**Course Syllabus**

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| **1** | **Course title** | Environmental Soil and Water Chemistry |
| **2** | **Course number** | 0644221 |
| **3** | **Credit hours** | 3 |  |
| **Contact hours (theory, practical)** | 2 lectures / 3hrs. lab session: A week |
| **4** | **Prerequisites/corequisites** | Principles of soil / General Chemistry 1 |
| **5** | **Program title** | [Bachelor in Land, Water and Environment](https://agriculture.ju.edu.jo/Lists/OurPrograms/school_Disp_Program.aspx?ID=13&Dept=Land%20Water%20and%20Environment) |
| **6** | **Program code** | 4 |
| **7** | **Awarding institution**  | University of Jordan |
| **8** | **School** | Agriculture |
| **9** | **Department** | Department of Land, Water and Environment |
| **10** | **Course level**  | Undergraduate |
| **11** | **Year of study and semester (s)** | 2022/2023 |
| **12** | **Other department (s) involved in teaching the course** | - |
| **13** | **Main teaching language** | English |
| **14** | **Delivery method** | √ Face to face learning ☐Blended ☐Fully online |
| **15** | **Online platforms(s)** | ☐Moodle √ Microsoft Teams ☐Skype ☐Zoom ☐Others………… |
| **16** | **Issuing/Revision Date** | 2022 |

**17 Course Coordinator:**

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| Name: Professor T.M. Abu-Sharar Contact hours: Office hoursOffice number: 22454 Phone number: 0795740855Email: t.m.abu-sharar@ju.edu.jo |

**18 Other instructors:**

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| None |

**19 Course Description:**

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| As stated in the approved study plan.Environmental Soil and Water Chemistry is a core course for the students of soil, water and environmental sciences and environmental engineering. The course deals with major physical and chemical features of liquid water and the chemical processes taking place in soil solutions or natural water bodies (e.g. ion-pair and complex ion formation, single ion activity, ion activity product and dissolution-precipitation principles and reactions), nature of inorganic and organic solids with which water is in equilibrium, models of chemical equilibria between solid and liquid phases (ion exchange and adsorption-desorption models). |

**20 Course aims and outcomes:**

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| 1. Aims:
2. Understanding the Chemical reactions of the aqueous/aquatic phase like natural water systems and chemical speciation of soluble ions.
3. Understanding the Nature of clay minerals and amorphous materials concerning surface reactions, anion and cation exchange…
4. Understanding the Solid-liquid phase equilibria e.g. dissolution/precipitation reactions
5. Understanding the Ion exchange and adsorption of chemical species onto the solid surfaces

B- Students Learning Outcomes (SLOs): Upon successful completion of this course, students will be able to:

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SLOsSLOs of the course | SLO (1) | SLO (2) | SLO (3) | SLO (4) | SLO (5) | SLO (6) | SLO (7) | SLO (8) | SLO (9) |
| 1. Be able to understand Chemical reactions of the aqueous/aquatic phase
 | √ |  |  |  | √ |  |  |  |  |
| 1. Understand the chemical speciation of soluble ions
 |  | √ |  |  |  |  | √ |  |  |
| 1. Be able to understand metal ligands , complex ions and ion pairs.
 | √ |  |  | √ |  |  |  |  |  |
| 1. Be able to know the nature of organic and inorganic solids
 |  | √ | √ |  |  |  |  | √ |  |
| 1. Be able to understand distribution of the cations on exchange sites and cation exchange equilibria:
 |  |  | √ |  |  | √ |  |  |  |
| 6. Understand and analysis ion exchange and adsorption-desorption models | √ |  |  | √ |  |  |  |  |  |

