| 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 | 2023/10/15 |
| | Deans Council Approval Decision Number | 265/2024/24/3/2 |
| | The Date of the Deans Council Approval Decision | 2024/1/23 |
| | Number of Pages | 07 |

| | | |
|---|---|---|
| 1. | Course Title | Environmental Isotopes |
| 2. | Course Number | 0305951 |
| 3. | Credit Hours (Theory, Practical) | 3, theory |
| | Contact Hours (Theory, Practical) | 3, theory |
| 4. | Prerequisites/Corequisites | - |
| 5. | Program Title | PH.D in Geology |
| 6. | Program Code | - |
| 7. | School/ Center | School of Science |
| 8. | Department | Geology |
| 9. | Course Level | PH D program |
| 10. | Year of Study and Semester (s) | - |
| 11. | Other Department(s) Involved in Teaching the Course | - |
| 12. | Main Learning Language | English |
| 13. | Learning Types | ✔ Face to face learning ☐Blended ☐Fully online |
| 14. | Online Platforms(s) | ✔ Moodle ✔ Microsoft Teams |
| 15. | Issuing Date | 25/04/2025 |
| 16. | Revision Date | |

**17. Course Coordinator:**

Name:Dr Najel YaseenContact hours: -

Office number:Geology 202Phone number: ext: 22275

Email:nyaseen@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:**

This course examines the use of radiogenic and stable isotopes as tracers of biogeochemical processes. Topics in the course include the theoretical basis for radiogenic and stable isotope chemistry, and the application of isotope studies in ecological, hydrological, and geochemical studies. Standards and measurements of stable and radioactive isotopes. Stable isotopes: oxygen, hydrogen, carbon, sulphur, and nitrogen. Radioisotopes: tritium, carbon 14, chlorine, krypton, argon, uranium series. Isotopes as indicators of environmental change.

**20.ProgramStudent 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)Students will be able to design and execute original research, employing advanced methodologies to generate new knowledge in their specialized area of geology

(SO2)Students will display the potential to seriously evaluate complex geological problems, the usage of analytical and problem-fixing capabilities to develop modern answers and interpretations of their studies.

(SO3)Students will benefit know-how in using cutting-edge gear, techniques, and technology applicable to their geological research, applying these abilities to research and cope with complicated geological phenomena.

(SO4)Students will effectively communicate their studies findings via academic guides, presentations, and conferences, making significant contributions to the scientific network and attractive technical and non-technical audiences.

(SO5)Students will showcase a sturdy dedication to ethical studies practices and apprehend the broader societal and environmental affects of their work, promoting sustainability and integrity within the subject.

(SO6)Students will demonstrate a determination to persistent mastering, actively enticing with rising studies, and professional improvement possibilities to maintain and amplify their know-how throughout their careers.

| PILO's | *National Qualifications Framework Descriptors* | | |
|---|---|---|---|
| | Competency (C) | Skills (B) | Knowledge (A) |
| 1. | X | ☐ | ☐ |
| 2. | ☐ | ☐ | X |
| 3. | ☐ | X | ☐ |
| 4. | ☐ | X | ☐ |
| 5. | X | | ☐ |
| 6. | ☐ | ☐ | X |

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

CLO1 Explain the theoretical foundations of radiogenic and stable isotope chemistry and their behavior in natural systems.

CLO2 Apply stable isotope techniques (oxygen, hydrogen, carbon, sulfur, nitrogen) to investigate ecological, hydrological, and geochemical processes.

CLO3 Utilize radioisotope methods (e.g., tritium, carbon-14, chlorine, krypton, argon, uranium series) to trace environmental changes and groundwater dynamics.

CLO4 Analyze isotope measurement data and critically assess the accuracy, standards, and limitations of isotopic methods.

CLO5 Integrate isotopic data from different systems to construct models of biogeochemical cycles and environmental changes.

CLO6 Communicate complex isotopic research findings effectively through scientific publications, technical reports, and presentations, adhering to ethical research standards.

| Course CLOs | The learning levels to be achieved | | | | | |
|---|---|---|---|---|---|---|
| | Remembering | Understanding | Applying | Analysing | evaluating | Creating |
| CLO (1) | ✔ | ✔ | | | | |
| CLO (2) | ✔ | | ✔ | | | |
| CLO (3) | ✔ | | ✔ | | | |
| CLO (4) | ✔ | | | ✔ | | |
| CLO (5) | ✔ | | | | ✔ | ✔ |

| | | | | | | |
|---|---|---|---|---|---|---|
| CLO (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) | SO (6) | Descriptors | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | A | B | C |
| CLO (1) | | ✔ | | | | | X | ☐ | ☐ |
| CLO (2) | | | ✔ | | | | ☐ | X | ☐ |
| CLO (3) | ✔ | | ✔ | | | | ☐ | X | ☐ |
| CLO (4) | | ✔ | | ✔ | | | ☐ | X | ☐ |
| CLO (5) | ✔ | | | | | ✔ | ☐ | ☐ | X |
| CLO (6) | | | | ✔ | ✔ | | ☐ | ☐ | X |

