DEPARTMENT of
Geology and Geoenvironment

PROGRAM OF UNDERGRADUATE STUDIES
COURSE UNITS OUTLINES

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COURSE UNITS: 1st Semester

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y1201**	**SEMESTER**	**1st**
TITLE	**PHYSICAL GEOGRAPHY AND THE ENVIRONMENT**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures-seminars & laboratory work and exercises, optional fieldwork	**5**	**6**

TYPE OF COURSE	**MANDATORY /** Scientific Area
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek
AVAILABILITY TO ERASMUS STUDENTS	YES (in English)
WEBPAGE (URL)	https://eclass.uoa.gr/courses/GEOL157/

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
On successful completion of the course the student: • **Defines** and **articulates** the natural processes (internal and external) that shape the Earth's topography • **Understand** the mechanisms of natural hazards and **evaluate** ways of dealing with them • **Compares** the impact of the human factor on natural processes, natural resources and the environment in general and **develops** environmental awareness • **Combine** and **interpret** landforms to identify the main morphological structures • **Use** techniques to represent relief morphology in topographic sections • **Recognizes** the processes of submarine topography and relates land and marine morphological features • **Knowledge** of the basic processes of the climate system and the spatial distribution of meteorological phenomena sciences.
Generic Competences
• Ability to apply knowledge in practical situations • Promote free, creative and inductive thinking • Ability to search for, process and analyse information with the use of necessary technologies

• Decision making • Ability to undertake research at an appropriate level • Ability to work in an international context • Commitment to conservation of the environment

(3) COURSE CONTENT

A. Lectures

The content of the course is structured in the following thematic sections:

- History and divisions of Geography (Physical Geography, Mathematical Geography, Anthropogeography)
- Erosion; Corrosion; Landscape formation; Types of landforms;
- Exogenous processes, landform, soil and plants, climate change;
- Landforms and climate;
- Characteristics of submarine terrain, coastal processes, fiord, coral reefs;
- Shape of the Earth; Earth in space; Evolution of the Earth's atmosphere;
- Hydraulic cycle, surface water, rivers, lakes, glaciers;
- Geological structure and landforms
- Environmental and Climate change;
- Topographic maps; Examination and interpretation of aerial photography;
- Physical geography and the environment;
- The atmosphere and the climate; Atmosphere pollution;
- The hydrosphere, coastal and river pollution; Lithosphere degradation and land pollution;
- Land corrosion processes; Biosphere and urban pollution;
- Detection, mapping and managing of environmental changes;
- Pollution in Greece;
- Physical Geography of Greece.

B. Laboratory Exercises:

Exercise 1 Coordinates, Topographic map
Exercise 2 Identify morphological structures on topographic maps.
Exercise 3 Topographic profile and hydrographic network
Exercise 4 Stages of the evolution of erosion and river deposits
Exercise 5 River and Coastal Terraces
Exercise 6 Coastal Morphology: Primary and Secondary
Exercise 7 Mid-examination
Exercise 8 Volcanic Morphology: Stages of the evolution of a volcano, geomorphological features of a volcano, volcanoes in Greece
Exercise 9 Pluton morphology: Stages of the evolution of the plutonic rocks
Exercise 10 Karst landscape: Recognition of karsts
Exercise 11 Landscape caused by landslides: Detection of main fault structures
Exercise 12 Landscape of folded rocks: Syncline and Anticline structures
Exercise 13 Submarine terrain: Geomorphological characteristics of the seafloor, plot of a bathymetric profile
Exercise 14 Final examination

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	IN TEACHING: – Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.

PLANNED LEARNING ACTIVITIES	**Activity** / **Student's effort** Lectures — 39 hours Lab exercises — 18 hours Fieldwork — - Tutorials — - Essay writing — 18 hours Autonomous study — 50 hours Final assessment preparation — 25 hours **Total student effort** — **150** ώρες
ASSESSMENT METHODS AND CRITERIA	**I. LECTURES (50%)** • Final written Exam (summative) The written exam includes Short Answer Questions and Multiple Choice Test **Ii. LABORATORY WORK (50%)** • Weekly Written Essays for every Lab Exercise (formative) • Mid-term examination (formative, summative). or • Final written examination (summative) The written exam includes Short Answer Questions, Multiple Choice Test and Solving Exercises Supplementary material (questions, exercises, etc.) for the exams is posted on the online **e-Class** platform (https://eclass.uoa.gr/courses/GEOL177/).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL
- Vouvalidis K., 2011. Physical Geography (in Greek)

II. ADDITIONAL READING
- Gournelos Th., 2015. Physical Geography and Environment Σημειώσεις (in Greek)
- Robert Christopherson, Ginger H. Birkeland, 2018, Geosystems: An Introduction to Physical Geography, 10th edition
- Joseph Holden 2004, Introduction to Physical Geography and the Environment. Prentice-Hall, London.
- Marsh, William M.; Kaufman, Martin M. (2013). Physical Geography: Great Systems and Global Environments. Cambridge University Press.
- Pidwirny, Michael. (2014). Understanding Physical Geography. Planet Earth Publishing, Kelowna, Canada.

III. JOUNRALS
- Progress in Physical Geography, SAGE publications
- Physical Geography, Taylor & Francis Online
- Bulletin of Geography. Physical Geography Series
- Progress in Physical Geography: Earth and Environment, Sage Journals
- Applied Geography, ScienceDirect.com by Elsevier
- Geojournal, Springer Link

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y1202**	**SEMESTER**	**1st**
TITLE	**PHYSICS**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises	**5**	**6**

TYPE OF COURSE	**MANDATORY /** Background
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek
AVAILABILITY TO ERASMUS STUDENTS	YES (in English)
WEBPAGE (URL)	http://eclass.uoa.gr/courses/PHYS193

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course the student:

- **Identifies** and the fundamental physical quantities
- **Interpret** the basic principles of kinematics, Newtonian dynamics, oscillations, wave mechanics and optics
- **Solves** problems based on the above principles of physics
- **Use**s computers to solve problems
- **Combines** and critically **evaluates** the data and results of the problems to be solved
- Identifies laboratory instruments and uses them to make simple measurements.
- Applies the knowledge acquired to relevant subjects in geology

Generic Competences

- Autonomous work
- Oral and written communication of scientific issues
- Ability to apply knowledge in practical situations
- Work in a team

- Ability to undertake research at an appropriate level
- Adapt to and act in new situations and cope under pressure
- Commitment to conservation of the environment

(3) COURSE CONTENT

A. Lectures:

- Basic concepts of Physics. Physical quantities and measurement standards. Conversion of units. Measurements and uncertainty. Vector and scalar quantities.
- Mechanics: Motion in one and more dimensions. Laws of motion and applications. Work and kinetic energy. Potential energy and conservation of energy. Momentum, impulse and collisions. Rigid object dynamics. Elastic properties of solids.
- Oscillations: Motion of an object attached to a spring. Mathematical representation of Simple Harmonic Motion. Energy of the Simple Harmonic Oscillator. The pendulum. Damped oscillations/ forced oscillations
- Waves: Propagation of a disturbance. Sinusoidal waves. The linear wave equation. Rate of energy transfer by sinusoidal waves. Superposition and interference. Reflection and transmission. Standing waves. Sound waves.
- Optics: Nature of light. Reflection. Refraction. Dispersion and prisms. Geometric optics (image formations, mirrors, lenses). Light waves (interference, diffraction, polarization)

Laboratory work:

Laboratory Exercises are carried out in groups of 2 or 3 students and an individual written assignment is delivered:

- **Exercise 1.** Measurements, uncertainties, errors, graphs
- **Exercise 2.** Measurement of focal length of a converging lens
- **Exercise 3.** Measurement of gravity acceleration with pendulum
- **Exercise 4.** Electric circuit - Ohm's law
- **Exercise 5.** Laser beam wavelength (He-Ne) measured with optical barrier
- **Exercise 6.** Thermocouple Calibration - Thermoelectric Phenomenon
- **Exercise 7.** Internal friction coefficient measurements

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	IN TEACHING: – Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	

Activity	Student's effort
Lectures	39 hours
Lab exercises	14 hours
Fieldwork	–
Tutorials	20 hours
Essay writing	20 hours
Autonomous study	42 hours
Final assessment preparation	15 hours
Total student effort	**150** ώρες

ASSESSMENT METHODS AND CRITERIA	I. LECTURES (**67%**) • Solving exercises in the classroom or at home during the semester (formative) • Written Exam (formative, summative) • Exams include short or extended answer questions and solving exercises and problems. II. LABORATORY EXERCISES (**33%**) • Weekly assessment of written essays for every Laboratory Exercise (formative, summative) Supplementary material for the exams (questions, exercises etc.) is posted on **e-Class** platform (https://eclass.uoa.gr/courses/PHYS193/).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL
- Giancoli, **Physics for Scientists and Engineers, Volume A,** Tziola [EUDOXUS code: 112692104] in Greek
- Giancoli, **Physics for Scientists and Engineers, Volume B**, Tziola [EUDOXUS code: 122074700] in Greek
- Halliday D., Resnick R., Walker J., **Physics,** Gutenberg [Κωδ. ΕΥΔΟΞΟΣ: 41959145] in Greek
- Serway R.A., Jewett J.W., **Physics for Scientists and Engineers, Volume A**, Kleidarithmos [EUDOXUS code: 22750100] in Greek
- Serway R.A., Jewett J.W., **Physics for Scientists and Engineers, Volume B**, Kleidarithmos [EUDOXUS code: 22750112] in Greek
- Young H., Freedman R., **University Physics, Volume A**, Papazisi [EUDOXUS code: 68387911] in Greek
- Young H., Freedman R., **University Physics, Volume B**, Papazisi [EUDOXUS code: 68387930] in Greek

II. ADDITIONAL READING
- Feynman, Leighton, Sands, 1989, **The Feynman Lectures on Physics, Volume A,** California Institute of Technology
- Paul G. Hewitt, 2022, **Conceptual Physics**, 13th ed. Pearson
- R. Shankar, 2014, **Fundamentals of Physics**, Yale University Press

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	SCHOOL OF SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
EDUCATION LEVEL	EQF level 6; NQF of Greece level 6		
CODE	Y1203	SEMESTER	1st
TITLE	CHEMISTRY		

TEACHING ACTIVITIES	HOURS/WEEK	ECTS
Lectures, seminars & laboratory training	5	6

TYPE OF COURSE	**MANDATORY /** Background
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek
AVAILABILITY TO ERASMUS STUDENTS	YES (in English)
WEBPAGE (URL)	e-Class - CHEMISTRY

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

This course introduces the fundamental principles of Chemistry via both a theoretical and a practical approach, and emphasizes the connection between Chemistry and Geology. On completion of the course the student will have the following subject specific competences:

- Understanding of the fundamental principles of chemistry via both a theoretical and a practical approach
- Understanding of the multi-thematic dimension of the subject of Chemistry
- Ability to solve elementary problems related to the basic principles of Chemistry
- Understanding of the connection between Chemistry and Geology
- An elementary skill in Chemistry through the combination of theory and practice (laboratory exercises)

Knowledge

- Knowledge and understanding of the relationship of atomic structure with the Periodic Table
- Knowledge and understanding of atomic, hybrid and molecular orbitals, and chemical bonding
- Knowledge and understanding of intermolecular forces and state of matter
- Knowledge and understanding of the basics of chemical thermodynamics and chemical equilibri-

um (homogeneous and heterogeneous systems)
- Basic knowledge of chemical kinetics and reaction mechanisms
- Knowledge and understanding of acids-bases, pH, indicators, buffers
- Basic knowledge of metal complexes and application to the determination of water hardness
- Basic knowledge of redox reactions, electrode potentials and electrochemical cells
- Basic knowledge of ion determination in solution
- Basic knowledge of organic chemistry (nomenclature, homologous series, chemical bonds, stereochemistry)
- Knowledge and understanding of safety procedures in the chemical laboratory

Skills

- Skills in solving basic Chemistry problems
- Skills in identifying proper methods for simple analyses in Chemistry and Geology
- Skills in evaluation and exploitation of experimental data

Abilities

- Ability to apply the knowledge gained by the students in dealing with problems related to Chemistry and Geology
- Ability to work responsibly and safely in a chemical laboratory
- Ability to evaluate and correlate experimental data with chemical processes and calculate the requested values
- Ability to work with others constructively in a laboratory environment

Generic Competences

- Search, analysis and synthesis of data and information, using the necessary technologies
- Ability to work autonomously
- Ability to work in a team
- Work in a multicultural environment
- Work in an interdisciplinary environment
- Promoting free, creative and inductive thinking
- Ability to make reasoned decisions

(3) COURSE CONTENT

Lectures:

- Atomic Structure and the Periodic Table
- Chemical Bonding and Molecular Structure
- Intermolecular Forces
- States of Matter
- Solutions
- Chemical Thermodynamics
- Chemical Equilibrium
- Chemical Kinetics
- Reaction Mechanisms
- Acid-Base Chemistry
- Metal Complex Compounds
- Redox Chemistry
- Qualitative Analysis
- Introduction to Organic Chemistry

Laboratory training:

- Laboratory safety rules - Laboratory equipment and functions
- Preparation of solutions
- Solubility of salts in water
- Chemical equilibrium

- Heat of reaction
- pH determination - Titration
- Water hardness
- Redox reactions
- Qualitative analysis

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	IN TEACHING: – Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** / **Student's effort** Lectures: 26 hours Laboratory training: 39 hours Studying: 39 hours Homework essays: 39 hours Preparation of evaluation: 7 hours **Total student effort**: **150** ώρες
ASSESSMENT METHODS AND CRITERIA	• **Oral examination** during the laboratory sessions. (formative) • **Evaluation of the laboratory reports** submitted after each laboratory session. (formative, summative) • **Theory and practical examination** (written, and/or oral, when recommended) at the end of the semester. (summative) To pass the Course, a minimum grade **5** (**out of 10**) is necessary in both the **theory and the practical examination at the end of the semester**. The **final grade** is calculated as follows: **0.7 × (theory grade) + 0.3 × (practical grade).** The practical grade includes the grade of the practical examination at the end of the semester, the grade of the oral examination during the laboratory sessions and the grades assigned to the laboratory reports.

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Βασικές Αρχές Ανόργανης Χημείας, Γ. Πνευματικάκης, Χ. Μητσοπούλου, Κ. Μεθενίτης [Κωδ. ΕΥΔΟΞΟΣ: 59396599]
- Γενική χημεία, Chang R., Overby J. [Κωδ. ΕΥΔΟΞΟΣ: 102074446]

II. ADDITIONAL READING

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III. RELATIVE JOURNALS

- Journal of Chemical Education, American Chemical Society

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y1204**	**SEMESTER**	**1st**
TITLE	**INTRODUCTION TO DIFFERENTIAL AND INTEGRAL CALCULUS AND STATISTICS**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
		6	**6**
TYPE OF COURSE	**MANDATORY /** Background		
PREREQUISITES	NONE		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek		
AVAILABILITY TO ERASMUS STUDENTS	YES (in English)		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL535		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
The purpose of the course is for students to acquire the ability to handle basic algebra and analysis tools that will help them in the computational part of their work. In this context, basic concepts of Linear Algebra and Integral and Differential Calculus are taught in this course. After successful completion of the course the student will be able to: • Perform matrix operations and find the inverse of a matrix. • Solve systems of equations using Matrices. • To find the eigenvalues and eigenvectors of a matrix and to square it. • Predict the limits of functions. • Calculate derivatives of functions of one variable and partial derivatives of functions of two or more variables. • Evaluate indefinite, definite, and generalized integrals of functions of one variable. • Calculate double integrals. • To calculate the area of surfaces using an integral. • Calculate volumes of solids using double integrals. • To be able to use the least squares method.

The second aim of the course is to acquaint students with basic concepts and results of Probability and Statistics, with the aim of modeling problems involving randomness in applications from various scientific areas. By successfully attending and completing the course, the student is able to:

- To know the concepts of random experiment, sample space and simple event.
- To know the classical and axiomatic foundations of probability theory as well as its basic properties.
- Know the concept of conditional probability and stochastic independence of possibility and solve probability problems by applying the Theorem of Total Probability and Bayes formula.
- Know the concept of random variable, distribution function and probability density function. To know the most basic discrete and continuous distributions.
- To construct confidence intervals for the unknown parameter of the sampling distribution that will contain it with a certain probability.
- Conduct basic statistical hypothesis tests to draw conclusions about the unknown parameter of the sampling distribution.

Generic Competences

- Promoting free, creative and inductive thinking
- Ability to work autonomously
- Ability for free, creative and inductive thinking
- Ability for analysis and synthesis
- Ability to be critical and self-critical
- Ability to resolve problems

(3) COURSE CONTENT

Introduction to Differential and Integral Calculus

- Basic definitions of matrices, matrix operations, matrix inverse, solving systems using inverses, determinants of matrices, properties of determinants, finding inverse matrix using adjoint, solving systems using Cramer's method, Eigenvalues and eigenvectors - definitions and properties, eigenspaces, Characteristic polynomial, matrix similarity, diagonalization, Cayley-Hamilton Theorem.
- Derivative of a function, geometric interpretation, rules of derivation, derivative of a complex function, limit of a function, l'Hospital rules.
- Indefinite integral- definition and properties, methods of integration.
- Definite integral- definition and properties, calculation of definite integral, Generalized integrals, applications.
- Functions of many variables. Partial derivative, higher order derivatives, calculation of partial derivatives.
- Least squares method.
- Double integral- definition and properties, calculation of double integral (Cartesian-polar coordinates), contour integral, applications.

Statistics

- Sum principle, multiplicative principle, sample space, simple events (intersection, union and difference of events, complementary event, disjoined and independent events, De Morgan formulas), classical definition of Probability (Laplace), axiomatic definition of Probability (Kolmogorov) and properties, probability of complementary events, probability of union of events, conditional probability, Total Probability Theorem, Bayes formula, independence of events, probability of intersection of independent events.
- Random variable, distribution function, probability density function, mean, variance, standard deviation, Poisson distribution, Normal distribution.
- Random sample, sample mean, sample variance, confidence intervals, and hypothesis tests for the mean of the distribution of random sample data.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	IN TEACHING: – Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** / **Student's effort** Lectures: 78 hours Individual Study/ Bibliography Analysis/ Preparation: 97 hours **Total student effort**: **175** ώρες
ASSESSMENT METHODS AND CRITERIA	**Assessment/Marking**: Final written exams in Greek (**100%**)

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- General Mathematics (in Greek), Ch. Massouros, Ch. Tsitouras, ISBN: 9786185066512 [Eudoxus code: 59392755]

II. ADDITIONAL READING

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III. RELATIVE JOURNALS

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COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	SCHOOL OF SCIENCE			
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT			
EDUCATION LEVEL	EQF level 6; NQF of Greece level 6			
CODE	Y1205	SEMESTER		3rd
TITLE	MINERALOGY-CRYSTALLOGRAPHY			
TEACHING ACTIVITIES			HOURS/WEEK	ECTS
Lectures, Lab Exercises			4	6
TYPE OF COURSE	**MANDATORY /** Scientific Area			
CO-REQUISITES	Knowledge of (Y1202).Physics and (Y1203) Chemistry			
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English			
AVAILABILITY TO ERASMUS STUDENTS	YES			
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL314 http://users.uoa.gr/~agodel/Files/courses.html			

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
Minerals are the primary constituents of Earth materials and essential components of the Solar System and the Universe. They are also produced by living organisms to form a variety of biominerals. The fundamental understanding of their structure and composition is crucial for all fields within the Earth & Environmental Sciences. This course aims to provide knowledge on modern Mineralogy-Crystallography needed principally in Geology, and particularly in Petrology/Geochemistry/Ore & Economic Geology. Moreover, to introduce the students to macroscopic, microscopic, analytical, thermal, and X-ray techniques applied in minerals research. On successful completion of the course the student: • **Comprehend** the importance of minerals and Mineralogy to society and to the study of the Earth & Environment and how the properties of chemical elements and their bonds regulate the structure and composition of minerals. • **Describe** the concepts of symmetry, crystallographic axis, unit cell, enantiomorphism/chirality, Quasicrystals, allotropy, polymorphism, solid solutions/isomorphism, exsolution, polytypism, defects/impurities, epitaxy, topotaxy, intergrowths, twinning, mineral growth, refractive index, isotropic/anisotropic, pleochroism, optical axis, uniaxial/biaxial, birefringence/interference color,

thermal behavior of minerals and X-ray diffraction (XRD) patterns of simple/basic minerals (e.g. halite, calcite, quartz),), relevant rocks (e.g. limestone), selected biominerals (e.g. whewellite) and molecular/organic crystals (e.g. sucrose)

- **Apply and Evaluates** specialized (free) software for studying crystal morphology & structure and interpreting powder X-ray diffraction data (WinXMorph, JCrystal, KrystalShaper, Kristall2000, VESTA, PowDLL, QualX2).

Generic Competences

- Ability to search for, process and analyse information with the use of necessary technologies
- Decision making
- Autonomous work
- Work in a team
- Commitment to conservation of the environment
- Promote free, creative and inductive thinking

(3) COURSE CONTENT

A. Lectures

- Introduction to Mineralogy and Materials Science; historical aspects; principles of Crystallography and crystal chemistry; crystalline and amorphous solid materials.
- Unit cell and crystal lattice; geometrical/morphological Crystallography (symmetry, crystal systems, Miller indices, crystallographic symbols, enantiomorphism/chirality, stereographic projection).
- Quasicrystals and related minerals and natural phases; intergrowth and twinning.
- Crystal and mineral nucleation & growth (crystallization), crystal growth inhibition; formation of minerals and growth from melt/magma & hydrothermal solutions, effect of pressure and metamorphic & deep minerals, minerals precipitating in solutions, biominerals.
- Epitaxy, topotaxy, exsolution, phase diagrams.
- Introduction to microscopic techniques (optical microscopy, SEM, TEM, AFM); basic principles of instrumental analysis in mineralogy (X-rays, e-, p+, Laser, MS, ion-beams).
- Optical Crystallography-Mineralogy (polarizing/petrographic microscope, optical properties of minerals, refractive index, isotropic/anisotropic, pleochroism, optical axis, uniaxial/biaxial, birefringence/interference color).
- Introduction to Solid-State Chemistry and structural Crystallography-Mineralogy (crystal structure, defects/impurities & color, solid solutions/isomorphism, allotropy, polymorphism, polytypism).
- X-rays and characterization of materials and minerals by means of powder X-ray diffraction (Bragg's law, X-ray diffraction patterns, unit cell constants); X-ray diffraction using Synchrotron radiation and portable & remote equipments.
- Thermal behaviour of minerals; thermal analyses (TGA, DTA, DSC).
- Selective -free- software for geometrical/morphological crystallography (WinXMorph http://cad4.cpac.washington.edu/WinXMorphHome/WinXMorph.htm; JCrystal & KrystalShaper http://jcrystal.com/; Kristall2000 http://www.kristall2000.de/).
- Selective free software for visualization of crystal structures (VESTA https://jp-minerals.org/vesta/en/).
- Selective -free- software for powder X-ray Diffraction / XRD (PowDLL http://users.uoi.gr/nkourkou/powdll/; QualX2 http://www.ba.ic.cnr.it/softwareic/qualx/).

B. Lab Exercises

Exercise 1. Introduction to the laboratory study of minerals & geomaterials; get familiar with samples of crystalline and amorphous natural and synthetic materials.

Exercise 2. Introduction to geometrical/morphological Mineralogy-Crystallography and macroscopic study of fundamental mineral crystals (e.g. quartz and calcite) and models.

Exercise 3. Geometrical/morphological Mineralogy-Crystallography of Cubic, Tetragonal, Orthorhombic, Monoclinic and Triclinic crystal systems.

