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

|     |  |  |
|-----|--|--|
| 1.  | <b>Course Title</b>  | Advanced Environmental Chemistry   |
| 2.  | <b>Course Number</b>                                       | 0353715  |
| 3.  | <b>Credit Hours (Theory, Practical)</b>                    | (3,0)  |
|     | <b>Contact Hours (Theory, Practical)</b>                   | Theory: three hour-lecture/week  |
| 4.  | <b>Prerequisites/ Corequisites</b>                         | Non  |
| 5.  | <b>Program Title</b>                                       | MS in Chemistry  |
| 6.  | <b>Program Code</b>  | 3  |
| 7.  | <b>School/ Center</b>                                      | Faculty of Graduate Studies  |
| 8.  | <b>Department</b>  | Chemistry  |
| 9.  | <b>Course Level</b>  | MSc degree   |
| 10. | <b>Year of Study and Semester (s)</b>                      | First year- 1 <sup>st</sup> and 2 <sup>nd</sup> Semesters  |
| 11. | <b>Other Department(s) Involved in Teaching the Course</b> | Non  |
| 12. | <b>Main Learning Language</b>                              | English  |
| 13. | <b>Learning Types</b>                                      | <input type="checkbox"/> Face to face learning <input checked="" type="checkbox"/> Blended <input type="checkbox"/> Fully online |
| 14. | <b>Online Platforms(s)</b>                                 | <input type="checkbox"/> Moodle <input checked="" type="checkbox"/> Microsoft Teams  |
| 15. | <b>Issuing Date</b>  | Nov 22, 2024   |
| 16. | <b>Revision Date</b>                                       | Nov 22, 2024   |

**17. Course Coordinator:**

|   |                                     |
|---|-------------------------------------|
| Name: <b>Prof. Dr. Sharif Arar</b>                            | Contact hours: 11:00 am -12:00 noon |
| Office number: 203 old chemistry building                     | Phone number: 065355000 Ext. 22150  |
| Email: <a href="mailto:s.arar@ju.edu.jo">s.arar@ju.edu.jo</a> |                                     |

**18. Other Instructors: (other semesters)****Name**

Office number:

Phone number:

Email:

Contact hours:

**19. Course Description:**

The major theme and importance of the course is to cover major significant topics of environmental chemistry including aquatic, atmospheric and soil chemistry. Classification of organic and inorganic pollutants with their basic properties, chemical structures, sources, uses, fate degradation products and metabolites in the environment (air, soil, water, plants, animals, and food), reactivity of compounds in natural and polluted environments. Toxicological chemistry focusing on their toxicity, mutagenicity, carcinogenicity and their allowable limits. Finally trace analysis of these chemical pollutants indicating analytical methods (sampling, sample preparation, and advanced instrumental techniques) employed in this field

**20. Program Intended Learning Outcomes:** (To be used in designing the matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program)

- SO1.** Demonstrate comprehensive knowledge and understanding of chemistry topics, achieving expertise in foundational research principles.
- SO2.** Develop independent research skills to solve complex problems, focusing on analytical and critical thinking.
- SO3.** Improve communication of scientific knowledge through structured reports, presentations, and discussions.
- SO4.** Engage in activities that enhance practical scientific skills and improve professional expertise.
- SO5.** Maintain ethical standards in research.

**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. Demonstrate outstanding knowledge in environmental chemistry
2. Develop in depth outstanding knowledge in classes of organic and inorganic pollutants with sharp distinction for persistent organic pollutants (POPs) and explain historical developments for these chemicals in the environment.
3. Acknowledge the toxicity of environmental pollutants and appreciate their safety limits.
4. Ability to perform risk health assessments for these toxic pollutants.
5. Develop skills, and advanced knowledge of how to analyze these pollutants at the trace and ultra trace levels.



