ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
Εθνικόν και Καποδιστριακόν Πανεπιστήμιον Αθηνών
ΙΔΡΥΘΕΝ ΤΟ 1837

SCHOOL OF SCIENCE

DEPARTMENT OF GEOLOGY AND GEOENVIRONMENT

Structure of the post-graduate programme "Exploration and Sustainable Exploitation of Mineral Resources" and Course Outlines

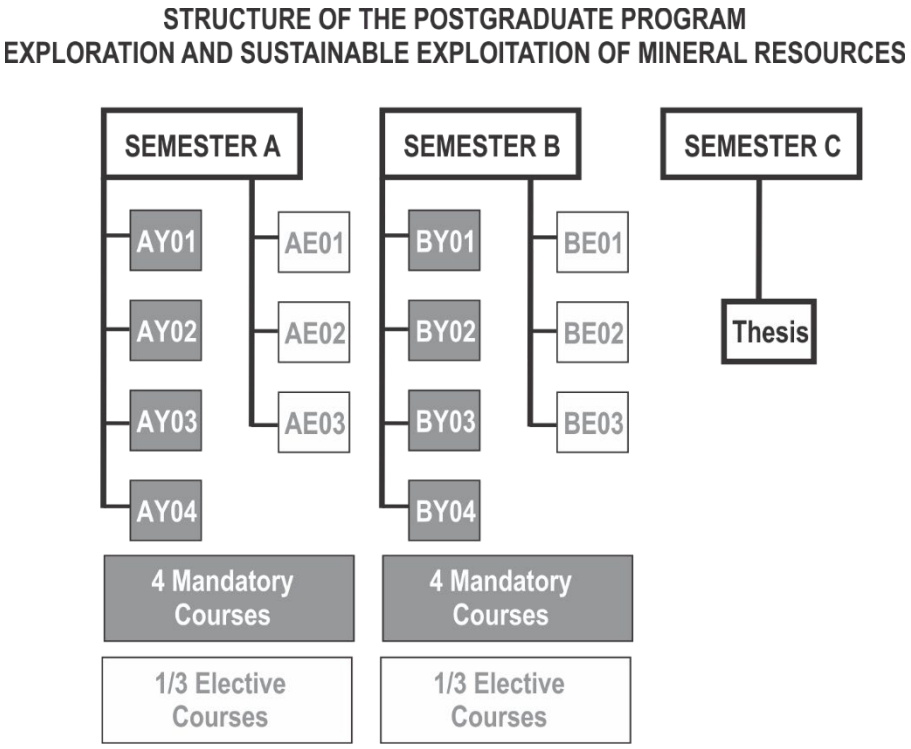
Table of Contents

The Postgraduate Programme Exploration and Sustainable Exploitation of Mineral Resources

Structure of the Postgraduate Programme

The duration of the Programme is three (3) academic semesters:

- Semester A: Students attend four compulsory courses and one elective course.
- Semester B: Students attend four compulsory courses and one elective course.
- Semester C: Students prepare a Master's Thesis.



First-semester courses

AY01. Mineral Deposits of Critical and Strategic Mineral Raw Materials

Instructors: Vasilatos, C., Voudouris, P., Papoutsa, A., Melfos, V., Mavrogonatos, K., Tombros, S.

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
LEVEL OF STUDIES	7		
COURSE CODE	**AY01**	**SEMESTER**	**1st**
COURSE TITLE	**ORE-DEPOSIT GEOLOGY OF CRITICAL AND STRATEGIC MINERAL RAW MATERIALS**		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**ECTS CREDITS**
		3	**6**
COURSE TYPE	Compulsory, specialized general knowledge, skills development		
PREREQUISITE COURSES:	Fundamental knowledge of Petrology, Geochemistry, Mineralogy and Ore-Deposit Geology		
LANGUAGE OF INSTRUCTION AND EXAMINATION:	Greek		
THE COURSE IS OFFERED TO ERASMUS STUDENTS ERASMUS	YES, in English		
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/GEOL741/		

(2) LEARNING OUTCOMES AND SKILLS

Learning Outcomes

Upon completion of the course, students:

- Understand the fundamental concepts, terminology, and importance of critical and strategic mineral raw materials for modern technological civilization.
- Understand the stages of mineral exploration and ore deposit discovery.
- Become familiar with the classification of mineral resources and reserves, geological deposit-genesis models, and the geotectonic settings in which deposits form.
- Acquire knowledge of the geology and characteristics of important types of critical-metal deposits, as well as their availability and significance at international and national levels.

Skills

- Recognition and evaluation of ore-deposit genetic models for critical mineral raw materials.
- Interpretation of geological and metallogenic information for selecting exploration target areas.
- Skills in integrating principles of sustainable mineral-resource utilization, with emphasis on the use of mining waste, metal recycling and rational management of available resources.
- Independent work
- Teamwork
- Searching for, analyzing and synthesizing data and information, including using the necessary technologies.
- Promotion of free, creative, inductive, and critical thinking
- Respect for the natural environment
- Project planning and management
- Decision-making

(3) COURSE CONTENT

The course examines critical and strategic mineral raw materials and their role in the modern technological and energy transition. It presents the general principles of ore-deposit geology, the classification of mineral resources and reserves, and the stages of exploration for their discovery. It analyses the principal genetic models and deposit types of important metals, such as rare earth elements, uranium and thorium, rechargeable-battery materials (lithium, cobalt, nickel, and graphite), platinum-group elements, copper, and other critical metals. It also examines secondary metal sources, recycling, anthropogenic deposits, and the occurrence of critical mineral raw materials in mining waste and in Greek deposits.

(4) TEACHING AND LEARNING METHODS – ASSESSMENT METHODS

MODE OF DELIVERY	• Face-to-face lectures. • Computer-based data-processing exercises. • Use of the NKUA e-Class platform to disseminate additional information, distribute material, resolve problems, and answer questions, etc.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	**In Teaching:** PowerPoint presentations (posted on the course page in NKUA e-Class and incorporating educational videos related to lecture content). **In Practical Exercises:** o PowerPoint presentations for the tutorial component of the Practical Exercises (posted on the course page in NKUA e-Class). They incorporate educational videos related to the lecture content. Communication with students: In addition to personal contact, the communication and blogging functions of NKUA e-Class are used for communication, distribution of material, answering questions, etc.
TEACHING ORGANISATION	***Activity*** — ***Semester Workload*** Lectures — 25 hours Exercises/Assignments — 50 hours Literature study — 60 hours Field exercises — 15 hours Total Course Workload — **150 hours**
STUDENT ASSESSMENT	Assessment is conducted in Greek or English (for international students or Erasmus students). Assessment includes short individual exercises during the semester **(formative assessment, 30%)** and an end-of-semester examination **(summative assessment)** which includes • an oral presentation (20%) and • a written assignment (50%) on a subject related to the course.

(5) RECOMMENDED BIBLIOGRAPHY

- Franco Pirajno, 2009, Hydrothermal Processes and Mineral Systems, [EUDOXUS Code: 73241410]
- Pohl, Economic Geology – Principles and Practice, Willey - Blackwell 2011. [EUDOXUS Code: 80504203]
- Taylor R., Ore Textures, Springer Berlin 2009 [EUDOXUS Code: 73249091
- John Ridley, Ore deposit geology, Cambridge University Press 2013
- Melfos, B., and Voudouris, P., Deposits of Greece, Kallipos Open Academic Editions [EUDOXUS Code: 112701600], in GREEK

RELATED JOURNALS

Economic Geology Journal, Society of Economic Geologists, Mineralium Deposita-International Journal for Geology, Mineralogy and Geochemistry of Mineral Deposits, Ore Geology Reviews, Ore and Energy Resource Geology, Resource Geology

AY02. Applications of Remote Sensing in Mineral Raw Material Exploration – Introduction to Machine Learning

Instructors: Vasilakis, E., Sykioti, O., Koutroumbas, K., Papoutsa, A.

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
LEVEL OF STUDIES	7		
COURSE CODE	**AY02**	**SEMESTER**	**1st**
COURSE TITLE	**APPLICATIONS OF REMOTE SENSING IN MINERAL RAW MATERIAL EXPLORATION – INTRODUCTION TO MACHINE LEARNING**		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS CREDITS**
	3	**6**

COURSE TYPE	Compulsory, specialized general knowledge, skills development
PREREQUISITE COURSES:	Ore-Deposit Geology, Petrology, and knowledge of the basic principles of remote sensing
LANGUAGE OF INSTRUCTION AND EXAMINATION:	Greek
THE COURSE IS OFFERED TO ERASMUS STUDENTS ERASMUS	YES, in English
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/GEOL742/

(2) LEARNING OUTCOMES AND SKILLS

Learning Outcomes

Upon completion of the course, students:

- Understand the fundamental principles of remote sensing and the interaction of electromagnetic radiation with minerals and rocks.
- Become familiar with the spectral properties of geological materials and the capabilities of satellite and airborne Earth-observation systems.
- Acquire fundamental knowledge of remote-sensing data-processing methods and the machine-learning principles applied to spectral-data analysis for geological and mining applications.