Exercise 4. Geometrical/morphological Mineralogy-Crystallography of Trigonal and Hexagonal crystal systems.
Exercise 5. Introduction to the methodology of characterization and analysis of minerals & geo-materials; demonstration of basic instruments (optical microscopes, electron microscopes, Laser spectrometers, X-Ray diffractometers).
Exercise 6. Introduction to structural Mineralogy-Crystallography and to the study of minerals by means of X-Rays (fluorescence, diffraction, absorption); get familiar with the X-Ray Diffractometer.
Exercise 7. Characterization of fundamental minerals and amorphous natural materials by powder X-ray Diffraction (XRD).
Exercise 8. Characterization of synthetic materials by powder X-ray Diffraction (XRD).
Exercise 9. Software -free- (WinXMorph http://cad4.cpac.washington.edu/WinXMorphHome/WinXMorph.htm; JCrystal & KrystalShaper http://jcrystal.com/; Kristall2000 http://www.kristall2000.de/; VESTA https://jp-minerals.org/vesta/en/).
Exercise 10. Software -free- for XRD (PowDLL http://users.uoi.gr/nkourkou/powdll/; QualX2 http://www.ba.ic.cnr.it/softwareic/qualx/).
Exercise 11. Introduction to Optical Mineralogy-Crystallography; get familiar with the transmitted-light (polarized/petrographic) microscope.
Exercise 12. Optical Mineralogy-Crystallography of fundamental minerals.
Exercise 13. Optical Mineralogy-Crystallography.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.

PLANNED LEARNING ACTIVITIES

Activity	Student effort
Lectures	26 hrs
Practice exercises	26 hrs
Seminars	13 hrs
Tutorials	-
Essey writing	40 hrs
Autonomous study	45 hrs
Final assessment preparation	-
Total student's effort	**150** hours

ASSESSMENT METHODS AND CRITERIA	Theory and practical examination (written and/or oral) at the end of the Course To pass the Course, a minimum grade **5** (out of 10) is necessary. Supplementary material for the exams (questions, exercises etc.) is posted on **e-Class** platform (https://eclass.uoa.gr/courses/GEOL314/).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- GODELITSAS A. and PAPOULIS D.: **Nanogeosciences**, Gotsis publications 2021, (in Greek).

II. ADDITIONAL READING

- ΘΕΟΔΩΡΙΚΑΣ Σ.Σ.: **Ορυκτολογία-Πετρολογία**, Εκδόσεις Χ. Σαούλη Ο.Ε., 2η Έκδοση, Θεσσαλονίκη 2002.
- ΚΟΚΚΟΡΟΣ Π.: **Γενική Ορυκτολογία**, Εκδόσεις Δ.Ν. Παπαδήμα, Έκδοσις Θ, Αθήνα 1987.
- ΟΙΚΟΝΟΜΟΥ Κ.Ε.: **Γεωμετρική και Οπτική Κρυσταλλογραφία**, Παν/μιο Αθηνών 1988.
- ΧΡΙΣΤΟΦΙΔΗΣ Γ. - ΣΟΛΔΑΤΟΣ Τ.: **Οπτική Ορυκτολογία**, Εκδόσεις Γιαχούδη 2012.
- GAINES R.V. et al.: **Dana’s New Mineralogy**, J.Wiley & Sons Inc. 1997.
- PERKINS D.: **Mineralogy**, Prentice Hall, 2nd Ed. 2001.
- PUTNIS A.: Introduction to Mineral Sciences, Cambridge Univ.

III. RELATIVE JOURNALS

- Proceedings of the National Academy of Sciences (PNAS)
- American Mineralogist

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**ΣΜ001**	**SEMESTER**	**1st**
TITLE	**SEMINAR COURSES 1: GETTING ACQUAINTED WITH GEOSCIENCE**		

TEACHING ACTIVITIES	HOURS/WEEK	ECTS
Lectures, Practical exercises	**2**	**1**

TYPE OF COURSE	**MANDATORY /SEMINAR /** Skills development
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL248

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

After the successful completion of the seminar and the field trip the newly admitted students:

- know how to be creative and efficient in the academic environment.
- know what the capabilities are offered by his student status.
- have a basic knowledge and handle properly of the essential equipment for the geological activities.
- know and be able to apply the safety rules that govern the geological fieldwork.
- know and be able to safely apply first aid procedures in case of emergency or accident.

Generic Competences

- Promote free, creative and inductive thinking
- Ability to plan and manage time.
- Oral and written communication of scientific issues
- Autonomous work
- Information and Communication Technology (ICT) skills

(3) COURSE CONTENT

The purpose of these seminars is to inform and educate the students in:

- the cognitive subjects of the Department of Geology and Geoenvironment,
- the actions, organizing and operating issues regarding the educational process,
- the capabilities and offers of the Erasmus programm,
- the capability to participate in the student internship in the public or private sector,
- the regulations of use and safety for the lab apparatus and lab materials,
- the measurements and data obtained by instruments,
- the object and practices for fieldwork and field training,
- the necessary equipment used by field geologists with emphasis to the correct and safe use,
- the safety rules, rules of behavior and contact during fieldwork,
- the presentation and preservation of geological heritage,
- the first aid application in case of emergency or accident during fieldwork or in the lab.

Field Trip

Daily field trip to Mountain Hymittos. A short field trip for the students to comprehend basic concepts and to get familiar with fieldwork, field measurements in accordance with safety rules and best practices for the preservation of the geological heritage.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	see table below
ASSESSMENT METHODS AND CRITERIA	Oral questions during the seminar. (formative, summative)

Activity	Student effort
Lectures	15 hours
Practice exercises	10 hours
Fieldwork	-
Tutorials	-
Essey writing	-
Autonomous study	-
Final assessment preparation	-
Total student's effort	**25** hours

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- LOZIOS, S., SOUKIS, K. & ANTONIOU, V., 2015, Geological Mapping and Field Exercises, Academic textbooks (Kallipos), Hellenic Academic Libraries, 280 p. (e-book: PDF, e-pub, in Greek)[EUDOXUS code: 320091].

II. ADDITIONAL READING

- ROB BUTLER, 2006, **Teaching Geoscience through Fieldwork**, GEES Learning and Teaching Guide, 56 p.

III. RELATIVE JOURNALS

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COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**ΣΜ002**	**SEMESTER**	**1st**
TITLE	**SEMINAR COURSES 2: INFORMATICS**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises	**2**	**2**

TYPE OF COURSE	**ELECTIVE /SEMINAR /** Skills development
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL563

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course the student will be able to:

- **Define** the basic concepts on management and response of seismic disasters.
- **Describe** and define the man-made disasters.
- **Analyse** how local, state, national and global institutions respond to the needs created during natural disasters.
- **Analyse** how political, economic and cultural factors are involved in dealing with a natural disaster.
- **Comprehend** and **analyse** specific international issues in relation to natural disasters, proposes and evaluates responses.
- **Define** how each national and international organization respond to the call for assistance during natural hazards
- **Analyze** specific international issues related to natural disasters and propose and evaluate responses
- **Identify** appropriate immediate responses to natural disasters
- **Implement** a disaster response program within 24 hours
- **Define** and **describe** the basic concept of script languages
- **Know** and **apply** the basic commands, and make simple programs on C and C++
- **Create** simple maps using the open source s/w GMT (Generic mapping tool)

• **Apply** processing techniques to process geodata using open source s/w
Generic Competences
• Decision making • Ability to work in a team • Autonomous work • Ability to search for, process and analyse information with the use of necessary technologies • Information and Communication Technology (ICT) skills • Ability to work in an interdisciplinary context • Ability to apply knowledge in practical situations

(3) COURSE CONTENT

A. Lectures

- Introduction to Seismic Disasters: concepts, management and response - Computational tools for real-time impact identification and assessment.
- Definitions for natural and man-made disasters. Description of local, state, national and global institutions respond to natural disasters. The role of local, state and international organisations such as the EU, the United Nations, the World Health Organization and NGOs during natural hazards. Evaluation of each organization's response to the call for help.
- Civil Protection plans for the effective response to catastrophic phenomena and the protection of life, health and property of citizens, as well as the natural environment in Greece, the EU and the USA
- Simulation of natural and man-made disasters (Professor P. Bodelson, StCloud State University, MN, USA).
- Seismic disaster management and response are foreseen, as well as screenings of relevant documentaries and films.
- Familiarization with the tools available for the identification of seismic parameters and the distribution of strong ground motion in direct time will take place in the computing machines of the Department of Geophysics-Geothermal. Use open source software to identify open population gathering places and health units and to map out escape routes in an urban environment.
- Simulation of earthquake disaster management in an urban environment. Virtual simulation of an earthquake disaster in an urban environment, in which each student has a distinct role. The community simulation to be attended by other members of the university for the recognition of the students' work.
- Introduction to programming language C++. Object orientated programming, parameter definition, basic commands.
- Writing simple programs to C and C++
- Introduction to t map projection systems and digital data objects.
- Organization and structure of the GMT system – similarities and differences between the Windows and Linux realizations of the GMT.
- Construction of simple graphs and maps from the command line.
- Construction of composite/multi-thematic graphs and maps with macro-instruction assemblies (batch files for Windows, shell scripts for Linux).
- Specialized applications in geology and geophysics (e.g. cross sections, incorporation of geological symbols, visualization of faults, earthquake fault-plane solutions etc.).

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.

PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	12 hours
	Practice exercises	16 hours
	Fieldwork	-
	Tutorials	–
	Essay writing	8 hours
	Autonomous study	10 hours
	Final assessment preparation	4 hours
	Total student's effort	**50** hours
ASSESSMENT METHODS AND CRITERIA	Students are evaluated according to their performance in Practical Training. (formative, summative) • Short test at the end of each lab exercise (formative) A course grade is issued.	

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Hanselman, D. and Littlefield, B., «Μάθετε το MATLAB 7», [Κωδ. Ευδόξου: 13789]
- Wessel P. And Smith, W.H.F., «The generic mapping tools v4.5.18”, (PDF).
- Sylves, Richard.2008. Disaster Policy and Politics. Congressional Quarterly: Washington, DC.
- https://www.civilprotection.gr/el/seismoi
- “The Generic Mapping Tools Cookbook”, (PDF
- Moller, C., «Numerical computing with MATLAB», MathWorks Inc., 2004 (PDF)
- Trauth, M.H., «MATLAB® Recipes for Earth Sciences», Springer, 2007.
- «The Generic Mapping Tools Cookbook», (PDF)
- Detailed Instructors' Notes (over 140 pages) and, exercise material posted on e-Class platform

COURSE UNITS: 2nd Semester

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**			
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**			
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**			
CODE	**Y2201**	**SEMESTER**	**2nd**	
TITLE	**INTRODUCTION TO GEOLOGY**			
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**	
Lectures-seminars & laboratory work and exercises, optional fieldwork		**7**	**6**	
TYPE OF COURSE	**MANDATORY /** Scientific Area			
PREREQUISITES	NONE			
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English			
AVAILABILITY TO ERASMUS STUDENTS	YES			
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL157			

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
On completion of the course the student will be able to: • understand the nature of the Science of Geology and its relationship to the other natural sciences, the reasons why we study the earth and the geologists' scope of work; • describe the origin, formation and evolution of the Earh and its position in the solar system, the nature of the earth's interior, the characteristics of the Earth's layers (i.e. crust, mantle, core, lithosphere, asthenosphere) and the processes that take place within it • describe the scientific progress that led to the unifying theory of lithospheric plates and identify the main lithospheric plates and the types of lithospheric plate boundaries • assess and understand the concept of geological time and the processes that take place within this time frame and apply the basic principles of relative and absolute dating; • identify the main surficial processes (i.e. weathering, erosion, sedimentation and name the basic mineral and rock types and their basic physical properties; • describe the types of tectonic processes within the crust and identify the main deformational structures; • understand the importance of mineral resources and ore formation;
Generic Competences

- Ability to search for, process and analyse information with the use of necessary technologies
- Ability to be critical and self-critical
- Autonomous work
- Oral and written communication of scientific issues
- Ability to apply knowledge in practical situations
- Promote free, creative and inductive thinking
- Ability to plan and manage time

(3) COURSE CONTENT

A. Lectures

- **Earth in space**: planetary system, formation of the earth.
- **Configuration of the earth's surface**: maps, terrestrial and ocean relief, map elements, topographic and geological maps.
- **Earth Structure and plate tectonics**: history of the exploration of the Earths' interior – the crust, mantle and core; lithosphere and asthenosphere – earths' magnetic field – isostacy – the evolution of the Lithospheric Plates unifying theory – Plate boundary types and associated processes – The Wilson and supercontinent cycles – hot spots and mantle plumes – mantle dynamics and the driving forces of plate tectonics.
- **Earth-surface dynamics**: internal and external processes, weathering and erosion, sedimentation. Soils. Mass wasting.
- Surface and ground-water. The hydrosphere, hydrological cycle, drainage networks, springs.
- **Earthquakes**: earthquake generation, seismic waves and sequences, measuring earthquakes, earth's seismic zones, earthquake concomitant effects, earthquake prediction.
- **Volcanoes**: the concept of volcanism, structure and life cycle of a volcano, volcano types, volcanic territories, monitoring and prediction of volcanic activity.
- **Minerals and rocks**: mineral chemistry and crystal structure, rock-forming minerals, igneous rocks, magma formation, plutons, sedimentary facies and environments, metamorphism, pressure and temperature conditions in the earth's interior, geobarometers-geothermometers, metamorphic facies, metamorphic types.
- **Geological time and the fossil record**: absolute and relative dating of rocks and events, fossils and fossil types, the organic world in the geological past, origin and evolution of humans.
- **Deformation of rocks**: types of tectonic deformation: faults and folds, lithological and depth constraints on deformation, experimental deformation.
- **Geological synthesis on local scale – the geological history concept.** Reading and interpreting a geological map – stratigraphic configuration – the stratigraphic column – cross-cutting relationships – maps of simple geological structures.
- **Geological Structure of the Hellenic Domain**: the Hellenic orogenic arc – alpine, pre- and post-alpine rocks of Greece – geotectonic units – seismicity and volcanism of Greece- A concise outline of the geological evolution of Greece.
- **Ores, industrial minerals and energy resources**: the concept of ore – ore and industrial deposits – an outline of energy resources – hydrothermal and geothermal energy.
- **Geology and the environment**: environmental geology – natural disasters and geological hazards – groundwater pollution – atmospheric pollution – geology in technical works and urban planning – geosites and natural heritage geological sites.

B. Laboratory Exercises

- The students work on simplified geological maps containing outcrops of horizontal, inclined, faulted, faulted and unconformable strata. They identify and characterize the structural elements of the maps and work on simple problems including map completion, cross sections and outcrop and subcrop patterns.

C. Fieldwork

SINGLE-DAY FIELD COURSE IN BEOTIA; CENTRAL GREECE. Field recognition of basic rock types; types of geological contacts (stratigraphic, tectonic); basic principles of geological mapping

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** — **Student effort** Lectures — 52 hours Practice exercises — 39 hours Fieldwork — 12 hours Tutorials — -s Essey writing — 5 hours Autonomous study — 20 hours Final assessment preparation — 22 hours **Total student's effort** — **150** hours
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted, either with progressive exams in separate sections of the course content or with the final examination of the entire course material which includes: **I. LECTURES (37.5%)** • Oral Examination (formative, summative)and/or • Written Exam with Short Answer Questions and Multiple Choice Test (formative, summative)and/or • Written Exam with Extended Answer Questions (formative, summative) **II. LAB EXERCISES (37.5%)** • Written exam with Solving Exercises and Problems (formative, summative) **II. FIELD EXERCISES (25%)** • Oral examination in the field and with evaluation of deliverables of required Work or Report (formative, summative) The evaluation criteria of the course and the participation rates are described in the Chapter «**Error! Reference source not found.**» of this syllabus and student handbook. Auxiliary material (questions, exercises, etc.) for the exams is posted on the online **e-Class** platform (https://eclass.uoa.gr/courses/GEOL157/).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Γεωλογία. Η επιστήμη της Γης, Παπανικολάου Δ. Ι.,Σίδερης Χ. Ι. [Κωδ. ΕΥΔΟΞΟΣ: 21407] –[IN GREEK][

II. ADDITIONAL READING

- ΚΡΑΝΗΣ, Χ. & ΣΚΟΥΡΤΣΟΣ, Ε., 2020: Κεφάλαια Μαθήματος «Εισαγωγή στη Γεωλογία»: Δομή της Γης και Εισαγωγής στην Τεκτονική των Λιθοσφαιρικών Πλακών. Διδακτικές Σημειώσεις, 71 σ.

- GROTZINGER, J., JORDAN, T., PRESS, F., SIEVER, R., 2007. Understanding Earth, 5th ed. W.H. Freeman & Co., New York.
- LUTGENS, F., TARBUCK, E.J., 2012. Essentials of Geology. 11th Ed. 550 p. Prentice-Hall, New Jersey.
- MARSHAK, S., 2008. Earth: portrait of a planet, 3rd ed. W.W. Norton & Co., New York.
- MONROE, J., WICANDER, R., HAZLETT, R., 2007. Physical Geology – Exploring the Earth, 6th ed. Thomson – Brooks Cole.
  MONROE, J., WICANDER, R., 2006. The changing Earth, 3rd ed. Brooks/Cole.
- THOMSON, G., TURK, J., 1998. Introduction to Physical Geology. Saunders College Publications.

III. RELATIVE JOURNALS

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COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y2202**	**SEMESTER**	**3rd**
TITLE	**SYSTEMATIC MINERALOGY-MINERAL IDENTIFICATION**		

TEACHING ACTIVITIES	HOURS/WEEK	ECTS
Lectures, Lab Exercises and Fieldwork	6	6

TYPE OF COURSE	**MANDATORY /** Scientific Area
PREREQUISITES	[recommended] Y1203 Chemistry Y1202 Physics Y1205 Mineralogy-Crystallography
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL215

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course the student:

- **Define** and **formulate** the basic principles, methods and applications of Systematic Mineralogy-Mineral Identification.
- **Classify** and **describe** the main groups of minerals, their physico-chemical properties, their structural characteristics, their associations and formation conditions, as these are essential components for understanding geological processes on our planet.
- **Comprehend** the basic Mineralogy required in the subjects of Geology-Geoenvironment, Petrology, Geochemistry, Ore Deposit formation, and Structural Geology.
- **Apply** the techniques of Systematic Mineralogy-Mineral Identification, and of optical microscopy with the aim of developing mental and practical skills that include mineral identification both macroscopically and under the microscope, as well as (free) software for determining the structural formula and of minerals from their electron probe microanalysis. The field exercise carried out aims to identify and collect minerals in the field.

Generic Competences

- Ability to search for, process and analyze information with the use of necessary technologies.
- Autonomous work.
- Ability to apply knowledge in practical situations.
- Work independently.
- Promote free, creative, and inductive thinking.
- Ability to plan and manage time.
- Information and Communication Technology (ICT) skills.

(3) COURSE CONTENT

A. Lectures

- Introduction to Systematic Mineralogy. Mineral definition. Nomenclature of minerals. Habit and growth of crystals. αντοχή, Physical properties of minerals: color, streak, hardness, luster, transparency, cleavage and fracture, density and specific gravity, magnetic and electrical properties, fluoresence, radioactivity.
- Chemical composition, structure and chemical properties of minerals: chemical elements, bonding, coordination polyhedra, ionic structures, isomorphism, solid solution, polymorphism, exsolution, pseudomorphism. Calculation of structural formula and nomenclature of a mineral from the electron probe microanalysis.
- Mineral formation and growth of minerals. Stability fields of minerals. Mineral assemblages. Paragenesis. Geological environments of mineral formation. Minerals in igneous, metamorphic and sedimentary rocks. Bowen's reaction series. Inclusions in minerals.
- Classification and description of minerals: Native elements, Sulfides, Antimonides, Arsenides, Selenides, Tellurides, Sulfoarsenides, Sulfosalts, Halides, Carbonates-Borates-Nitrates, Sulfates, Chromates-Tungstates-Molybdates, Phosphates-Arsenates-Vanadates, Oxides-Hydroxides, Nesosilicates, Sorosilicates, Cyclosilicates, Inosilicates, Phyllosilicates, Tectosilicates.
- Minerals of Greece and conditions of their genesis. Visit to the Mineralogy-Petrology Museum and description of the mineral groups through the museum's collections.

B. Lab exercises.

Practice exercises are taught in small groups of students and are graded at the end of the exercise.

Exercise 1. Introduction to the macroscopic identification of minerals. Familiarity with mineral samples and identification of their hardness based on the Mohs Hardness Scale.

Exercise 2. Macroscopic identification of Native Elements, Halides and Sulfate minerals. Description of their physical properties and their chemical composition.

Exercise 3. Macroscopic identification of Sulfides. Description of their physical properties and their chemical composition.

Exercise 4. Macroscopic identification of Carbonates. Description of their physical properties and their chemical composition.

Exercise 5. Macroscopic identification of Nesosilicates, Sorosilicates, Cyclosilicates. Description of their physical properties and their chemical composition.

Exercise 6. Macroscopic identification of Inosilicates, Phyllocilicates and Tectosilicates. Description of their physical properties and their chemical composition.

Exercise 7. Macroscopic identification of Oxides/Hydroxides. Description of their physical properties and their chemical composition.

Exercise 8. Microscopic identification of Tectosilicates with Transmitted Light Microscopy.

Exercise 9. Microscopic identification of Inosilicates with Transmitted Light Microscopy.

Exercise 10. Microscopic identification of Phyllosilicates with Transmitted Light Microscopy.

Exercise 11. Microscopic identification of Nesosilicates, Sorosilicates and Cyclosilicates with Transmitted Light Microscopy.

Exercise 12. Microscopic identification of Halides, Carbonates and Sulfates with Transmitted Light Microscopy.

Exercise 13. Calculation of mineral structural formula and nomenclature of minerals from chemical analyses using PC software programs.

C. Fieldwork
C1. One day field excursion in the Lavreotiki area. Introduction to the geology and mineralization of Lavreotiki area. Information on the ancient methods of mining and ore processing in the area. Collection and identification of minerals and rocks.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** / **Student effort** Lectures: 39 hours Practice exercises: 39 hours Fieldwork: 9 hours Tutorials: – Essey writing: 10 hours Autonomous study: 37 hours Final assessment preparation: 16 hours **Total student's effort**: **150** hours
ASSESSMENT METHODS AND CRITERIA	I. LECTURES (**60%**) • Oral or written final examination (summative). Exams include short or extended answer questions, multiple choice tests. II. LAB EXERCISES (**37.5%**) • Oral or written final examination on macroscopic and microscopic identification of minerals (summative). • Solving problems of calculating the chemical formula and nomenclature of minerals from their chemical analysis. Delivery of report with calculated structural formulas (**12.5%**, summative). III. FIELDWORK (**12.5%**) • Sampling and identification of minerals and rocks. Assessment of fieldwork report (**12.5%**, summative).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Katerinopoulos, A., 2008**, The world of Minerals**, Publ. S. Athanassopoulos, (EUDOXUS code: 45279), in Greek.

II. ADDITIONAL READING

- Theodorikas S.S., 2013, Mineralogy-Petrology, Melissa Publ., in Greek.
- Christofides, G. & Soldatos, T., 2012, Optical Mineralogy, Giahoudi Publ., in Greek.
- Dyar, M.D. et al., 2008, **Mineralogy and Optical Mineralogy**, MSA, Chantilly.
- Gaines, R.V. et al., 1997, **Dana's New Mineralogy**, J.Wiley & Sons Inc.
- Hibbard, M.J. & Hibbard M., 2001,**Mineralogy: A Geologist's Point of View**, McGraw-Hill Science/Engineering/Math, 1st Ed.
- Perkins, D., 2001, **Mineralogy**, Prentice Hall, 2nd Ed.

- Voudouris, P., Karampelas, S., Melfos, V. & Graham, I., 2020, **Mineralogy and Geochemistry of Gems**. Minerals MDPI, 528p, https://doi.org/10.3390/books978-3-03928-077-3 2020

III. RELATIVE JOURNALS

- European Journal of Mineralogy, Online ISSN: 1617-4011, Print ISSN: 0935-1221, DMG, SEM, SIMP, SFM.
- Minerals, Online ISSN: 2075-163X, MDPI.

