Form: Course Syllabus		
	Form Number	EXC-01-02-02A
	Issue Number and Date	2/3/24/2022/2963 05/12/2022
	Number and Date of Revision or Modification	
	Deans Council Approval Decision Number	2/3/24/2023
	The Date of the Deans Council Approval Decision	23/01/2023
	Number of Pages	06

1.	**Course Title**	Spectroscopic Methods of Chemical Analysis
2.	**Course Number**	0333911
3.	**Credit Hours (Theory, Practical)**	(3,0)
	Contact Hours (Theory, Practical)	Theory: three hour-lecture/week
4.	**Prerequisites/ Corequisites**	Non
5.	**Program Title**	Ph.D in chemistry
6.	**Program Code**	3
7.	**School/ Center**	Faculty of Graduate Studies
8.	**Department**	Chemistry
9.	**Course Level**	Ph.D
10.	**Year of Study and Semester (s)**	Programs years 1st or 2nd semesters
11.	**Other Department(s) Involved in Teaching the Course**	Non
12.	**Main Learning Language**	English
13.	**Learning Types**	x☐Face to face learning ☐Blended ☐Fully online
14.	**Online Platforms(s)**	☐Moodle X☐ Microsoft Teams
15.	**Issuing Date**	21-11-2024
16.	**Revision Date**	23-11-2024

17. Course Coordinator:

Name: **Prof. Dr. Sharif Arar** Contact hours: 11:00 am -12:00 noon

Office number: 203 old chemistry building Phone number: 065355000 Ext. 22150

Email: **s.arar@ju.edu.jo**

18. Other Instructors:

Name:
Office number:
Phone number:
Email:
Contact hours:
Name:
Office number:
Phone number:
Email:
Contact hours:

19. Course Description:

Underscore some spectroscopic methods including state of the art mass-spectrometry techniques and instrumentation, and 1D and 2D NMR covering theory of NMR experiment, instrumentation, pulsed FT-NMR techniques. Practical aspects of data acquisition and processing. Applications to organic and biomolecules structural characterization and analysis.

20. Program Student Outcomes (SO's): (To be used in designing the matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program)

SO1. Develop chemistry expertise, focus on theory and practice, and contribute to advancing knowledge in a specific research field.

SO2. Conduct original, high-quality research that advances knowledge in chemistry by developing complex projects using innovative methodologies.

SO3. Mentor junior researchers and students and demonstrate leadership in the scientific community through collaboration, peer review, and knowledge exchange.

SO4. Recognize the ethical implications and responsibly use chemistry solutions to tackle global challenges.

SO5. Participate in ongoing professional development to stay up to date with the latest research and innovations.

21. Course Intended Learning Outcomes (CLO's): (Upon completion of the course, the student will be able to achieve the following intended learning outcomes)

1. Gain advanced knowledge in recent techniques in mass spectrometry and tandem mass-spectrometry.

2. Parallel obtained depth knowledge in analyzing and interpreting molecular structure data by applying principles of fragmentation and mass-spectrometry guidelines.

2. Gain and develop in depth knowledge in one dimensional NMR theory, experiment, instrumentation, and related 1D pulsed FT-NMR techniques in addition to practical aspects of data acquisition and processing.

3. Develop enhanced knowledge in 1D-NMR spectrum interpretation applications with focusing on the chemical shifts and coupling constants in ^{1}H and ^{13}C for structural elucidation

4. Gain and develop in depth knowledge in two dimensional NMR theory, experiment, instrumentation, and related 2D pulsed FT-NMR techniques for homo and heteronuclear correlations, in addition to practical aspects of data acquisition and processing.

5. Develop enhanced knowledge in 2D-NMR spectrum interpretation applications with focusing on the chemical shifts and coupling constants in ^{1}H and ^{13}C for structural elucidation and conformation

6. Communicate spectroscopic data through structured reports and presentations and develop enhanced knowledge in application of mass-spectrometry, 1D-FT-NMR, 2D-NMR, in combination with other spectroscopic techniques for structural elucidation, conformation of organic molecules and biomolecules for research frontiers and development

Course CLOs	The learning levels to be achieved					
	Remembering	Understanding	Applying	Analysing	evaluating	Creating
1	✓	✓		✓		
2	✓	✓		✓		
3	✓	✓		✓		
4	✓	✓	✓	✓	✓	
5	✓	✓		✓	✓	✓

6	✓	✓		✓	✓	✓

22. The matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program:

Program SO's / Course CLO's	SO (1)	SO (2)	SO (3)	SO (4)	SO (5)
CLO (1)	✓	✓			
CLO (2)	✓	✓			
CLO (3)	✓	✓			
CLO (4)	✓	✓		✓	✓
CLO (5)	✓	✓	✓	✓	✓
CLO (6)	✓	✓	✓	✓	✓