6. Demonstrate outstanding knowledge in solving research problems, data interpretation, reporting and presentation with ethical commitment.

| 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 SOs<br>Course CLOs | SO (1) | SO (2) | SO (3) | SO (4) | SO (5) |
|----------------------------|--------|--------|--------|--------|--------|
| 1                          | ✓      | ✓      |        | ✓      |        |
| 2                          | ✓      | ✓      |        | ✓      |        |
| 3                          | ✓      | ✓      |        | ✓      |        |
| 4                          | ✓      | ✓      |        | ✓      |        |
| 5                          | ✓      | ✓      |        | ✓      |        |
| 6                          | ✓      | ✓      | ✓      | ✓      | ✓      |

**23. Topic Outline and Schedule:**

| Week | Lecture | Topic   | ILO/s Linked to the Topic | Learning Types<br>(Face to Face/ Blended/ Fully Online) | Platform Used   | Synchronous / Asynchronous Lecturing | Evaluation Methods                    | Learning Resources        |
|------|---------|---|---------------------------|---|-----------------|--------------------------------------|---------------------------------------|---------------------------|
| 1    | 1 + 2   | Introduction to environmental chemistry.<br>Aquatic, soil, and air pollution  | 1                         | Blended   | Microsoft teams | Synchronous                          | Quizzes/group discussion+<br>Mid-exam | Lecture notes, references |
| 2    | 1 + 2   | Introducing environmental pollutants and their classifications.<br>Plant protecting chemicals   | 1                         | Blended   | Microsoft teams | Synchronous                          | Quizzes/group discussion+<br>Mid-exam | Lecture notes, references |
| 3    | 1 + 2   | Plant protecting chemicals classes, basic properties, chemical structures, sources, uses, fate degradation products and metabolites in the environment (air, soil, water, plants, animals, and food), reactivity of compounds in natural and polluted environments, toxicity, methods of analysis | 2                         | Blended   | Microsoft teams | Synchronous                          | Quizzes/group discussion+<br>Mid-exam | Lecture notes, references |
| 4    | 1 + 2   | Reactivity of plant protecting compounds in natural and polluted environments, toxicity, methods of analysis  | 2, 3                      | Blended   | Microsoft teams | Synchronous                          | Quizzes/group discussion+<br>Mid-exam | Lecture notes, references |
| 5    | 1 +     | Polychlorinated biphenyls (PCBs):<br>Definition, chemistry  | 2, 3                      | Blended   | Microsoft teams | Synchronous                          | Quizzes/group discussion+             | Lecture notes, references |



|   |             |  |         |         |                    |             |  |                                 |
|---|-------------|--|---------|---------|--------------------|-------------|--|---------------------------------|
|   | 2<br>2      | and occurrence,<br>production, uses,<br>Ballschmitter<br>classification<br>(congeners), release to<br>environment (air,<br>water, soil), fat and<br>metabolism, toxicity<br>and carcinogenicity,<br>exposure health<br>Effects, methods<br>of analysis   |         |         |                    |             | Mid-exam                                 |                                 |
| 6 | 1<br>+<br>2 | Polychlorinated<br>dibenzo-p-dioxins/<br>Polychlorinated<br>dibenzofurans:<br>definition,<br>occurrence,<br>chemistry, fat and<br>metabolism, toxicity<br>and carcinogenicity,<br>and<br>exposure health<br>effects, methods of<br>analysis  | 2,<br>3 | Blended | Microsoft<br>teams | Synchronous | Quizzes/group<br>discussion+<br>Mid-exam | Lecture<br>notes,<br>references |
| 7 | 1<br>+<br>2 | Polycyclic Aromatic<br>Hydrocarbons (PAHs):<br>introduction and<br>definition, sources and<br>occurrence,<br>chemistry, categories,<br>production, toxicity<br>and carcinogenicity,<br>exposure health<br>Effects, release to<br>environment (air,<br>water, soil), fat and<br>metabolism, their<br>biochemistry, methods<br>of analysis | 2,<br>3 | Blended | Microsoft<br>teams | Synchronous | Quizzes/group<br>discussion+<br>Mid-exam | Lecture<br>notes,<br>references |
| 8 | 1<br>+<br>2 | Nitrates and nitrites:<br>Occurrence,<br>production,<br>concentrations in<br>different matrices,   | 2,<br>3 | Blended | Microsoft<br>teams | Synchronous | Quizzes/group<br>discussion+<br>Mid exam | Lecture<br>notes,<br>references |