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y2203**	**SEMESTER**	**2nd**
TITLE	**CLIMATOLOGY AND CLIMATE CHANGES**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures-seminars & laboratory work and exercises, optional fieldwork	**5**	**6**

TYPE OF COURSE	**MANDATORY /** Scientific Area
PREREQUISITES	There are no prerequisite courses, but basic knowledge of High School Physics is required in the relevant subjects of Geology
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL149

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course the student:

- **Explains** the physical principles that underpin the science of Climatology
- **Understand** and **interpret** the basic processes of the climate system
- **Define** and **articulate** the main climatic elements at different scales of space and time
- **Identify** and **describe** the characteristics of the climate system at global, regional and local scales
- **Understand** the difference between climate variability and climate change
- **Knows** the principles of operation and use of meteorological instruments to make meteorological and climatological measurements
- **Combines** and **evaluates** climatic data and information to solve problems related to both basic research and applied subjects in the Earth sciences.

Generic Competences

- Ability to apply knowledge in practical situations
- Ability to search for, process and analyse information with the use of necessary technologies

• Oral and written communication of scientific issues • Autonomous work • Information and Communication Technology (ICT) skills • Commitment to conservation of the environment

(3) COURSE CONTENT

Lectures: The content of the course is structured in the following thematic sections:

- History and division of Climatology.
- Composition and structure of the atmosphere.
- Radiation and energy balance.
- Temperatures on the earth's surface.
- Water in the atmosphere. Humidity, Clouds, Precipitation
- Pressure and Motion in the Atmosphere - General circulation of the atmosphere
- Winds and local wind systems
- Atmospheric disturbances.
- Classification, description and configuration of the earth's climates
- Climatic and bioclimatic indicators.
- Climate change (theories of climate change, changes during the period of instrumental observation, changes in historical times, methods of paleoclimatology, feedback mechanisms and impacts on climate).
- Introduction to climate models.
- Climate of Greece (climatic factors, climatic elements, climate change).

Laboratory work:

Laboratory exercises include the submission of short individual assignments on a weekly basis.

- **Exercise 1.** Error Analysis
- **Exercise 2.** Frequency Distribution of Climatic Parameters
- **Exercise 3.** Solar and Earth Radiation
- **Exercise 4.** Air temperature
- **Exercise 5.** Atmospheric Humidity
- **Exercise 6.** Precipitation
- **Exercise 7.** Atmospheric Pressure
- Exercise 8. Wind
- **Exercise 9.** Satellite products in meteorology and climatology & Weather forecasting (takes place at the facilities of the Hellenic National Meteorological Service).

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	39 hours
	Practice exercises	18 hours
	Fieldwork	-
	Tutorials	-
	Essey writing	18 hours
	Autonomous study	50 hours

	Final assessment preparation 25 hours **Total student's effort** **150** hours
ASSESSMENT METHODS AND CRITERIA	**I. LECTURES** (**50%**) • Final written Exam (summative) The written exam includes Short Answer Questions and Multiple Choice Test **II. LABORATORY WORK** (**50%**) • Weekly Written Essays for every Lab Exercise (formative, summative) • Final written exam (summative) The written exam includes Short Answer Questions, Multiple Choice Test and Solving Exercises Supplementary material (questions, exercises, etc.) for the exams is posted on the online **e-Class** platform (https://eclass.uoa.gr/courses/GEOL149/).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Barry R.G., Hall-McKim E.A., Nastos P. (scientific editor), 2022, **Climatologly and Climate Change** [EUDOXOS code:112691796] in Greek
- Maheras P., Balafoutis C., 1997, **General climatology with elements of meteorology**, UNIVERSITY STUDIO PRESS [Κωδ. ΕΥΔΟΞΟΣ: 17166] in Greek

II. ADDITIONAL READING

- Barry R.G., Hall-McKim E.A., 2014, **Essentials of the Earth's Climate System**, Cambridge University Press

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y2204**	**SEMESTER**	**2nd**
TITLE	**GIS AND INTRODUCTION TO REMOTE SENSING**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures-seminars & laboratory work		**6**	**6**
TYPE OF COURSE	**MANDATORY /** Skills Development		
PREREQUISITES	NONE		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL123 https://delos.uoa.gr/opendelos/search?dp=geol&ay=-1&st=4e812e15		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
The aim of the course is to understand the basic principles of Geographical Information Systems, the acquaintance with remote sensing data and the processing of geographical data, as necessary tools for studies in the field of geosciences. Students will become familiar with Geographical Information Systems and Remote Sensing, both theoretically and practically, using the appropriate specialized software. On successful completion of the course the student: • **Defines** and **formulates** the basic principles, methods and applications of Geographic Information Systems (GIS). • **Comprehends** the different coordinate systems. • **Comprehends** the different types of data in a GIS (raster, vector and raster grid). • **Applies** methods of numerical and statistical analysis of geographic data. • **Combines** different data types to **create** thematic maps. • **Describes** the different simulation methods and modeling of geographic data • **Defines** and **formulates** the basic principles, methods and applications of Remote Sensing.

• **Applies** techniques to process remote sensing data.
Generic Competences
• Ability to apply knowledge in practical situations • Promote free, creative and inductive thinking • Ability to plan and manage time • Ability to search for, process and analyse information with the use of necessary technologies • Adapt to and act in new situations and cope under pressure • Autonomous work • Information and Communication Technology (ICT) skills

(3) COURSE CONTENT

A. Lectures:

General Characteristics of Geographical Information Systems

- Input Data
- Data Analysis
- Coordinate Systems
- three-variable variables
- Applications of arithmetic and statistical analysis
- Introduction to Remote Sensing
- Elements of electromagnetic radiation
- Types of Remote Sensing Data
- Forms of resolution
- Stages of digital data processing.

B. Practical Exercises:

- Introduction to ArcGIS
- Raster Data Input
- Vector Data Input – Digitization
- Vector Data Input from Databases
- Data Analysis
- Cartography
- Three-variable variables
- Input of Remote Sensing data, Spectral Channels
- Surface temperature distribution maps, True color image composition
- Composition of false color images, Geometric correction

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	39 hours
	Practice exercises	39 hours
	Fieldwork	-
	Tutorials	-
	Essey writing	-

	Autonomous study 42 hours Final assessment preparation 30 hours **Total student's effort** **150** hours
ASSESSMENT METHODS AND CRITERIA	**Course theory (50%):** (summative) • The grade is based on the written examination at the end of the semester. **Laboratory Exercises (50%).** The score is distributed as follows: • The weekly participation in the homework (**20%**) that is done in the classroom is evaluated (formative) • Two progress tests, one in the middle of the semester and one at the end, each of which receives **40%** of the lab score. (formative) • Supplementary material with lectures and exercises is posted on the **e-Class** platform http://eclass.uoa.gr/courses/GEOL123

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Barry R.G., Hall-McKim E.A., Nastos P. (scientific editor), 2022, **Climatologly and Climate Change** [EUDOXOS code:112691796] in Greek
- Maheras P., Balafoutis C., 1997, **General climatology with elements of meteorology**, UNIVERSITY STUDIO PRESS [Κωδ. ΕΥΔΟΞΟΣ: 17166] in Greek

II. ADDITIONAL READING

- Barry R.G., Hall-McKim E.A., 2014, **Essentials of the Earth's Climate System**, Cambridge University Press

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y2205**	**SEMESTER**	**2nd**
TITLE	**MACROPALAEONTOLOGY**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures-seminars &laboratory work and exercises, optional fieldwork		**6**	**6**
TYPE OF COURSE	**MANDATORY /** Scientific Area		
PREREQUISITES	NONE		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL237		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
Upon successful completion of the course, students will be able to: • define the basic principles of Palaeontology • understand the atmosphere-hydrosphere-biosphere- lithosphere relationship in the global eco-system and the evolution of organisms in relation to terrestrial and extraterrestrial phenomena. • Apply the basic principles of description, identification, and taxonomy of the main groups of in-vertebrate fossils (porifera, cnidarians, brachiopods, mollusks, arthropods, echinoderms), verte-brates (fishes, amphibians, reptiles, birds, mammals) and plants (pteridophytes, gymnosperms, angiosperms). • Comprehend the significance of animal and plant fossils in geology/stratigraphy. • recognize the use of animal and plant fossils and unknowledge their applications as geological fa-cies indicators and tools for the interpretation of palaeoenvironmental and palaeoclimatic chang-es. • Examine and determine the relative age of geological formations using fossils • communicate issues relating to the history and evolution of life on Earth to specialist and broad audiences.

Generic Competences
• Ability to search for, process and analyse information with the use of necessary technologies • Autonomous work • Ability to work in a team • Ability to apply knowledge in practical situations • Oral and written communication of scientific issues • Ability to undertake research at an appropriate level • Commitment to conservation of the environment

(3) COURSE CONTENT

This is the introductory course in the science of Palaeontology. The course deals with the study of the main groups of fossils corresponding to invertebrate, vertebrate animals and plant organisms. These organisms serve as dating tools, but also as palaeoecological indicators and are highlighted as ideal tools in environmental and geo-environmental research.

Lectures

Research Object and Study Methods. Applications of Palaeontology. Fossils, types of fossils and fossilization methods, facies. The significance of fossils.

Systematics, fossil terminology, nomenclature, and classification. Principles of evolution, palaeoecology, and taphonomy. Fossils and geological time, stratigraphic scale, biochronology, biosratigraphy, temporal constants in independent time scales. Early life forms, evolution of living organisms in geological time, mass extinctions. Applied Palaeontology: The contribution of Palaeontology to Stratigraphy, palaeobiogeography, palaeogeography, mapping, palaeoenvironment, palaeoceanography, palaeoclimatology. Introduction to Palaeontology: the main taxonomic groups of Invertebrates, Vertebrates and Plants with an emphasis on the Greek fossil record. Principles of palaeontological material conservation, palaeontological excavations. Natural History Museums, fossil curation and palaeontological outreach, palaeontological collections and databases.

Laboratory and practical exercises

Exercise 1: Recognition of fossil categories, types of fossils, fossilization methods, and nomenclature of fossils.

Exercise 2: Recognition and identification of anthozoans and sponges genera, understanding their fossilization process. Comprehension of their use in stratigraphy and palaeoenvironment.

Exercise 3: Recognition and identification of brachiopod genera. Understanding their use in stratigraphy and the palaeoenvironment.

Exercise 4: Recognition and identification of bivalve mollusk genera. Understanding their use in stratigraphy and the palaeoenvironment.

Exercise 5: Recognition and identification of gastropod mollusk species and cephalopod genera. Understanding their use in stratigraphy and the palaeoenvironment.

Exercise 6: Recognition and identification of trilobites, ammonites, rudists, and echinoderms. Understanding their use in stratigraphy and the palaeoenvironment

Exercise 7: Identification of invertebrate fossils in the legents of geological maps. Interpretation of the relative stratigraphical age and paleoenvironment.

Recognition and identification of trilobites, ammonites, rudists, and echinoderms. Understanding their use in stratigraphy and the palaeoenvironment.

Exercise 8: Introduction to mammal odontology, morphological types of teeth.

Exercise 9: Recognition of fossils of basic taxonomic groups of vertebrates (Horses and Hipparions, Rhinoceroses, Hippos, Pigs, main Proboscidean groups) based on their dental morphological characteristics.

Exercise 10: Practical training in the Department's Museum of Palaeontology and Geology, recognizing fossils, significant vertebrate faunas in the Greek region.

Exercise 11: Introduction to Palaeobotanical methodology, leaf morphology and identification.

Exercise 12: Identification of Palaeophytic plant fossils (Pteridophytes, Gymnosperms). Fossil plant assemblages as a biostratigraphic proxy.

Exercise 13: Identification of Cenophytic plant fossils (Conifers, Angiosperms). Palaeoclimatic reconstruction based on plant fossil assemblages.

Fieldwork

C1. One-day field exercise in the broader area of Pikermi-Rafina: Terrestrial facies and characteristics of Pikermi fauna. Marine facies (Neritic) and characteristics of Macrofossils in the formations of the Lower Pliocene.
Collection of palaeontological samples in these formations (recognition of different lithological horizons and the macrofossils characterizing them, sampling method, recording sampling details: identification of macrofossils, interpretation of palaeoenvironment, correlation with significant geological events and natural hazards).
C2. Botanical Garden Julia & Alexander N. Diomedes: Plant observation, plant diversity/major taxonomic groups, geobotany

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	See table below
ASSESSMENT METHODS AND CRITERIA	Students are assessed as follows: • Small individual exercise assignments **10%** (formative) • Fieldwork exercises **10%** (formative) Written exam including multiple-choice/free text questions and fossil Identification **80%** (summative)

Activity	Student effort
Lectures	39 hours
Practice exercises	39 hours
Fieldwork	12 hours
Tutorials	- hours
Essey writing	6 hours
Autonomous study	30 hours
Final assessment preparation	24 hours
Total student's effort	**150** hours

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Dott, R.H. & Prothero, D.R., 1994. Evolution of the Earth. McGraw-Hill, INC.
- Γεωργιάδου-Δικαιούλια Ε., Συμεωνίδης Ν.Κ. & Θεοδώρου Γ.Ε. (2003). Παλαιοντολογία. Μέρος Β΄: Ασπόνδυλα, σελ. 1-237, Αθήνα.
- Γεωργιάδου-Δικαιούλια Ε., Συμεωνίδης Ν.Κ. & Θεοδώρου Γ.Ε. (2003). Παλαιοντολογία. Μέρος Γ΄: Σπονδυλωτά, σελ. 1-277, Αθήνα.
- Benton M.J. (2005). Vertebrate palaeontology. Blackwell Publishing, 1-455.
- Willis K., McElwain J. (2002) The Evolution of Plants. Oxford University Press, 408 Pages

III. RELATIVE JOURNALS

- Palaeontology ISSN 1475-4983
- Review of Palaeobotany and Palynology ISSN: 0034-6667

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E4201**	**SEMESTER**	**2nd**
TITLE	**MATHEMATICAL METHODS IN GEOSCIENCES**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises	**4**	**4**

TYPE OF COURSE	**ELECTIVE /** Background
PREREQUISITES	[recommended] Y1204 Introduction to Differential and Integral Calculus and Statistics
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	https://eclass.uoa.gr/courses/GEOL386

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

Earth Science is required to address a variety of complex problems with profound effects on society by providing **answers technically robust and quantitatively accurate**. Accordingly, on successful completion of the Course, the students should have acquired:

- Dexterity in using and programming scientific computing engines (MATLAB and OCTAVE) and their toolboxes.
- Dexterity in the spectral analysis and information extraction from spatio-temporal scientific data.
- Familiarization with the basic concepts of Linear Algebra and metric spaces.
- Dexterity in the numerical simulation/modelling and interpretation of simple natural or artificial phenomena, e.g. by using general least squares.
- Comprehension of the evolutionary dynamics of systems and phenomena through familiarization

with first and second order differential equations.
- Basic skills in common techniques of manipulating/processing and displaying scientific data and images.
- Introduction to the theory and practice of fundamental data analysis techniques such as (linear) filtering and numerical interpolation.
- Familiarization with critical appraisal of data and results.
- Comprehension of the capabilities and constraints of analytical methods and software, so as to be able to select and apply the more suitable of those.
- Dexterities necessary in addressing different practical problems related to data analysis and interpretation (economic, environmental, technical etc.)

Generic Competences

- Ability to search for, process and analyse information using appropriate technologies
- Ability to apply knowledge in practical situations
- Promote free, creative and inductive thinking
- Autonomous work
- Oral and written communication of scientific issues

(3) COURSE CONTENT

Combination of theoretical introductions (lectures) and practical training with scientific computing engines (MATLAB or OCTAVE) and their associated signal, modeling and statistical analysis toolboxes.

- Introduction to MATLAB/OCTAVE with parallel review of the principles of Linear Algebra.
- Fourier analysis, Fourier series and the Fourier transform. Power spectra and their physical interpretation. Concepts of sampling and digitization. The z-transform. Correlation and Convolution. Fast Fourier Transforms. Examples and applications in the analysis of natural phenomena.
- Coordinate systems, vector spaces and metric spaces. Matrices and their properties. Metric tensors: concepts, properties and utilization. Eigenvalue/eigenvector decomposition, singular value decomposition and their physical interpretation. Applications to the analysis of matrices and images; applications to geophysical and geotechnical problems – analysis of the stress, strain and impedance tensors.
- Solution of linear systems of equations with applications to earth-scientific problems.
- Simulation and modelling of data and physical processes: Linear, general and non-linear least squares. Multiple Linear Regression and applications. Non-linear least-squares inversion theory and applications.
- Linear Filters and Systems. Transfer functions and causality. Wavelets and wavelet transforms. Applications to the description of physical systems, time series, maps and images. Data smoothing and accentuation; application to time series, maps and images.
- Interpolation and extrapolation in one dimension (interpolating polynomial, linear and non-linear interpolation techniques). Interpolation in two and three dimensions with introduction to the concepts of triangulation and tessellation. Geostatistical interpolation methods (e.g. Kriging).
- Introduction to fractals and fractal objects. Fractal distributions and fractal clustering. Dynamic systems and self-organized criticality – introduction to the non-extensive statistical mechanics. Examples from the Earth Sciences (terrain, drainage systems, coastlines, fragmentation and porosity, faulting and tectonics, seismicity and seismogenesis, etc.).
- Simple differential equations: concept and solutions. Examples and applications (radioactive decay, remanent magnetization, geothermal gradient).
- Non-linear differential equations: basic concepts and applications.
- Partial differential equations (Laplace, diffusion, wave): Concepts and solution. Examples and applications (e.g. static potentials, hear transfer, wave diffusion and propagation).
- Numerical solution of partial differential equations – the finite difference approach with examples and applications.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	see table below
ASSESSMENT METHODS AND CRITERIA	• Students are evaluated by a formative assessment process in Greek. Foreign students from European Union countries (e.g. attending through the Erasmus programme) are evaluated by the same process in English. • The final grade is the arithmetic mean of the grades of all reports prepared and submitted as part of the practical training program.

Activity	Student effort
Lectures	26 hours
Practice exercises	26 hours
Fieldwork	-
Tutorials	-
Essey writing	8 hours
Autonomous study	30 hours
Final assessment preparation	10 hours
Total student's effort	**100** hours

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Μαθηματικές Μέθοδοι Φυσικής Τόμος I, Βεργάδος Ι., Πανεπιστημιακές Εκδόσεις Κρήτης, [Κωδ. ΕΥΔΟΞΟΣ: 230]
- Μάθετε το MATLAB 7, D. Hanselman, B. Littlefield [Κωδ. ΕΥΔΟΞΟΣ: 13789]

II. ADDITIONAL READING

- Trauth, M.H., «MATLAB® Recipes for Earth Sciences», Springer, 2007.
- Snieder, R., 1997, "A guided tour of Mathematical Physics", Samizdat Press [PDF]
- Βέργαδος, Ι., «Μαθηματικές Μέθοδοι Φυσικής», Τόμος ΙΙ Πανεπιστημιακές Εκ-δόσεις Κρήτης.
- Τραχανάς, Σ., «Διαφορικές Εξισώσεις, Τόμος Ι Συνήθεις Διαφορικές Εξισώσεις»
- Τραχανάς, Σ., «Μερικές Διαφορικές Εξισώσεις»
- Arfken, G.B and Weber, H.J., 2005. Mathematical Methods for Physicists, 6th Edition, Elsevier.
- Scales, J.A. et al., 2001. Introductory Geophysical Inverse Theory, Samizdat Press. (PDF)
- Claerbout, J., 1976. Fundamentals of Geophysical Data Processing, Samizdat Press.
- Claerbout, J., 1996, Imaging the Earth's Interior, Samizdat Press.
- Turcotte, D.L., 1997. Fractals and Chaos in Geology and Geophysics, Cambridge University Press.

COURSE UNITS: 3rd Semester

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	SCHOOL OF SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
EDUCATION LEVEL	EQF level 6; NQF of Greece level 6		
CODE	Y3201	SEMESTER	3rd
TITLE	IGNEOUS ROCKS-MAGMATIC PROCESSES		

TEACHING ACTIVITIES	HOURS/WEEK	ECTS
Lectures and Practical exercises	5	6

TYPE OF COURSE	**MANDATORY /** Scientific Area
PREREQUISITES	**Y2202** Systematic Mineralogy – Mineral Identification
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL235

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course the student:

- **Comprehens** the basic petrological concepts, the rock-forming minerals and the methods of petrological research (from sampling to preparation).
- **Identifies** and **describes** the mineralogical constituents and textures of igneous rocks at macroscopic and microscopic scales (using a polarizing microscope).
- **Classifies** the igneous rocks using their classification methods (geological, mineralogical, chemical).
- **Explains** the mechanisms through which magma is created and knowing its composition (e.g. granitic, basaltic), **interprets** its physical properties (e.g. viscosity).
- Theoretically and experimentally **approaches** melting, crystallisation, differentiation, annealing and cooling of magma by constructing and applying binary and ternary phase diagrams.
- **Distinguishes** between the forms of intrusive and extrusive magmatic bodies, the categories and forms of different types of volcanoes and their products.
- **Synthesizes** and **combines** petrological data of petro-tectonic assemblages and ophiolitic complexes and **interprets** their evolution in geological time and space and in different geotectonic environments.

Generic Competences

- Ability to apply knowledge in practical situations
- Promote free, creative and inductive thinking
- Ability to plan and manage time
- Ability to work in a team
- Ability to search for, process and analyse information with the use of necessary technologies
- Autonomous work
- Information and Communication Technology (ICT) skills

(3) COURSE CONTENT

A. Lectures

- Rocks and the rock-cycle (Definitions)
- From the birth of the Universe to the creation and evolution of the Earth - Petrological perspective
- The interior of the Earth (Crust - Mantle - Core).
- Lithospheric plates, magmatism and volcanism.
- Composition of igneous rocks.
- Classification (geological, structural, mineralogical, petrochemical, chemical) of igneous rocks
- Textures of igneous rocks: degree of crystallinity, grain size, shape, mode of bonding, arrangement and orientation, degree of deformation or recrystallisation.
- Magma (origin, characteristics in terms of mineralogical and chemical composition, homogeneous melt and volatile content, temperature, density, viscosity, flow)
- Thermodynamics of magmas (introduction) – Phase Rule
- Melting and crystallization
- Phase diagrams (simple one-component, binary, ternary) examples from igneous petrology. Equilibrium, fractional crystallization and melting, water and silicate melts.
- Formation of magmas (primary and derived magmas) - Partial melting.
- Basaltic magma (origin, mantle source, parent rocks, physico-chemical controls on partial melting)
- Granitic magma (origin, mantle source, parent rocks, physico-chemical factors controlling partial melting)
- Magma diversity (primary and derived magmas, magmatic differentiation, magma contamination or assimilation, magma mixing)
- Rise of Magma
- Crystallisation of magma
- Igneous structures (types of magmatic bodies)
- Volcanoes and volcanism (classification, explosivity, products)
- Volcanic centres of world interest
- The Aegean volcanic arc

B. Practical and Laboratory Exercises :

Exercises 1&2: Practice in methods of classification of igneous rocks (geological, mineralogical, chemical). Use of igneous rock nomenclature. Practice in projection on I.U.G.S. ternary diagrams. Calculation of normative mineralogy of a rock by converting its chemical composition into equivalent mineral percentages using MS Office Excel.

Exercises 3&4: Identification of structural characteristics of igneous rocks (texture) based on morphological, mineralogical and tectonic parameters.

Exercise 5: Identification and determination of petrographic characteristics (macroscopic and microscopic) of acid plutonic rocks (Granitoids).

Exercise 6: Identification and determination of petrographic characteristics (macroscopic and microscopic) of intermediate and basic plutonic rocks (Diorite, Gabbroic).

Exercise 7: Identification and determination of petrographic characteristics (macroscopic and microscopic) of ultramafic rocks (Peridotites, Pyroxenites) and Ophiolite Complexes Units.

