# SYLLABUS

## Seismic, magnetic and gravimetric interpretation

University year 2025 - 2026

**1. Information regarding the programme**

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| 1.1. Higher education institution | Universitatea Babeș-Bolyai din Cluj Napoca |
| 1.2. Faculty | Biology and Geology |
| 1.3. Department | Geology |
| 1.4. Field of study | Geology |
| 1.5. Study cycle | Masters, 2 years |
| 1.6. Study programme/Qualification | Geology of Energy Resources / Masters |
| 1.7. Form of education | Full-time education |

**2. Information regarding the discipline**

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|---|---|---|---|---|---|---|---|
| 2.1. Name of the discipline | **Seismic, magnetic and gravimetric interpretation** | | | | | Discipline code | **BME1122** |
| 2.2. Course coordinator | | | | | Șef lucr. dr. Dan Mircea Tămaș | | |
| 2.3. Seminar coordinator | | | | | Șef lucr. dr. Dan Mircea Tămaș | | |
| 2.4. Year of study | 1 | 2.5. Semester | 2 | 2.6. Type of evaluation | E | 2.7. Discipline regime | Ob |

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

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|---|---|---|---|---|---|
| 3.1. Hours per week | **4** | of which: 3.2 course | **2** | 3.3 seminar/laboratory | **2** |
| 3.4. Total hours in the curriculum | 154 | of which: 3.5 course | 28 | 3.6 seminar/laborator | **28** |
| **Time allotment for individual study (ID) and self-study activities (SA)** | | | | | **hours** |
| 3.5.1. Learning using manual, course support, bibliography, course notes (SA) | | | | | 28 |
| 3.5.2. Additional documentation (in libraries, on electronic platforms, field documentation) | | | | | 23 |
| 3.5.3. Preparation for seminars/labs, homework, papers, portfolios and essays | | | | | 22 |
| 3.5.4. Tutorship | | | | | 16 |
| 3.5.5. Evaluations | | | | | 4 |
| 3.5.6. Other activities | | | | | 2 |
| **3.7. Total individual study hours** | **98** | | | | |
| **3.8. Total hours per semester** | **154** | | | | |
| **3.9. Number of ECTS credits** | **6** | | | | |

**4. Prerequisites** (if necessary)

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| 4.1. curriculum | Basic knowledge in geophysics |
| 4.2. competencies | Use of computer |

**5. Conditions** (if necessary)

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| 5.1. for the course | • ***Face-to-face activities*** – Courses are conducted in an interactive format, in classrooms equipped with the necessary infrastructure. The physical presence of students is essential to facilitate discussions and clarify complex concepts.<br>• ***Video projection system*** – Indispensable for illustrating theoretical and practical content. The projected materials include: PowerPoint presentations with diagrams, graphs, and schematics, 3D animations and simulations of hydrocarbon migration processes, trap formation, and sedimentary basin evaluation, as well as industry video examples demonstrating the practical application of theoretical knowledge. |

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| | <ul><li>***Access to digital learning materials*** – Access to educational content through various online platforms (faculty website, BCU website, platforms such as Moodle or Microsoft Teams), including course support materials and basic bibliography.</li><li>***Didactic interaction*** – Encouraging active student participation through methods such as open questions and discussions aimed at stimulating critical thinking, real case study examples for applying theoretical knowledge, and debates on current topics in the hydrocarbon field and energy sector.</li></ul> |
| 5.2. for the seminar /lab activities | <ul><li>***Face-to-face activities*** – Laboratory sessions are conducted in an interactive format, in classrooms equipped with the necessary infrastructure. Many of the practical activities will involve written exercises, manual mapping, various experiments, as well as digital exercises. The physical presence of students is mandatory (minimum 70%) to facilitate discussions and clarifications related to complex concepts.</li><li>***Computers and video projection system*** – The available computers must be suitable for running specialized software packages (e.g., Petrel, OpendTect, PetroMod, etc.). The projection system is essential both for illustrating practical content and for real-time guidance during lab work.</li><li>***Participation in at least 70% of the laboratory sessions*** is a requirement for students to be eligible to take the exam (either during the regular session and/or the resit session).</li></ul> |

**6.1. Specific competencies acquired [1]**

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|---|---|
| **Professional/essential competencies** | <ul><li>Fundamental definitions and concepts necessary for interpreting seismic, magnetic and gravimetric data;</li><li>Ability to interpret gravity and magnetic data;</li><li>Ability to perform hand-based interpretation of 2D seismic reflection data;</li><li>Ability to perform computer-based interpretation of 2D and 3D seismic reflection data;</li><li>Ability to build internally consistent maps and 3D models based on seismic data;</li><li>Ability to understand, create and use seismic attributes to aid interpretation.</li></ul> |
| **Transversal competencies** | <ul><li>The use of theoretical knowledge in solving specific practical problems;</li><li>Acquiring knowledge in using geophysical data to aid geological interpretation and model construction;</li><li>Acquiring knowledge than can be used in the interpretation of the basin evolution and advanced subsurface energy evaluations.</li></ul> |

