☑Moodle ☑Microsoft Teams ☐Skype ☐Zoom
16	**Issuing/Revision Date**	Nov. 1, 2023

17 Course Coordinator:

Name: Prof. Mohammad Hudaib
http://eacademic.ju.edu.jo/m.hudaib/default.aspx

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18 Other instructors:

Name: N/A

19 Course Description:

The course will cover advanced study of the modern methods of chromatography used in separation and purification including TLC, CC, GC, HPLC and other hyphenated techniques. Aspects of different extraction and purification methods and analytical method validation will also be covered. At the end of the course the student is expected to acquire basic and applied knowledge regarding chromatography and separation science. The student will realize the importance of chromatography in different pharmaceutical fields including drug discovery, drug identification and characterization, and will recognize its wide application in quantitative and qualitative pharmacopoeial analysis including its application in the limit test of impurities and in the assay of different drugs. The proper selection of the best chromatographic technique and conditions to resolve certain separation problems will be covered and discussed. The course is designed to be integrated. There is an online video/lecture/presentation after a couple of face-to-face lectures

20 Course aims and outcomes:

A- Aims:

- To understand the definition, basics and types of separation and chromatographic techniques.
- To understand the importance and various applications of chromatography in pharmacy.

- To recognize the variables of chromatographic process and the best conditions to achieve the best results.
- To get familiar with common and specialized chromatographic techniques (e.g., hyphenated systems), pharmacopeial drug analysis (assay related substances), bioanalysis, and method development and validation.

B- Students Learning Outcomes (SLOs):

Upon successful completion of this course, students will be able to:

Discriptors	CLO No.	SLOs of the program: Program Learning Outcomes (PLOs) / SLOs of the course: Course Learning Outcomes (CLOs)	Learner	Problem Solver	Communicator	PLO (5) Professional
Knowledge	K1	Recall basic concepts in analytical and organic pharmaceutical chemistry fields used in the science of extraction and separation.				
	K2	Define concepts, principles, and information regarding extraction, separation, and chromatographic techniques.				
Skills	S1	Select the best extraction and/or separation techniques for analytical and preparative pharmaceutical applications.				
	S2	Analyze qualitatively and quantitatively the chromatographic outputs of analytical pharmaceutical applications.				
	S3	Handle problems by thinking critically, suggesting and discussing potential strategies and solutions to the chromatographic problems.				
Competencies	C1	Demonstrate **integrity**, by not cheating and not committing plagiarism, and **respect** to tutors and classmates by observing active listening inside the classroom and by complying with tutor's instructions and relevant university regulations				

21. Topic Outline and Schedule:

Week	Lecture	Topic	Intended Learning Outcome	Learning Methods (Face to Face/Blended/ Fully Online)	Platform	Synchronous / Asynchronous Lecturing	Evaluation Methods	Resources
1	1.1	**Introduction (Syllabus, Objectives, SLOs, and Assessment)**	K1-K2	Face to Face	Lecturing / on-campus	Synchronized with smartboard/Microsoft teams	Exam, Quiz	Textbook, References, handouts
	1.2	**Extraction vs Separation**	K1-K2	Face to Face	Lecturing / on-campus	Synchronized with smartboard/Microsoft teams	Exam, Quiz	Textbook, References, handouts
	1.3	**Solvent Extraction (Basics and Methods)**	K1-K2	Face to Face	Lecturing / on-campus	Synchronized with smartboard/Microsoft teams	Exam, Quiz	Textbook, References, handouts
2	2.1	**Basics of Chromatography**	K1-K2	Face to Face	Lecturing / on-campus	Synchronized with smartboard/Microsoft teams	Exam, Quiz	Textbook, References, handouts
	2.2	**Mechanisms of separation**	K1-K2	Face to Face	Lecturing / on-campus	Synchronized with smartboard/Microsoft teams	Exam, Quiz	Textbook, References, handouts