Exercise 8: Identification and determination of petrographic characteristics (macroscopic and microscopic) of acid volcanic rocks.

Exercise 9: Identification and determination of petrographic characteristics (macroscopic and microscopic) of intermediate and basic volcanic rocks.
Exercise 10: Identification and determination of petrographic characteristics (macroscopic and microscopic) of subvolcanic rocks.
Exercise 11: Identification and determination of petrographic characteristics (macroscopic and microscopic) of pyroclastic rocks.
Exercises 12&13: Construction and interpretation of binary phase diagrams.

C. Fieldwork

ONE DAY FIELDWORK IN ATTICA - CORINTHIA: Triassic pyroclastic rocks (Parnitha), Ophiolite complex of Gerania (Corinthia), Quaternary volcanic rocks (Corinthia). Study of igneous rocks of various lithologies (acidic pyroclastics, mantle rocks, lavas and pyroclastics of basic composition). Training in fieldwork methods, development of sampling methods, identification of the main mineralogical constituents of igneous rocks, their structural and morphological characteristics, classification of igneous rocks based on their macroscopic petrographic characteristics. Collection, synthesis and evaluation of petrological and geological data, report writing.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** / **Student effort** Lectures: 39 hours Practice exercises: 26 hours Fieldwork: 10 hours Tutorials: - Essey writing: 12 hours Autonomous study: 36 hours Final assessment preparation: 27 hours **Total student's effort**: **150** hours
ASSESSMENT METHODS AND CRITERIA	I. LECTURES (**50%**) • Written final examination (summative). II. LAB EXERCISES (**42%**) • Weekly assessment of lab exercises (formative). and • Written final examination (summative). III. FIELDWORK (**8%**) • Oral examination in the field with assessment of the field book and/or the required report or essay (formative, summative). Supplementary material for the exams (questions, exercises etc.) is posted on e-Class platform (https://eclass.uoa.gr/courses/GEOL235/).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Textbooks and notes uploaded on the electronic platform **e-class**
- Κοκκινάκης, Α. (2011): «Μαγματικά Πετρώματα», σελ. 389.
- Best, M.G. (2002): Igneous and Metamorphic Petrology (2nd Edition), p. 752.
- Philpotts, A. & Ague, J.J. (2009): Principles of Igneous and Metamorphic Petrology (2nd Edition), p. 684.
- Winter, J.D. (2009): Principles of Igneous and Metamorphic Petrology (2nd Edition), p. 720.

III. RELATIVE JOURNALS

- Journal of Petrology, Online ISSN 1460-2415, Print ISSN 0022-3530, Oxford University Press.
- Contributions to Mineralogy and Petrology, Online ISSN 1432-0967, Print ISSN 0010-7999, Springer Nature.
- Earth and Planetary Science Letters, Online ISSN 1385-013X, Print ISSN 0012-821X, Elsevier.

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y3202**	**SEMESTER**	**3rd**
TITLE	**PETROLOGY OF SEDIMENTARY ROCKS**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises, Laboratory exercises, and Fieldwork		**5**	**6**
TYPE OF COURSE	**MANDATORY /** Scientific Area		
PREREQUISITES	[recommended] Y2202 Systematic Mineralogy-Mineral Identification		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL228		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course the student:

- **Defines** and **formulates** the basic principles, methods, and applications of Sedimentary Petrology.
- **Classifies** and **describes** rocks from all sedimentary lithologies.
- **Identifies** and **records** the components, textures, structures, and particular features of the main petrological types of sedimentary rocks.
- **Comprehends** and **evaluates** their depositional and diagenetic processes and environments.
- **Specifies** and **applies** appropriate techniques in the discrimination and study of sedimentary minerals and rocks.
- **Comprehends** and **applies** the methodology for the study of sedimentary rocks in the field.
- **Constructs** the graphic log and column of a sedimentary succession and **distinguishes** and **describes** its main units/lithofacies.
- **Combines** and **evaluates** the depositional and diagenetic characteristics of sedimentary rocks in the exploration of natural mineral- and energy resources, in industrial applications, and in paleogeographical, paleoclimatic and archaeometric studies.

Generic Competences

- Ability to search for, process and analyse information with the use of necessary technologies.
- Autonomous work.

- Ability to apply knowledge in practical situations.
- Work in a team.
- Promote free, creative, and inductive thinking.
- Ability to plan and manage time.
- Information and Communication Technology (ICT) skills.

(3) COURSE CONTENT

It is the basic course that deals with the origin, composition, chemistry, processes and environments of deposition and diagenesis of sedimentary rocks while accents their significant contribution to the understanding of the geological history of the Earth, and their great economic importance.

A. Lectures

- Introduction (Fundamentals of Sedimentary Petrology - Origin and kinds of sedimentary constituents – Sedimentary processes - Sedimentary environments - Plate-tectonic classification of sedimentary basins).
- Mineralogy and chemistry of sedimentary rocks – Geochemical classification of sedimentary environments.
- Weathering and Residual deposits (Soils, Laterites, Bauxites)
- Depositional processes and environments of sedimentary rocks.
- Diagenetic processes, products, and environments of sedimentary rocks.
- Sedimentary structures (groups, main types and their location, standard sequences of sedimentary structures).
- Petrophysical characteristics (porosity and permeability).
- Generalized genetic models – Tectonic settings.
- Siliciclastic rocks (Conglomerates and breccias, Sandstones, Mudstones and shales)
- Volcaniclastic deposits (Agglomerates and volcanic breccias, Lapillistones, Tuffs)
- Carbonate rocks (Limestones, Dolomites)
- Evaporites
- Sedimentary iron deposits
- Cherts
- Phosphorites
- Organic-rich deposits (Coals, Oil shales, and Petroleum)

B. Practical and Laboratory Exercises :

Part A (Exercises 1, 2): Definitions, methodology of macroscopic study and laboratory methods/techniques of sedimentary rocks. Identification, classification and description of the physical and petrophysical characteristics of sedimentary rocks. Petrogenetic minerals of sedimentary rocks. Sedimentary lithologies

Part B (Exercises 3, 4): Sedimentary textures – Textural features and their practical applications/measurements.

Part C (Exercise 5): Identification and description of sedimentary structures. Graphic representation methods of a sedimentary succession (log, column). Introduction to facies analysis.

Part D (Exercises 6 - 12): Identification, description and systematic classification of the main petrological types from all sedimentary lithologies, using rock hand specimens (macroscopic study) and thin sections (microscopic study) from special collections.

Part E (Exercise 13): Essay delivery, discussion and evaluation of the field exercise.

C. Fieldwork

One-day field excursion (Loutraki – Vouliagmeni Lake in Corinthia): Field study techniques and sampling methods of sedimentary rocks. Identification, discrimination, description, and petrogenetic history of sedimentary rocks/formations from various groups/lithologies. Measurement, data recording and representation of a selected sedimentary succession (drawing of a simplified sketch of sedimentary section, and construction of graphic log and sedimentary column).

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	see table below
ASSESSMENT METHODS AND CRITERIA	see below

PLANNED LEARNING ACTIVITIES

Activity	Student effort
Lectures	39 hours
Practice exercises	26 hours
Fieldwork	8 hours
Tutorials	-
Essay writing	12 hours
Autonomous study	30 hours
Final assessment preparation	35 hours
Total student's effort	**150** hours

ASSESSMENT METHODS AND CRITERIA

I. LECTURES (65%)
- Written examination with short or extended answer questions and multiple choice tests (summative).
  or
- Oral final examination (summative).

II. PRACTICE EXERCISES (25%)
- Individual practical training assignments (formative).
- Identification-description-classification of sedimentary rock hand specimens (formative, summative).

III. FIELDWORK EXERCISE (10%)
- Oral examination in the field (formative).
- Assessment of the field exercise essay (summative).

Supplementary material (tables, exercises, guides, etc.) for the exams of the course and the fieldwork, is posted on **e-Class** platform

(5) RECOMMENDED READING

I. ADDITIONAL READING

- M. Kati, **Petrology of Sedimentary Rocks** (Course text, in Greek).
- Blatt, H. & Tracy, R.J., 1996, ***Sedimentary Rocks. In: Petrology: Igneous, Sedimentary, and Metamorphic (2nd edition),*** Freeman and Company, New York, 514 p.
- Boggs, S.Jr., 2009, ***Petrology of Sedimentary Rocks (2nd edition),*** Cambridge, 600 p.
- James, N.P. & Jones, B., 2016, ***Origin of Carbonate Sedimentary Rocks,*** Wiley, UK, 446p.
- Pettijohn, F.J., Potter, P.E. & Siever, R., 1987, ***Sand and Sandstone (2nd edition),*** Springer-Verlag, New York, 618 p.
- Tucker, M.E., 2001, ***Sedimentary Petrology (3rd edition),*** Blackwell Science, Oxford, 262 p.
- Tucker, M.E., 2011, ***Sedimentary Rocks in the Field (4th edition),*** Wiley-Blackwell, 275 p.

II. RELATIVE JOURNALS

- Journal of Sedimentary Research, Online ISSN: 1938-3681, Print ISSN: 1527-1404, SEPM.
- Sedimentary Geology, Online ISSN: 1879-0968, Print ISSN: 0037-0738, Elsevier.
- Sedimentology (IAS), Online ISSN: 1365-3091, Print ISSN: 0037-0746, IAS, Wiley.

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y3203**	**SEMESTER**	**3th**
TITLE	**SEISMOLOGY**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Practical Exercises & Laboratory work and exercises	**5**	**6**

TYPE OF COURSE	**MANDATORY /** Scientific Area
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL137

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course the student:

- **Describes** the basic principles of Seismology.
- **Determines** arrival times and seismic wave amplitudes.
- **Distinguishes** the types of seismic waves.
- **Calculates** the source parameters.
- **Determines** focal mechanisms.
- **Combines** knowledge of the properties of the Earth's interior to determine its structure.
- **Suggests** the appropriate magnitude scale.

Generic Competences

- Ability to apply knowledge in practical situations
- Promote free, creative and inductive thinking
- Ability to plan and manage time
- Ability to search for, process and analyse information with the use of necessary technologies

- Oral and written communication of scientific issues
- Autonomous work
- Information and Communication Technology (ICT) skills

(3) COURSE CONTENT

A. Lectures:

- Historical review and basic concepts of Seismology
- Elements of the theory of oscillation and elastic waves, motion equation
- Types and propagation of seismic waves, structure and characteristics of the Earth's interior
- Seismic motion recording instruments, basic principles of seismometer and seismograph operation
- Methods for the determination of seismic parameters
- Basic principles of rupture, geometrical parameters of a seismic fault, focal mechanism
- Macroseismic effects of earthquakes (intensity, scales)
- Elements of Earthquake Prediction
- Spatial and temporal distribution of seismic activity and correlation with active tectonic structures

B. Practical Exercises & Laboratory work and exercises:

PART A: Measurement of seismic parameter, error calculation and graphs.
PART B: Seismogram analysis (determination of arrival times, travel times, origin time, epicentral and hypocentral distances, azimuth and backazimuth).
PART C: Determination of earthquake magnitude and seismic moment.
PART D: Microseismic hypocenter determination.
PART E: Focal mechanism determination.
PART F: Macroseismic epicenter and magnitude determination.
PART G: Study of an aftershock sequence.
PART H: Calculation of focal parameters using PC

C. Field exercises

One-day Educational Exercise at the premises of the Geodynamic Institute of the National Observatory of Athens: Historical evolution of seismological instruments and seismological data analysis

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	39 hours
	Practice exercises	26 hours
	Fieldwork	5 hours
	Tutorials	-
	Essey writing	22 hours
	Autonomous study	42 hours
	Final assessment preparation	16 hours
	Total student's effort	**150** hours

ASSESSMENT METHODS AND CRITERIA	Theory and practical examination (written and/or oral) at the end of the Course To pass the Course, a minimum grade **5** (**out of 10**) for both the theory and practical examinations is necessary. **I. LECTURES (50%)** • Written or Oral Examination (Summative) **II. LABORATORY EXERCISES (40%)** • Problem solving during practical exercises, delivery of laboratory exercises (Formative) • Written or oral examination with Solving Exercises and Problems (Summative) **III. FIELDWORK EXERCISE (10%)** • Oral examination (in-situ) (Formative) • Delivery of Fieldwork report (Formative)

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Introduction to seismology. Papazachos B.C., G.F. Karakaisis, P.M. Chatzidimitriou. [Code EUDOXUS: 11254], in Greek
- General seismology vol. A, A. Tselentis [Code EUDOXUS: 59395397], in Greek

II. ADDITIONAL READING

- I. Kassaras and G. Kaviris, 2017. Laboratory Seismology, 268 pp., Athens. Available in e-class, in Greek
- Kaviris, G., Papadimitriou, P., Kravvariti, Ph., Kapetanidis, V., Karakonstantis, A., Voulgaris, N. and Makropoulos, K., 2015. A detailed seismic anisotropy study during the 2011-2012 unrest period in the Santorini Volcanic Complex. Physics of the Earth and Planetary Interiors, 238, 51-88
- Makropoulos, K., Kaviris, G. and Kouskouna, V., 2012. An updated and extended earthquake catalogue for Greece and adjacent areas since 1900. Nat. Hazards Earth Syst. Sci., 12, 1425-1430.

III. RELATIVE JOURNALS

- Bulletin of the Seismological Society of America, SSA Journals
- Geophysical Journal International, Oxford University Press
- Journal of Geophysical Research, AGU Publications
- Physics of the Earth and Planetary Interiors, Journal, Elsevier
- Tectonophysics, Journal, Elsevier

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	SCHOOL OF SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
EDUCATION LEVEL	EQF level 6; NQF of Greece level 6		
CODE	Y3205	SEMESTER	3rd
TITLE	STRUCTURAL GEOLOGY AND TECTONICS		

TEACHING ACTIVITIES	HOURS/WEEK	ECTS
Lectures, Lab Exercises and Fieldwork	6	6

TYPE OF COURSE	**MANDATORY /** Scientific Area
PREREQUISITES	Lab exercises of the course: Introduction to Geology (Y2201).
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL135 http://opencourses.uoa.gr/courses/GEOL4/

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course the student:

- **Define** and **formulate** the basic principles, methods and applications of Structural Geology and Tectonics.
- **Classify** and **describe** in three dimensions (3D), the brittle or plastic tectonic structures and fabrics, produced during deformation, in all scales of observation and structural levels.
- **Comprehend** the deformation mechanisms and the relationships between tectonic structures from microscopic to meso- and macroscopic scale.
- **Determine**, using various techniques, the components of deformation, the three-dimensional strain and the oriented strain ellipsoid.
- **Define** the forces, the oriented stress ellipsoid and the stress field, resulting to deformed rocks and their structures and fabrics.
- **Apply** the structural analysis and synthesis techniques revealing the deformation and stress field history in different geotectonic regimes.
- **Combine** and **evaluate** various structural data using classical and modern techniques (software and apps) of structural geology, to solve geological problems related to both basic and applied re-

search.
Generic Competences
• Ability to search for, process and analyze information with the use of necessary technologies. • Autonomous work. • Ability to apply knowledge in practical situations. • Ability to work in a team • Promote free, creative, and inductive thinking. • Ability to plan and manage time. • Information and Communication Technology (ICT) skills.

(3) COURSE CONTENT

A. Lectures

- Introduction to Structural Geology and Tectonics.
- The frame of plate tectonics.
- Force and stress.
- Deformation and strain.
- Rock mechanics and rheology.
- Fractures and brittle deformation.
- Extensional fractures, joints, and veins.
- The birth and growth of faults.
- Kinematic and paleostress analysis.
- Recognition of faults in the field.
- Folds and fold mechanisms.
- Foliation and cleavage.
- Lineations.
- Boudinage.
- Shear zones and fault-related rocks.
- Contractional regimes and thrust faults.
- Extensional regimes and normal faults.
- Strike-slip faults, transpression and transtension.

B. Lab exercises.

Practice exercises are taught in small groups of students and are graded at the end of the exercise.

Exercise 1. Stereographic projection of planar and linear fabrics on the Schmidt and Wulff nets. Use of stereonet software and apps.

Exercise 2. Calculation of angular relationships between planar and linear features, using a Schmidt or Wulf stereonet.

Exercise 3. Solve geological problems with the Schmidt net. Statistical analysis of structural data.

Exercise 4. Constructing a geological cross section in kink folded and unconformably covered strata.

Exercise 5. Constructing a geological cross section in geological strata deformed by upright folds, strike-slip faults, and dykes.

Exercise 6. Classification of faults based on the dip of the fault plane and the pitch (Angelier and Mariolakos-Papanikolaou methods).

Exercise 7. Classification of folds based on a) the dip of the axial plane and the plunge of the fold axis (Fleuty method), b) the interlimb angle and c) Ramsay's dip isogons method.

Exercise 8. Calculating elongation in two dimensions (planar strain), using balanced cross-sections with normal or thrust faults and deformed objects (fossils, reduction spots, minerals etc.).

Exercise 9. Calculating elongation in two dimensions (planar strain), in folded strata (upright folds).

Exercise 10. Plotting oriented strain ellipsoids on the Flinn diagram and relate them to specific fold and normal or reverse fault patterns.

Exercise 11. Correlation of oriented stress ellipsoids with specific shear, open or close fracture patterns. Drawing of principal stress axes and related fractures in map and cross-section view and their projection in stereonet.

Exercise 12. Constructing a geological cross section in an extended part of the lithosphere under pure shear conditions. Determination of strain and stress ellipsoids. Projection of the principal stress and strain axes and the related conjugate set of normal faults in a Scmidt net.

Exercise 13. Determination of the stress ellipsoid using fault kinematic data in combination with data from laboratory triaxial compression tests on samples of the fractured rock.

C. Fieldwork

C1. One day field excursion in the wider area of Corinth Canal – Gerania Mt. Normal faults cutting the Neogene formations and marginal active normal faults on the southern margin of Gerania Mt. horst.

C2. One day field excursion in the wider area of Corinthia and Argolida Prefecture. Marginal normal faults, bounding small Neogene continental basins (Corinthia). Syn-sedimentary and thrust faults in the Tripolis and SubPelagonian units (Argolida).

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** / **Student effort** Lectures: 52 hours Practice exercises: 26 hours Fieldwork: 14 hours Tutorials: – Essey writing: – Autonomous study: 42 hours Final assessment preparation: 16 hours **Total student's effort**: **150** hours
ASSESSMENT METHODS AND CRITERIA	I. LECTURES (**35%**) • Short test at the end of each lecture (formative). • Mid-term examination (formative, summative). • or • Oral or written final examination (summative). Exams include short or extended answer questions, multiple choice tests, simplified sketches and drawings, simplified cross-sections and maps and stereographic projections. II. LAB EXERCISES (**35%**) • Weekly assessment of lab exercises (formative, summative). • or/and • Written final examination (summative). II. FIELDWORK (**30%**) • Oral examination in the field with assessment of the field book and/or the required report or essay (formative, summative).

	Supplementary material for the exams (questions, exercises etc.) is posted on **e-Class** platform (https://eclass.uoa.gr/courses/GEOL135/).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- D. Papanikolaou & S. Lozios. **Structural geology and Tectonics**, da Vincy, 480 p., (EUDOXUS code: 32998223), in Greek.

II. ADDITIONAL READING

- Davis, G. H., Reynolds, S. J. & Kluth, Ch. F., 2011, **Structural Geology of Rocks and Regions**, Wiley, 839 p.
- Fossen, H., 2016, **Structural Geology**, Cambridge, 510 p.
- Fossen, H., 2016, **Structural Geology (e-modules)**, https://folk.uib.no/nglhe/StructuralGeoBookEmodules2ndEd.html
- Moores, M., E. & Twiss, J., R., 1995, **Tectonics**, W. H. Freeman and Company, 415 p.
- Van der Pluijm, B. & Marshak, S., 2004, **Earth Structure. An Introduction to Structural Geology and Tectonics**, W.W. Norton & Company, 674 p.

III. RELATIVE JOURNALS

- Journal of Structural Geology, Online ISSN: 1873-1201, Print ISSN: 0191-8141, Elsevier.
- Tectonics, Online ISSN:1944-9194, Print ISSN:0278-7407, AGU Publications.
- Tectonophysics, Online ISSN: 1879-3266, Print ISSN: 0040-1951, Elsevier.

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	SCHOOL OF SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
EDUCATION LEVEL	EQF level 6; NQF of Greece level 6		
CODE	Y3206	SEMESTER	3rd
TITLE	BIOGEOSCIENCES-PRINCIPLES OF MICROPALAEON-TOLOGY		
TEACHING ACTIVITIES		HOURS/WEEK	ECTS
Lectures-seminars &laboratory work and exercises, optional fieldwork		4	6
TYPE OF COURSE	MANDATORY / Scientific Area		
PREREQUISITES	Knowledge of Paleontology (Y2205 Macropalaeontology)		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL163		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
Upon successful completion of the course the student: • Defines and formulates the relationship between the applications of geobiological knowledge in paleoenvironments and in modern depositional environments • Comprehends and applies the basic principles of Micropaleontology, concerning laboratory techniques for processing and preparation of micropaleontological samples, as well as optical and electron microscopy techniques • Combines and evaluates problems related to the above principles • Comprehends the atmosphere-hydrosphere-biosphere-lithosphere relationship and its functions in space and time, the process of accumulation of energy and materials in terrestrial ecosystems and the degree of anthropogenic impact. • Defines the biosynthetic and metabolic processes necessary for the development of life, the role of microorganisms in the control of biogeochemical cycles, as well as the role of molecular markers in the reconstruction of oceanic, terrestrial and atmospheric paleo-conditions. • Applies the basic principles of identification, description and classification of the main groups of

microfossils (coccolithophores/calcareous nannoplankton, benthic and planktonic foraminifera, diatoms, radiolaria) based on their physiological and morphological data
- Comprehends and explains the overall role of microfossils in geology, stratigraphy and sedimentary processes as also their contribution to modern geo-environmental and climate research
- Classifies and describes the microfossil groups and applies them as biostratigraphic and paleoceanographic indices
- Combines and evaluates the relevant literature, with an emphasis on studies in the Greek area.

Generic Competences

- Ability to apply knowledge in practical situations
- Promote free, creative and inductive thinking
- Ability to plan and manage time
- Ability to work in a team
- Oral and written communication of scientific issues
- Autonomous work
- Information and Communication Technology (ICT) skills
- Commitment to conservation of the environment
- Ability to work in an interdisciplinary context

(3) COURSE CONTENT

A. Lectures:

Introduction to BioGeosciences

Basic elements of cell function, the role of biological metabolism in changing environmental conditions, the biological derivatives preserved in the geological record as well as the changes that occur in biomolecules and elements due to sedimentary processes and the recycling of organic matter and inorganic elements through biogeochemical cycles.

Basic principles of Micropaleontology

Physiology and morphology, basic principles of identification, description, determination and classification of the main groups of microfossils (coccolithophores / calcareous nannoplankton, benthic and planktonic foraminifera, diatoms, radiolaria).

Geoenvironmental applications of microfossils

Use of microfossils in biostratigraphic applications, and in paleoceanographic, paleoenvironmental and paleoclimatic research, as well as their contribution to the processes of sedimentation and their interaction with the modern environment and climate. Computational exercises.

Laboratory techniques

Sampling and analyses protocols.

Biofacies

Identification and use of the microfacies and the content in microfossils for the determination of the characteristic sedimentary sequences in the Greek area.

B. Practical and Laboratory Exercises :

Exercises 1 to 4 Identification of the main microfossil groups (coccolithophores/calcareous nannoplankton, benthic and planktonic foraminifera): with contemporaneous use of PCs, stereoscopes and polarizing microscopes.

Exercises 5 & 6 Dating of depositional sequences based on calcareous nannoplankton and planktonic foraminifera -biostratigraphy. Understanding of transport and reworking processes in the sedimentary sequences.

Exercise 7 Practical exercises in the lab and the Scanning Electron Microscope.

Exercise 8 Computational exercise-methods for estimating marine environmental paleo-conditions in the surface sediments.