|    |       |   |                  |                       |                 |             |                                      |                           |
|----|-------|---|------------------|-----------------------|-----------------|-------------|--------------------------------------|---------------------------|
|    |       | toxicity and carcinogenicity, methods of analysis   |                  |                       |                 |             |                                      |                           |
| 9  | 1 + 2 | Nitrosamines: occurrence and chemistry, concentrations in different matrices, toxicity and carcinogenicity, and exposure health effects, methods of analysis          | 2, 3             | Blended               | Microsoft teams | Synchronous | Quizzes/group discussion+ Final exam | Lecture notes, references |
| 10 | 1 + 2 | Mycotoxins: definition and introduction, toxicity and carcinogenicity, exposure health Effects, occurrence, concentrations in different matrices, methods of analysis | 2, 3             | Blended               | Microsoft teams | Synchronous | Quizzes/group discussion+ Final exam | Lecture notes, references |
| 11 | 1 + 2 | Environmental Toxicology  | 4                | Blended               | Microsoft teams | Synchronous | Quizzes/group discussion+ Final exam | Lecture notes, references |
| 12 | 1 + 2 | Risk assessment of toxic and carcinogenic pollutants  | 4                | Blended               | Microsoft teams | Synchronous | Quizzes/group discussion+ Final exam | Lecture notes, references |
| 13 | 1 + 2 | Lab demonstration for sample preparation of environmental samples and trace analysis  | 5                | Blended               | Microsoft teams | Synchronous | Discussion And instructor evaluation | Lecture notes, references |
| 14 | 1 + 2 | Seminar topic   | 1, 2, 3, 4, 5, 6 | Blended/ face to face | Microsoft teams | Synchronous | Discussion And instructor evaluation | Topic seminar references  |

## 24. Evaluation Methods:

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



| Evaluation Activity                | Mark | Topic(s)                         | ILO/s Linked to the Evaluation activity | Period (Week) | Platform |
|------------------------------------|------|----------------------------------|---|---------------|----------|
| Oral presentations /term paper     | 15   | All related topics in the course | 1,2,3,4, and 5                          | 13-14         | FF       |
| Quizzes, HomeWorks and assignments | 15   | Weeks 1-10                       | 1,2,3,4,                                | 3, 6, 11      | FF       |
| Mid exam                           | 30   | Weeks 1-7                        | 1,2, 3                                  | 11-12         | FF       |
| Final Exam                         | 40   | All topics weeks 1-13            | 1,2,3,4, and 5                          | 15-16         | FF       |
|                                    |      |                                  |   |               |          |

## 25. Course Requirements:

Students should have a computer, internet connection, and Microsoft teams.  
 The instructor is provided with a laptop and data show for lecturing and presentations  
 Lab equipment for environmental samples preparation, trace and ultras trace analysis like HPLC and GCMS and other advanced spectroscopic techniques.

## 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 I 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 (hard or soft copies)
- Videos (Recorded Lectures) if needed

#### **B- Recommended books, materials, and media:**

1. Skoog, D.; Holler, and West, Principles of Instrumental Analysis, 7<sup>th</sup> edition, 2016
2. Manahan, Stanley E ( 2000) "FRONTMATTER" Environmental Chemistry . CRC Press LLC. Boca Raton, Florida





3. Viktor Shatalov, Knut Breivik, Torunn Berg, Sergey Dutchak and Jozef Pacyna (Ch.8) Persistent Organic Pollutants. EMEP Assessment Report – Part I. [http://emep.int/publ/reports/2004/assessment/Part1\\_139-160\\_08-Pops.pdf](http://emep.int/publ/reports/2004/assessment/Part1_139-160_08-Pops.pdf)
4. WHO (2008) PERSISTENT ORGANIC POLLUTANTS (POPs). Children's Health and the Environment. <http://www.who.int/ceh/capacity/POPs.pdf>
5. Roger Reeve (2002) Introduction to Environmental Analysis. John Wiley & Sons Ltd, England
6. Modern Environmental Analysis Techniques for Pollutants, 1<sup>st</sup> Edition Chaudhery Mustansar Hussain PhD (Author), Rustem Kecili (Author), 2019.
7. abriel Jiménez-Skrzypek, Cristopher Domínguez-Hernández, Javier González-Sálamo, Javier Hernández-Borges, Chapter 18 - Environmental analysis: Persistent organic pollutants, Editor(s): Salvatore Fanali, Bezhan Chankvetadze, Paul R. Haddad, Colin F. Poole, Marja-Liisa Riekkola, In Handbooks in Separation Science, Liquid Chromatography (Third Edition), Elsevier, Volume 2, 2023, Pages 607-645.
8. Any convenient related recent publication to the course topics

## 28. Additional information:

NA

Name of the Instructor or the Course Coordinator:  
.....**Prof. Dr. Sharif Arar**.....

Signature: Arar 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: .....