Skills

- Skills in processing and analyzing satellite and spectral data to detect and map minerals, rocks and hydrothermal alteration associated with metallogenic systems.
- Application of remote-sensing image pre-processing and transformation techniques.
- Use of basic machine-learning algorithms for the classification and spectral unmixing of geological materials.
- Use of combined remote-sensing and imaging-spectroscopy data to support mineral-resource exploration and monitor the environmental impacts of mining activities.

- Independent work
- Teamwork
- Searching for, analyzing, and synthesizing data and information, including using the necessary technologies.
- Promotion of free, creative, inductive, and critical thinking
- Respect for the natural environment
- Project planning and management
- Decision-making

(3) COURSE CONTENT

The course presents the fundamental principles of remote sensing and its applications in mineral raw material exploration. It examines electromagnetic radiation, reflectance spectroscopy, and the spectral properties of minerals and rocks. Earth-observation platforms and sensors are presented, together with methods for pre-processing and analyzing remote-sensing data to detect and map geological formations and alteration associated with mineralization. The course also introduces fundamental machine-learning concepts and their combined use with spectral data for mineral-resource exploration and monitoring the environmental impacts of mining activities.

(4) TEACHING AND LEARNING METHODS – ASSESSMENT METHODS

MODE OF DELIVERY	• Face-to-face lectures. • Computer-based data-processing exercises. • Use of the NKUA e-Class platform to disseminate additional information, distribute material, resolve problems, and answer questions, etc.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	**In Teaching:** PowerPoint presentations (posted on the course page in NKUA e-Class and incorporating educational videos related to lecture content). **In Practical Exercises:** o PowerPoint presentations for the tutorial component of the Practical Exercises (posted on the course page in NKUA e-Class). They incorporate educational videos related to the lecture content. Communication with students: In addition to personal contact, the communication and blogging functions of NKUA e-Class are used for communication, distribution of material, answering questions, etc.
TEACHING ORGANISATION	***Activity*** — ***Semester Workload*** Lectures — 25 hours Exercises/Assignments — 50 hours Literature study — 60 hours Field exercises — 15 hours Total Course Workload — **150 hours**
STUDENT ASSESSMENT	Assessment is conducted in Greek or English (for international students or Erasmus students). Assessment includes short individual exercises during the semester **(formative assessment, 30%)** and an end-of-semester examination **(summative assessment)** which includes • an oral presentation (20%) and • a written assignment (50%) on a subject related to the course.

(5) RECOMMENDED BIBLIOGRAPHY

- Astaras, T., 2010. Remote Sensing–Photointerpretation in the Geosciences, Gkiourdas Publications, pp. 484, in GREEK

RELATED JOURNALS

GIS and Remote Sensing Journal, International Journal of Remote Sensing, Remote Sensing of Environment, Journal of Remote Sensing, Journal of photogrammetry and Remote sensing

AY03. Mineral exploration mapping, sampling, and the use of modern portable equipment

Instructors: Papadopoulos, A., Stouraiti, C., Voudouris, P., Soukis, K., Papoutsa, A., Anastasatou, M., Vasilatos, C., Kydonakis, K., Megremi, I.

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
LEVEL OF STUDIES	7		
COURSE CODE	**AY03**	**SEMESTER**	**1st**
COURSE TITLE	**MINERAL EXPLORATION MAPPING, SAMPLING AND USE OF MODERN PORTABLE EQUIPMENT**		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**ECTS CREDITS**
		3	**6**
COURSE TYPE	Compulsory, specialized general knowledge, skills development		
PREREQUISITE COURSES:	Ore-Deposit Geology, Petrology, Mineralogy, Tectonics		
LANGUAGE OF INSTRUCTION AND EXAMINATION:	Greek		
THE COURSE IS OFFERED TO ERASMUS STUDENTS ERASMUS	YES, in English		
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/GEOL743/		

(2) LEARNING OUTCOMES AND SKILLS

Learning Outcomes

Upon completion of the course, students:

- Understand the fundamental principles of mineral exploration mapping and sampling in mining and geological settings.
- Become familiar with sampling theory, drilling types, and the basic statistical concepts relating to the reliability of geological data, such as accuracy, precision, and systematic errors.
- Know the procedures for recording geological data.
- Know the principles of quality assurance and quality control in the collection and evaluation of geological and geochemical information.

Skills

- Skills in designing and implementing sampling programmes in mineral exploration.
- Ability to systematically map and record geological data in mines, quarries, and surface outcrops.
- Collection of representative samples of minerals, rocks, ores and sediments, and description and sampling of drill cores.
- Experience in the use of modern portable analytical equipment (e.g., XRF, LIBS and Vis–NIR–SWIR) for in-situ geochemical analyses.
- Evaluation of analytical results to support mineral-resource exploration and rational utilization.
- Independent work
- Teamwork
- Searching for, analyzing, and synthesizing data and information, including using the necessary technologies.
- Promotion of free, creative, inductive, and critical thinking
- Respect for the natural environment
- Project planning and management
- Decision-making

(3) COURSE CONTENT

The course covers the fundamental principles of mapping and sampling in the context of mineral raw material exploration. It presents sampling theory and methods, drilling types, and principles of data quality assurance. It examines techniques for mapping and recording geological information in mines and quarries, as well as procedures for collecting and describing samples and drill cores. It also presents modern methods of in-situ geochemical analysis using portable spectroscopic instruments, together with the processing and evaluation of the data generated.

(4) TEACHING AND LEARNING METHODS – ASSESSMENT METHODS

MODE OF DELIVERY	• Face-to-face lectures. • Computer-based data-processing exercises. • Use of the NKUA e-Class platform to disseminate additional information, distribute material, resolve problems, and answer questions, etc.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	**In Teaching:** PowerPoint presentations (posted on the course page in NKUA e-Class and incorporating educational videos related to lecture content). **In Practical Exercises:** ○ PowerPoint presentations for the tutorial component of the Practical Exercises (posted on the course page in NKUA e-Class). They incorporate educational videos related to the lecture content. Communication with students: In addition to personal contact, the communication and blogging functions of NKUA e-Class are used for communication, distribution of material, answering questions, etc.
TEACHING ORGANISATION	***Activity*** — ***Semester Workload*** Lectures — 25 hours Exercises/Assignments — 40 hours Literature study — 35 hours Field exercises — 40 hours Total Course Workload — **150 hours**
STUDENT ASSESSMENT	Assessment is conducted in Greek or English (for international students or Erasmus students). Assessment includes short individual exercises during the semester **(formative assessment, 30%)** and an end-of-semester examination **(summative assessment)** which includes • an oral presentation (20%) and • a written assignment (50%) on a subject related to the course.

(5) RECOMMENDED BIBLIOGRAPHY

- Lozios, S., Soukis, K. & Antoniou, V., 2015, Geological Mapping and Field Exercises, Hellenic Academic Electronic Textbooks and Aids, Hellenic Academic Libraries Link, 280 pp. [EUDOXUS Code: 320091], in GREEK
- Bennison, M.G., Olver, A.P. & Moseley, A.K.C., 2011, Introduction to Geological Structures and Maps, 168 pp., Routledge.
- Coe, L. A. (ed), Argles, W. T., Rothery, A. D., Spicer, A. R., 2010, Geological Field Techniques, 323 pp., Wiley-Blackwell
- Mc Clay, K., 1991, The Mapping of Geological Structures, 168 pp., Wiley-Blackwell.
- Marjoribanks, R., 1997, Geological Methods in mineral exploration and mining, Springer.

RELATED JOURNALS

Economic Geology Journal, Society of Economic Geologists, Mineralium Deposita-International Journal for Geology, Mineralogy and Geochemistry of Mineral Deposits, Ore Geology Reviews, Ore and Energy Resource Geology, Resource Geology

AY04. Geochemical and Geophysical Survey Methods in Mineral Raw Materials Exploration

Instructors: Stouraiti, C., Alexopoulos, I., Dilalos, S., Sakellaris, G., Argyraki, A., Kelepertzis, S., Sakkas, V.

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
LEVEL OF STUDIES	7		
COURSE CODE	**AY04**	**SEMESTER**	**1st**
COURSE TITLE	**GEOCHEMICAL AND GEOPHYSICAL PROSPECTING METHODS IN MINERAL RAW MATERIAL EXPLORATION**		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**ECTS CREDITS**
		3	**6**
COURSE TYPE	Compulsory, specialized general knowledge, skills development		
PREREQUISITE COURSES:	Geochemistry, Geophysics, Ore-Deposit Geology		
LANGUAGE OF INSTRUCTION AND EXAMINATION:	Greek		
THE COURSE IS OFFERED TO ERASMUS STUDENTS ERASMUS	YES, in English		
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/GEOL744/		

(2) LEARNING OUTCOMES AND SKILLS

Learning Outcomes
Upon completion of the course, students: • Understand the fundamental principles of the geochemical and geophysical methods used in mineral exploration. • Acquire knowledge of the geochemical cycle and primary and secondary geochemical environments. • Understand the concept of a geochemical anomaly and the importance of indicator elements in deposit exploration and discovery. • Know the operating principles of the principal geophysical methods for subsurface investigation and their application to the investigation of geological structures and deposits.