Exercise 9 Computational exercise-methods for estimating marine environmental paleo-conditions in the water column.

Exercise 10 Microfacies-microfossils in carbonate rocks

C. Fieldwork

C1. One day field excursion in the wider area of Corinth Canal – Gerania Mt. **C2. One day field excursion in the wider area of Corinthia and Argolida Prefecture.** **Facies** (neritic-pelagic) and characteristic microfossils of alpine and postalpine formations. **Collection of micropaleontological samples** in alpine and postalpine deposits (recognition of various lithologies and included microfossils, sampling techniques in the field: sample collection and coding)

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** — **Student effort** Lectures — 26 hours Practice exercises — 26 hours Fieldwork — 14 hours Tutorials — - Essey writing — 24 hours Autonomous study — 20 hours Final assessment preparation — 40 hours **Total student's effort** — **150** hours
ASSESSMENT METHODS AND CRITERIA	For the lab: • Lab essays **30%** (formative, summative) • Written final examination during the last (13) week of semester (**20%)** (summative) • concerning the identification of microfossils, • biostratigraphic applications, proxies calculations and computational exercises For the theoretical part: • written assessment and multiple choice exercises (**35%**) (summative) • questions concerning the topics discussed in the field-work (**15%**) (summative)

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Triantaphyllou, M.V., Dimiza, M.D., 2012. Micropaleontology & Geoenvironment. ION publications, 168 pp., ISBN 978-960-508-058-7. [EUDOXUS code: 22769096], in Greek
- **II. ADDITIONAL READING**
- Dermitzakis, M.D., Georgiades-Dikaioulia, E., 1985, Introduction to Marine Micropaleontology, 720 pp., Eptalofos publications, Athens, in Greek
- Micropaleontology and Applications, Zambetakis-Lekkas, A., Antonarakou, A., Drinia, H., Tsourou, Th., A. Di Stefano, N. Baldassini (e-book: pdf, e-pub)[Eudoxus code: 320254]
- Haq, B.U., Boersma, A., 1998. Introduction to marine micropaieontology. Elsevier Science (Singapore) Pte Ltd, p. 376.
- Armstrong, H.A., Brasier, M.D., 2005. Microfossils. Blackwell Publishing Ltd, p. 296.
- Bown, P.R., 1998. Calcareous Nannofossil Biostratigraphy. Chapman and Hall, Kluwer Academic,
- Thierstein, H.R., Young, Y.R., 2004. Coccolithophores from Molecular Processes to Global Impact.

Springer, Berlin

- Murray, J., 2006. Ecology and Applications of Benthic Foraminifera. Cambridge University Press, p. 426.
- Nomaki et al., 2015. Variation in the nitrogen isotopic composition of amino acids in benthic foraminifera: Implications for their adaptation to oxygen-depleted environments. Limnology and Oceanography 60, 1906-1916.
- **III. RELATIVE JOURNALS**
- **Marine Micropaleontology,** Online ISSN: **1872-6186**
- **BioGeosciences,** Online ISSN: 1726-4189
- **Revue de Micropaleontologie,** Online ISSN: 1873-4413

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	SCHOOL OF SCIENCE			
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT			
EDUCATION LEVEL	EQF level 6; NQF of Greece level 6			
CODE	E3202	SEMESTER	3rd	
TITLE	ROCK-FORMING MINERALS			
TEACHING ACTIVITIES			HOURS/WEEK	ECTS
Lectures, Practical exercises, Fieldwork			4	4
TYPE OF COURSE	**ELECTIVE /** Scientific Area			
PREREQUISITES	[recommended] Y1205 Mineralogy-Crystallography Y2202 Systematic Mineralogy - Mineral Identification			
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English			
AVAILABILITY TO ERASMUS STUDENTS	YES			
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL231			

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

Specialized Mineralogy courses with emphasis to rock-forming minerals and their formation processes.

On successful completion of the course the student:

- **Defines** and **Describes** rock-forming minerals processes, their structure and chemical composition
- **Comprehends** and **distinguishes** solid-solutions, isomorphism, polymorphism, exsolution using optical microscopy, X-ray techniques, and spectroscopic methods.
- **Combines** and **evaluates** structure and chemical composition for the characterization of most rock-forming minerals and their formation processes

Generic Competences

- Ability to apply knowledge in practical situations
- Ability to work in a team
- Ability to search for, process and analyse information with the use of necessary technologies

• Oral and written communication of scientific issues • Ability to undertake research at an appropriate level

(3) COURSE CONTENT

A. Lectures

Nucleation and crystal growth of minerals; growth of mineral crystals from magma/melt cooling & hydrothermal fluids (igneous minerals), effect of pressure (metamorphic minerals & deep minerals), sedimentary minerals; Silicates (olivine, SiO_2-polymorphs, feldspars, pyroxenes, amphiboles, phyllosilicates) and carbonate minerals (calcite, aragonite, dolomite); Crystal structure, defects-color, solid-solutions, isomorphism, polymorphism, allotropy, polytypism; epitaxy, topotaxy, exsolution, phase diagrams; study of rock-forming minerals by microscopic techniques (optical microscopy & petrographic microscope, SEM, TEM, AFM); basic principles of instrumental characterization & analyses of rock-forming minerals (X-rays, e^-, p^+, Laser, MS, ion-beams).

B. Lab exercises

The laboratory exercises include mineral identification under the microscope, as well as determination of structure and composition of solid solutions and exsolution processes using optical and spectroscopic techniques (microscopes, SEM-EDS, XRD), and processing results using necessary software and technologies.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	see table below
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted in Greek (there is the possibility of examination in English for Erasmus students). The final grade of the course is formed by a series of tests that include: I. Exams on the theoretical part • Written or Oral Exams (**60% of the final grade**). II. Laboratory Exams (**40% of the final grade**).

Activity	Student effort
Lectures	26 hours
Practice exercises	26 hours
Fieldwork	-
Tutorials	-
Essey writing	-
Autonomous study	20 hours
Final assessment preparation	28 hours
Total student's effort	**100** hours

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- ΘΕΟΔΩΡΙΚΑΣ Σ.Σ.: Ορυκτολογία-Πετρολογία, Εκδόσεις Μέλισσα., 4η Έκδοση, Θεσσαλονίκη 2017.
- ΚΟΚΚΟΡΟΣ Π.: Γενική Ορυκτολογία, Εκδόσεις Δ.Ν. Παπαδήμα, Έκδοσις Θ, Αθήνα 1987.
- ΧΡΙΣΤΟΦΙΔΗΣ Γ, ΣΟΛΔΑΤΟΣ Τ. Οπτική Ορυκτολογία, Εκδόσεις Γιαχούδη, Θεσσαλονίκη 2013.
- DYAR M.D. et al.: *Mineralogy and Optical Mineralogy*, MSA, Chantilly 2008.
- GAINES R.V. et al.: *Dana's New Mineralogy*, J.Wiley & Sons Inc. 1997.
- HIBBARD M.J. and HIBBARD M.: *Mineralogy: A Geologist's Point of View*, McGraw-Hill Science/Engineering/Math, 1st Ed. 2001.
- KLEIN C. and HURLBUT C.S.Jr.: *Manual of Mineralogy* (after J.D. Dana), J.Wiley & Sons, revised 21st Edition 1999.
- ZUSSMAN J et al. (Eds.): **Introduction to the Rock-Forming Minerals**, Mineralogical Society of Great Britain and Ireland; 3rd ed. edition, 2013.
- PERKINS D.: *Mineralogy*, Prentice Hall, 2nd Ed. 2001.
- WENK H.R, BULAKH A.: *Minerals, their constitution and origin*. Cambridge University Press 2004.

III. RELATIVE JOURNALS

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COURSE UNITS: 4th Semester

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y4201**	**SEMESTER**	**4th**
TITLE	**PETROLOGY OF METAMORPHIC ROCKS**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Practical Exercises, Laboratory exercises, Fieldwork		**5**	**6**
TYPE OF COURSE	**MANDATORY /** Scientific Area		
PREREQUISITES	[recommended] **Y2202** Systematic Mineralogy-Mineral Identification **Y3201** Igneous Rocks-Magmatic Processes **Y3202** Petrology Of Sedimentary Rocks		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL217		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
Upon successful completion of the course, the student: • rigorously **describes** mineral assemblages of metamorphic rocks and **identifies** their corresponding petrological types as well as their corresponding protoliths before metamorphic imprinting took place. • **assesses** the geotectonic environment of formation of a metamorphic rock series and **infers** its genetic mechanisms. • **estimates** the temperature and pressure conditions of rock metamorphism in the Earth's interior and the time required for metamorphic events to take place at both macro (e.g., orogenic) and micro (e.g., chemical zoning in minerals) scales. • **extracts** physicochemical information from minerals and rocks and **proposes** their spatiotemporal evolution, **stands** by its opinion, supports its arguments, **revises** current views, and **generates** new knowledge. • **evaluates** the geodynamic evolution of the Greek area over time within the wider region of the Eastern Mediterranean (Balkans – Asia Minor).

Generic Competences
• Ability to apply knowledge in practical situations • Promote free, creative and inductive thinking • Ability to plan and manage time • Ability to work in a team • Ability to search for, process and analyse information with the use of necessary technologies • Autonomous work • Information and Communication Technology (ICT) skills • Ability to work in an international context • Commitment to conservation of the environment • Ability to work in an interdisciplinary context

(3) COURSE CONTENT

A. Lectures:

The content of the lectures includes five thematic units:

- DISTRIBUTION OF PRESSURE, TEMPERATURE AND DENSITY IN THE EARTH (Sources of heat in the crust and mantle, heat flow, continental and oceanic crustal geotherms, lithostatic pressure and tectonic overpressure, spatial distribution of pressure and temperature in crustal-scale shear zones, mineralogical stratification of the upper mantle, geotectonic environments and geothermal gradients, heat transfer during continental collision, and thermal evolution of thickened crust).
- TYPES OF METAMORPHISM, METAMORPHIC TEXTURES, METAMORPHIC TIME SCALES, METAMORPHISM AND GEOTECTONIC SETTINGS (Criteria for classification of metamorphic types, metamorphic grade, progressive and retrograde metamorphism, isograds, metamorphic facies, series and sequences, spatial distribution of metamorphic facies in active continental margins and oceanic subduction zones, description of metamorphic textures and fabrics, crystalloblastic series).
- PETROLOGY OF METAMORPHIC ROCKS DERIVED FROM DIFFERENT IGNEOUS AND SEDIMENTARY PROTOLITHS (mafic, ultramafic, argillaceous/pelitic, carbonate, quartzose, quartzofeldspathic).
- ULTRAHIGH-PRESSURE AND ULTRAHIGH-TEMPERATURE METAMORPHISM (Greek and Bulgarian Rhodope Metamorphic Province).
- METAMORPHIC CASE STUDIES (Scottish Highlands and Cyclades).

B. Practical Exercises :

The content of the practice exercises includes four thematic modules:

PART A. Lithostatic pressure in the crust and mantle. Calculation of steady-state continental geotherms and surface heat flow.

PART B. ACF and AFM diagrams (mineral and rock projections, identification of metamorphic reactions and facies).

PART C. Diffusion, closure temperature and cooling rates. Calculation of chemical zoning in minerals and investigation of the suitability of minerals as chronometers and thermometers.

PART D. Thermodynamics. Calculation of metamorphic-reaction boundaries (ideal endmembers and solid solutions, water-absent and water-present reactions, investigation of the importance of heat capacity in the calculations), solution and applications of geothermobarometers.

Γ. Laboratory Exercises

Macroscopic identification of metamorphic minerals and metamorphic rocks of the Greek area derived from different igneous and sedimentary protoliths.

C. Field exercise

ONE-DAY FIELD EXCURSION TO MOUNT PENDELI AND/OR MOUNT HYMETTUS. Training in identifying metamorphic rocks from different igneous and sedimentary protoliths, sampling methods (recording of longitude, latitude, altitude, labeling and description of samples), measuring of structural elements (foliation, lineation), identifying kinematic indicators, making geodynamic interpretation of the site based on observations and measurements.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	see table below

Activity	Student effort
Lectures	26 hours
Practical Exercises	22 hours
Laboratory work and/or exercises	4 hours
Fieldwork	8 hours
Preparation of field-exercise report (observations, measurements, sample description and interpretation)	10 hours
Homework	20 hours
Preparation for laboratory progressive exams	20 hours
Preparation for final Assessment	40 hours
Total student's effort	**150** hours

ASSESSMENT METHODS AND CRITERIA

The assessment method through which the final grade is determined includes a series of tests as follows:

I. LECTURES (**50%**) (summative)
- Oral Examination and/or
- Written Examination with Short-Answer Questions and Multiple-Choice Test and/or
- Written Examination with Extended-Answer Questions

II. PRACTICE AND LABORATORY EXERCISES (**40%**)
- Written progress examination in the practice exercises during the semester (**10%**) (formative)
- Written examination involving solving exercises and problems in the Practice Exercises and Oral Examination in the Laboratory Exercises (**30%**) (summative)

III. FIELD EXERCISES (FIELDWORK) (**10%**)
- Active participation in the compulsory field exercise followed by a written report (**10%**) (formative)

(5) RECOMMENDED READING

I. EUDOXUS PORTAL
- Petrology of Metamorphic Rocks, D. Kostopoulos (Κωδ. ΕΥΔΟΞΟΣ: 122076666)
- Petrology of Metamorphic Rocks - Thermodynamic and Thermomechanical Processes (in Greek; EUDOXUS Code No.: 86195557)

II. ADDITIONAL READING
- Frank S. Spear, 1993. Metamorphic Phase Equilibria and Pressure-Temperature-Time Paths. Monograph, Mineralogical Society of America
- Anthony R. Philpotts & Jay J. Ague, 2009. Principles of Igneous and Metamorphic Petrology (2nd

Edition) Cambridge University Press
- John D. Winter, 2014. Principles of Igneous and Metamorphic Petrology (2nd Edition) Pearson Education Limited

III. RELATIVE JOURNALS
- Journal of Petrology (Oxford University Press)
- Journal of Metamorphic Geology (Wiley)
- Lithos (Elsevier)
- Contributions to Mineralogy and Petrology (Springer Link)

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y4202**	**SEMESTER**	**4th**
TITLE	**GEOPHYSICS**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures and Practical Training		**6**	**6**
TYPE OF COURSE	**MANDATORY /** Scientific Area		
PREREQUISITES	[recommended] Y1202 Physics Y1204 Introduction to Calculus and Statistics Y2201 Introduction to Geology Y2204GIS and Introduction to Remote Sensing		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL210		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
On completion of the course the students will have acquired: • Comprehension of the place of planet Earth in the Cosmos and of the consequences on the evolution of its inanimate and animate sub-systems. • Understanding of the structure and evolution of planet Earth, i.e. of the complex processes that formed its internal composition and organization and which are continuously reconfiguring its surface. • Understanding of the physical principles that make it possible to image and study the interior of the Earth, and that the same principles can be applied to the study of the Earth's oceans and atmosphere, as well as to the remote observation of other planets • Familiarization with the principles of the basic geophysical methods used in studying the interior of the Earth, and with the methods and techniques used in the quantitative interpretation of the corresponding geophysical (and other scientific) observations.

- Experience on how to combine, compare and critically appraise data and results from different lines of inquiry, (e.g. geological, petrological and geophysical), in order to extract information about the structure and evolution of the interior of the Earth.
- Improved ability to compile and present scientific reports.
- A host of practical skills useful in their continued education and in the analysis of both academic and practical problems, (economic/mining, environmental, technical etc.), which can be addressed by Geophysics and a host of related earth-scientific disciplines.

Generic Competences

- Ability to search for, process and analyse information using the necessary technologies
- Application of knowledge in practical situations
- Promotion of free, creative and inductive thinking
- Autonomous work
- Team work
- Oral and written communication of scientific matters
- Ability to plan and manage time

(3) COURSE CONTENT

A. Theoretical background (lectures).

- **Role and Contribution of Geophysical Sciences** in the study of the lithosphere and the interior of the Earth.
- **Formation, Structure and Composition of the Earth's Interior:**Formation and differentiation of the Planet. Shape, internal structure and composition. Distribution of temperature, pressure, density, mechanical and electrical properties in the interior of the Earth. Basic structure of the Earth's core, mantle and crust.
- **Heat of the Earth's Interior:**Origin, sources and distribution of heat. Natural radioactivity, distribution of radioactive elements and radioactive heating. Principles of heat diffusion and transfer, heat flow. Thermal convection in the Earth's core and mantle – consequences for the structure, dynamics and evolution of the lithosphere and the surface of the Earth.
- **Gravityand Gravity Exploration:**Gravity potential and the gravity field of the Earth. Shape of the Earth: the geoid and the ellipsoid. Isostasy. The concept of a "gravity anomaly" and its application to the exploration of the interior of the Earth: measurements, processing, analysis and interpretation. Elements of Geodesy and introduction to Satellite Geodesy.
- **Geomagnetism and Magnetic Exploration:**Elements of the Earth's magnetic field. Generation, changes and origin of changes in the Earth's main magnetic field; external fieldsof magnetospheric, ionospheric and atmospheric origin;importance and consequences on the surface of the Planet. Field reversals and their utilization – elements of Paleomagnetism. The concept of "magnetic anomaly" and its application to the exploration of the Earth's interior – measurements, analysis and interpretation.
- **Elements of Geo-Electromagnetism:**Electrical and magnetic properties of minerals and rocks. Electrical structure of the Earth. Natural EM fields (magnetospheric, ionospheric and atmospheric). Elements of EM theory: diffusion and propagation of EM waves in finite Earth structures and relevant Earth responsefunctions.
- **Electromagnetic Exploration:**Overview. Natural field exploration methods (Magnetotelluric, Magnetovariational/GDS). Elements of Controlled source exploration methods in the frequency and time domains. Data analysis and interpretation. Elements of Geoelectric exploration.
- **Seismic Exploration:**Stress and strain. Seismic wave propagation and attenuation. Seismic excitation sources. Seismic refraction and reflection methods.Seismic tomography. Measurements, processing, analysis and interpretation of seismic exploration data.
- **Introduction to the Earth System.** The physics Earth system and sub-systems and their interactions. The core – mantle – lithosphere system. The core – magnetosphere/ionosphere – lithosphere system. Crustal dynamic systems.
- Multi- and Trans-disciplinary geophysical investigation of the Earth's interior – structural and geodynamic analysis with geophysical methods: Examples and applications.

B. Practical Training: Data analysis and interpretation with specialized/dedicated software; compilation of technical reports.

- Introduction to the management and visualization of geophysical data.
- Introduction to the concept of “geophysical anomalies”.
- Gravity anomaliesand their qualitative interpretation.
- Gravity anomalies” and their quantitative interpretation: Introduction to geophysical modelling of local and regional gravity anomalies.
- Magnetic anomalies and their qualitative interpretation.
- Magnetic anomalies and their quantitative interpretation: detection of buried structures and objects.
- Electromagnetic exploration of buried geological structures: Qualitative appraisal and interpretation of magnetotelluric soundings.
- Electromagnetic exploration of buried geological structures: Quantitative interpretation of magnetotelluric soundings/ introduction to the concepts of geophysical inversion.
- Geoelectric exploration: Familiarization with the relevant equipment. Field measurements. Processing, interpretation and appraisal of geoelectric soundings and ERT tomograms.
- Seismic exploration: Concepts, pprocessing and interpretation of seismic refraction and reflection data.
- Heat transfer and heat flow in the Earth: Concepts, quantitative analysis and interpretation.
- Multi-parametric exploration of the Earth’s interior.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	see table below
ASSESSMENT METHODS AND CRITERIA	The final grade is formed through a series of tests that include: • **Written examinations:** The main examination (formative, summative) takes place at the end of the semester (June) and, in case of failure, an auxiliary examination takes place in September (also formative, summative). The written examination account for_**50% of the final grade**. • **Written reports:** These are prepared and submitted as part of the practical exercise program. (formative, summative). The mean grade of all reports accounts for **50% of the final grade**

PLANNED LEARNING ACTIVITIES:

Activity	Student effort
Lectures	52 hours
Practice exercises	26 hours
Fieldwork	-
Tutorials	
Essey writing	16 hours
Autonomous study	34 hours
Final assessment preparation	22 hours
Total student's effort	**150** hours

(5) RECOMMENDED READING

- I. EUDOXUS PORTAL

- Τζάνης Α., 2020. «Στοιχεία Γενικής και Εφαρμοσμένης Geophysicsς», Εκδόσεις Νέον, Αθήνα (Κωδ. ΕΥΔΟΞΟΣ: 94645607)
- Παπαζάχος Κ., Παπαζάχος Β., 2013. «Εισαγωγή στη Geophysics», Εκδόσεις ΖΗΤΗ, Θεσσαλονίκη (Κωδ. ΕΥΔΟΞΟΣ: 33093728)

II. ADDITIONAL READING

- W. Lowrie, 2007, Fundamentals of Geophysics Cambridge University Press
- Frank M. Stacey & Paul M. Davies, 2008, Physics of the Earth, 4th edition, Cambridge University Press
- C.M.R. Fowler, The Solid Earth: An introduction to Global Geophysics, Cambridge University Press.
- Alan Mussett & Aftab Khan, Looking into the Earth; Cambridge University Press.
- Λούης, Ι., 2004. «Εισαγωγικά Μαθήματα στην Διερευνητική Geophysics», ανέκδοτο βιβλίο, 245 σελ., [PDF].
- Παπαδόπουλος, Τ., 2010, «Εισαγωγή στη Geophysics», Εκδόσεις Νέων Τεχνολογιών, ISBN 978-960-6759-49-9, 2010, 249 σελ., (Κωδ. ΕΥΔΟΞΟΣ: 7969)
- Additional literature for further study is available in electronic form at: (e-Class NKUA | Y4202 - GEOPHYSICS | Optional Literature

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y4203**	**SEMESTER**	**4th**
TITLE	**GEOCHEMISTRY**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures-seminars & laboratory work and exercises, fieldwork		**6**	**6**
TYPE OF COURSE	**MANDATORY /** Scientific Area		
PREREQUISITES	Y1203 Chemistry [recommended] **Y1205 Error! Reference source not found.** [recommended]		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL103 http://opencourses.uoa.gr/courses/GEOL2/		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
Upon successful completion of the course, the student is able to: • • Identify and describe basic geochemical processes related to the occurrence and distribution of chemical elements within the Earth's interior and surface. • • Apply the principles of chemistry to interpret geological processes that control the concentrations and distribution of chemical elements in magma and the primary rocks derived from it. • • Predict the behaviour of chemical elements in the Earth's surface environment and the alteration of the chemical composition of geologic materials under conditions of chemical weathering. • • Extend the applications of chemical methods to realistic scenarios of geological samples (in solid or liquid state) that deviate from the ideal behaviour. • • Calculate critical geochemical parameters for solving geochemical problems related to the atmosphere, land, and oceans. • • Use appropriate tools and laboratory instruments to carry out simple geochemical measurements. • • Combine knowledge of geology, mineralogy, and chemistry to design work plans and make deci-

sions regarding the exploration and exploitation of mineral resources and environmental protection.

Generic Competences

- Ability to apply knowledge in practical situations
- Promote free, creative and inductive thinking
- Ability to plan and manage time
- Ability to work in a team
- Oral and written communication of scientific issues
- Information and Communication Technology (ICT) skills
- Commitment to conservation of the environment

(3) COURSE CONTENT

A. Lectures

Unit 1: Geochemical Processes in the Earth's Interior

- Multi- and Trans-disciplinary geophysical investigation of the Earth's interior – structural and geodynamic analysis with geophysical methods: Examples and applications.
- Geochemistry in the curriculum. Subject of Geochemistry. Course content. Introduction to processes in the Earth's interior.
- Classification of elements. Chemical bonds & crystal structures.
- Principles of Cosmochemistry – Formation of planets – Formation and differentiation of the Earth.
- Ionic substitutions in crystals. Theory of the partition coefficient of trace elements.
- Geochemistry of igneous rocks.
- Geochemistry of magmas and geotectonic environment I.
- Geochemistry of magmas and geotectonic environment II.
- Geochemistry of radiogenic isotopes.
- Thermodynamics of geological systems. Activity, fugacity, chemical potential.

