**EARTH SCIENCE INTEGRATION FOR ENERGY AND ENVIRONMENT**

**SYLLABUS**

## 1. Information regarding the programme

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| 1. 1 Higher education institution | **Babeş-Bolyai University** |
| 1.2 Faculty | **Faculty of Environmental Science and Engineering** |
| 1.3 Department | Environmental Analysis and Engineering |
| 1.4 Field of study | Environmental Engineering |
| 1.5 Study cycle | Bachelor level |
| 1.6 Study programme / Qualification | Environmental Engineering |

## 2. Information regarding the discipline

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|---|---|---|---|---|---|---|---|
| 2.1 Name of the discipline | **Emerging natural energy and strategic resources** | | | | | | |
| 2.2 Course coordinator | **PhD. Giuseppe ETIOPE** | | | | | | |
| 2.3 Seminar coordinator | **PhD. Giuseppe ETIOPE** | | | | | | |
| 2.4 Year of study | **4** | 2.5 Semester | **7** | 2.6. Type of evaluation | **C.** | 2.7 Type of discipline | **OPT** |

## 3. Total estimated time (hours/semester of didactic activities)

| | | | | | |
|---|---|---|---|---|---|
| 3.1 Hours per week | **4** | 3.2 Of which: course | **2** | 3.3 seminar/laborator | **2** |
| 3.4 Total hours in the curriculum | 56 | 3.5 Of which: course | 28 | 3.6 seminar/laborator | 28 |
| Time allotment: | | | | | hours |
| Learning using manual, course support, bibliography, course notes | | | | | 10 |
| Additional documentation (in libraries, on electronic platforms, field documentation) | | | | | 10 |
| Preparation for seminars/labs, homework, papers, portfolios and essays | | | | | 10 |
| Tutorship | | | | | 8 |
| Evaluations | | | | | 2 |
| Other activities: visits, workshops, and other academic activities | | | | | 2 |

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| 3.7 Total individual study hours | 42 |
| 3.8 Total hours per semester | 98 |
| 3.9 Number of ECTS credits | 4 |

## 4. Prerequisites (if necessary)

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| 4.1 curriculum | • no requirements |
| 4.2 competencies | • fundamental knowledge of chemistry and physics |

## 5. Conditions (if necessary)

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| 5.1 for the course | • Class room with a video projector device and whiteboard |
| 5.2 or the seminar /lab activities | • Laboratory equipped with water and common laboratory glassware. Instrumental equipment. |

**6. Specific competencies acquired**

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| **Professional competencies** | • Ability to integrate geological concepts with reference to environment and energy<br>• Understanding major terrestrial fluids (type of waters and gases)<br>• How to detect and analyse fluids (ability to manage laboratories tools for fluid analyses)<br>• Fundamental knowhow of the conventional and emerging energy and strategic resources (e.g. hydrocarbons, hydrogen, helium) |
| **Transversal competencies** | • Environmental role of terrestrial fluids (environmental geochemistry) and their impact<br>• Ability to integrate basic chemical, physical, geological and environmental concepts<br>• Team work for the analysis of complex phenomena |

**7. Objectives of the discipline** (outcome of the acquired competencies)

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| 7.1 General objective of the discipline | • Integrating geological, chemical and physical processes that can affect the environment and offer energy resource. |
| 7.2 Specific objective of the discipline | • Understanding geochemical process (solids, liquids and gas) impacting the environment.<br>• Understanding geochemical process (solids, liquids and gas) providing conventional and alternative energy and strategic resources.<br>• Improving students' capacity to analyze complex systems and to compare various theories based on arguments. |

