SYLLABUS

Structural geology in hydrocarbon exploration

University year 2025-2026

1. Information regarding the programme

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

2.1. Name of the discipline	**Structural geology in hydrocarbon exploration**					Discipline code	**BME1112**
2.2. Course coordinator				Lect. dr. Alexandra Tămaș			
2.3. Seminar coordinator				Lect. dr. Alexandra Tămaș			
2.4. Year of study	1	2.5. Semester	1	2.6. Type of evaluation	E	2.7. Discipline regime	Ob

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

3.1. Hours per week	**11**	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**
3.5. 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)

4.1. curriculum	Basic knowlege of structural geology, hydrocarbon geology, sedimentary basins.
4.2. competencies	Computer skills.

5. Conditions (if necessary)

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. 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. 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.

	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 energy sector.
5.2. for the seminar /lab activities	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. Computers and video projection system – The available computers must be suitable for running specialized software packages (e.g., Petrel, Move, PetroMod, etc.). The projection system is essential both for illustrating practical content and for real-time guidance during lab work. 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).

6.1. Specific competencies acquired [1]

Professional/essential competencies	• Ability to recognize the importance of structural geology in subsurface exploration; • Ability to recognize structural families and styles; • Ability to analyse structures in different tectonic settings; • Ability to predict, validate and document structural evolution; • Ability to identify and understand faults and their importance as conduits or traps; • Ability to write reports and scientific papers.
Transversal competencies	• The use of theoretical knowledge in solving specific practical problems. • Acquiring some basic knowledge that can be used in the interpretation of the basin evolution and its subsurface resources.

6.2. Learning outcomes

Knowledge	The student knows: • The role and importance of structural geology in subsurface exploration for hydrocarbons and other resources. • The main types of structural data and tools used in subsurface interpretation, including maps, cross-sections, seismic data, and modeling techniques. • Classification and geometry of structural families: folds, faults, fractures, and their associated styles. • Principles of kinematic evolution and timing of deformation events in various tectonic settings. • Structural characteristics and trap types in extensional, compressional, strike-slip, passive margin, and complex tectonic settings (e.g., salt/shale tectonics, inversion, multi-rift). • Methods of structural prediction, validation, and restoration using balancing, physical models, and surface analogs. • Concepts related to fault behavior as seals or conduits, fault seal analysis, and their implications for fluid migration and trap integrity.

[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.

Skills	The student is able to: • Analyze and interpret subsurface structural data from seismic sections, well logs, and outcrop analogs. • Identify structural traps and evaluate their potential in different tectonic contexts (extensional, compressional, strike-slip, etc.). • Build and validate structural models using balancing techniques, forward modeling, and restoration. • Apply kinematic concepts to reconstruct structural histories and assess their impact on reservoir distribution. • Perform structural trap integrity analysis including fault seal potential and fluid migration pathways. • Use surface analogs and physical models to support and test subsurface structural interpretations. • Communicate technical interpretations and models effectively through written reports and visual materials.
Responsibility and autonomy:	The student has the ability to work independently to: • Plan and execute structural interpretations of subsurface data for exploration and development purposes. • Make justified geological decisions based on the integration of structural concepts and available data. • Independently assess trap geometry and fault behavior with respect to hydrocarbon migration and retention. • Critically evaluate the validity of structural models through restoration, balancing, and analog comparisons. • Produce professional-quality documentation and presentations of structural analyses and subsurface models. • Maintain ethical and scientific rigor in the interpretation of geologic data under uncertainty.

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

7.1 General objective of the discipline	• To equip students with the theoretical understanding and practical skills required to interpret and model subsurface structures, assess structural traps, and support exploration and reservoir development decisions using structural geology principles.
7.2 Specific objective of the discipline	• To introduce the relevance of structural geology in hydrocarbon and resource exploration. • To train students in interpreting structural data from seismic, well, and field analog sources. • To develop competency in identifying and analyzing structural traps across diverse tectonic settings. • To apply techniques such as balancing, restoration, and forward modeling for validating structural models. • To teach how to assess fault integrity, seal potential, and fluid migration in structurally complex settings. • To build capacity for independent thinking, integration of data, and communication of structural interpretations in professional contexts.

8. Content

8.1 Course	Teaching methods	Remarks
1. Introduction: Course objectives and learning outcomes Link between structural geology and subsurface resources. The role of structural geologist and a structural model in subsurface exploration.	Presentation, discussions, case studies, exercises.	
2. Principles, tools, and data used in structural interpretation.		
Structural families and styles. Folds, faults and fracture.		
3. Variability in timing and spatial distribution of structures.		
4. Kinematic evolution of structures.		

5. Analysis of structural traps in extensional settings		
6. Analysis of structural traps in compressional settings		
7. Analysis of structural traps in strike-slip settings		
8. Analysis of structural traps in passive margins		
9. Analysis of structural traps in complex settings Multirift Inversion		
10. Analysis of structural traps in complex settings Salt and shale tectonics		
11. Predicting, validating and documenting structural evolution Surface analogues Physical models		
12. Predicting, validating and documenting structural evolution Balancing, restoration and forward modelling		
13. Faults as conduits or traps Trap integrity and fault seal analysis Fluid migration pathways		
Bibliography: common with laboratory		
8.2 Seminar / laboratory	Teaching methods	Remarks
1. Hands-on exercises to develop structural interpretation skills.	Presentation, case studies, discussions, exercises on paper and using specialized software (e.g. MOVE, Petrel)	
2. Individual or group project		
Bibliography		

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 lectures and lab activities are designed and updated to give the students the necessary scientific knowledge and practical abilities required by the professional environment.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 Course	Assessment of knowledge	Written exam	100%
10.5 Seminar/laboratory			

10.6 Minimum standard of performance			
• Minimum of 50% of the subjects required by the written exam.			

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

	General label for Sustainable Development

Date:
11.03.2025

Signature of course coordinator

Lect. dr. Alexandra Tămaş

Signature of seminar coordinator

Lect. dr. Alexandra Tămaş

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.*”.