Unit 2: Geochemical Processes on the Earth's Surface

- Geochemistry of aqueous solutions – Chemical composition of natural waters.
- Processes of chemical weathering – Factors, chemical reactions, products.
- Redox geochemical processes.
- Elements of organic geochemistry – Geochemistry of fossil fuels and environmental impact.
- Processes in the 'critical zone' – Soil geochemistry.
- Enrichment factors of chemical elements in soil.
- Marine geochemistry.
- Geochemistry of hydrothermal solutions.

B. Laboratory Exercises

Laboratory Exercises are conducted in small groups of students and are graded at the end of the Laboratory session.

Exercise 1: Normalization of rock chemical composition – practice in processing geochemical data from the literature using a computer.

Exercise 2: Behaviour of trace elements in magmatic processes – calculation of partition coefficient.

Exercise 3: Geochronology – calculation of rock age using the Rb/Sr method.

Exercise 4: Geochemistry of continental waters – units of concentration in solutions, calculation of parameters characterizing the chemical composition of natural waters.

Exercise 5: Extraction of Cu from ore – conducting an experiment in the lab, balancing redox chemical reactions that occur in nature.

Exercise 6: Solubility of minerals – experimental determination of solubility product of minerals in the lab –taking laboratory measurements.

Exercise 7: Processing of laboratory measurements of mineral solubility using a computer – calculation of ionic strength of solution, ion activity coefficient, ion activity, mineral saturation index, and change in mineral solubility with temperature.

C. Field work

One-day fieldwork exercise in Lavrion: Training in soil, surface water, and rock sampling. Study of acid rock and acid mine drainage in the field.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** — **Student effort** Lectures — 52 hours Practice exercises — 24 hours Fieldwork — 8 hours Tutorials — - Essey writing — 20 hours Autonomous study — 36 hours Final assessment preparation — 10 hours **Total student's effort** — **150** hours
ASSESSMENT METHODS AND CRITERIA	The final grade of the course is formed by a series of tests that include: **I. Written Exams** • **Two optional progress exams** during the semester (participation percentage in the final grade **30% each**) (formative, summative) and/or **a final written exam** with short-answer questions (**60% of the final grade without participation in progress exams**) (formative, summative). **II. Laboratory Exercises** • Problem-solving during practical exercises, submission of laboratory assignments (reporting of completed tasks with calculations) (**25% of the final grade**) (formative, summative). **III. Active participation in the compulsory Fieldwork exercise** • (soil sampling, short-answer questions) (**15% of the final grade**) (formative, summative).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Εισαγωγή στη Γεωχημεία, Αρχές και Εφαρμογές., Kula C. Misra (επιμέλεια: Α. Αργυράκη, Χ. Στουραΐτη) [Κωδ. ΕΥΔΟΞΟΣ: 68406899]

II. ADDITIONAL READING

- Introduction to Geochemistry- Principles and Applications., Kula C. Misra Wiley- Blackwell

- Μαθήματα Γεωχημείας, Μητρόπουλος Π., Κελεπερτζής Α. [Κωδ. ΕΥΔΟΞΟΣ: 22771432]
- Γεωχημεία, Σ. Θεοδωρίκα [Κωδ. ΕΥΔΟΞΟΣ: 38144136]

III. RELATIVE JOURNALS

- Applied Geochemistry, Elsevier
- Journal of Exploration Geochemistry, Elsevier
- Geochimica et Cosmochimica Acta, Elsevier

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y4205**	**SEMESTER**	**4th**
TITLE	**OCEANOGRAPHY**		

TEACHING ACTIVITIES	HOURS/WEEK	ECTS
Lectures, Lab Exercises and Fieldwork	**5**	**6**

TYPE OF COURSE	**MANDATORY /** Scientific Area
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek
AVAILABILITY TO ERASMUS STUDENTS	YES (in English)
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL293

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course the student:

- **Defines** and **articulates** the natural processes (internal and external) that shape the Earth's topography
- **Understand** the mechanisms of natural hazards and **evaluate** ways of dealing with them
- **Compares** the impact of the human factor on natural processes, natural resources and the environment in general and **develops** environmental awareness
- **Combine** and **interpret** landforms to identify the main morphological structures
- **Use** techniques to represent relief morphology in topographic sections
- **Recognizes** the processes of submarine topography and relates land and marine morphological features
- **Knowledge** of the basic processes of the climate system and the spatial distribution of meteorological phenomena sciences.

Generic Competences

- Ability to apply knowledge in practical situations

- Promote free, creative and inductive thinking
- Ability to search for, process and analyse information with the use of necessary technologies
- Decision making
- Ability to undertake research at an appropriate level
- Ability to work in an international context
- Commitment to conservation of the environment

(3) COURSE CONTENT

A. Lectures

- Introduction to the science of Oceanography (historical development, present situation in Greece, research institutions and tools, economic dimension).
- Exchange of energy and matter between atmosphere - sea (e.g. water cycle) and sea - land (river inputs).
- Physical properties of seawater (temperature, salinity, density, dissolved gases, light and sound propagation) (2 lectures).
- Marine dynamics (waves, currents, tides) and its relation to coastal and submarine geomorphology (3 lectures).
- Basic principles and concepts of biological oceanography
- Basic principles of sedimentation (e.g. origin, size, sedimentation conditions) and distribution of sediments in marine basins.
- Geological, temporal and modern sea level changes
- Submarine geomorphological and morphodynamic evolution of the submarine relief and continental margins (continental shelf, shelf slope, trenches, mid-ocean ridge, abyssal fields).
- Basic principles of classification and types of coasts (e.g. primary, secondary, tectonic, volcanic, etc.) - Coastal sedimentary environments (deltas, coastal zones, curved headlands, island barriers, etc.).
- Principles of seismic (acoustic) survey of the seabed and its subsoil (methodology, instruments and equipment).

B. Lab exercises.

Laboratory Exercises are individual and are graded at the end of the Laboratory.

- Introductory Laboratory - Laboratory Regulations - Units of Measurement
- Oceanographic Research Instruments and Instruments
- Thermal and Hydrological Balance of marine basins (e.g. Aegean Sea)
- Temperature - Salinity - Density of seawater
- Marine Primary Production
- Astronomical tides
- Waves (anemogenic) of the open sea
- Offshore currents and coastal currents (of wave origin)
- Ocean geography and morphological characteristics of the seabed
- Coastal Geomorphology (landforms)
- Coastal sediments - Changes in bathymetry
- Acoustic (seismic) survey of the seabed

C. Fieldwork

C1. One-day field exercise in the area of Chalkida. Oceanographic measurements and observations at the Evripos Strait, Liani Ammos beach (intertidal zone) and coastal landslide (location: Exo Panagitsa).

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.

USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	IN TEACHING: – Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** — **Student's effort** Lectures — 39 hours Lab exercises — 26 hours Fieldwork — 8 hours Tutorials — - Essay writing — 13 hours Autonomous study — 40 hours Final assessment preparation — 16 hours **Total student effort** — **150** ώρες
ASSESSMENT METHODS AND CRITERIA	I. LECTURES (60%) • Written examination of 2 hours during the examination period of the semester (formative, summative). The examination includes extended or short answer questions.. II. LAB EXERCISES (**40%**) • Grading of each exercise at the end of the Workshop (formative, deductive) and a 1-hour written examination with multiple questions and/or exercise solution (deductive). III. FIELDWORK (10%) • .Oral examination in the countryside with evaluation of the countryside test booklet Supplementary material for the exams (questions, exercises etc.) is posted on **e-Class** platform

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- S. Poulos. Introduction in Oceanography or Oceanology, DISIGMA Publising, (EUDOXUS code: 102076267), in Greek.

II. ADDITIONAL READING

- S.. Leontaris. Introduction to Oceanography, SYMMETRIA Publications [Ref.]
- A. Theodorou. Oceanography: Introduction to the Marine Environment, ATH. STAMOULIS

III. RELATIVE JOURNALS

- Mediterranean Marine Science
- Oceanology
- J. Marine Systems
- J. Marine Geology
- J. GeoMarine Letters

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y4206**	**SEMESTER**	**4th**
TITLE	**SEDIMENTARY ENVIRONMENTS AND PROCESSES**		

TEACHING ACTIVITIES	HOURS/WEEK	ECTS
Lectures-seminars &laboratory work and exercises, optional fieldwork	**5**	**6**

TYPE OF COURSE	**MANDATORY /** Scientific Area
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL199

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course, the students::

- **Understand** and **apply** the basic principles of sedimentology, particularly those related to laboratory techniques for sample processing and interpretation of paleoenvironmental sedimentation.
- **Define** the basic characteristics and categories of sedimentary environments.
- **Understand** the processes of sedimentary layer formation and modelling.
- **Identify** the different types of sediments and the conditions that favour their formation.
- **Apply** methods and techniques for the study and analysis of sedimentary environments.
- **Formulate** hypotheses on the evolution and changes in sedimentary systems.
- **Combine** data from different sources for a comprehensive understanding of sedimentary processes.
- **Determine** the relationship between sedimentary processes and environmental factors.
- **Assess** the impacts of anthropogenic activities on sedimentary environments.

Generic Competences

- Ability to apply knowledge in practical situations

- Promote free, creative and inductive thinking
- Ability to search for, process and analyse information with the use of necessary technologies
- Ability to be critical and self-critical
- Oral and written communication of scientific issues
- Decision making
- Information and Communication Technology (ICT) skills
-

(3) COURSE CONTENT

A. Lectures.

- Introduction - Basic concepts of sedimentology,
- Physical Sedimentology - Mechanisms of sediment transport - Basic types of deposition - Sediment classification.
- Sedimentary Structures
- Sedimentary environments and sedimentary facies
- Continental Sedimentary Environments (a) glacial, (b) aeolian, (c) alluvial, (d) fluvial and (e) lacustrine
- Marginal marine/transitional sedimentary environments (a) deltas, (b) lagoons, (c) coastal marshes, (d) barrier islands, (e) tidal flats, and (f) estuaries/floodplains.
- Marine sedimentary environments (shelf environments, submarine fans and pelagic depositional environments).
- Volcaniclastic sedimentation.
- Carbonate sedimentation.
- Basic principles of Sequence Stratigraphy

B. Practical and Laboratory Exercises

The laboratory examination is integrated into the written examination of the course and includes questions covering the theoretical and practical knowledge acquired during the laboratory exercises. These questions represent 30% of the total course grade.

EXERCISE 1: Granulometric analysis - Physical properties of sediments
EXERCISE 2: Granulometric analysis - Physical properties of sediments
EXERCISE 3: Physical and hydraulic characteristics of sediments.
EXERCISE 4: Triangular diagrams - Sedimentary environments
EXERCISE 5: Sedimentary Structures
EXERCISE 6: Paleocurrent analysis
EXERCISE 7: Carbonate sedimentation - Components and Classification of carbonate sequences,
EXERCISE 8: Carbonate Sedimentation - Microfacies
EXERCISE 9: Sediment dating methods and sedimentation rate calculation.

C. One-day fieldwork in Alepochori

Neogene sediments in the Megara basin, stratigraphic column of the Neogene marine, lagoonal and alluvial sedimentary phases, collection of samples, recording of on-site observations on sediments and construction of a lithostratigraphic column, and interpretation of the paleo-sedimentary environment.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.

PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	39 hours
	Practice exercises	18 hours
	Fieldwork	15 hours
	Tutorials	- hours
	Essay writing	- hours
	Autonomous study	43 hours
	Final assessment preparation	35 hours
	Total student's effort	**150** hours
ASSESSMENT METHODS AND CRITERIA	I. LECTURES (**60%**) • Final written examinations of two hours at the end of the semester (Formative, Conclusive) Written exams include multiple-choice questions to assess understanding of key concepts, short-answer questions for specific knowledge, developmental questions to develop and explain topics in depth, and matching questions to connect concepts. In addition, true/false questions to evaluate key facts, problems or exercises requiring the application of theoretical knowledge, and diagrams or figures to interpret and analyze graphical information are included.. II. LAB EXERCISES (**30%**) • Weekly assessment of lab exercises (formative, summative). • or/and • Written final examination (summative). • III. FIELDWORK (**10%**) • Oral examination in the field (formative, summative). Supplementary material for the exams (questions, exercises etc.) is posted on **e-Class** platform (**https://eclass.uoa.gr/courses/GEOL199**).	

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Drinia H. & Avrakidis P. 2023. Sedimentology - Sendimentary Environments. https://repository.kallipos.gr/handle/11419/9642 [EUDOXUS CODE 122074375] (in Greek).

II. ADDITIONAL READING

- Leeder M., 2011. Sedimentology and Sedimentary Basins: From Turbulence to Tectonics, 784 ps, Wiley- Blackwell, ISBN: 978-0-632-03627-1
- Reading H. G., (Editor), 1996. Sedimentary Environments, Facies and Stratigraphy, 704 pp, Wiley, ISBN: 978-0-632-03627-1.
- Nickols G., 2009. Sedimentology and Stratigraphy, 432 pp Wiley-Blackwell, ISBN-13:978-1405135924, ISBN-10:1405135921.
- Catuneanu O., 2006. Principles of Sequence Stratigraphy, 1st Edition. Elsevier: The Netherlands
- Flügel, E. Microfacies Analysis of Carbonate Rocks; Springer Verlag: Berlin, Germany, 2010; 745 pp.
- Selley R. C., 2000. Applied Sedimentology. Elsevier. https://doi.org/10.1016/B978-0-12-636375-3.X5001-0
- McLane M., 1995. Sedimentology. Oxford University Press. 448 pp.

III. RELATIVE JOURNALS

- Sedimentology (IAS), Wiley-Blackwell
- Journal of Sedimentary Environments, Springer, Brazil, Online ISSN 2447-9462

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E4202**	**SEMESTER**	**4th**
TITLE	**DYNAMIC GEOLOGY**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Lab exercises, Fieldwork	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL170 http://opencourses.uoa.gr/courses/GEOL101/

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

Dynamic Geology deals with the deformation of Earth's solid crust and large-scale tectonic structures associated with it. In other words, it deals with the deformation at the scale of Tectonic Plates, examining both the auttoalistic patterns that operate today on the planet, as well as the orogenetic zones, continents, and oceans, which give us data on the distribution and movement of plates, in older geological periods.

Upon successful completion of the course the student is able to:

- Describes Plate Tectonics basic elements and identifies the various forms of evidence from different branches of Geology that can be used to understand the movement of lithospheric plates in different geological periods.
- Describes and analyzes the importance of the mid-ocean ridges in the formation of oceanic crust and in the spread of the ocean floor and the zonal form of magnetism in the oceanic crust, describes the importance of the lithosphere and the asthenosphere in the movement of lithospheric plates, explains the distribution of earthquakes and volcanoes, the formation and the location of large mountain ranges and how those distributions are evidence for the theory of Plate Tectonics.

• Analyzes and describes the basic types of plate margins and how they interact at the triple junctions. • Apply the techniques of analysis and synthesis with the aim of determining the history and evolution of a sequence of rocks in geological time and space and in various geotectonic environments (orogenetic systems, tectonic basins, active areas, etc.). • Collects, combines, applies, synthesizes, compares and evaluates data from various branches of Geology, using the theory of Plate Tectonics, to solve geological problems related hydrocarbon exploration, exploration of deposits, active faults, earthquake generation, natural disasters, etc.
Generic Competences
• Ability to apply knowledge in practical situations • Promote free, creative and inductive thinking • Ability to search for, process and analyse information with the use of necessary technologies • Ability to undertake research at an appropriate level • Autonomous work

(3) COURSE CONTENT

A. Lectures

The main fields presented and developed during the course are the following:

Introduction to Geotectonics (Continental Crust, Oceanic Crust, Lithosphere and Asthenosphere, etc). Oceanic Basins, Precambrian Shields, Phanerozoic Regions. Introduction to Lithospheric Plate Tectonics Divergent Margins, passive margins. Transform Faults. Convergence Margins. Subduction Zones, island arcs and active continental margins. Collision, Orogenesis – Anatomy of Orogenetic Zones. Structure of the Main Orogenetic Chains. Old Orogens, Young Orogens.

B. Lab Exercises

Exercises for the construction of geological cross-sections and the determination of geotectonic integration and evolution in terms of Lithospheric Plate Tectonics, from geological maps with various geotectonic environments

C. Field Exercises (Outdoors)

ONE-DAY FIELD TRIP IN CORINTHIA – ARGOLIDA: (Ophiolites, alpine rocks, interpretation of deposition environment, evolution in terms of Plate Tectonics)

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	26 hours
	Practice exercises	13 hours
	Fieldwork	10 hours
	Tutorials	- hours
	Essey writing	16 hours
	Autonomous study	20 hours
	Final assessment preparation	15 hours
	Total student's effort	**100** hours

ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted, either with progressive exams in separate sections of the course content or with the final examination of the entire course material which includes: I. LECTURES (**50%**) (formative, summative) • Oral Examination and/or • Written Exam with Short Answer Questions and Multiple Choice Test and/or • Written Exam with Extended Answer Questions II. LAB EXERCISES (**35%**) (formative, summative) • Written exam with Solving Exercises and Problems III. FIELD EXERCISES (**15%**) (formative, summative) • Oral examination in the field and with evaluation of required Report or Essay The evaluation criteria of the course and the participation rates are described in the Chapter «**Error! Reference source not found.**» of this syllabus and student handbook. Auxiliary material (questions, exercises, etc.) for the exams is posted on the online e-Class platform

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Lekkas, S. Lozios, S & Skourtsos E., Introduction to Geotectonics, 332 pages. University of Athens (in Greek).
- Allen, A. P. and Allen, R. J. 2004. Basin Analysis. Principles and Applications. Oxford: Blackwell Scientific Publications.
- Moores, M. E. and Twiss, J. R. 1995. Tectonics. New York: W. H. Freeman and Company.
- Olsen H. K. (Editor). 1995. Continental Rifts. Evolution, Structure, Tectonics. Publication No. 264 of the International Lithosphere Program. Amsterdam: Elsevier Science B. V.
- Pluijm, van der A. B. and Marshak S. 1997. Earth Structure. An Introduction to Structural Geology and Tectonics. U.S.A.: McGraw-Hill Companies, Inc.
- Davies, F. G. 1999. Dynamic Earth. Plates, Plumes and Mantle Convection. Cambridge: Cambridge University Press.
- Frisch W., Meschede M. & Blakey R., 2011. Plate Tectonics. Continental Drift and Mountain Building. Springer.

III. RELATIVE JOURNALS

- Tectonics
- Journal of Geodynamics

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E4203**	**SEMESTER**	**4TH**
TITLE	**EXPLORATION OF THE EARTH'S INTERIOR**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises, Laboratory exercises	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	Y3203 Seismology [recommended]
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL244

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course, the student:

- **Identifies** discontinuities and **describes** the layers of the Earth's interior.
- **Distinguishes** the differences between various methods of exploring the Earth's interior, and **selects** appropriate methods according to the needs of the research.
- **Calculates**, through data analysis, the parameters used in each method of exploring the Earth's interior.
- **Identifies** seismic phases and **calculates** their propagation velocity.
- **Combines** different methods that have been applied in typical case-studies.
- **Interprets** seismic tomography results on global, regional and local scales.
- **Evaluates** the results of studies published in international journals and **concludes** whether the exploration methods are applicable, and in which cases.

Generic Competences

- Ability to apply knowledge in practical situations
- Promote free, creative and inductive thinking
- Ability to search for, process and analyse information with the use of necessary technologies

- Ability to be critical and self-critical
- Oral and written communication of scientific issues

(3) COURSE CONTENT

A. Lectures

- Introduction to the exploration of the Earth's interior: basic concepts, historical review of the evolution of knowledge about the Earth's structure.
- Propagation of elastic seismic waves in the Earth's interior: elasticity theory, types and properties of seismic waves, wave-fronts, seismic ray theory, Fermat's principle, Snell's law, Huygens' principle, reflection, refraction, diffraction, head-waves, ray parameter, polarization of particle motion, wave transformations.
- Identification of discontinuities in the Earth's interior: seismic wave travel-time curves, phase triplication effect, caustics, low-velocity zone, Earth's core shadow zone.
- Structure of the Earth: distinction of crustal types (continental, oceanic), lithosphere, asthenosphere, upper/lower mantle, transition zone, D” layer, outer/inner core, one-dimensional models of the Earth for seismic wave propagation velocities, changes in physical properties and mineral composition with depth, nomenclature of major discontinuities, nomenclature of seismic phases.
- Rayleigh and Love surface waves: propagation and properties of surface waves, phase and group velocity, dispersion effect, methods of measuring phase/group velocities, construction of 1D shear-wave velocity models from dispersion curves, global propagation of surface waves.
- Seismic tomography: categorization by data type and study scale, the forward and inverse problems, parameterization of tomographic inversion, synthetic tests, reliability assessment of results, construction of 3D velocity models.
- Interpretation of tomographic models: identification of velocity anomalies at global, regional and local scales, interpretation of velocity anomalies as a function of depth, mantle tomography, mid-ocean ridges, subducting plates, hot spots/mantle plumes, tomography in fault zones, tomography in volcanic environments, evaluation of the resolution of tomographic models.
- Surface wave tomography: the cross-correlation function, waveform stacking, Eikonal tomography (apparent phase velocity), multi-pathing effects, Helmholtz tomography (structural velocity), ambient noise tomography, examples of applications.
- Seismic anisotropy: physical causes of seismic anisotropy, shear-wave splitting (SWS) effect, methods of measuring the splitting parameters in S and SKS waves, anisotropy in the upper crust, anisotropy in the upper mantle, relation between SWS parameters and mantle flow.
- The D” layer: lower mantle tomography, large low velocity shear-wave velocity provinces (LLSVP), ultra-low velocity zones (ULVZ), anisotropy and scattering phenomena at the base of the lower mantle, methods of structure determination in the D” layer, interpretation of observations.
- Receiver functions method: convolution and deconvolution, the H-k stacking method (crustal thickness and Vp/Vs velocity ratio), back-projection of receiver functions at depth, common conversion point stacking technique, applications to determine the depth of major discontinuities (Moho discontinuity, lithosphere-asthenosphere boundary, discontinuities in the transition zone, discontinuities related to subducting plates).
- Velocity spectrum analysis (vespagrams), brief introduction to seismic arrays, detection of weak amplitude seismic phases.

B. Practical and Laboratory Exercises :

- Applications of Snell's law, calculation of critical angle, angle of reflection, angle of refraction, ray parameter for P, SV and SH waves.
- Calculation of epicentral distances, arrival times and propagation velocity of direct, reflected and refracted body-waves and layer thickness; triplication phase imaging.
- Trajectories of global surface waves, calculation of arrival times, travel-time curves, apparent propagation velocity of Rayleigh waves.
- Construction and interpretation of tomographic models.
- Calculation of Rayleigh wave group velocity dispersion curves using time-variable Gaussian filters.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	see table below
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted in Greek (there is the possibility of examination in English for Erasmus students), with the final examination on the entire course material and, presentation of individual essay on a specific methodology on Earth's interior exploration and includes: I. LECTURES (**50%**) • Individual report and oral presentation per student (formative, summative) II. PRACTICE EXERCISES (**50%**) • Problem solving during the Practice Exercises, Delivery of Laboratory reports • Written exam with Solving Exercises and Problems (formative) •

PLANNED LEARNING ACTIVITIES:

Activity	Student effort
Lectures	26 hours
Practice exercises	13 hours
Fieldwork	-
Tutorials	-
Essay writing	26 hours
Autonomous study	13 hours
Final assessment preparation	22 hours
Total student's effort	**100** hours

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- General seismology vol. A, A. Tselentis [Code EUDOXUS: 59395397], in Greek
- Introduction to seismology. Papazachos B.C., G.F. Karakaisis, P.M. Chatzidimitriou. [Code EUDOXUS: 11254], in Greek

II. ADDITIONAL READING

- Bormann, P. (Ed.), 2012. New Manual of Seismological Observatory Practice (NMSOP-2), Potsdam : Deutsches GeoForschungszentrum GFZ; IASPEI.
- Dziewonski, A.M., Romanowicz, B.A., 2007. Seismology and the Structure of the Earth, Treatise on Geophysics. ISBN 978-0-444-51929-0.
- Lin, F.-C., Ritzwoller, M.H., Yang, Y., Moschetti, M.P., Fouch, M.J., 2011. Complex and variable crustal and uppermost mantle seismic anisotropy in the western United States. Nat. Geosci. 4, 55–61. https://doi.org/10.1038/ngeo1036
- McNamara, A.K., 2019. A review of large low shear velocity provinces and ultra low velocity zones. Tectonophysics 760, 199–220. https://doi.org/10.1016/j.tecto.2018.04.015
- Piromallo, C., Morelli, A., 2003. P wave tomography of the mantle under the Alpine-Mediterranean area. J. Geophys. Res. Solid Earth 108. https://doi.org/10.1029/2002JB001757
- Romanowicz, B., 2011. Surface Waves. In: Gupta, H.K. (eds) Encyclopedia of Solid Earth Geophysics.