**6.2. Learning outcomes**

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| **Knowledge** | The student knows:<ul><li>Fundamental concepts, definitions, and physical principles underlying seismic, magnetic, and gravimetric methods.</li><li>Types and properties of seismic waves and how they relate to subsurface geological structures.</li><li>Principles of seismic data acquisition, processing, and calibration techniques.</li><li>Seismic attributes, inversion techniques, and how they contribute to subsurface interpretation.</li><li>The structural and stratigraphic significance of seismic reflections in 2D and 3D seismic datasets.</li><li>Basic and advanced interpretation strategies using gravity and magnetic geophysical methods.</li><li>Methods of integrating seismic, gravity, and magnetic data for comprehensive geological models.</li><li>The role of geophysical interpretation in basin analysis and hydrocarbon exploration.</li><li>Theoretical background of software tools used in seismic interpretation (e.g., Petrel, OpendTect).</li></ul> |

[1] One can choose either competences or learning outcomes, or both. If only one option is chosen, the row related to the other option will be deleted, and the kept one will be numbered 6.

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| **Skills** | The student is able to:<br>• Perform manual (hand-based) interpretation of 2D seismic reflection data, including fault and horizon picking.<br>• Use specialized software (e.g., Petrel, OpendTect) for interpreting 2D and 3D seismic data.<br>• Generate and interpret seismic attributes and apply inversion techniques to refine geological models.<br>• Interpret gravity and magnetic data and integrate these with seismic interpretations.<br>• Build internally consistent geological maps and 3D models using seismic and potential field data.<br>• Analyze and interpret subsurface structures (folds, faults, stratigraphic traps) from seismic datasets.<br>• Apply calibration methods to correlate seismic data with well logs and geological information.<br>• Solve practical geological problems by applying geophysical interpretation techniques.<br>• Present and explain interpretation results through clear technical documentation and visualization tools. |
| **Responsibility and autonomy:** | The student has the ability to work independently to obtain:<br>• Consistent and well-documented interpretations of seismic, gravity, and magnetic data sets.<br>• Fully integrated subsurface models by combining various geophysical datasets and geological information.<br>• Accurate assessments of basin evolution and structural frameworks using geophysical methods.<br>• Seismic interpretation projects and reports using professional standards and industry tools.<br>• Critical analysis of data quality and interpretive uncertainty in geophysical datasets.<br>• Adaptation of workflows to diverse geological settings and exploration objectives.<br>• Independent exploration of new seismic attributes and inversion tools to enhance interpretation.<br>• Responsible application of geophysical knowledge in support of sustainable subsurface resource evaluation.<br>• Continuous self-directed learning to remain updated with evolving geophysical interpretation techniques and tools. |

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

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| **7.1 General objective of the discipline** | • To provide students with a solid theoretical and practical foundation in the interpretation of seismic, magnetic, and gravimetric data, enabling them to construct accurate subsurface models and support geological and energy-related decision-making processes through geophysical methods. The discipline aims to develop critical thinking, analytical skills, and proficiency in both manual and computer-based interpretation techniques relevant to basin analysis. |
| **7.2 Specific objective of the discipline** | • To familiarize students with the fundamental principles and data types used in subsurface geophysics, particularly seismic, gravity, and magnetic methods.<br>• To develop the ability to interpret 2D and 3D seismic reflection data, both manually and using industry-standard software tools (e.g., Petrel, OpendTect).<br>• To teach students how to calibrate seismic data and integrate it with well log and geological information.<br>• To introduce seismic attributes and inversion techniques as tools for enhancing interpretation accuracy.<br>• To provide the skills required to analyze gravity and magnetic anomalies and integrate them with seismic interpretation results.<br>• To train students in building coherent geological maps and 3D models based on geophysical data.<br>• To encourage the use of geophysical data in evaluating basin evolution, structural frameworks, and subsurface energy potential.<br>• To enhance students' problem-solving abilities by applying geophysical methods to real-world geological scenarios.<br>• To promote independent and responsible interpretation of geophysical data, adhering to scientific, ethical, and industry standards. |

**8. Content**

| 8.1 Course | Teaching methods | Remarks |
|---|---|---|
| Intro to subsurface geophysics | Presentation, discussions, case studies | |
| Seismic waves and data acquisition and processing | | |
| Calibration of seismic data | | |
| Seismic attributes and inversion | | |
| Seismic interpretation tools | | |
| Seismic interpretation in a structural context | | |
| Seismic interpretation in a stratigraphic context | | |
| Gravity and magnetic geophysical methods in hydrocarbon exploration | | |
| Integrating gravity and magnetics with seismic interpretation | | |