Skills	
• Skills in designing geochemical and geophysical surveys for mineral-resource exploration. • Selection of appropriate sampling media and geophysical techniques according to the geological setting and stage of exploration. • Ability to correctly collect, prepare, manage, and evaluate geochemical samples, and to process and visualize geochemical data for the identification of geochemical anomalies. • Ability to process and interpret geophysical measurements and integrate geophysical–geological models for effective deposit investigation.	• Independent work • Teamwork • Searching for, analyzing, and synthesizing data and information, including using the necessary technologies. • Promotion of free, creative, inductive, and critical thinking • Respect for the natural environment • Project planning and management • Decision-making

(3) COURSE CONTENT

The course presents the principal geochemical and geophysical methods used in mineral raw material exploration. It examines the geochemical cycle, geochemical environments, and techniques for sampling and analysis in different media (rocks, soils, sediments, water, vegetation, and gases). It also presents the fundamental principles of geochemical-survey design, the processing and mapping of geochemical data, and the interpretation of geochemical anomalies. In parallel, it analyses the main geophysical methods for subsurface investigation, including electrical and electromagnetic methods, magnetotellurics, ground-penetrating radar and seismic methods, and their applications to the investigation of metallic-mineral deposits and energy resources.

(4) TEACHING AND LEARNING METHODS – ASSESSMENT METHODS

MODE OF DELIVERY	• Face-to-face lectures. • Computer-based data-processing exercises. • Use of the NKUA e-Class platform to disseminate additional information, distribute material, resolve problems, and answer questions, etc.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	**In Teaching:** PowerPoint presentations (posted on the course page in NKUA e-Class and incorporating educational videos related to lecture content). **In Practical Exercises:** ○ PowerPoint presentations for the tutorial component of the Practical Exercises (posted on the course page in NKUA e-Class). They incorporate educational videos related to the lecture content. Communication with students: In addition to personal contact, the communication and blogging functions of NKUA e-Class are used for communication, distribution of material, answering questions, etc.
TEACHING ORGANISATION	***Activity*** — ***Semester Workload*** Lectures — 25 hours Exercises/Assignments — 50 hours Literature study — 60 hours Field exercises — 15 hours Total Course Workload — **150 hours**
STUDENT ASSESSMENT	Assessment is conducted in Greek or English (for international students or Erasmus students). Assessment includes short individual exercises during the semester **(formative assessment, 30%)** and an end-of-semester examination **(summative assessment)** which includes • an oral presentation (20%) and • a written assignment (50%) on a subject related to the course.

(5) RECOMMENDED BIBLIOGRAPHY

- Dentith, M., & Mudge, S.T., 2014, Geophysics for the Mineral Exploration Geoscientist, 454 pp., Cambridge University Press.
- Telford, W.M., Geldart, L.P., & Sheriff, R.E., 1990, Applied Geophysics, 792 pp., Cambridge University Press.
- Talapatra, A.K., 2020, Geochemical Exploration and Modelling of Concealed Mineral Deposits, 201 pp., Springer
- Govett, G.J.S. (ed.), 1983, Rock Geochemistry in Mineral Exploration, Handbook of Exploration Geochemistry, Vol. 3, 461 pp., Elsevier.
- Hawkes, H.E., & Webb, J.S., 2012, Geochemistry in Mineral Exploration: Harper's Geoscience Series, 430 pp., Literary Licensing, LLC.
- Misra, K.C., 2018, Introduction to Geochemistry: Principles and Applications, scientific editors: Argyraki, A., & Stouraiti, C.; translation: Oikonomou, M., Tartas, T., & Frangkiadaki, C., 556 pp., Pedio Publications, in GREEK

RELATED JOURNALS

Geochemistry: Exploration, Environment, Analysis, Journal of Geochemical Exploration, Applied Geochemistry, Exploration Geophysics, Geophysical Prospecting, Geophysics

AE01. Digital mapping and GIS in mineral-deposit exploration

Instructors: Evelpidou, N., Vasilakis, E., Sakellaris, G., Roumpedakis, S., Karkani, A.

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
LEVEL OF STUDIES	7		
COURSE CODE	**AE01**	**SEMESTER**	**1st**
COURSE TITLE	**DIGITAL MAPPING AND GIS IN ORE-DEPOSIT EXPLORATION**		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS CREDITS**
	3	**6**

COURSE TYPE	Elective, specialized general knowledge, skills development
PREREQUISITE COURSES:	Geological Mapping, Ore-Deposit Geology, Petrology, Tectonics
LANGUAGE OF INSTRUCTION AND EXAMINATION:	Greek
THE COURSE IS OFFERED TO ERASMUS STUDENTS ERASMUS	YES, in English
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/GEOL745/

(2) LEARNING OUTCOMES AND SKILLS

Learning Outcomes

Upon completion of the course, students:

- Understand the fundamental principles of digital mapping and Geographic Information Systems (GIS), and their importance in ore-deposit exploration.
- Know the types of geospatial data, coordinate reference systems, map georeferencing, and procedures for creating and managing geodatabases.
- Have knowledge of tools for analyzing and visualizing geological data, as well as the capabilities for compiling thematic maps and three-dimensional visualization of geological information.

Skills

- Skills in collecting, processing, and managing geospatial data derived from fieldwork, remote sensing, and other geoscientific sources.
- Ability to create and organize geodatabases and to digitize and vectorize maps.
- Spatial analysis of geological, geochemical, and geophysical information in a GIS environment.
- Ability to integrate different layers of geospatial information.
- Use of spatial-analysis tools, digital elevation models, and data from modern technologies (e.g., UAV and LiDAR) to support mineral-resource exploration and evaluation.

- Independent work
- Teamwork
- Searching for, analyzing, and synthesizing data and information, including using the necessary technologies.
- Promotion of free, creative, inductive, and critical thinking
- Respect for the natural environment
- Project planning and management
- Decision-making

(3) COURSE CONTENT

The course introduces the fundamental concepts and applications of digital mapping and GIS in ore-deposit exploration. It presents the types of geospatial data, map base layers, coordinate reference systems, and map georeferencing and digitization procedures. It examines techniques for collecting and processing digital field data and applications of modern technologies such as UAV and LiDAR. It also presents tools for spatial analysis, geodatabase creation, geological data processing, and compilation of thematic maps and three-dimensional models in a GIS environment to support ore-deposit exploration.

(4) TEACHING AND LEARNING METHODS – ASSESSMENT METHODS

MODE OF DELIVERY	• Face-to-face lectures. • Computer-based data-processing exercises. • Use of the NKUA e-Class platform to disseminate additional information, distribute material, resolve problems, and answer questions, etc.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	**In Teaching:** PowerPoint presentations (posted on the course page in NKUA e-Class and incorporating educational videos related to lecture content). **In Practical Exercises:** o PowerPoint presentations for the tutorial component of the Practical Exercises (posted on the course page in NKUA e-Class). They incorporate educational videos related to the lecture content. Communication with students: In addition to personal contact, the communication and blogging functions of NKUA e-Class are used for communication, distribution of material, answering questions, etc.
TEACHING ORGANISATION	***Activity*** — ***Semester Workload*** Lectures — 25 hours Exercises/Assignments — 50 hours Literature study — 60 hours Field exercises — 15 hours Total Course Workload — **150 hours**
STUDENT ASSESSMENT	Assessment is conducted in Greek or English (for international students or Erasmus students). Assessment includes short individual exercises during the semester **(formative assessment, 30%)** and an end-of-semester examination **(summative assessment)** which includes • an oral presentation (20%) and • a written assignment (50%) on a subject related to the course.

(5) RECOMMENDED BIBLIOGRAPHY

- Evelpidou, N., Tzouxanioti, M., Karkani, A., 2023. Geographic Information Systems from Theory to Practice: Using ArcGIS Pro. Kallipos, Open Academic Editions. https://dx.doi.org/10.57713/kallipos-367 [EUDOXUS Code: 127532912] in GREEK
- Evelpidou, N., Tzouxanioti, M., Karkani, A., 2022, Geographic Information Systems, [EUDOXUS Code: 102072040] in GREEK
- Evelpidou, N., Antoniou, V., 2015. Geographic Information Systems. ISBN: 978-960-603-164-9, 158 pp. (e-book: PDF, e-pub) [EUDOXUS Code: 320066] in GREEK

RELATED JOURNALS

Remote Sensing, GIS and Remote Sensing Journal, Journal of Geographic Information System, Transactions in GIS.