Encyclopedia of Earth Sciences Series. Springer, Dordrecht. https://doi.org/10.1007/978-90-481-8702-7_143

- Shearer, P.M., 1999. Introduction to Seismology, Cambridge University Press, September 1999, pp. 272. ISBN 0521660238.
- Stein, S. and M. Wysession, 2003. An Introduction to Seismology, Earthquakes and Earth Structure, Blackwell Publishing Ltd., Hoboken.

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**ΣΜ003**	**SEMESTER**	**4th**
TITLE	**SEMINAR COURSES 3: PROGRAMMING-APPLICATIONS IN GEOSCIENCE**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
PART A: Data Analysis with Python (12 hours) Lectures, Practical exercises, Laboratory exercises PART B: The specific software “G.EN.I-MA” (Geo-Environmental Information Management) and the “G.EN.I-MA web” presentation (8 hours) Lectures, Practical exercises, Laboratory exercises	**2**	**0.5**

TYPE OF COURSE	**ELECTIVE /SEMINAR /** Skills development
PREREQUISITES	Y1204 Introduction to Differential and Integral Calculus and Statistics
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL532

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

PART A: Data analysis with Python (12 hours)

On successful completion of the seminar course the student::

- **Composes** algorithms for mathematical calculations.
- **Calculates** basic statistical quantities.
- **Analyzes** data and results of their processing, in various ways of visualization (such as scatter charts and histograms).
- **Develops** scripts.

PART B: The specific software “G.EN.I-MA” (Geo-Environmental Information Management) and the “G.EN.I-MA web” presentation (8 hours).

Upon successful completion of the course, students will be able to:

• **Analyzes** geological and geoenvironmental problems • **Composes** specific Tools for Geodata Processing on a GIS / web GIS environment or a stand-alone application. • **Develops** web maps**,** websites & web applications
Generic Competences
• Ability to apply knowledge in practical situations • Ability to plan and manage time • Ability to search for, process and analyse information with the use of necessary technologies • Autonomous work • Information and Communication Technology (ICT) skills •

(3) COURSE CONTENT

Part A: Data analysis with Python

Duration: 12 hours

A. Lectures

- Data types (strings, numbers, Boolean, sequences).
- Workflows and conditionals.
- Basic functions.
- File management.
- Numerical operators and algorithm implementation with NumPy.
- Data visualization with Matplotlib.
- Management and statistical processing of dataframes with Pandas.
- Examples of Python applications in geosciences.

B. Practical Exercises and Laboratory Exercises:

A1 Reading and handling files.
A2 Basic functions and data types.
B1 Data analysis and visualization I.
B2 Data analysis and visualization II.
C1 Statistical processing.

PART B: The specific software "G.EN.I-MA" (Geo-Environmental Information Management) and the "G.EN.I-MA web" presentation.

Duration: 8 Hours

A. Lectures

- The structure of the stand-alone specific Tool for the data processing and diagrams creation "The Time Series of Displacement for each GPS station" (python script (Pandas, Date) / HTML / Javascript)
- The structure of the specific Tool for the Ground Deformation Maps production (ArcGIS/Model Builder/Python)
- The Specific Tool for Terrain Analysis (Data processing, DEM and terrain analysis data creation (morphological slopes and the aspect of the slopes, morphological discontinuities etc).
- The Website development for the specific software representation:

1. Web Static Generator Framework HUGO / Markdown / HTML / JavaScript and ATOM environment.
2. Website Navigation - Applications in Geological and Geophysical research (http://users.uoa.gr/~vassilopoulou/genima)

B. Practical and Laboratory Exercises:

A. Geoprocessing – Geodata management - thematic & synthetic layers creation (Python & ArcGIS)
B. Specific Tools creation for thematic layers production (ArcGIS PRO / Model Builder / Python) –

Export code to Python file.
C. Web Applications (HTML/CSS/HUGO/MARKDOWN/ATOM)
D. Web GIS & Web GIS Applications (ArcGIS Online)

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	see table below
ASSESSMENT METHODS AND CRITERIA	In order to successfully complete the course, the student must have attended: • At least 10 hours of ώρες lectures and practical exercises from Part A: Data Analysis with Python (Formative) or/and • at least 6 hours of lectures and practical exercises from Part B: The specific software “G.EN.I-MA” (Geo-Environmental Information Management) and the “G.EN.I-MA web” presentation. (Formative)

PLANNED LEARNING ACTIVITIES

Activity	Student effort
Lectures	10 hours
Practice exercises	10 hours
Fieldwork	-
Tutorials	-
Essey writing	-
Autonomous study	20 hours
Final assessment preparation	-
Total student's effort	**40** hours

(5) RECOMMENDED READING

I. ADDITIONAL READING

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II. RELATIVE JOURNALS

▪

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**ΣΜ004**	**SEMESTER**	**4th**
TITLE	**SEMINAR COURSES 4: ESSAY WRITING**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
	1	**2**

TYPE OF COURSE	**ELECTIVE /SEMINAR /** Skills development
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL546

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

Upon completion of this seminar course, students will be able to:

- search for references and use bibliographic references correctly in essays
- understand the principles of scientific ethics, evaluate and apply them in the writing of scientific texts
- comprise the structure of a work and deal with difficulties that arise during its writing
- prepare technical geological reports
- write scientifically sound texts, developing the subject comprehensively and taking into account the existing knowledge
- present the results of their work or study to a scientific or general public.

Generic Competences

- Oral and written communication of scientific issues
- Information and Communication Technology (ICT) skills
- Ability to work in an international context
- Ability to work in an interdisciplinary context
- Autonomous work

(3) COURSE CONTENT

The aim of this seminar course is to familiarize students with the scientific methodology focusing on the search and use of scientific literature, the writing of scientific papers and technical reports and the techniques of presenting scientific results. The seminar includes the following thematic topics:

Collection, study and use of bibliography

- Scientific bibliography / large bibliographic databases
- Scientific journals / bibliographic indicators
- Scientific databases / open access science
- Use of references in essays / bibliographic reference systems / bibliographic reference management software
- Accurate use of scientific literature / Plagiarism

Writing assignments

- bibliographic and research essays
- Stages of essay writing
- Structure of scientific essays
- Technical issues: writing style, language, text setting

Writing geological reports

- Studies of technical projects
- Urban planning studies
- Studies to avoid effects on water
- Studies to avoid environmental impact

Scientific Presentations: dissemination and communication of science

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	12 hours
	Practice exercises	12 hours
	Essay writing	14 hours
	Autonomous study	12 hours
	Total student's effort	**50** hours
ASSESSMENT METHODS AND CRITERIA	Small individual or group essays during the semester related to the topics of the Seminar. (formative)	

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Government Gazette volumes:
  1902B/2007, 838Δ/1998, 35 B/1999, 678B/1990, 29B/1986, 1016B/1997, 1595B/2004, 820B/1980, 552B/2003.

III. RELATIVE JOURNALS

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COURSE UNITS: 5th Semester

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	SCHOOL OF SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
EDUCATION LEVEL	EQF level 6; NQF of Greece level 6		
CODE	Y5201	SEMESTER	5th
TITLE	GEOMORPHOLOGY		

TEACHING ACTIVITIES	HOURS/WEEK	ECTS
Lectures & laboratory work and exercises, fieldwork	5	6

TYPE OF COURSE	**MANDATORY /** Scientific Area
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL121 https://eclass.gunet.gr/courses/OCGU161/

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
Upon completion of the course the student will: • **Identify** and **describe** the interactions of the lithosphere, hydrosphere and atmosphere in the creation and formation of the terrestrial landscape, • **Recognize** and **identify** the different landforms on the Earth's surface, both today and in its recent past, • **Comprehend**, **distinguish** and **interpret** the geomorphological processes that affect the development and evolution of landforms in different environments and different climatic zones, • **Apply** geomorphological analysis and research methods • **Classify** the geomorphological characteristics of the terrestrial landscape • **Calculate** the morphological parameters of the landforms, • **Collect**, **analyze**, **combine** and **compose** geomorphological data and related literature, in the construction of geomorphological maps, in the evolution of landforms in time and space and in the identification of geomorphological hazards, • **Compare** and **evaluate** data using geomorphological research methods to solve problems such as: spatial and temporal evolution of the landscape, the assessment of environmental and morphological changes, the environmental impact of human activities on the landscape.

Generic Competences
• Ability to apply knowledge in practical situations • Promote free, creative and inductive thinking • Ability to plan and manage time • Ability to work in a team • Ability to search for, process and analyse information with the use of necessary technologies • Adapt to and act in new situations and cope under pressure • Commitment to conservation of the environment

(3) COURSE CONTENT

A. Lectures

- Earth relief. Endogenous - exogenous processes. Landforms and factors that control them
- Modern directions of geomorphology
- Geomorphological maps, geomorphological mapping
- Research issues in Geomorphology
- Structure shapes (sedimentary - horizontal - single - folded - crystalline)
- Landforms of metamorphic rocks
- Volcanoes
- Faults, fault lines, cliffs
- Weathering, erosion, deposition
- Active, inactive landforms
- Gravity Movements
- Hydrological cycle
- Fluvial cycle, hydrographic networks
- Geomorphic environments: Fluvial Geomorphology
- Geomorphology of slopes
- Aeolian Geomorphology
- Karstic Geomorphology
- Tectonic Geomorphology
- Morphometric indicators
- Coastal Geomorphology
- Glacial Geomorphology
- Geomorphological risks and environmental impacts.

B. Practical Exercises:

- Fluvial Geomorphology
- Watershed Sketching
- Quantitative analysis of hydrographic network (drainage basin mean slope calculation, drainage frequency, drainage density through GIS)
- Terraces
- Hydrology
- Geomorphology of slopes
- Aeolian Geomorphology
- Karstic Geomorphology
- Morphometric indicators
- Coastal Geomorphology
- Coastal erosion
- Coastal cliffs
- Coastal deposition
- Glacial Geomorphology
- Geomorphological mapping

C. Field Trips **Daily field trip in Corinth** (Geomorphological mapping, coastal landforms, morphotectonics, erosion, sea level changes, sampling). **3-hour field trip in Kaisariani** (Identification and mapping of fluvial terraces, calculations and measurements of their morphometric characteristics, their lithological and sedimentological composition with specialized instruments).

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** / **Student effort** Lectures: 39 hours Practice exercises: 26 hours Fieldwork: 33 hours Tutorials: - Essey writing: 15 hours Autonomous study: 20 hours Final assessment preparation: 17 hours **Total student's effort**: **150** hours
ASSESSMENT METHODS AND CRITERIA	**Lectures (50%)** the grade is based on examination during the semester and at the end of the semester in one of the following ways (summative): • Oral or • Written, with short-answer questions and multiple choice or • Written with extended-answer questions **Laboratory exercises (50%)** the score is distributed as follows: • **10%** by the weekly participation in the exercises done in the classroom (formative) • **30%** in the final exams (summative) • **10%** from the reports done, from the field activities. (formative)

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Evelpidou N., 2018. Geomorphology Laboratory Exercises. Academic Publishing, p. 300. [Book website] [Code Eudoxus: 77117790]
- Evelpidou N., 2020. Geomorphology. Tziola Publishing, Athens. ISBN: 978-960-418-605-1(Book website) [Code Eudoxus : 86054269]
- Pavlopoulos K., 2011. Geomorphology, Introduction to Geosciences, (Book website)[Code Eudoxus : 12777167]

II. ADDITIONAL READING

- Pavlopoulos K., Evelpidou N., Vassilopoulos A., 2009, 'Mapping Geomorphological Environments', published by Springer, ISBN: 978-3-642-01949-4, p.235. (Book website)

III. RELATIVE JOURNALS

- Geomorphology
- Continental Shelf Research
- Geologica Acta
- GeoMarine Letters
- Global and Planetary Change
- Holocene
- International Journal of Earth Science
- Journal of Coastal Research
- Marine Geology
- Quaternary International
- Quaternary Science Reviews

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	SCHOOL OF SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
EDUCATION LEVEL	EQF level 6; NQF of Greece level 6		
CODE	Y5202	SEMESTER	5th
TITLE	STRATIGRAPHY		

TEACHING ACTIVITIES	HOURS/WEEK	ECTS
Lectures and Laboratory Exercises	5	6

TYPE OF COURSE	MANDATORY / Scientific Area
PREREQUISITES	Basic principles knowledge of Y2205 Macropalaeontology Y3205 Biogeosciences-Principles of Micropaleontology Y4206 Sedimentary Environments and Processes Y3205Tectonic Geology
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL188

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

Upon successful completion of the course the student:

- Comprehends the basic principles of Stratigraphy and in particular the handling of methods and knowledge related to laboratory techniques of observation and processing of field data
- Combines and evaluates field rock and fossil samples and prepares them for further laboratory analyses, as well as to interpret the final laboratory results
- Synthesizes all the data in order to interpret the paleogeographic evolution of the study area
- Comprehends the basic principles of identification, description, identification and classification of pre-orogenic, syn-orogenic and post-orogenic formations of an area
- Clarifies the stratigraphic and tectonic structure of an area and its paleogeographic integration into various environments through geological time
- Defines the relative age of geological formations using micro- and macro-fossils in order to recognize the isochronous formations of an area, as well as the relationship between them in space and time
- Estimates the absolute age of geological formations using biostratigraphic indices and correlation

with the International Chronostratigraphic Chart and the Astronomical Time Scale • Combines and evaluates the relevant literature • Comprehends and recognizes the major stages of Earth's history
Generic Competences
• Ability to apply knowledge in practical situations • Promote free, creative and inductive thinking • Ability to plan and manage time • Ability to work in a team • Oral and written communication of scientific issues • Autonomous work • Information and Communication Technology (ICT) skills • Commitment to conservation of the environment • Ability to work in an interdisciplinary context

(3) COURSE CONTENT

A. Lectures

- Definition of Stratigraphy, its role and importance on Earth-sciences
- Traditional and modern stratigraphic methods
- Lithostratigraphy and facies relationships; Biostratigraphy; Chronostratigraphy; Geochronology; Isotopic Stratigraphy; Astrochronology
- Chemostratigraphy and paleoclimatic stratigraphic indices
- Sequence Stratigraphy and sea level change; transgressions, eustatism
- Magnetotratigraphy, Seismic Stratigraphy, sedimentary basins
- Depositional environments, Paleogeography
- Historic Geology, Precambrian, Paleozoic, Mesozoic, Cenozoic
- Stratigraphic outcrops of various geological time periods in Greece

B. Practical and Laboratory Exercises

Exercise 1 Construction and lithostratigraphic correlation of stratigraphic columns and stratigraphic sections. Fossil content and relative datings. Construction of synthetic stratigraphic column

Exercise 2 Preparation for the fieldtrips. Basic principles of stratigraphic methods-sampling-stratigraphic sections and columns. Absolute ages based on biostratigraphic indices and corellation with the International Chronostratigraphic Chart and the Astronomical Time scale.

Exercise 3 Stratigraphic sequences & tectonism

Exercise 4 Neritic alpine sequences / tectonism and flysch. Discontinuities in the stratigraphic sequence: unconformities, normal and reverse faults, thrusts

Exercise 5 Pelagic alpine sequences / tectonism and flysch. Discontinuities in the stratigraphic sequence: unconformities, normal and reverse faults, thrusts

Exercise 6 Transitional sequences / tectonism and flysch. Discontinuities in the stratigraphic sequence: unconformities, normal and reverse faults, thrusts

Exercise 7 Lateral transgressions/basin rifting

Exercises 8-9 Identification of stratigraphic and tectonic formations, tectonic relationships based on stratigraphic and sedimentological data, palaeogeographical inclusion in the geotectonic units of the Greek area.

Exercise 10 Postalpine formations and stratigraphic correlations.

C. Fieldwork

Two one-day fieldtrips: determination of alpine formations and geotectonic units (neritic, pelagic and transitional facies), based on lithologic, biostratigraphic, sedimentary and tectonic features. Recognition of unconformities and tectonic contacts.

Sampling of alpine and postalpine deposits, sampling techniques in the field: sample collection and coding. Construction of stratigraphic columns and stratigraphic sections.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** — **Student effort** Lectures — 39 hours Practice exercises — 26 hours Fieldwork — 14 hours Tutorials — - Essey writing — 20 hours Autonomous study — 18 hours Final assessment preparation — 33 hours **Total student's effort** — **150** hours
ASSESSMENT METHODS AND CRITERIA	For the lab: • Lab essays **20%** (formative, summative) • Written final examination during the last (13) week of semester (**30%)** (summative) • concerning the recognition of stratigraphic characteristics of certain paleogeographic regimes and the tectonic impact on the stratigraphic sequences. Recognition of various paleogeographic regimes and geological units. For the theoretical part: • written assessment and multiple choice exercises (**35%**) (summative) • questions concerning the topics discussed in the fieldwork (**15%**) (summative)

(5) RECOMMENDED READING

- **I. EUDOXUS PORTAL**
- Karakitsios, V., 2001. Stratigraphy, ASTARTI Publications, 503 pp, ISBN 960-263-095-7. [Code EUDOXUS: 4869]
- Κουφός, Γ.Δ., 2008, Μαθήματα Στρωματογραφίας, ISBN: 9789601217567, [Code EUDOXUS: 17383]"
- **II. ADDITIONAL READING**
- Brookfield, M., 2004. Principles of Stratigraphy. Blackwell Publishing Ltd, 340 p.
- Doyle, P., Bennett M., 1998. Unlocking the Stratigraphical Record: Advances in Modern Stratigraphy. J. Wiley & Sons Ltd, 532 p.
- Nichols G., 2009, Stratigraphy: Concepts and Lithostratigraphy. Wiley-Blackwell, 397 p.
- Wicander R., Monroe , J., 1993. Historical Geology: Evolution of the Earth and Life through Time. West Publishing Company, 640 p.
- Schoch, R., 1989, Stratigraphy: Principles and Methods. Van Nostrand Reinhold (New York), 375 p.
- **III. RELATIVE JOURNALS**
- Episodes, Online ISSN: 2586-1298
- Newsletter on Stratigraphy, Online ISSN: 2363-6122

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y5203**	**SEMESTER**	**5th**
TITLE	**ENGINEERING GEOLOGY**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Lab Exercises		**6**	**6**
TYPE OF COURSE	**MANDATORY /** Scientific Area		
PREREQUISITES	NONE		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL205		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
Upon successful completion of the course, the student: • **Understands and interprets** the role of geo-material as a carrier, a loading element, and a construction material. • **Assesses and determines** the geotechnical conditions as well as the general behavior of the geological environment in relation to the impact of man-made interventions and catastrophic phenomena. • **Combines and evaluates** details and data from geotechnical field and laboratory research. **Performs** geotechnical classification of soil and rock formations and **determines** the geotechnical parameters of the design of a project. • **Interprets** the mechanisms and factors that contribute to the occurrence of landslides. **Applies** basic principles of slope stability and familiarizes with their protection and restoration measures. • **Applies** the techniques of engineering geology in the various stages of design and construction of important engineering projects. (tunnels, dams, foundations, etc).

Generic Competences
• Ability to search for, process and analyze information with the use of necessary technologies. • Autonomous work. • Ability to apply knowledge in practical situations. • Work in a team. • Decision making. • Ability to plan and manage time. • Information and Communication Technology (ICT) skills.

(3) COURSE CONTENT

A. Lectures

- INTRODUCTION TO ENGINEEIRING GEOLOGY (Role and main branches of engineering geology, engineering projects and geology).
- PHYSICAL AND MECHANICAL PROPERTIES OF GEOMATERIALS (Composition and structure, Physical and mechanical properties of rocks, Stress and strain- geostatic stresses, strength and mechanical behavior of rocks , Discontinuities and mechanical behavior of rock masses, Geo-technical classification of rock mass, Estimation of geotechnical design parameters, Physical properties of soils, Classification of soils, Shear strength, Mechanical parameters).
- GEOTECHNICAL SITE INVESTIGATION (Study stages of the various engineering projects and designs, Engineering geological-geotechnical maps, sampling, in-situ testing: SPT Standard Penetration Test, CPT Cone Penetration Test, Pressure Meter Test, Cross-hole test, permeability tests).
- GROUND IMPROVEMENT (compactions, preloading, drainage and dewatering, excavation and replacement, grouting methods, geosynthetics in various ground improvement problems),
- FOUNDATIONS (General principles of engineering project foundations, Shallow and deep foundations, Design parameters).
- LANDSLIDES – SLOPE STABILITY (Classification of landslides, Landslides causes, Stability analysis of soil and rock slopes, slope stability under seismic loading, Protection and rehabilitation measures, Landslides monitoring systems).
- UNDERGROUND STRUCTURES (Influence of geological conditions on the choice of slotting in the design and construction of underground structures, classification systems of tunnels and empirical design methods, mechanisms of failure and deformation, tunnel construction methods, NATM and support systems).
- DAMS (Types of dams, selection of a dam location, tightness of dams, related and accompanying projects, design criteria, geo-technical requirements , construction methods).

B. Lab Exercises

Practice exercises are taught in small groups of students and are graded at the end of the exercise.

Exercise 1. Rock drilling and sampling. Determination of Rock Quality Designation (RQD) of Rock Cores.

Exercise 2. Classification and characterization of rock masses.

Exercise 3. Soil drilling and sampling – Soil classification exercise (Unified Soil Classification System USCS).

Exercise 4. In situ tests: Standard Penetration Test (SPT).

Exercise 5. Soil classification and geotechnical parameter estimation – Creation of Geotechnical cross-section.

Exercise 6. In-situ Permeability Tests - MAAG, LEFRANC.

Exercise 7. In-situ Permeability Tests LUGEON.

Exercise 8. Rock slope stability problems – wedge failure.

Exercise 9. Rock slope stability problems – plane failure.

Exercise 10. Rock slope stability problems – toppling.

Exercise 11. Soil slope stability analysis by limit equilibrium methods.

Exercise 12. Geological and geotechnical considerations for tunnel construction sites.

Exercise 13. Geological and geotechnical considerations for dam construction sites.

C. Fieldwork

C1. One day field excursion in the dam of Ladonas, Arcadia. Stages of construction and operation of the dam, basic components and accompanying constructions, geological and tectonic structures, hydrology of the wider and narrow area of the project.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** / **Student effort** Lectures: 52 hours Practice exercises: 26 hours Fieldwork: 12 hours Tutorials: - hours Essey writing: 13 hours Autonomous study: 23 hours Final assessment preparation: 24 hours **Total student's effort**: **150** hours
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted with the final examination of the entire course material which includes: I. LECTURES (**50%**) • Written Exam with Short Answer Questions and Multiple Choice Test (summative) • and/or • Written Exam with Extended Answer Questions (summative). II. LAB EXERCISES (**50%**) • Weekly assessment of lab exercises (formative, summative). • and • Written final examination (summative).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Stournaras G., Stavropoulou M. 2010, **Engineering Geology,** Publisher Tziola, 428 p. [EUDOXUS code: 18549027], in Greek.