Week	Lecture	Topic	Intended Learning Outcome	Learning Methods (Face to Face/Blended/ Fully Online)	Platform	Synchronous / Asynchronous Lecturing	Evaluation Methods	Resources
3	3.1	**Videos on separation concept:** https://www.youtube.com/watch?v=0m8bWKHmRMM https://www.youtube.com/watch?v=23W5Z_redfs	K1-K2	blended	E-learning / MS Teams	…	Exam, Quiz	E-learning / YouTube
	3.2	**Chromatographic techniques**	K1-K2	Face to Face	Lecturing / on-campus	Synchronized with smartboard/Microsoft teams	Exam, Quiz	Textbook, References, handouts
4	4.1	**Thin Layer Chromatography** (Principles and Applications)	K1-K2	Face to Face	Lecturing / on-campus	Synchronized with smartboard/Microsoft teams	Exam, Quiz	Textbook, References, handouts
	4.2	**Selected TLC Videos (YouTube)**	K1-K2	blended	E-learning / MS Teams	…	Exam, Quiz	E-learning / YouTube
5	5.1	**Efficiency of Separation** (Factors affecting resolution and peak broadening, Van Deemter Equation)	K1-K2 S1-S3	Face to Face	Lecturing / on-campus	…	Exam, Quiz	Textbook, References, handouts

Week	Lecture	Topic	Intended Learning Outcome	Learning Methods (Face to Face/Blended/ Fully Online)	Platform	Synchronous / Asynchronous Lecturing	Evaluation Methods	Resources
	5.2	**Selected Videos on Band Broadening (YouTube): e.g.** https://www.youtube.com/watch?v=wG5nDzKuGDU https://www.youtube.com/watch?v=u7EPAPQDLlY https://www.youtube.com/watch?v=p2KvzK81s2g	K1-K2 S1-S3	blended	E-learning / MS Teams			E-learning / YouTube
6	6.1	**Gas Chromatography** (Principles and Applications)	K1-K2 S1-S3	Face to Face	Lecturing / on-campus	Synchronized with smartboard/Microsoft teams	Exam, Quiz	Textbook, References, handouts
	6.2	**Selected Videos on GC (YouTube): e.g.** https://www.youtube.com/watch?v=IgdcyAQDKro	K1-K2 S1-S3	blended	E-learning / MS Teams	Synchronized with smartboard/Microsoft teams	Exam, Quiz	E-learning / YouTube
7	7.1	**Gas Chromatography** (Detectors)	K1-K2 S1-S3	Face to Face	Lecturing / on-campus	Synchronized with smartboard/Microsoft teams	Exam, Quiz	Textbook, References, handouts

Week	Lecture	Topic	Intended Learning Outcome	Learning Methods (Face to Face/Blended/ Fully Online)	Platform	Synchronous / Asynchronous Lecturing	Evaluation Methods	Resources
	7.2	**Selected Videos on GC (YouTube): e.g.**	K1-K2 S1-S3	blended	E-learning / MS Teams	Synchronized with smartboard/Microsoft teams	Exam, Quiz	E-learning / YouTube
8	8.1	**Gas Chromatography** (GC-MS applications in analysis)	K1-K2 S1-S3	Face to Face	Lecturing / on-campus	Synchronized with smartboard/Microsoft teams	Exam, Quiz	Textbook, References, handouts
	8.2	**GC-MS: Use of combined MS-KI Matching Approach in Identification (Volatile Oils as Practical Example)**	K1-K2 S1-S3	Face to Face	Lecturing / on-campus	Synchronized with smartboard/Microsoft teams	Exam, Quiz	Textbook, References, handouts
9	9.1	**HPLC** (Principle and instrumentation)	K1-K2	Face to Face	Lecturing / on-campus	…	Exam, Quiz	Textbook, References, handouts
	9.2	**Selected Videos on HPLC (YouTube): e.g.** https://www.youtube.com/watch?v=Ia8yrBL2Xwc	K1-K2	blended	E-learning / MS Teams	Synchronized with smartboard/Microsoft teams	Exam, Quiz	E-learning / YouTube

Week	Lecture	Topic	Intended Learning Outcome	Learning Methods (Face to Face/Blended/ Fully Online)	Platform	Synchronous / Asynchronous Lecturing	Evaluation Methods	Resources
10	10.1	**HPLC, Separation Techniques, and Applications** (Partition/Adsorption vs Other Techniques)	K1-K2 S1-S3	Face to Face	Lecturing / on-campus	Synchronized with smartboard/Microsoft teams	Exam, Quiz	Textbook, References, handouts
	10.2	**Selected Videos on HPLC (YouTube):**	K1-K2 S1-S3	blended	E-learning / MS Teams	Synchronized with smartboard/Microsoft teams	Exam, Quiz	E-learning / YouTube
11	11.1	**HPLC Detectors and Hyphenated Techniques**	K1-K2	Face to Face	Lecturing / on-campus	Synchronized with smartboard/Microsoft teams	Exam, Quiz	Textbook, References, handouts
	11.2	HPLC vs LC-MS	K1-K2 S1-S3	Face to Face	Lecturing / on-campus	…	Exam, Quiz	Textbook, References, handouts
12	12.1	**Quantitative and Qualitative Applications of various types of chromatography:** 1. TLC (Identification and Impurity Profiling)	K1-K2 S1-S3	Face to Face	Lecturing / on-campus	Synchronized with smartboard/Microsoft teams	Exam, Quiz	Textbook, References, handouts