AE02. Applications of Microscopy in the Exploration and Evaluation of Mineral Raw Materials

Instructors: Papoutsa, A., Georgatou, A., Voudouris, P., Vasilatos, C., Mavrogonatos, K., Pomonis, P., Papadopoulos, A.

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
LEVEL OF STUDIES	7		
COURSE CODE	**AE02**	**SEMESTER**	**1st**
COURSE TITLE	**APPLICATIONS OF MICROSCOPY IN THE EXPLORATION AND EVALUATION OF MINERAL RAW MATERIALS**		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**ECTS CREDITS**
		3	**6**
COURSE TYPE	Elective, specialized general knowledge, skills development		
PREREQUISITE COURSES:	Knowledge of Mineralogy, Petrology and Ore-Deposit Geology		
LANGUAGE OF INSTRUCTION AND EXAMINATION:	Greek		
THE COURSE IS OFFERED TO ERASMUS STUDENTS ERASMUS	YES, in English		
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/GEOL746/		

(2) LEARNING OUTCOMES AND SKILLS

Learning Outcomes	
Upon completion of the course, students: • Understand the fundamental principles and capabilities of optical and electron microscopy in the study of ores and minerals. • Know the mineralogical and textural characteristics of different deposit types and their importance for interpreting the geological processes that led to their formation. • Have knowledge of the relationships between ore and rock-forming minerals and of alteration zones. • Understand how the conditions of deposit formation are investigated through the study of fluid inclusions.	
Skills	
• Skills in microscopic identification and characterization of metallic and non-metallic minerals in thin and polished sections. • Use of electron-microscopy and microanalysis techniques. • Interpretation of the mineralogical and textural characteristics of ores to identify deposit-forming processes and evaluate the quality and technological behavior of mineral raw materials. • Ability to relate ore mineralogy and texture to issues of exploitation, metallurgical processing, and environmental management.	• Independent work • Teamwork • Searching for, analyzing, and synthesizing data and information, including using the necessary technologies. • Promotion of free, creative, inductive, and critical thinking • Respect for the natural environment • Project planning and management • Decision-making

(3) COURSE CONTENT

The course presents applications of optical and electron microscopy in the study and evaluation of mineral raw materials. It examines the mineralogical and textural characteristics of ores and their importance for understanding deposit-genesis models in different geological settings, including magmatic, hydrothermal, sedimentary, metamorphic, and metasomatic systems. It also presents methods for studying fluid inclusions and the relationships between ore and rock-forming minerals, as well as the importance of mineralogy and textural characteristics in mining utilization, metallurgical processing, and environmental evaluation of mineral raw materials.

(4) TEACHING AND LEARNING METHODS – ASSESSMENT METHODS

MODE OF DELIVERY	• Face-to-face lectures. • Computer-based data-processing exercises. • Use of the NKUA e-Class platform to disseminate additional information, distribute material, resolve problems, and answer questions, etc.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	**In Teaching:** PowerPoint presentations (posted on the course page in NKUA e-Class and incorporating educational videos related to lecture content). **In Practical Exercises:** o PowerPoint presentations for the tutorial component of the Practical Exercises (posted on the course page in NKUA e-Class). They incorporate educational videos related to the lecture content. Communication with students: In addition to personal contact, the communication and blogging functions of NKUA e-Class are used for communication, distribution of material, answering questions, etc.
TEACHING ORGANISATION	***Activity*** — ***Semester Workload*** Lectures — 25 hours Exercises/Assignments — 65 hours Literature study — 60 hours Total Course Workload — **150 hours**
STUDENT ASSESSMENT	Assessment is conducted in Greek or English (for international students or Erasmus students). Assessment includes short individual exercises during the semester **(formative assessment, 30%)** and an end-of-semester examination **(summative assessment)** which includes • an oral presentation (20%) and • a written assignment (50%) on a subject related to the course.

(5) RECOMMENDED BIBLIOGRAPHY

- Nesse, W.D., 2013, Introduction to Optical Mineralogy, 4th ed., 361 pp., New York, Oxford University Press.
- Taylor, R.G., 2009, Ore Textures: Recognition and Interpretation, 282 pp., Dordrecht–Heidelberg–London–New York, Springer-Verlag Berlin Heidelberg.

RELATED JOURNALS

Economic Geology Journal, Society of Economic Geologists, Mineralium Deposita-International Journal for Geology, Mineralogy and Geochemistry of Mineral Deposits, Ore Geology Reviews, Ore and Energy Resource Geology, Resource Geology

AE03. Mining Activity and Sustainability

Instructors: Megremi, I., Papadopoulos, A., Vasilatos, C., Anastasatou, M., Laskaridis, K., Kydonakis, K., Papoutsa, A.

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
LEVEL OF STUDIES	7		
COURSE CODE	**AE03**	**SEMESTER**	**1st**
COURSE TITLE	**MINING ACTIVITY AND SUSTAINABILITY**		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS CREDITS**
	3	**6**

COURSE TYPE	Elective, specialized general knowledge, skills development
PREREQUISITE COURSES:	Ore-Deposit Geology, General Geology
LANGUAGE OF INSTRUCTION AND EXAMINATION:	Greek
THE COURSE IS OFFERED TO ERASMUS STUDENTS ERASMUS	YES, in English
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/GEOL747/

(2) LEARNING OUTCOMES AND SKILLS

Learning Outcomes

Upon completion of the course, students:

- Understand the fundamental principles of sustainable development and their relationship to mining activity and mineral raw material management.
- Know the United Nations Sustainable Development Goals, the challenges of climate change and strategies for protecting biodiversity.
- Have knowledge of the environmental impacts of mining and metallurgical activities and of circular-economy principles.
- Have knowledge of the institutional and regulatory framework governing mining-waste management and the sustainable development of the mining sector.

Skills

- Skills in evaluating the environmental and social impacts of mining projects and applying tools for the sustainable management of mineral resources.
- Use of methods such as mining-activity life-cycle assessment and preparation of environmental impact assessments.
- Skills in characterizing, sampling, and evaluating mining waste and selecting appropriate management technologies.
- Practical skills in material stabilization and reuse.
- Integration of circular-economy principles into resource and waste management.

- Independent work
- Teamwork
- Searching for, analyzing, and synthesizing data and information, including using the necessary technologies.
- Promotion of free, creative, inductive, and critical thinking
- Respect for the natural environment
- Project planning and management
- Decision-making

(3) COURSE CONTENT

The course examines the relationship between mining activity and sustainable development and natural resource management. It presents the principles of sustainable development, the United Nations Sustainable Development Goals, and issues of climate change, biodiversity protection and environmental governance. It examines the environmental impacts of extraction, beneficiation, and metallurgy, as well as principles of sustainable mining-waste management. It also presents technologies for waste management and utilization, methods for material stabilization and recycling, and the European and national regulatory framework governing mining activity and environmental protection.

(4) TEACHING AND LEARNING METHODS – ASSESSMENT METHODS

MODE OF DELIVERY	• Face-to-face lectures. • Computer-based data-processing exercises. • Use of the NKUA e-Class platform to disseminate additional information, distribute material, resolve problems, and answer questions, etc.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	**In Teaching:** PowerPoint presentations (posted on the course page in NKUA e-Class and incorporating educational videos related to lecture content). **In Practical Exercises:** o PowerPoint presentations for the tutorial component of the Practical Exercises (posted on the course page in NKUA e-Class). They incorporate educational videos related to the lecture content. Communication with students: In addition to personal contact, the communication and blogging functions of NKUA e-Class are used for communication, distribution of material, answering questions, etc.
TEACHING ORGANISATION	***Activity*** — ***Semester Workload*** Lectures — 25 hours Exercises/Assignments — 65 hours Literature study — 60 hours Total Course Workload — **150 hours**
STUDENT ASSESSMENT	Assessment is conducted in Greek or English (for international students or Erasmus students). Assessment includes short individual exercises during the semester **(formative assessment, 30%)** and an end-of-semester examination **(summative assessment)** which includes • an oral presentation (20%) and • a written assignment (50%) on a subject related to the course.

(5) RECOMMENDED BIBLIOGRAPHY

- Lodhia, S.K. (ed.), 2020, Mining and Sustainable Development: Current Issues, 1st ed., 274 pp., London, Routledge.
- Biggs, T., 2025, Mining: Why It's Essential for a Sustainable Future, 1st ed., 224 pp., Cambridge, Polity Press.
- Gorai, A.K., & Nimaje, D.S. (eds.), 2017, Sustainable Mining Practices, 260 pp., New Delhi, Narosa Publishing House.
- UNDP & UN Environment, 2018, *Managing Mining for Sustainable Development: A Sourcebook*, 230 pp., Bangkok, United Nations Development Programme.

RELATED JOURNALS

Journal of Sustainable Mining; International Journal of Mining, Reclamation and Environment; Mining (MDPI); Mining, Metallurgy & Exploration; Journal of Mining and Environment; Journal of Sustainable Mining and Industry; Sustainability (MDPI).