**23. Topic Outline and Schedule:**

| Week | Lecture | Topic | CLO/sLinked to the Topic | Learning Types (Face to Face/Blended/ Fully Online) | Platform Used | Synchronous / Asynchronous Lecturing | Evaluation Methods | Learning Resources |
|---|---|---|---|---|---|---|---|---|
| 1 | | General introduction | | | | | | |
| 2 | 2 | Introduction to Environmental Isotope Geochemistry<br><br>Fundamentals of Stable and Radiogenic Isotope Systems | 1 | Face to Face | | | Exams + assignments | Suggested readings + papers |
| 3 | 2 | Standards, Calibration, and Measurement Techniques<br><br>Instrumentation: Mass Spectrometry and Radiometric Methods | 4 | Face to Face | | | Exams + assignments | Suggested readings + papers |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 4 | 2 | Stable Isotopes of Oxygen and Hydrogen in the Water Cycle<br><br>Applications: Hydrology, Climate Reconstructions | 2 | Face to Face | | | Exams + assignments | Suggested readings + papers |
| 5 | 2 | Stable Isotopes of Carbon and Sulfur in Ecosystems<br><br>Isotope Applications in Biogeochemical Cycles | 2, 5 | Face to Face | | | Exams + assignments | Suggested readings + papers |
| 6 | 2 | Stable Isotopes of Nitrogen in Environmental Studies<br><br>Case Study 1: Tracing Pollution Sources Using Stable Isotopes | 3 | Face to Face | | | Exams + assignments | Suggested readings + papers |
| 7 | 2 | Radiogenic Isotopes: Tritium and Carbon-14 Dating<br><br>Radiogenic Isotopes: Chlorine, Krypton, Argon Applications | 3 | Face to Face | | | Exams + assignments | Suggested readings + papers |
| 8 | 2 | Case Study 2: Groundwater Residence Time Using Tritium and C-14<br><br>**Midterm Exam** | | Face to Face | | | Exams + assignments | Suggested readings + papers |
| 9 | 2 | Uranium Series Isotopes: Processes and Environmental Applications<br><br>Radioisotopes as Indicators of Environmental Changes | 4 | Face to Face | | | | |
| 10 | 2 | Quantitative Interpretation of Isotope Data<br><br>Sources of Error and Uncertainty in Isotopic Analyses | 4 | Face to Face | | | Exams + assignments | Suggested readings + papers |
| 11 | 2 | Case Study 3: Stable Isotope Signals in Climate Change Research<br><br>Ethics in Isotope Research and Environmental Studies | 5, 6 | Face to Face | | | Exams + assignments | Suggested readings + papers |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 12 | 2 | Case Study 3: Stable Isotope Signals in Climate Change Research<br><br>Ethics in Isotope Research and Environmental Studies | 5, 6 | Face to Face | | | Exams + assignments | Suggested readings + papers |
| 13 | 2 | Student Presentations on Selected Case Studies | 6 | Face to Face | | | Exams + assignments | Suggested readings + papers |
| 14 | 2 | **Final EXAM** | | Face to Face | | | Exams + assignments | Suggested readings + papers |

**24. Evaluation Methods:**

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

| Evaluation Activity | Mark | Topic(s) | CLO/s Linked to the Evaluation activity | Period (Week) | Platform |
|---|---|---|---|---|---|
| Midterm Exam | 30 | TBD | 1,2,3 | End of eighth week | |
| Home Assignments | 10 | TBD | 1,2,3,4,5,6 | Each two weeks | |
| Project and presentation | 20 | TBD | 1,2,3,4,5,6 | Term-long project due at the end of the semester | |
| Final Exam | 40 | TBD | 3,4,5,6 | End of semester | |

**25. Course Requirements:**

students should have a computer, internet connection, account on a specific software/platform…(elearning)

**26. Course Policies:**

A- Attendance policies: following the school regulations.

B- Absences from exams and submitting assignments on time: following the school regulations.

C- Health and safety procedures: following the school regulations.

D- Honesty policy regarding cheating, plagiarism, misbehavior: following the school regulations.

E- Grading policy: following the school regulations.

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

**27. References:**

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

1. **Clark, I. D., & Fritz, P. (1997).** ***Environmental isotopes in hydrogeology*****. Lewis Publishers**
2. **Chyi, L. L., & Morrison, J. (2022).** ***Environmental isotopes for hydrology and environmental science: Principles and applications*** **(2nd ed.). CRC Press.**

B- Recommended books, materials, and media:

3. Kendall, C., & McDonnell, J. J. (Eds.). (1998). *Isotope tracers in catchment hydrology*. Elsevier.
4. Faure, G., & Mensing, T. M. (2005). *Isotopes: Principles and applications* (3rd ed.). Wiley.
5. Hoefs, J. (2018). *Stable isotope geochemistry* (8th ed.). Springer.

**28. Additional information:**

| | | |
|---|---|---|
| | Signature: | Date: |
| Name of the Instructor or the Course Coordinator: **Dr. Najel Yaseen** | ……..…… | **25/04/2025**…… |
| Name of the Head of Quality Assurance Committee/ Department | Signature: ……..…… | Date: ……..…… |
| Name of the Head of Department **Dr Bety Saqarat** | Signature: ……..…… | Date: ……..…… |
| Name of the Head of Quality Assurance Committee/ School ofScience **Prof. Emad A. Abuosba** | Signature: ……..…… | Date: ……..…… |
| Name of the Dean or the Director **Prof. Mahmoud I. Jaghoub** | Signature: ……..…… | Date: ……..…… |