Week	Lecture	Topic	Intended Learning Outcome	Learning Methods (Face to Face/Blended/ Fully Online)	Platform	Synchronous / Asynchronous Lecturing	Evaluation Methods	Resources
		2. HPLC (Assay) 2. GC (Identification and Assay)						
	12.2	**Selected Pharmacopoeial Monographs**	K1-K2 S1-S3	Face to Face	Lecturing / on-campus		Exam, Quiz	Textbook, References, handouts
13-15	13.1	Student presentations: Topics: e.g. Common detectors of GC/GC-MS/Volatile Oil Analysis in Pharmacopoeia /HPLC and LC-MS	K1-K2 S1-S3 C1	blended	Report Discussion / E-learning		Assignment (Report and Presentation)	Literature
	14.1	= = =	K1-K2 S1-S3 C1	blended	Report Discussion / E-learning		Assignment (Report and Presentation)	Literature
	15.1	= = =	K1-K2 S1-S3 C1	blended	Report Discussion / E-learning		Assignment (Report and Presentation)	Literature

22 Evaluation Methods:

Opportunities to demonstrate achievement of the SLOs are provided through the following assessment methods and requirements:

Evaluation Activity	Mark	Topic(s)	CLOs	Period (Week)	Platform
Quizzes	10 (20)	Topics 1-2 Topics 7-8	K1-K2, S1-S3, C1	5th week 10th week	On campus
Midterm Exam	30	Topics 1-6	K1-K2, S1-S3, C1	8th week	On campus
Assignment	10 (20)	TBC	K1-K2, S1-S3, C1	14th week	On campus
Final Exam	40 (50)	All	K1-K2, S1-S3, C1	16th week	On campus

23 Course Requirements

Students should have:

- Computer
- Internet connection
- Active university account on Moodle (e-learning) website
- Active university account on Microsoft Teams

24 Course Policies:

A- Attendance policies: As per the applicable university regulations

B- Absences from exams and handing in assignments on time: As per the applicable university regulations

C- Health and safety procedures: N/A

D- Honesty policy regarding cheating, plagiarism, misbehavior: As per the applicable university regulations

E- Grading policy:

- Midterm exam (30%)
- Course work- Assignment & Quiz (20-30%)
- Final exam (40-50%)

F- Available university services that support achievement in the course:

- Moodle (e-learning) website
- Microsoft Teams institutional subscription

25 References:

A- Required book (s), assigned reading and audio-visuals:

- Pharmaceutical Analysis; A Textbook for Pharmacy Students and Pharmaceutical Chemists by David Watson. 2nd Edition

B- Recommended books, materials, and media:

Undergraduate instrumental analysis by James W.Robinson.

1) Introduction to spectroscopy: A guide for students of organic chemistry by Donald L.Pp, Gary M.L., and George S.K.
2) Principles of Instrumental analysis. D. Skoog, F.J. Holler and T.A Nieman
3) Analytical Chemistry: An introduction for D.A. Skoog, D.M. West and F.J.Holler
4) Bp, USP
5) ICH Guidelines (Validation of Analytical Procedures), Q2(R1). ICH: 2005.
   URL: (http://www.ich.org/products/guidelines/quality/quality-single/article/validation-of-analytical-procedures-text-and-methodology.html)

26 Additional information:

Name of Course Coordinator: **Prof. Mohammad Hudaib;** Signature: Mohammad Hudaib; Date: **1/11/2023**
Head of Curriculum Committee/Department: ---------- Signature: ----------
Head of Department: ---------- Signature: ----------
Head of Curriculum Committee/Faculty: ---------- Signature: ----------
Dean: ---------- Signature: ----------