Second-semester courses

BY01. Introduction to Mining Project Management – Health and Safety in Exploration and Mining

Instructors: Pavloudakis, F., Roumpos, C., Vasilatos, C., Roumpedakis

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
LEVEL OF STUDIES	7		
COURSE CODE	**BY01**	**SEMESTER**	**2nd**
COURSE TITLE	**INTRODUCTION TO MINING PROJECT MANAGEMENT – HEALTH AND SAFETY IN EXPLORATION AND EXTRACTION**		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**ECTS CREDITS**
		3	**6**
COURSE TYPE	Compulsory, general background, specialized general knowledge, skills development		
PREREQUISITE COURSES:	Ore-Deposit Geology		
LANGUAGE OF INSTRUCTION AND EXAMINATION:	Greek		
THE COURSE IS OFFERED TO ERASMUS STUDENTS ERASMUS	YES, in English		
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/GEOL748/		

(2) LEARNING OUTCOMES AND SKILLS

Learning Outcomes	
Upon completion of the course, students: • Understand the structure and operation of mining projects from the exploration stage through production and the operation of mining facilities. • Know the fundamental concepts of mining data management, investment appraisal, and the economic organization of mining projects. • Have knowledge of health and safety principles in mining activity, the relevant legislation, and risk-management procedures during mineral raw material exploration, extraction, and processing.	
Skills	
• Skills in the basic design and evaluation of mining projects, including analysis of economic parameters, assessment of investment viability, and preparation of business plans in the mining sector. • Ability to identify and evaluate risks associated with mining activities and apply procedures for occupational-risk prevention and management. • Ability to apply health, safety and environmental-protection rules when designing and implementing mineral-resource exploration and exploitation activities.	• Independent work • Teamwork • Searching for, analyzing, and synthesizing data and information, including using the necessary technologies. • Promotion of free, creative, inductive, and critical thinking • Respect for the natural environment • Project planning and management • Decision-making

(3) COURSE CONTENT

The course introduces the fundamental principles of mining project management and the operating procedures of mining facilities from exploration through production. It presents concepts such as the distinction between ore and waste rock, determination of the cut-off grade and mining reconciliation. It also examines fundamental principles of business planning, investment appraisal and the organization of mining enterprises. In parallel, it analyses the principles of risk management, health and safety legislation in mining activity, and procedures for preventing and addressing occupational risks during mineral raw material exploration, extraction, and processing.

(4) TEACHING AND LEARNING METHODS – ASSESSMENT METHODS

MODE OF DELIVERY	• Face-to-face lectures. • Computer-based data-processing exercises. • Use of the NKUA e-Class platform to disseminate additional information, distribute material, resolve problems, and answer questions, etc.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	**In Teaching:** PowerPoint presentations (posted on the course page in NKUA e-Class and incorporating educational videos related to lecture content). **In Practical Exercises:** o PowerPoint presentations for the tutorial component of the Practical Exercises (posted on the course page in NKUA e-Class). They incorporate educational videos related to the lecture content. Communication with students: In addition to personal contact, the communication and blogging functions of NKUA e-Class are used for communication, distribution of material, answering questions, etc.
TEACHING ORGANISATION	***Activity*** — ***Semester Workload*** Lectures — 25 hours Exercises/Assignments — 65 hours Literature study — 60 hours Total Course Workload — **150 hours**
STUDENT ASSESSMENT	Assessment is conducted in Greek or English (for international students or Erasmus students). Assessment includes short individual exercises during the semester **(formative assessment, 30%)** and an end-of-semester examination **(summative assessment)** which includes • an oral presentation (20%) and • a written assignment (50%) on a subject related to the course.

(5) RECOMMENDED BIBLIOGRAPHY

- Darling, P. (ed.), 2011, SME Mining Engineering Handbook, 3rd ed., 2 volumes, 1,984 pp., Englewood, Colorado, Society for Mining, Metallurgy & Exploration.
- You, G.G., 2024, Mining Project Value Optimization, 1st ed., 194 pp., Singapore, Springer Singapore.
- Ministry of Environment, Energy and Climate Change, 2011, Regulation on Mining and Quarrying Operations (KMLE), Ministerial Decision D7/A/oik. 12050/2223/2011, Government Gazette 1227/B/14-06-2011, Athens, National Printing Office, in GREEK
- Karmis, M. (ed.), 2001, Mine Health and Safety Management, 452 pp., Littleton, Colorado, Society for Mining, Metallurgy, and Exploration (SME).

RELATED JOURNALS

Mining (MDPI); Health and Safety in Mining; Canadian Mining Journal; International Journal of Project Management.

BY02. Introduction to Geostatistics – Applications of Geostatistics in mineral exploration, resource estimation and resource management

Instructors: Kapageridis, I., Roumpedakis, Sakellaris, G., Kydonakis, K.

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
LEVEL OF STUDIES	7		
COURSE CODE	**BY02**	**SEMESTER**	**2nd**
COURSE TITLE	**INTRODUCTION TO GEOSTATISTICS – APPLICATIONS OF GEOSTATISTICS IN MINERAL EXPLORATION, RESOURCE ESTIMATION AND RESERVE MANAGEMENT**		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**ECTS CREDITS**
		3	**6**
COURSE TYPE	Compulsory, general background, specialized general knowledge, skills development		
PREREQUISITE COURSES:	Ore-Deposit Geology, Mathematics, Introduction to Statistics, Digital Mapping, Ore-Deposit Geology of Critical and Strategic Mineral Raw Materials		
LANGUAGE OF INSTRUCTION AND EXAMINATION:	Greek		
THE COURSE IS OFFERED TO ERASMUS STUDENTS ERASMUS	YES, in English		
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/GEOL749/		

(2) LEARNING OUTCOMES AND SKILLS

Learning Outcomes	
Upon completion of the course, students: • Understand the fundamental principles of statistics and geostatistics and their importance in geological data analysis and deposit evaluation. • Are familiar with concepts such as probability distributions, correlation, and regression, as well as the fundamental principles of spatial variability and structural analysis using variograms. • Possess knowledge of the principal methods for grade estimation and resource calculation, as well as three-dimensional geological modelling of deposits.	
Skills	
• Skills in processing and evaluating geological and drilling data (geochemical, geophysical, lithological, and technical) using statistical and geostatistical methods. • Structural analysis of spatial data, construction, and fitting of variogram models, and application of estimation methods such as kriging to calculate grades and resources. • Creation of three-dimensional geological deposit models, estimation of mineral reserves, and use of geostatistical tools to support the design and optimal management of mining projects.	• Independent work • Teamwork • Searching for, analyzing, and synthesizing data and information, including using the necessary technologies. • Promotion of free, creative, inductive, and critical thinking • Respect for the natural environment • Project planning and management • Decision-making

(3) COURSE CONTENT

The course presents the fundamental principles of statistics and geostatistics and their applications to mineral exploration and resource estimation. It examines concepts of probability and descriptive statistics, as well as methods for analyzing spatial variability, including variograms and variogram models. It presents grade-estimation methods such as kriging, together with techniques of multivariate analysis and geostatistical simulation. It also examines procedures for processing drilling data, three-dimensional geological deposit modelling and calculation of mineral reserves in grid and block models, as well as fundamental principles of mine design in accordance with international reporting standards.

(4) TEACHING AND LEARNING METHODS – ASSESSMENT METHODS

MODE OF DELIVERY	• Face-to-face lectures. • Computer-based data-processing exercises. • Use of the NKUA e-Class platform to disseminate additional information, distribute material, resolve problems, and answer questions, etc.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	**In Teaching:** PowerPoint presentations (posted on the course page in NKUA e-Class and incorporating educational videos related to lecture content). **In Practical Exercises:** o PowerPoint presentations for the tutorial component of the Practical Exercises (posted on the course page in NKUA e-Class). They incorporate educational videos related to the lecture content. Communication with students: In addition to personal contact, the communication and blogging functions of NKUA e-Class are used for communication, distribution of material, answering questions, etc.
TEACHING ORGANISATION	***Activity*** — ***Semester Workload*** Lectures — 25 hours Exercises/Assignments — 65 hours Literature study — 60 hours Total Course Workload — **150 hours**
STUDENT ASSESSMENT	Assessment is conducted in Greek or English (for international students or Erasmus students). Assessment includes short individual exercises during the semester **(formative assessment, 30%)** and an end-of-semester examination **(summative assessment)** which includes • an oral presentation (20%) and • a written assignment (50%) on a subject related to the course.