23. Topic Outline and Schedule:

Week	Lecture	Topic	CLO/s Linked to the Topic	Learning Types Face to Face (FF) Blended (BL) Fully Online (FO)	Platform Used	Synchronous (S) Asynchronous (A)	Evaluation Methods	Learning Resources
1	2 lectures	Fundamentals and concepts and methodology of	1	Face to face	Non	Non	Quizzes/group	References-section

		advanced mass spectrometry					discussion+ mid-exam	-27-part-B
2	2 lectures	Tandem mass spectrometry, recent instrumentation, designing mass-spectrometry experiments and MS data interpretation	1	Face to face	Non	Non	Quizzes/group discussion+ mid-exam	References-section-27-part-B
3	2 lectures	Theory of the one dimensional Fourier transform-nuclear magnetic resonance spectroscopy (FT-NMR) experiment,	2	Face to face	Non	Non	Quizzes/group discussion+ mid-exam	References-section-27-part-B
4	2 lectures	Pulsed 1D-FT-NMR techniques	2	Face to face	Non	Non	Quizzes/group discussion+ mid-exam	References-section-27-part-B
5	2 lectures	practical aspects of data acquisition and processing.	2	Face to face	Non	Non	Quizzes/group discussion+ mid-exam	References-section-27-part-B
6	2 lectures	Overview ^{1}H and ^{13}C chemical shifts and associated coupling constants and related molecular structure elucidation	2	Face to face	Non	Non	Quizzes/group discussion+ mid-exam	References-section-27-part-B

7	1 lecture	1D-NMR spectrum interpretation applications with focusing on the chemical shifts and coupling constants in 1H and 13C for structural elucidation	2,3	Face to face	Non	Non	Quizzes/group discussion+ mid-exam	References-section-27-part-B
7	1 lecture	two dimensional NMR theory, and experiment	4	Face to face	Non	Non	Quizzes/group discussion+ mid-exam	References-section-27-part-B
8	2 lectures	Instrumentation, and related 2D pulsed FT-NMR techniques for homo and heteronuclear correlations	4	Face to face	Non	Non	Quizzes/group discussion+ mid-exam	References-section-27-part-B
9	2 lectures	Practical aspects of data acquisition and processing.	4	Face to face	Non	Non	Quizzes/group discussion+ +Mid+final exam	References-section-27-part-B
10	2 lectures	2D-NMR spectrum interpretation applications with focusing on the chemical shifts and coupling constants in 1H and 13C	4,5	Face to face	Non	Non	Quizzes/group discussion+ Final-exam	References-section-27-part-B
11	1 lecture	Application of 2D-FT-NMR for structural elucidation and conformation	4,5	Face to face	Non	Non	Quizzes/group	References-section

							discussion+ Final-exam	-27-part-B
11	1 lecture	Application of 1D-FT-NMR, 2D-FT-NMR , mass-spectrometry, FT-IR for structural elucidation and conformation	1,2,3,4,5,6	Face to face	Non	Non	Quizzes/group discussion+ Final-exam	References-section-27-part-B
12	1 lecture	Application of 1D-FT-NMR, 2D-FT-NMR , mass-spectrometry, FT-IR for structural elucidation and conformation	1,2,3,4,5,6	Face to face	Non	Non	Quizzes/group discussion+ Final-exam	References-section-27-part-B
12	1 lecture	Application of 1D-FT-NMR, 2D-FT-NMR , mass-spectrometry, FT-IR for structural elucidation and conformation	1,2,3,4,5,6					References-section-27-part-B
13	2 lectures	Seminar topics	1,2,3,4,5,6	Face to face	Non	Non	Quizzes/group discussion+ Final-exam	Topic seminar references
14	2 lectures	Seminar topics	1,2,3,4,5,6	Face to face	Non	Non	Quizzes/group discussion+ Final-exam	Topic seminar references

24. Evaluation Methods:

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

Evaluation Activity	Mark	Topic(s)	CLO/s Linked to the Evaluation activity	Period (Week)	Platform
Oral presentations /term paper	20	All related topics in the course	1,2,3,4, 5,6	13-14	Face to face
Quizzes, HomeWorks and assignments	10	Topics in weeks 1-10	1,2,3,4, and 5	3, 6, 11	Face to face
Mid-exam	30	Weeks 1-8	1,2,3,4	11	In the department
Final-exam	40	Weeks 1-12	1,2,3,4, 5	16	In the department

25. Course Requirements:

Students should have a computer, internet connection, Microsoft teams For Instructor, Some laboratory equipment for demonstrations, and data show for lecturing

26. Course Policies:

A- Attendance policies:

Attending the course is mandatory. Failure to sit an exam will result in a mark of zero, unless a valid reason (with supporting documentation) for the absence is presented.