Bibliography

Chopra, S. and Marfurt, K.J. 2008. Seismic Attributes for Prospect Identification and Reservoir Characterization. SEG Geophysical Developments Series No. 11, 464 p., Society of Exploration Geophysicists.
Kearey, P., Brooks, M., and Hill, I. 2002. An Introduction to Geophysical Exploration. 3rd edition, 268 p. Blackwell Science Ltd.
Veeken, P.C.H. 2007. Seismic Stratigraphy, Basin Analysis And Reservoir Characterisation. Handbook of Geophysical Exploration – Seismic Exploration, v. 37, 509 p., Elsevier.

| 8.2 Seminar / laboratory | Teaching methods | Remarks |
|---|---|---|
| Case studies prepared for the students, where they learn to use hand-based and computer-based (Petrel, Opendtect) methods to use and interpret seismic, magnetic and gravimetric data | Presentation, case studies, discussions, exercises | |

Bibliography

Chopra, S. and Marfurt, K.J. 2008. Seismic Attributes for Prospect Identification and Reservoir Characterization. SEG Geophysical Developments Series No. 11, 464 p., Society of Exploration Geophysicists.
Kearey, P., Brooks, M., and Hill, I. 2002. An Introduction to Geophysical Exploration. 3rd edition, 268 p. Blackwell Science Ltd.
Veeken, P.C.H. 2007. Seismic Stratigraphy, Basin Analysis And Reservoir Characterisation. Handbook of Geophysical Exploration – Seismic Exploration, v. 37, 509 p., 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 Seismic, Magnetic and Gravimetric Interpretation course is aligned with the requirements of the scientific community, professional associations, and employers in the energy and geoscience industries. Its content reflects international scientific advancements and incorporates the use of leading software tools for geophysical data analysis. The curriculum is designed to meet the standards set by professional organizations such as AAPG, SEG, and EAGE, as well as by industry leaders like OMV Petrom, ROMGAZ, OMV, etc. It provides the necessary competencies for international certifications and places a strong emphasis on practical skills, including the interpretation of seismic, magnetic, and gravimetric data for subsurface exploration. The course ensures that graduates are well-prepared to enter the workforce and address challenges in geophysical exploration, while upholding safety and sustainability standards.

**10. Evaluation**

| Activity type | 10.1 Evaluation criteria | 10.2 Evaluation methods | 10.3 Percentage of final grade |
|---|---|---|---|
| 10.4 Course | Theoretical: open-ended or multiple-choice questions for assessing fundamental knowledge. | Written assessment of theoretical and practical knowledge (multiple-choice questions, open- | 60% |

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| | Practical: solving a case study or interpreting a data set. | ended questions, interpretation exercises, calculations). | |
| 10.5 Seminar/laboratory | Active participation in discussions, case studies, and group activities, as well as completion of assignments or practical exercises based on real or simulated data, with scores awarded for accuracy, creativity, and application of learned techniques. | Grading of individual projects completed during lab sessions. | 40% |
| 10.6 Minimum standard of performance | | | |
| • Participation in at least 70% of the practical laboratory sessions;<br>• Understanding at least 50% of the information presented during the lectures;<br>• Understanding at least 60% of the information presented during the laboratory sessions. | | | |

**11. Labels ODD (Sustainable Development Goals)[2]**

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|---|---|---|---|---|---|---|---|---|
| | General label for Sustainable Development | | | | | | | |
| 1 FĂRĂ SĂRĂCIE | 4 EDUCAȚIE DE CALITATE | 5 EGALITATE DE GEN | 7 ENERGIE CURATĂ ȘI LA PREȚURI ACCESIBILE | 8 MUNCĂ DECENTĂ ȘI CREȘTERE ECONOMICĂ | 9 INDUSTRIE, INOVAȚIE ȘI INFRASTRUCTURĂ | 12 CONSUM ȘI PRODUCȚIE RESPONSABILE | 13 ACȚIUNE CLIMATICĂ | 17 PARTENERIATE PENTRU REALIZAREA OBIECTIVELOR |

Date:
11.03.2025

Signature of course coordinator

Şef lucr. dr. Dan Mircea Tămaș

Signature of seminar coordinator

Dr. Volker Schuller

Date of approval:
28.03.2025

Signature of the head of department

Conf. dr. Nicolae Har

[2] Keep only the labels that, according to the *Procedure for applying ODD labels in the academic process*, suit the discipline and delete the others, including the general one for *Sustainable Development* – if not applicable. If no label describes the discipline, delete them all and write „*Not applicable*.”.