(5) RECOMMENDED BIBLIOGRAPHY

- Kapageridis, I.K., 2006, Introduction to Geostatistics, 238 pp., Athens, Ion Publications, in GREEK
- Goovaerts, P., 1997, Geostatistics for Natural Resources Evaluation, Applied Geostatistics Series, 496 pp., Oxford University Press.
- Yarus, J.M., & Chambers, R.L. (eds.), 1994, Stochastic Modeling and Geostatistics: Principles, Methods, and Case Studies, AAPG Computer Applications in Geology, Vol. 3, 379 pp., American Association of Petroleum Geologists.
- Isaaks, E.H., & Srivastava, R.M., 1989, An Introduction to Applied Geostatistics, 561 pp., Oxford University Press.
- McKillup, S., & Dyar, M.D., 2010, Geostatistics Explained: An Introductory Guide for Earth Scientists, xvi + 396 pp., Cambridge–New York, Cambridge University Press.
- Emery, X., & Séguret, S.A., 2020, Geostatistics for the Mining Industry: Applications to Porphyry Copper Deposits, 1st ed., 272 pp., Boca Raton–London–New York, CRC Press/Taylor & Francis.

RELATED JOURNALS

Geostatistics; Journal of Geovisualization and Spatial Analysis

BY03. Hydrocarbon reservoirs and geological storage of CO_2

Instructors: Kontakiotis, G., Antonarakou, A., Kati, M., Koutsovitis, P., Kalaitzidis, S.

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
LEVEL OF STUDIES	7		
COURSE CODE	**BY03**	**SEMESTER**	**2nd**
COURSE TITLE	**HYDROCARBON RESERVOIRS AND GEOLOGICAL STORAGE OF CO_2**		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**ECTS CREDITS**
		3	**6**
COURSE TYPE	Compulsory, general background, specialized general knowledge, skills development		
PREREQUISITE COURSES:	Sedimentary-Rock Petrology, Geochemistry, Geophysics, Tectonics, Mineralogy		
LANGUAGE OF INSTRUCTION AND EXAMINATION:	Greek		
THE COURSE IS OFFERED TO ERASMUS STUDENTS ERASMUS	YES, in English		
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/GEOL755/		

(2) LEARNING OUTCOMES AND SKILLS

Learning Outcomes

Upon completion of the course, students:

- Understand the role of Carbon Capture and Storage (CCS) in the energy transition and the reduction of greenhouse-gas emissions.
- Know the fundamental components of petroleum systems, the characteristics of geological reservoirs and cap rocks, and the geological structures that act as traps for gas storage.
- Have knowledge of reservoir petrophysical properties and of the geochemical processes occurring during the storage of CO_2 and other gases.
- Know the regulatory framework governing improved geological storage.

Skills

- Skills in evaluating geological formations as potential sites for underground storage of CO_2 or/ and other gases, considering the geological, petrophysical and geochemical characteristics of the reservoirs.
- Interpretation of data relating to structure, porosity, permeability, and behavior of rocks under storage conditions.
- Ability to use simulations to estimate the long-term stability and safety of geological-storage systems.

- Independent work
- Teamwork
- Searching for, analyzing, and synthesizing data and information, including using the necessary technologies.
- Promotion of free, creative, inductive, and critical thinking
- Respect for the natural environment
- Project planning and management
- Decision-making

(3) COURSE CONTENT

The course examines the role of carbon capture and geological storage (CCS) in the energy transition. It presents the fundamental components of petroleum systems, the characteristics of geological reservoirs and cap rocks, and the types of geological traps that permit the underground storage of CO_2, natural gas or/and hydrogen. The course examines the petrophysical properties of the reservoirs, the geochemical interactions between rocks and gases. and aqueous phases and the formation of new mineral phases. It also presents alternative methods of geological storage, simulations of CO_2 storage systems, and the relevant legal and regulatory framework.

(4) TEACHING AND LEARNING METHODS – ASSESSMENT METHODS

MODE OF DELIVERY	• Face-to-face lectures. • Computer-based data-processing exercises. • Use of the NKUA e-Class platform to disseminate additional information, distribute material, resolve problems, and answer questions, etc.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	**In Teaching:** PowerPoint presentations (posted on the course page in NKUA e-Class and incorporating educational videos related to lecture content). **In Practical Exercises:** o PowerPoint presentations for the tutorial component of the Practical Exercises (posted on the course page in NKUA e-Class). They incorporate educational videos related to the lecture content. Communication with students: In addition to personal contact, the communication and blogging functions of NKUA e-Class are used for communication, distribution of material, answering questions, etc.
TEACHING ORGANISATION	***Activity*** — ***Semester Workload*** Lectures — 25 hours Exercises/Assignments — 65 hours Literature study — 60 hours Total Course Workload — **150 hours**
STUDENT ASSESSMENT	Assessment is conducted in Greek or English (for international students or Erasmus students). Assessment includes short individual exercises during the semester **(formative assessment, 30%)** and an end-of-semester examination **(summative assessment)** which includes • an oral presentation (20%) and • a written assignment (50%) on a subject related to the course.

(5) RECOMMENDED BIBLIOGRAPHY

- Ktenas, D., Kosmidou, V., & Spinos, S., 2020, Underground Geological Storage of CO_2 and Natural Gas in the in Greece, technical report, 71 pp., Hellenic Hydrocarbon Resources Management — HHRM. in GREEK
- Ahmed, T., 2010, Reservoir Engineering Handbook, 4th ed., 1.472 pp., Gulf Professional Publishing/Elsevier.
- Jahn, F., Cook, M., & Graham, M., 2008, Hydrocarbon Exploration and Production, 2nd ed., Developments in Petroleum Science, Vol. 55, 456 pp., Elsevier Science.
- Lee, K.S., Cho, J., & Lee, J.H., 2020, *CO_2* Storage Coupled with Enhanced Oil Recovery, 1st ed.,111 pp., Springer.
- Surdam, R.C. (ed.), 2013, Geological CO_2 Storage Characterization: The Key to Deploying Clean Fossil Energy Technology, 1st ed., 301 pp.., New York, Springer.
- Saini, D., 2017, Engineering Aspects of Geologic CO_2 Storage: Synergy between Enhanced Oil Recovery and Storage, Springer Briefs in Petroleum Geoscience & Engineering, 1st ed., 73 pp., Springer.

RELATED JOURNALS

Energy and Fuels; International Journal of Greenhouse Gas Control; Journal of Petroleum Geology

BY04. Geotechnical assessment of open excavations and underground works

Instructors: Papadopoulos, A., Stavropoulou, M., Roumpos, C., Pavloudakis, Roumpedakis, S., Exadaktylos, G.

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
LEVEL OF STUDIES	7		
COURSE CODE	**BY04**	**SEMESTER**	**2nd**
COURSE TITLE	**GEOTECHNICAL ASSESSMENT OF OPEN EXCAVATIONS AND UNDERGROUND WORKS**		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**ECTS CREDITS**
		3	**6**
COURSE TYPE	Compulsory, general background, specialized general knowledge, skills development		
PREREQUISITE COURSES:	Engineering Geology, Ore-Deposit Geology		
LANGUAGE OF INSTRUCTION AND EXAMINATION:	Greek		
THE COURSE IS OFFERED TO ERASMUS STUDENTS ERASMUS	YES, in English		
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/GEOL750/		

(2) LEARNING OUTCOMES AND SKILLS

Learning Outcomes	
Upon completion of the course, students: • Understand the fundamental principles of engineering geology and geotechnical engineering relating to the design and operation of extractive projects. • Know the classification of geotechnical soil and rock-mass types, their properties and behavior during excavation and exploitation. • Acquire knowledge of the principal open-pit and underground mining methods, mining-project design parameters, and failure and stability mechanisms in slopes and underground excavations.	
Skills	
• Skills in evaluating the geotechnical parameters that affect the design and safety of extractive projects. • Use of laboratory and in-situ tests to characterize soils and rock masses, analyze the stability of slopes and underground excavations, and design stabilization measures. • Ability in the design and scheduling of open-pit and underground operations and in selecting appropriate extraction methods. • Ability to monitor geotechnical hazards, contributing to the safe and efficient utilization of mineral resources.	• Independent work • Teamwork • Searching for, analyzing, and synthesizing data and information, including using the necessary technologies. • Promotion of free, creative, inductive, and critical thinking • Respect for the natural environment • Project planning and management • Decision-making

(3) COURSE CONTENT

The course examines the geotechnical parameters affecting the design and operation of extractive projects. It presents the classification of geotechnical soil and rock-mass types, laboratory and in-situ characterization tests, and the assessment of geological hazards in mining projects. It analyses the principal open-pit and underground mining methods, the design and scheduling of extraction operations, and the factors affecting the selection of mining methods. It also presents methods for analyzing and assessing the stability of slopes and underground excavations, techniques for supporting and stabilizing rock masses, and measures for addressing geotechnical hazards such as landslides and groundwater inflows.