B- Absences from exams and handing in assignments on time:

Proof of illness requires a signed medical certificate. Notify me as soon as possible if you are going to miss an exam. If any course component is missed for a valid reason, that portion of the exam grade will/may be shifted to the final examination.

C- Health and safety procedures:

Special Needs Students: Feel free to inform your instructor of your special needs in order for you to have a productive learning experience.

D- Honesty policy regarding cheating, plagiarism, misbehavior:

When writing a report or paper on a given topic, you must read up the necessary information on the topic, and then present it in your own words and writing. If you want to use an exact sequence of text or an idea or data from someone else's work, that is considered a quote, then that work must be cited (you must give a proper credit to the author) specifically as a reference. Therefore, if you are caught cheating on any component of Chem.741 you will be assigned a grade of zero for the course. We shall also place a letter describing the offense in your student file.

If you see someone cheating during an exam or writing a paper or report, inform us/the proctors in the following ways: 1) Write a short message on your exam paper or report indicating what is happening. 2) Raise your hand and the proctor or myself will come over – then let us know and point out your note; we will take it from there.

It is important to point out that there is a difference between plagiarism and working out answers to a lab report or an assignment with a friend. If your writing is based on your own words and your understanding of the material, then that is acceptable. If, however, you simply write your friend's thought or answer, i.e. the same thing (cut and paste), then you have committed plagiarism. Simply, plagiarism is cheating; if you are unclear about any part of this issue or have any question, please speak up and let me know.

E- Grading Scheme and policy:

- Assignments are due at the beginning of the class, unless otherwise specified.
- Assignments, and suggested problems are intended as partial preparation for exams. Failure to put forth effort is perilous.
- Assignments are due on the dates noted. Assignments will be done individually; each student must hand in their own answers. It is acceptable, however, for students to help each other in collaborating to solve problems and figuring out answers. We will be assuming that, you will be taking the responsibility to make sure you personally understand the solution to any problem

arising from such collaboration. You also must indicate on each assignment with whom you collaborated.

• The final exam for this course is cumulative covering all material presented in the class, the exam will test your comprehension and your ability to problem solve.

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

- E-Learning resources and Microsoft teams
- Computer Lab

27. References:

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

- Handouts
- Lecture Notes soft copies
- Videos (Recorded Lectures) if needed

B- Recommended books, materials, and media:

1- Skoog, D.; Holler, and West, Principles of Instrumental Analysis, 7th edition, 2016
2- Mass Spectrometry: An Applied Approach, editor(s):Marek Smoluch, Giuseppe Grasso, Piotr Suder, Jerzy Silberring, 2019
3- NMR Spectroscopy: Basic Principles, Concepts and Applications in Chemistry, 3rd Edition, Harald Günther, 2013
4- Experimental Approaches of NMR Spectroscopy I, Methodology, 2024
5- Nuclear Magnetic Resonance Spectroscopy: An Introduction to Principles, Applications, and Experimental Methods, 2nd Edition, Joseph B. Lambert, Eugene P. Mazzola, Clark D. Ridge, 2018
6- Organic Structure Determination Using 2-D NMR Spectroscopy, A Problem-Based Approach, Second Edition • 2012
7- Two-Dimensional (2D) NMR Methods 1st Edition, by K. L. Ivanov (Editor), P. K. Madhu (Editor), G. Rajalakshmi (Editor), 2023
8- Structure Determination of Organic Compounds, 2020
9- Any convenient recent textbook or article

28. Additional information:

NA

Name of the Instructor or the Course Coordinator: **Prof. Dr. Sharif Arar** Signature: …… Date: 22-11-2024 ……..……

The Head of Graduate Studies Committee/ Department Chemistry **Dr. Murad AlDamen, Prof.**	**Signature:** **……...……**	**Date:** **……..……**
The Head of Department of Chemistry **Dr. Murad AlDamen, Prof.**	**Signature:** **……...……**	**Date:** **……..……**
Vice Dean for Graduate Studies and Scientific Research / School of Science **Dr. Kamal Sweidan, Prof.**	**Signature:** **……...……**	**Date:** **……..……**
The Dean of School of Science **Dr. Mahmoud I. Jaghoub, Prof.**	**Signature:** **……...……**	**Date:** **……..……**