**8. Content**

| **8.1 Course (2 hours /week)** | **Teaching methods** | **Remarks** |
|---|---|---|
| 8.1.1. Introduction. Terminology | Lecture<br><br>Interaction<br><br>Exposure<br><br>Presentation of case studies<br><br>Conversation<br><br>Explanation | Attendance at the course is optional, but recommended.<br><br>Attendance at the seminar /laboratory activities are MANDATORY; max. 20% absences can be accepted.<br><br>Students who have more than 20% absences at the seminar/laboratory cannot participate to the exam. |
| 8.1.2. Main geological processes at global scale | | |
| 8.1.3. Understanding rocks and minerals | | |
| 8.1.4. Units of measurement for fluids and conversions | | |
| 8.1.5. Understanding waters in terrestrial systems | | |
| 8.1.6. Understanding gases in terrestrial systems | | |
| 8.1.7. Rock-fluid interaction impacting the environment | | |
| 8.1.8. Rock-fluid interaction providing energy resources | | |
| 8.1.9. Gas as energy resource: hydrocarbons. Implication for the environment | | |
| 8.1.10. Gas as energy resource: $H_2$. Implications for the environment | | |
| 8.1.11. Gas as strategic resource: He. Implications for the environment. | | |
| 8.1.12. Integration of the studied concepts (to better understand the environment) | | |
| 8.1.13. Schematic integration – interaction with students. Q&A section | | |
| 8.1.14. Resume of the studied material. Preparation for the exam | | |

**Bibliography**:


1. **Etiope G.,** 2015, *Natural gas Seepage. The earth's hydrocarbon degassing*, Springer, Switzerland, 199 p.
2. **Hunt J.M.,** 1996, *Petroleum Geochemistry and Geology*, 2nd edition, Ed. W.H. Freeman Co., New York.
3. **Marshall C.P., Fairbridge R.W.,** 1999, *Encyclopaedia of Geochemistry*, Kluwer Academic Publisher, 747 p.
4. **Prost G., Prost B.,** 2020, *The Geology Companion, Essentials for Understanding the Earth*, 1st edition, CRC Press, 488 p.


| **8.2. Seminar / laboratory 2 hours/ week** | **Teaching methods** | **Remarks** |
|---|---|---|
| 8.2.1. Labor protection rules in laboratories. Presentation of the used instruments. | Conversation<br><br>Experiments<br><br>Learning by discovering<br><br>Discussions and debates, preparation of tasks | Team work<br><br>Individual work |
| 8.2.2 Sampling methods for fluids (water and gas). Handling of sampling devices. | | |
| 8.2.3 Calibration / verification of instruments using standards. | | |
| 8.2.4 Field measurements of $CO_2$ and $CH_4$ from air | | |
| 8.2.5 Extraction of gases from water and analyses of $CO_2$, $CH_4$ and $H_2$. Conversion of units. | | |
| 8.2.6 Extraction of total petroleum hydrocarbons from fluids and TPH analyses. | | |
| 8.2.7 Field measurements of methane and $CO_2$ from soil. | | |
| 8.2.8 Flux measurements of $CO_2$ and $CH_4$ (soil-respiration). | | |
| 8.2.9 Rock density determinations. | | |
| 8.2.10 Statistical interpretation of data. | | |
| 8.2.11 Data reporting. Calculations and conversions. | | |
| 8.2.12 Errors, uncertainty, LOD, LOQ. | | |
| 8.2.13 Recovery of one laboratory. | | |
| 8.2.14 Laboratory examination. | | |

**Bibliography**:


1. **Etiope G**., Laboratory and seminary work sheets, 2025.
2. **Marshall C.P., Fairbridge R.W.,** 1999, *Encyclopaedia of Geochemistry*, Kluwer Academic Publisher, 747 p.
3. **De Vivo B., Belkin H., Lima A.,** 2024, *Environmental Geochemistry, Site Characterization, Data Analysis, Case Histories, and Associated Health Issues*, 3rd edition, Elsevier.


**9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program.**

- The course "**Emerging natural energy and strategic resources** " enables the graduates to work for National and International Agencies/Companies/Research Institutes for positions involving energy resources exploration and environmental studies.
- Identification of natural energy resources based on surface geochemistry
- Identification and management of soil and water pollution problems

**10. Evaluation**

| Type of activity | 10.1 Evaluation criteria | 10.2 Evaluation methods | 10.3 Share in the grade |
|---|---|---|---|
| 10.4 Course | Correctness of answers – correct acquisition and understanding of the issues covered in the course | Examination | **70 %** |
| 10.5 Seminar/Lab activities | Correctness of answers – correct acquisition and understanding of the issues studied and practiced in the seminary / laboratory | Laboratory examination | **30 %** |
| | | | |
| 10.6 Minimum performance standards: | | | |
| - minimum grade 5 | | | |

Date

05.12.2024

Signature of course and seminar coordinator

Giuseppe ETIOPE

Date of approval

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Signature of the head of department

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