(4) TEACHING AND LEARNING METHODS – ASSESSMENT METHODS

MODE OF DELIVERY	• Face-to-face lectures. • Computer-based data-processing exercises. • Use of the NKUA e-Class platform to disseminate additional information, distribute material, resolve problems, and answer questions, etc.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	**In Teaching:** PowerPoint presentations (posted on the course page in NKUA e-Class and incorporating educational videos related to lecture content). **In Practical Exercises:** ○ PowerPoint presentations for the tutorial component of the Practical Exercises (posted on the course page in NKUA e-Class). They incorporate educational videos related to the lecture content. Communication with students: In addition to personal contact, the communication and blogging functions of NKUA e-Class are used for communication, distribution of material, answering questions, etc.
TEACHING ORGANISATION	***Activity*** — ***Semester Workload*** Lectures — 25 hours Exercises/Assignments — 65 hours Literature study — 60 hours Total Course Workload — **150 hours**
STUDENT ASSESSMENT	Assessment is conducted in Greek or English (for international students or Erasmus students). Assessment includes short individual exercises during the semester **(formative assessment, 30%)** and an end-of-semester examination **(summative assessment)** which includes • an oral presentation (20%) and • a written assignment (50%) on a subject related to the course.

(5) RECOMMENDED BIBLIOGRAPHY

- Komodromos, E.M., 2006, Construction and Mechanics of Tunnels and Underground Works, 124 pp., Chania, University of Thessaly. Ahmed, T., 2010, Reservoir Engineering Handbook, 4th ed., 1,472 pp., Gulf Professional Publishing/Elsevier, in GREEK
- Tatiya, R.R., 2013, Surface and Underground Excavations: Methods, Techniques and Equipment, 2nd ed., 886 pp., Boca Raton–London–New York, CRC Press/Taylor & Francis.
- Stacey, T.R., & Swart, A.H., 2001, Practical Rock Engineering Practice for Shallow and Opencast Mines, 65 pp., Johannesburg, The Safety in Mines Research Advisory Committee (SIMRAC).

RELATED JOURNALS

International Journal of Rock Mechanics and Mining Sciences; Rock Mechanics and Rock Engineering; Journal of Rock Mechanics and Geotechnical Engineering; Engineering Geology; Bulletin of Engineering Geology and the Environment; Mining Geotechnics; Geotechnics

BE01. Mining Project Permitting and Environmental Management

Instructors: Vasilatos, C., Stouraiti, C., Zachariadis, P., Xynogalou, S., Lampou, D., Varvitsioti, E., Stavropoulos, X.

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCIENCE			
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT			
LEVEL OF STUDIES	7			
COURSE CODE	**BE01**	**SEMESTER**	**2nd**	
COURSE TITLE	**MINING PROJECT PERMITTING AND ENVIRONMENTAL MANAGEMENT**			
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**ECTS CREDITS**	
		3	**6**	
COURSE TYPE	Elective, general background, specialized general knowledge, skills development			
PREREQUISITE COURSES:	Ore-Deposit Geology, Engineering Geology, Geochemistry			
LANGUAGE OF INSTRUCTION AND EXAMINATION:	Greek			
THE COURSE IS OFFERED TO ERASMUS STUDENTS ERASMUS	YES, in English			
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/GEOL751/			

(2) LEARNING OUTCOMES AND SKILLS

Learning Outcomes

Upon completion of the course, students:

- Understand the institutional, administrative, and economic framework governing the development and operation of mining projects.
- Know the Mining Code, permitting procedures, and the fundamental principles of environmental management in the extractive sector.
- Acquire knowledge of the fundamental principles of economic investment appraisal, business planning and project management.
- Have knowledge of risk-assessment and risk-management procedures in mining activities.

Skills

- Application of permitting and regulatory-compliance procedures for mining projects.
- Analysis of the technical, economic, and environmental parameters affecting the viability of extractive investments, and evaluation of investment projects using fundamental economic indicators and risk analyses.
- Ability to integrate environmental, social and governance (ESG) parameters into the planning of mining activities.
- Application of risk-management and occupational-safety procedures in the mining sector.
- Independent work
- Teamwork
- Searching for, analyzing, and synthesizing data and information, including using the necessary technologies.
- Promotion of free, creative, inductive, and critical thinking
- Respect for the natural environment
- Project planning and management
- Decision-making

(3) COURSE CONTENT

The course presents the institutional, technical, and economic framework governing the permitting and operation of mining projects. It examines the historical development and importance of the mineral-resources industry, the factors affecting mineral availability, and the principal provisions of the Mining Code concerning exploration and exploitation rights. It also presents fundamental principles of business planning, economic investment appraisal and project management in the mining sector, as well as procedures for preparing technical and economic reports in accordance with international standards. In parallel, it analyses environmental management, risk management and occupational safety, together with regulatory requirements for protecting workers, the environment, and local communities.

(4) TEACHING AND LEARNING METHODS – ASSESSMENT METHODS

MODE OF DELIVERY	• Face-to-face lectures. • Computer-based data-processing exercises. • Use of the NKUA e-Class platform to disseminate additional information, distribute material, resolve problems, and answer questions, etc.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	**In Teaching:** PowerPoint presentations (posted on the course page in NKUA e-Class and incorporating educational videos related to lecture content). **In Practical Exercises:** o PowerPoint presentations for the tutorial component of the Practical Exercises (posted on the course page in NKUA e-Class). They incorporate educational videos related to the lecture content. Communication with students: In addition to personal contact, the communication and blogging functions of NKUA e-Class are used for communication, distribution of material, answering questions, etc.
TEACHING ORGANISATION	***Activity*** — ***Semester Workload*** Lectures — 25 hours Exercises/Assignments — 65 hours Literature study — 60 hours Total Course Workload — **150 hours**
STUDENT ASSESSMENT	Assessment is conducted in Greek or English (for international students or Erasmus students). Assessment includes short individual exercises during the semester **(formative assessment, 30%)** and an end-of-semester examination **(summative assessment)** which includes • an oral presentation (20%) and • a written assignment (50%) on a subject related to the course.

(5) RECOMMENDED BIBLIOGRAPHY

- Guide for Conducting Environmental Inspections, Ministry of Environment and Energy, Athens, 2018. in GREEK
- Code of Professional Ethics, National Transparency Authority, July 2022. in GREEK
- National Plan and Programmes for Regular Environmental Inspections, Ministry of Environment and Energy, Athens, 2017. in GREEK
- The practical implementation and operation of the European policies on preventing and combating Environmental Crime, Council of the European Union
- Manual of Permitting Procedures for Projects of Common Interest, Ministry of Economy, Development and Tourism, 2016. in GREEK
- Galanis, P., Environmental Assessment and Permitting, Nomiki Bibliothiki AEETE, 2022. in GREEK
- Kougkolos, A., Karathanasis, S., Environmental Impact Assessment, Tziolas Publications, 2021. in GREEK

RELATED JOURNALS

Environment & Law, Nomiki Bibliothiki.; Resources Policy, Elsevier; Resources, MDPI; Journal of Sustainable Mining, Central Mining Institute – National Research Institute; Sustainable Mining, Springer Nature

BE02. Industrial Minerals and Sustainable Development

Instructors: Vasilatos, C., Megremi, I., Gianni, E., Laskaridis, K., Anastasatou, M., Gkontelitsas, A., Roulia, M.

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
LEVEL OF STUDIES	7		
COURSE CODE	**BE02**	**SEMESTER**	**2nd**
COURSE TITLE	**INDUSTRIAL MINERALS AND SUSTAINABLE DEVELOPMENT**		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**ECTS CREDITS**
		3	**6**
COURSE TYPE	Elective, general background, specialized general knowledge, skills development		
PREREQUISITE COURSES:	Mineralogy, Petrology, Ore-Deposit Geology of Critical and Strategic Mineral Raw Materials		
LANGUAGE OF INSTRUCTION AND EXAMINATION:	Greek		
THE COURSE IS OFFERED TO ERASMUS STUDENTS ERASMUS	YES, in English		
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/GEOL752/		

(2) LEARNING OUTCOMES AND SKILLS

Learning Outcomes	
Upon completion of the course, students: • Understand the role of industrial minerals and rocks in modern industry and their contribution to economic development and the energy transition. • Know the main categories of industrial minerals, their properties, and their principal applications in different industrial sectors. • Acquire knowledge of methods for identifying and evaluating industrial-mineral deposits, their processing and beneficiation procedures, and the environmental and regulatory parameters associated with their utilization.	
Skills	
• Evaluation of the quality and suitability of industrial minerals and rocks for specific industrial applications. • Correlation of the physicochemical and mineralogical characteristics of materials with the requirements of different technological uses and processing methods. • Ability to evaluate technical and environmental parameters during industrial-mineral exploration and exploitation. • Investigation of opportunities for utilizing mining by-products and developing secondary uses within the circular economy.	• Independent work • Teamwork • Searching for, analyzing, and synthesizing data and information, including using the necessary technologies. • Promotion of free, creative, inductive, and critical thinking • Respect for the natural environment • Project planning and management • Decision-making

(3) COURSE CONTENT

The course examines the importance and modern uses of industrial minerals and rocks in the twenty-first century, as well as their contribution to sustainable development and addressing climate change. It presents methods for identifying and evaluating deposits, extraction processes (onshore and offshore), and techniques for processing and beneficiating industrial minerals. It also examines their applications in different industrial sectors, including the production of cement, ceramics, glass, plastics, and other materials, as well as environmental applications and opportunities for utilizing mining by-products. Finally, it presents the development prospects of the industrial minerals and rocks sector in Greece.