**Program Learning Outcomes:**1. Demonstrate comprehensive understanding of the scientific and theoretical knowledge of land, water and environment.
2. Contribute to agricultural development, as well as food and water security.
3. Demonstrate problem solving skills and well developed linguistic and communication skills while upholding professional ethics
4. Access land characteristics and their suitability for different agricultural uses.
5. Tackle basic problems of water, land and agricultural environment.
6. Analyse and interpret soil and water quality parameters.
7. Use sound scientific principles for the determination of crop water requirement, and design of irrigation systems for the proper management of agricultural water.
8. Determine the optimal use of water and land to ensure the sustainability of resources and the environment.
9. Develop​ innovative solution for tackling the adverse effects of water scarcity caused by climate change and desertification​
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**21. Topic Outline and Schedule:**

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| **Week** | **Lecture** | **Topic** | **Student Learning Outcome** | **Learning Methods (Face to Face/Blended/ Fully Online)** | **Platform** | **Synchronous / Asynchronous Lecturing** | **Evaluation Methods** | **Resources** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 1.1 |  Review of concepts of analytical chemistry. and Chemical units and SI units | 1 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition. |
| 1.2 |  Ion water interaction. And Solute -solute interactions | 1 |  Face to face | Teams |  |   Problem sets & Exams |   Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition. |
| 1.3 |  Thermodynamic background of mean and single ion activity coefficients (γ±, γion). | 2 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition. |
| 2 | 2.1 |   Chemical, electrochemical and physical properties of liquid water | 2 |   Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition. |
| 2.2 |  Ligands and metal‑ligand complexes. | 3 | Face to face | Teams |  |  Problem sets & Exams |   Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 2.3 |  Complex ions and ion pairs.Hydrolysis and deprotonation | 3 |  Face to face | Teams |  |  Problem sets & Exams |   Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| **Week** | **Lecture** | **Topic** | **Student Learning Outcome** | **Learning Methods (Face to Face/Blended/ Fully Online)** | **Platform** | **Synchronous / Asynchronous Lecturing** | **Evaluation Methods** | **Resources** |
| 3 | 3.1 | Henry's law. | 2 |  Face to face | Teams |  |  Problem sets & Exams |   Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 3.2 |  Solubility products and phase diagrams of metals of interest to soil chemistry | 2 |  Face to face | Teams |  |  Problem sets & Exams |    Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 3.3 |  Phosphorus phase diagram, Iron phase diagram | 2 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 4 | 4.1 |  Topics of the third week to be continued | 2 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 4.2 |  Primary minerals in soil: :i) Formation of mineralsii) Crystalline structure. | 4 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 4.3 |  iii) Chemical and physical Properties. | 4 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 5 | 5.1 |  Types of Crystals and crystal chemistry of orthosilicate minerals. | 4 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 5.2 |  Pauling's Rules. | 4 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 5.3 |   Layer silicatesi) Structure ii) Physico‑chemical properties. iii) Classification. | 4 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 6 | 6.1 | Topics from the Fifth week to be continued | 4 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 6.2 |  X-ray diffraction and identification of orthosilicate minerals | 4 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 6.3 |  Last topic to be continued. | 4 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 7 | 7.1 |  Soil organic matter: i) Origin and nature. ii) Functional groups.  iii) Fractionation | 4 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 7.2 |  iv) Physico‑chemical properties | 4 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 7.3 |  v) Contribution to pH‑dependent charge on soil complex. | 5 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 8 | 8.1 |  Theory of ion distribution in the solid liquid interphase: Helmholtz, Gouy and Chapman, and Diffuse double layer models | 5 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 8.2 |   Last topic to be continued. | 5 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 8.3 |   Last topic to be continued. | 5 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 9 | 9.1 |  Thermodynamics of cation exchange equilibria: Ganssen, Kerr, Vanselow, and Gapon models | 5 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 9.2 |  Last topic to be continued. | 5 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 9.3 |  Last topic to be continued. | 5 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 10 | 10.1 |   USSL Staff's model of cation exchange equilibria | 5 |  Face to face  | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 10.2 |  Applications of the exchange models to arid zone soils. | 5 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 10.3 |  Last topic to be continued. | 5 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| **Week** | **Lecture** | **Topic** | **Student Learning Outcome** | **Learning Methods (Face to Face/Blended/ Fully Online)** | **Platform** | **Synchronous / Asynchronous Lecturing** | **Evaluation Methods** | **Resources** |
| 11 | 11.1 |  Last topic from the Tenth week to be continued. | 5 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 11.2 |  Cases of deviation from the theoretical exchange equilibria | 5 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 11.3 |  Last topic to be continued | 5 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 12 | 12.1 |  1) Mineral weathering: Physical and chemical weathering. | 6 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 12.2 |  2) Measurements of the extent of chemical weathering in soils. | 6 |  Face to face | Teams |  | Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 12.3 |   Last topic to be continued | 6 |  Face to face | Teams |  | Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 13 | 13.1 |   1) Specific and non‑specific anion adsorption.  | 6 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 13.2 |   2) Differentiation between Precipitation and adsorption. | 6 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 13.3 |  Langmuir adsorption models. | 6 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 14 | 14.1 |  Nature and formation of acid, saline, sodic, and alkaline soils. | 6 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 14.2 |  Major physico‑chemical properties 6of arid zone soils. | 6 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 14.3 |    Last topic to be continued | 6 |  Face to face | Teams |  |   Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 15 | 15.1 | Last topic to be continued.  | 6 |  Face to face | Teams |  |  Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |
| 15.2 | Revision of the entire course | 6 |  Face to face | Teams |  |   Problem sets & Exams |  Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition |

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**22 Evaluation Methods:**

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Evaluation Activity** | **Mark** | **Topic(s)** | **SLOs** | **Period (Week)** | **Platform** |
| First exam | 15 | - | - | 6th week | Face to Face |
| Second exam | 15 | - | - | 12th week | Face to Face |
| Final Lab | 15 | - | - | 15th week | Face to Face |
| Final exam | 40 | - | - | In Final Exam Schedules | Face to Face |
| Lab Reports | 5 | - | - | weekly | Face to Face |
| Home work assignments | 10 | - | - | Every few weeks  | Face to Face |

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**23 Course Requirements**

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| **(e.g: students should have a computer, internet connection, webcam, account on a specific software/platform…etc):** Account on Microsoft teams |

**24 Course Policies:**

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| 1. Attendance policies:

UJ regulations are applied when a student exceeds 15% of an excused absence.1. Absences from exams and submitting assignments on time:

Make up Exams: It is applicable when an acceptable and valid excuse is presented at the applicable time. 1. Health and safety procedures:

According to the rules and regulations of the University of Jordan.1. Honesty policy regarding cheating, plagiarism, misbehavior:

According to the roles and regulations of the University of Jordan.E- Grading policy:1. Available university services that support achievement in the course:

E-learning Microsoft Team |

**25 References:**

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| 1. Required book(s), assigned reading and audio-visuals:

Sparks, D.L. 2001. Environmental Soil Chemistry. 2nd Edition. Academic Press. NY.1. Recommended books, materials, and media:

1.Essington, M. E. 2004. Soil and water Chemistry: An IntegrativeApproach. CRC Press. USA2. Evangelou, V.P.1998.Environmental Soil and Water Chemistry: Principles and Applications. Wiley. A soft copy of this text is available for the students. ISBN: 978-0-471-16515-63.Sposito, G.1989. The Chemistry of Soils. Oxford University Press. New York.4. Selected topics from selected websites. |

**26 Additional information:**

|  |
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| None |

Name of Course Coordinator: -- T.M. Abu-Sharar -----------------Signature: ----------------- Date: -------------------

Head of Curriculum Committee/Department: ---------------------------- Signature: ------------------------------------

Head of Department: ------------------------------------------------------------ Signature: ------------------------------

Head of Curriculum Committee/Faculty: ---------------------------------------- Signature: ---------------------------

Dean: ---------------------------------------------------------- Signature: -------------------------------------------