(4) TEACHING AND LEARNING METHODS – ASSESSMENT METHODS

MODE OF DELIVERY	• Face-to-face lectures. • Computer-based data-processing exercises. • Use of the NKUA e-Class platform to disseminate additional information, distribute material, resolve problems, and answer questions, etc.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	**In Teaching:** PowerPoint presentations (posted on the course page in NKUA e-Class and incorporating educational videos related to lecture content). **In Practical Exercises:** o PowerPoint presentations for the tutorial component of the Practical Exercises (posted on the course page in NKUA e-Class). They incorporate educational videos related to the lecture content. Communication with students: In addition to personal contact, the communication and blogging functions of NKUA e-Class are used for communication, distribution of material, answering questions, etc.
TEACHING ORGANISATION	***Activity*** — ***Semester Workload*** Lectures — 25 hours Exercises/Assignments — 65 hours Literature study — 60 hours Total Course Workload — **150 hours**
STUDENT ASSESSMENT	Assessment is conducted in Greek or English (for international students or Erasmus students). Assessment includes short individual exercises during the semester **(formative assessment, 30%)** and an end-of-semester examination **(summative assessment),** which includes • an oral presentation (20%) and • a written assignment (50%) on a subject related to the course.

(5) RECOMMENDED BIBLIOGRAPHY

- Ciullo A.P., 1996, Industrial minerals and their uses. A Handbook & Formulary, 647 pages, Elsevier.
- I.G.M.E., 2011, Greece's Mineral Wealth – New Development Opportunities for Sustainable and Productive Investments. in GREEK
- Tsirambidis, A., 2005, The Mineral Wealth of Greece. Giachoudi I.K.E. Publications. in GREEK

RELATED JOURNALS

Industrial Minerals; Sustainability (MDPI); Waste and biomass valorisation; Cement and concrete composites; International Journal of Mineral Processing; Resources, Conservation & Recycling; Recycling (MDPI)

BE03. Tectonics in the Exploration and Exploitation of Mineral Raw Materials

Instructors: Soukis, K., Laskari, S., Moustaka, E., Roumpedakis, S., Koutsovitis, P.

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
LEVEL OF STUDIES	7		
COURSE CODE	**BE03**	**SEMESTER**	**2nd**
COURSE TITLE	**TECTONICS IN MINERAL RAW MATERIAL EXPLORATION AND EXPLOITATION**		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**ECTS CREDITS**
		3	**6**
COURSE TYPE	Elective, general background, specialized general knowledge, skills development		
PREREQUISITE COURSES:	Tectonics, Ore-Deposit Geology		
LANGUAGE OF INSTRUCTION AND EXAMINATION:	Greek		
THE COURSE IS OFFERED TO ERASMUS STUDENTS ERASMUS	YES, in English		
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/GEOL753/		

(2) LEARNING OUTCOMES AND SKILLS

Learning Outcomes

Upon completion of the course, students:

- Understand the role of tectonics in the genesis, distribution, and discovery of mineral raw material deposits.
- Understand the relationship between geotectonic settings and metallogenesis, and the principal tectonic structures associated with the formation and control of deposits.
- Acquire knowledge of the principal methods of tectonic analysis and the importance of structural data in interpreting geological processes and investigating metallogenic systems.

Skills

- Recognition and mapping of tectonic structures associated with deposit genesis and discovery.
- Collection and analysis of structural data in the field, and measurement and interpretation of structural elements in geological sections and drill cores.
- Statistical processing and visualization of structural data.
- Ability to use tectonic information to identify potential metallogenic targets and support geological mineral-resource exploration.
- Independent work
- Teamwork
- Searching for, analyzing, and synthesizing data and information, including using the necessary technologies.
- Promotion of free, creative, inductive, and critical thinking
- Respect for the natural environment
- Project planning and management
- Decision-making

(3) COURSE CONTENT

The course examines the role of tectonic processes and structures in the genesis and distribution of mineral raw material deposits. It presents the relationship of deposit types to different geotectonic settings and analyses tectonic structures associated with metallogenic systems, such as fault zones, volcanic structures, and metamorphic core complexes. It also examines tectonic structures controlling the emplacement and crystallization of magmatic bodies and their importance in hydrothermal and sedimentary systems. Methods for measuring and analyzing structural elements in the field and in drill cores are presented, together with techniques for statistical processing and visualization of structural data.

(4) TEACHING AND LEARNING METHODS – ASSESSMENT METHODS

MODE OF DELIVERY	• Face-to-face lectures. • Computer-based data-processing exercises. • Use of the NKUA e-Class platform to disseminate additional information, distribute material, resolve problems, and answer questions, etc.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	**In Teaching:** PowerPoint presentations (posted on the course page in NKUA e-Class and incorporating educational videos related to lecture content). **In Practical Exercises:** o PowerPoint presentations for the tutorial component of the Practical Exercises (posted on the course page in NKUA e-Class). They incorporate educational videos related to the lecture content. Communication with students: In addition to personal contact, the communication and blogging functions of NKUA e-Class are used for communication, distribution of material, answering questions, etc.
TEACHING ORGANISATION	***Activity*** — ***Semester Workload*** Lectures — 25 hours Exercises/Assignments — 65 hours Literature study — 60 hours Total Course Workload — **150 hours**
STUDENT ASSESSMENT	Assessment is conducted in Greek or English (for international students or Erasmus students). Assessment includes short individual exercises during the semester **(formative assessment, 30%)** and an end-of-semester examination **(summative assessment)** which includes • an oral presentation (20%) and • a written assignment (50%) on a subject related to the course.

(5) RECOMMENDED BIBLIOGRAPHY

- Julie V. Rowland, David A. Rhys (Eds), Applied Structural Geology of Ore-Forming Hydrothermal Systems, 2020, Reviews in Economic Geology, Vol. 2, Society of Economic Geologists
- Rod Holcombe, 2017, Mapping and Structural Geology in Mineral Exploration
- Roger Marjoribanks, 2010, Geological Methods in Mineral Exploration and Mining, Springer Science & Business Media
- David Pollard, Fundamentals of Structural Geology, Cambridge University Press, 2005
- Soumyajit Mukherjee, Atlas of Structural Geology, Elsevier Science Publishing Co Inc, 2020

RELATED JOURNALS

Economic Geology Journal, Society of Economic Geologists ; Mineralium Deposita ; International Journal for Geology ; Mineralogy and Geochemistry of Mineral Deposits; Ore Geology Reviews ; Resource Geology; Geology of Ore Deposits; Springer Nature; Journal of Structural Geology, Elsevier; Tectonics, AGU

Third-semester courses

MT – Master's Thesis

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
LEVEL OF STUDIES	7		
COURSE CODE	**BE03**	**SEMESTER**	**3rd**
COURSE TITLE	**MASTER'S THESIS**		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**ECTS CREDITS**
			30
COURSE TYPE	Compulsory, specialized general knowledge, skills development		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION AND EXAMINATION:	Greek/English		
THE COURSE IS OFFERED TO ERASMUS STUDENTS ERASMUS	No		
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/GEOL754/		

(2) LEARNING OUTCOMES AND SKILLS

Learning Outcomes	
Upon completion of the course, students: • Have studied in depth a specific subject within the scientific fields covered by the MSc Programme; • Have applied the relevant knowledge acquired during their studies and developed their capacity for synthesis. • Have learned to locate appropriate scientific information in the relevant scientific literature. • Have acquired skills in writing a scientific text; and • Have acquired skills in organizing and orally presenting the subject of the thesis.	
Skills	
• Searching for, analyzing, and synthesizing data and information using the necessary technologies and literature. • Independent work • Work in an interdisciplinary environment • Promotion of free, creative, and inductive thinking • Understanding of specialized topics • Preparation and oral presentation of the thesis	• Respect for the natural environment • Project planning and management • Decision-making

(3) COURSE CONTENT

Formulation of a research question; research design; literature search and review; structuring the methodology; data collection and implementation of the methodology; processing of results; writing the thesis; oral presentation of the thesis.

(4) TEACHING AND LEARNING METHODS – ASSESSMENT METHODS

MODE OF DELIVERY	Individual meetings between the supervisor and the student. Primarily independent work organized and monitored by the supervisor.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	Use of the internet, electronic libraries and databases, reference-management software, and other specialized software depending on the research subject.
TEACHING ORGANISATION	***Activity*** — ***Semester Workload*** Supervised study — 150 hours Independent study — 300 hours Laboratory and computational research — 200 hours Thesis writing — 70 hours Presentation preparation — 30 hours **Total Course Workload — 750 hours**
STUDENT ASSESSMENT	The student presents the thesis in a public presentation and submits its written text to the three-member examination committee. The final assessment is determined by the three-member committee.

(5) RECOMMENDED BIBLIOGRAPHY

The recommended bibliography is determined by the research subject of the Master's thesis in consultation with the supervisor.