II. ADDITIONAL READING

- Luis Gonzalez de Vallejo, Mercedes Ferrer. 2011. **Geological Engineering**, Publisher CRC Press.
- F G Bell. 2007. **Engineering Geology**, 2nd Edition. EButterworth-Heinemann, Oxford.
- Hoek E. 2007. Practical Rock Engineering,

III. RELATIVE JOURNALS

- ENGINEERING GEOLOGY - Title: Engineering Geology, Publisher: Elsevier BV, Editors in chief: G.B. Crosta, R.J. Shlemon, Frequency: 7 Volumes Annually
- NATURAL HAZARDS - Title: Natural Hazards, Publisher: Springer, Editors in chief: T. Glade, T,S. Murty, V. Schenk, Frequency: Monthly, Frequency: Monthly

- LANDSLIDES - Title: Landslides, Publisher: Springer, Editor in chief: K. Sassa, Frequency: Quarterly
- BULLETIN OF ENGINEERING GEOLOGY AND THE ENVIRONMENT - Title: Bulletin of Engineering Geology and the Environment, Publisher: Springer, Editor in chief: A. B. Hawkins, Frequency: Quarterly
- GEOTECHNICAL AND GEOLOGICAL ENGINEERING - Title: Geotechnical and Geological Engineering, Publisher: Springer, Editor in chief: T.B. Edil, P.G. Marinos, Frequency: Bimonthly

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y5204**	**SEMESTER**	**5th**
TITLE	**GEOLOGY OF GREECE**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Lab Exercises		**7**	**6**
TYPE OF COURSE	**MANDATORY /** Scientific Area		
PREREQUISITES	Y3205 STRUCTURAL GEOLOGY AND TECTONICS [recommended] Since it is a synthesis course, the basic knowledge acquired by students after successfully attending the compulsory courses of the 2nd, 3rd and 4th semester is necessary		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL113 http://opencourses.uoa.gr/courses/GEOL14/		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

It is a synthesis course in which the students are introduced to the geotectonic units and the geotectonic structure of Greece. Furthermore, they learn about the different views on the paleogeographic organization and evolution of the units of Greece and the orogenic cycles that shaped the present-day geological structure.

With the practical exercises, students construct cross-sections based on excerpts from the 1:50.000 geological maps of the Geological Survey of Greece.

Upon successful completion of the course, the student is able to:

- Recognize assign and describe the geotectonic units of Greece
- Describe their geotectonic evolution, as reflected in their stratigraphic column the structural position and the deformation and/or metamorphic history.

• Understand, describe and interpret the processes through which the rocks and the geotectonic units of the Hellenides were formed and evolved, as well as the geological structure of the regions of Greece. • Read and analyze a geological map and clarify the structure. • Construct geological cross-sections that depict the geological structure of an area • Apply the basic technics of analysis and synthesis and define the history and evolution of the deformation through the geological time. • Evaluate the geological structure of an area, compare and correlate with other areas and compose the overall geological structure and evolution.
Generic Competences
• Ability to apply knowledge in practical situations • Promote free, creative and inductive thinking • Ability to plan and manage time • Oral and written communication of scientific issues • Decision making • Ability to undertake research at an appropriate level • Autonomous work

(3) COURSE CONTENT

A. Lectures

- INTRODUCTION TO THE GEOTECTONIC FRAME OF GREECE. Greece within the alpine orogenic system of Tethys. Organization and evolution of the alpine system of Tethys. Orogenetic mechanisms – shallow and deep geodynamic phenomena.
- THE HELLENIC ARC. The current geodynamic -geotectonic regime in the Hellenic arc.
- POST_ALPINE AND MOLASSIC SEDIMENTS OF GREECE (Mollasic formations, age and evolution. Post-alpine basins and formations).
- THE HELLENIDES Alpine and Pre-alpine formations of the Hellenic Arc. Description of Tectonostratigraphic domains and geotectonic units of Greece.
- SYNTHESIS. Models of Paleogeographical Organization of the Greeks. Orogenic circles. Orogenetic evolution of the Hellenides.Basic concepts and methods.

B. Lab exercises

Lab exercises are taught in small groups of students and are graded at the end of the exercise.

PART A: Geological formations, geotectonic units of the External Hellenides, stratigraphic and tectonic structures. Stratigraphic columns. Construction of geological cross-section in excerpts of 1:50,000 geological maps Greek Geological Survey. Geotectonic evolution (5-6 weeks).

PART B: Geological formations, geotectonic units of the Internal Hellenides, stratigraphic and tectonic structures. Stratigraphic columns. Construction of geological cross-section in excerpts of 1:50,000 geological maps Greek Geological Survey. Geotectonic evolution (5-6 weeks).

PART C: Construction of geological cross-section and stratigraphic columns on 1: 50,000 scale maps of the Geological Survey of Greece. (1-2 weeks).

C. Fieldwork exercises

Field Exercises (Outdoor): TWO SINGLE-DAY FIELD EXERCISES in selected areas of Greece: Geological Formations, Geotectonic Units, Structures, and Evolution.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.

PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	39 hours
	Practice exercises	52 hours
	Fieldwork	19 hours
	Tutorials	- hours
	Essay writing	- hours
	Autonomous study	10 hours
	Final assessment preparation	30 hours
	Total student's effort	**150** hours
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted with the final examination of the entire course material which includes: I. LECTURES (**50%**) • Written Exam with Short Answer Questions and Multiple Choice Test (summative) • and/or • Written Exam with Extended Answer Questions (summative). II. LAB EXERCISES (**50%**) • Weekly assessment of lab exercises (formative, summative). • and • Written final examination (summative).	

(5) RECOMMENDED READING

I. EUDOXUS PORTAL
- Papanikolaou D.J., (2015) The Geology of Greece, 443pp Patakis Publications

II. ADDITIONAL READING
- Katsikatsos, G.,. 1992. Geology of Greece, Papasotiriou Publications, 451 pp.
- Koukouvelas Ioannis Geology of Greece Liberal Books, 368pp.
- Mountrakis D.M., (2010), Geology and Geotectonic evolution of Greece, University Studio Press, 373 pp.

III. RELATIVE JOURNALS
- International Journal of Earth Sciences, Springer
- Tectonophysics, Elsevier
- Tectonics, AGU Publications
- Geological Society of London Special Publications

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E5201**	**SEMESTER**	**5th**
TITLE	**SEISMOLOGY OF GREECE - PLATE TECTONICS**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Laboratory exercises		**3**	**4**
TYPE OF COURSE	**ELECTIVE /** Scientific Area		
PREREQUISITES	Y3203 Seismology [recommended]		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL139		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course, the student:

- **Names** and **categorizes** the major and minor tectonic plates of the Earth.
- **Distinguishes** the types of tectonic plate boundaries, and **describes** their relative and absolute motions.
- **Identifies** and **explains** the causes and characteristics of high seismic activity in the different regions of the Earth in relation to plate tectonics theory (interplate and intraplate earthquakes).
- **Identifies** the main tectonic structures of Greece and **describes** the distribution of seismicity in Greece in relation to the tectonic plates involved.
- **Calculates** the parameters of earthquake focal mechanisms and **relates** the rupture types and principal stress axes to the different types of tectonic plate boundaries.
- **Describes** the stress field in Greece and **relates** it to the focal mechanisms in each region.
- **Identifies** the types of forces acting on tectonic plates and **deduces** the causes that shape the modern form of the Earth.

Generic Competences

- Ability to apply knowledge in practical situations

• Promote free, creative and inductive thinking • Ability to search for, process and analyse information with the use of necessary technologies • Ability to be critical and self-critical • Oral and written communication of scientific issues

(3) COURSE CONTENT

A. Lectures

- Introduction to lithospheric plate tectonics, historical background, global fracture zones.
- Paleomagnetism, polar wander, geomagnetic pole reversal, age of the oceanic lithosphere.
- Earth's structure, seismic discontinuities.
- Lithospheric plates: plate composition, types of boundaries, categories, nomenclature.
- Relative and absolute motions of lithospheric plates, geodetic observations, reference frames, Euler axes and poles.
- Triple junctions, velocity diagrams, types of triple junctions, stability of triple junctions.
- Forces on tectonic plates: thermal convection currents, driving forces, drag forces.
- Subduction zones: Wadati-Benioff zones, stresses in subducting plates, degree of plate coupling, seismic tomography in subduction zones.
- Earthquake focal mechanisms, rupture types, stress field, relationship between focal mechanisms and plate boundaries.
- Tectonics of the Eastern Mediterranean.
- Seismicity in Greece, Aegean microplate, Anatolian microplate, Hellenic arc.
- Seismotectonics of Greece, major tectonic structures.
- Stress field in Greece, distribution of focal mechanisms.
- Hot spots, mantle plumes, seismic tomography of the mantle.
- Island arcs, types of subduction zones, accretionary prism, gravity anomalies, volcanism.
- Earthquakes at divergent and convert plate boundaries, earthquakes on transform faults.
- Intraplate seismicity, passive margins of lithospheric plates, induced seismicity.

B. Practical and Laboratory Exercises:

- Collection of data on recent strong earthquakes, description of their main characteristics and their correlation with lithospheric plate boundaries.
- Calculation of linear velocity of lithospheric plate motion.
- Calculation of relative plate motions at triple junctions, boundaries' geometry, characterization of triple junction stability.
- Estimation of seismicity characteristics of the Greek region.
- Identification of focal mechanisms and their correlation with lithospheric plate boundaries.
- Characterization of focal mechanisms on lithospheric plate boundaries
- Construction and interpretation of seismic tomograms in subduction zones.
- Calculation of absolute plate motion velocity from the age of submarine mountains in hotspot trails.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	26 hours

	Practice exercises	13 hours
	Fieldwork	-
	Tutorials	-
	Essey writing	13 hours
	Autonomous study	33 hours
	Final assessment preparation	15 hours
	Total student's effort	**100** hours
ASSESSMENT METHODS AND CRITERIA	The student evaluation includes: I. LECTURES (**50%**) • Oral examination with essay development (for the characterization of seismicity and seismotectonic characteristics, type and characteristics of plate motion with emphasis on the Greek area) (formative, summative) II. PRACTICE EXERCISES (**50%**) • Presentation of individual essay (formative)	

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Δελήμπασης Ν.Δ. Εισαγωγή στην τεκτονική των λιθοσφαιρικών πλακών, [Κωδ. ΕΥΔΟΞΟΣ: 11257] (in Greek)

II. ADDITIONAL READING

- Bird, P., 2003. An updated digital model of plate boundaries, Geochem. Geophys. Geosyst., 4, 1027.
- Cox, A., and Hart, R.B., 1986. Plate tectonics: How it works. Blackwell Scientific Publications, Palo Alto.
- Frisch, W., Meschede, M., Blakey, R., 2011. Plate tectonics: Continental drift and mountain building, Plate Tectonics: Continental Drift and Mountain Building. Springer Berlin Heidelberg, Berlin, Heidelberg.
- Makropoulos K., G. Kaviris and V. Kouskouna, 2012. An updated and extended earthquake catalogue for Greece and adjacent areas since 1900. Nat. Hazards Earth Syst. Sci., 12, 1425-1430.

III. RELATIVE JOURNALS

- Bulletin of the Seismological Society of America, SSA Journals
- Geophysical Journal International, Oxford University Press
- Journal of Geophysical Research, AGU Publications
- Tectonophysics, Journal, Elsevier

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E5202**	**SEMESTER**	**5th**
TITLE	**QUATERNARY GEOLOGY AND ARCHAEOGEOMOR-PHOLOGY**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL296

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

Upon successful completion of the course students will:

- **Identify** and **describe** climate change during the Quaternary period,
- **Understand**, **distinguish** and **interpret** the natural processes that have taken place during the last geological period and their effects on the evolution of the earth's relief and in the wider area's archeological sites,
- **Calculate** the morphometric parameters of the Quaternary erosional and depositional landforms, as well as the changes of the sea level
- **Apply** methods and techniques of geomorphological analysis, for the determination of environmental - morphological changes in terrestrial and aquatic environment and in archaeological sites,
- **Collect** and **analyze** the literature related to the course contents
- **Combine** and **compose** examples of studies that have been done internationally and in Greece,
- **Explain**, **collect**, **compare** and **evaluate** data in problem solving such as finding, promoting and protecting archaeological sites in relation to erosional or depositional processes
- Use geomorphological methods and modern technologies in locating archaeological sites.

Generic Competences
• Ability to search for, process and analyse information with the use of necessary technologies • Oral and written communication of scientific issues • Ability to undertake research at an appropriate level • Autonomous work • Ability to work in an interdisciplinary context

(3) COURSE CONTENT

A. Lectures

Quaternary Geology:

- Quaternary climate change and its impact on environment and relief.
- Glacial - Interglacial periods and their relation to sea level changes.
- Holocene transgression and impacts on the coastal environment.
- Sea level changes and Sea level indicators: archaeological, biological, geomorphological. Accuracy of each category.
- Present-day trends of sea level change.
- Chronostratigraphy and lithostratigraphy of Quaternary deposits.
- Quaternary deposits in Greece and wider Mediterranean region and their particular characteristics.
- Sampling-analysis of sediments and geomorphological and environmental changes.
- Basic methods of geochronology.
- Karstic & coastal landforms and their role in Quaternary Geology.

Archaeogeomorphology:

- Contribution of geomorphological analysis to the understanding of the evolution of the landscape of the wider area of archaeological sites and determination of environmental - morphological changes in a) coastal environments, b) fluvial environments, c) desert environments, d) lakes etc.
- Geoarchaeological analysis of ancient harbors of the Mediterranean and examples from Greece and internationally.
- Sea level changes and coastal geoarchaeology.
- Examples of archaeogeomorphological studies in Greece and the wider Mediterranean region.
- Problems of finding, promoting and protecting archaeological sites in relation to erosional or depositional processes.
- Use of modern methods and new technologies in locating archaeological sites.

B. Practical and Laboratory Exercises :

The exercises are the continuation and practice based on the course lectures. They include exercises with maps, satellite images, aerial photographs, as well as calculations, measurements, questionnaires and special tasks for:

- the determination of sea level changes,
- identification and interpretation of biological, archaeological and geomorphological indicators of sea level change
- the geomorphological processes of coastal evolution of geoarchaeological sites
- geomorphological and environmental changes
- the basic methods of geochronology
- identification and mapping of Quaternary deposits,
- solving problems of finding, promoting and protecting archaeological sites in relation to processes of erosion or deposition
- methods of research of palaeogeographical evolution and evolution archeological sites
- research methods of geoarchaeological studies in ancient harbors

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	See table below
ASSESSMENT METHODS AND CRITERIA	I. LECTURES (**50%**) (summative) • Presentation of a topic selected by a list II. PRACTICE EXERCISES (**50%**) (formative) • Delivery, through the eclass, of assignments that included solving problems during laboratory exercises.

PLANNED LEARNING ACTIVITIES

Activity	Student effort
Lectures	26 hours
Practice exercises	13 hours
Fieldwork	-
Tutorials	-
Essay writing	20 hours
Autonomous study	21 hours
Final assessment preparation	20 hours
Total student's effort	**100** hours

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Evelpidou, N., 2019. Sea level changes. Da Vinci, Athens. ISBN: 9789609732321. (book website) [Code Eudoxus: 86054068] (in Greek).
- Evelpidou, N., Karkani, A., 2024. Quaternary Geology and Archaeogeomorphology. Kallipos, Open Academic Publishing. https://dx.doi.org/10.57713/kallipos-255 [Code Eudoxus: 122074392]

II. ADDITIONAL READING

- Bailey, G., Galanidou, N., Peeters, H., Jöns, H., & Mennenga, M. (Eds.). (2020). The Archaeology of Europe's Drowned Landscapes (Vol. 35). Springer International Publishing. https://doi.org/10.1007/978-3-030-37367-2
- Ehlers, J., & Gibbard, P. L. (2004). Quaternary glaciations-extent and chronology: part I: Europe. Elsevier.
- Elias, S.A., 2007. Encyclopedia of Quaternary Science. Elsevier
- Menzies, J., & Van der Meer, J. (Eds.). (2018). Past Glacial Environments. Elsevier. https://doi.org/10.1016/C2014-0-04002-6

III. RELATIVE JOURNALS

- Geoarchaeology
- Journal of Quaternary Science
- Oxford Journal of Archaeology
- Palaeogeography Palaeoclimatology Palaeoecology
- Quaternary International
- Quaternary Perspectives
- Quaternary Research
- Quaternary Science Reviews
- Radiocarbon
- The Holocene
- Geosciences

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E5203**	**SEMESTER**	**5th**
TITLE	**VOLCANOLOGY**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Laboratory exercises	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL223

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course the student:

- **Comprehens** the basic petrological concepts, the rock-forming minerals and the methods of petrological research (from sampling to preparation).
- **Explains** the mechanism of different types of volcanic eruptions and **interprets** volcanic deposits and their stratigraphic succession.
- **Analyzes** petrological data to interpret the magma fragmentation processes leading to the formation of volcanic ash.
- **Assesses** the degree of volcanic hazard in order to take the necessary precautionary measures.
- **Approaches** the modelling of volcanic eruptions with a view to managing emergencies and crises and minimising the impact on people and the environment.

Generic Competences

- Ability to apply knowledge in practical situations
- Promote free, creative and inductive thinking
- Information and Communication Technology (ICT) skills

- Ability to work in a team
- Ability to search for, process and analyse information with the use of necessary technologies
-

(3) COURSE CONTENT

Theory:

- **Fundamentals -** in-depth knowledge of the terms of volcanology. The basic principles of volcanology: basic knowledge of volcanoes. Distribution of recent and current volcanic activity on the earth's surface.
- **Classification of volcanoes -** based on the geotectonic characteristics of volcanoes and their petrographic features,
- **Volcanic series -** understanding the physicochemical characteristics of the lavas.
  The importance and role played by parameters such as temperature-pressure-viscosity-flow velocity and lava form).
- **Lithospheric plates and volcanoes -** evolution of volcanism on a global scale according to the theory of lithospheric plate motion in time and space.
- **Mechanism of volcanic eruptions -** Mechanisms of magma ascent in the interior of the earth. The disruption of the equilibrium of volcanic systems is considered. Mechanisms of magma rupture and formation of explosive columns.
- **Types of volcanic eruptions -** A detailed description is given of the types of volcanic eruptions, taking into account various qualitative and quantitative criteria such as the mode of ejection of volcanic products, the dimensions and shape of the volcanic edifice, the rate of volcanic eruption and the degree of hazard.
- **Post-volcanic phenomena -** The types of volcanic products emanating from volcanoes such as steam, fumaroles, solfatars and thermometallic vents.
- **Types of volcanic products -** Morphological characteristics of lavas. Pyroclastic products (classification, transport and deposition).
- **Space volcanism.** Cases of volcanism on other planets. Cryo-volcanism and comparative study with terrestrial volcanism.
- **Volcanism and Ecology -** The relationship of volcanism with humans, culture and the environment.
- **Volcanic hazards -** examples of volcanic areas and the degree of risk they pose. Ways of managing and dealing with any form of volcanic hazard.
- **Volcanoes as a source of energy -** areas of geothermal interest, how they are created and the extent to which they can be exploited.
- **Volcanoes in Greece -** A detailed description of volcanic centres in various regions of Greece. Volcanic centres in continental and marine environments - Volcanism older than the Miocene - Recent volcanism Active volcanic arc of the South Aegean (Methana-Susaki, Milos, Santorini and Kos-Nisyros volcanoes.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** / **Student effort** Lectures: 26 hours Practice exercises: 13 hours Fieldwork: 10 hours

	Tutorials - Essey writing 13 hours Autonomous study 18 hours Final assessment preparation 20 hours **Total student's effort** **100** hours
ASSESSMENT METHODS AND CRITERIA	• Written examination (**80%**) (summative) • Development/examination of the topic of the individual project (**20%**) (formative)

(5) RECOMMENDED READING

I. EUDOXUS PORTAL
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II. ADDITIONAL READING
- Textbooks and notes uploaded on the electronic platform **e-class**.
- Peter Francis & Clive Oppenheimer (2004). Volcanoes. Oxford University Press.
- Robert W. Decker & Barbara B. Decker (1992). Mountains of Fire. The nature of volcanoes. Cambridge University Press

III. RELATIVE JOURNALS
- Bulletin of Volcanology, Springer Nature.
- Journal of Applied Volcanology, Springer Nature.
- Journal of Volcanology and Geothermal Research, Elsevier
- Journal of Petrology, Oxford University Press.

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	SCHOOL OF SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
EDUCATION LEVEL	EQF level 6; NQF of Greece level 6		
CODE	E5207	SEMESTER	5th
TITLE	KARST GEOMORPHOLOGY-PRINCIPLES OF SPELEOLO-GY		

TEACHING ACTIVITIES	HOURS/WEEK	ECTS
Lectures, Lab Exercises and Fieldwork	3	4

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL124

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course the student:

- **Recognizes** the karst relief,
- **Understands** the processes that affect the generation and evolution of karst formations and caves,
- **Apply** techniques for classifying geomorphological features in stages of evolution
- **Composes** and **constructs** digital maps using remote sensing data as a basic cartographic background
- **Detects** the environmental degradation of karst cavities
- **Evaluates** spatial data for cave management, exploitation and protection

Generic Competences

- Ability to apply knowledge in practical situations
- Ability to search for, process and analyse information with the use of necessary technologies
- Autonomous work
- Commitment to conservation of the environment

(3) COURSE CONTENT

A. Lectures

- Introduction to the concept of karst, processes, surface forms, evolution stages
- Karst processes, conditions, effects on the creation and formation of karst: lithology, stratigraphy, tectonics, eustatism, climate, paleogeography and human activities
- Karst and climate zones. Global spread of karst.
- Karst landforms, surface and underground karst forms, correlation with stages of evolution
- Principles of speleology, types of caves, speleogenesis, cave deposits, cave microclimate
- Mapping methods, 3D visualization, new technologies and equipment in cave research
- Cultural value of the caves. Management, protection and sustainable development (Geotourism,, legislation-studies, preliminary studies, monitoring conditions during operation)

B. Lab Exercises

The Practice Exercises are carried out using printed maps, and/or digital aerial photographs-satellite images displayed on the screens of the Department's PC Lab, mostly individually and graded at the end of the Laboratory.

Exercise 1. Identification of karst fields on paper maps (ideon Andron)
Exercise 2. Analysis of digital survey data. Mapping and quantification of cave deposits (Koutouki)
Exercise 3. Identification of karst fields on satellite images and DEMs (part I) (Parnassos, Ghiona)
Exercise 4. Identification of karst fields on satellite images and DEMs (part II) (Parnassos, Ghiona)

C. Fieldwork

C1. One full day field exercise at a show cave. Optional visit on a Sunday with a guided tour from an experienced speleologist.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** — **Student effort** Lectures — 26 hours Practice exercises — 13 hours Fieldwork — 6 hours Tutorials — - hours Essey writing — 26 hours Autonomous study — 21 hours Final assessment preparation — 8 hours **Total student's effort** — **100** hours
ASSESSMENT METHODS AND CRITERIA	I. Course theory (**60%**) • Multiple choice online exams (Summative) II. Laboratory Exercises (**40%**) • Evaluation of each exercise at the end of the class (Formative). • Supplementary material for the exams (questions, exercises etc.) is posted on **e-Class** platform http://eclass.uoa.gr/courses/GEOL124

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Miliana Goloubovic-Deligianni, 2019, Environmental Karst Geomorphology, [EVDOXOS: 77120352]

II. ADDITIONAL READING

- Bogli, A., 1980. Karst hydrology and physical speleology. Springer-Verlag, p. 284.
- Derek, F. & Williams, P., 2007. Karst Hydrogeology and Geomorphology, John Wiley & Sons, p. 562.
- Gillieson, D., 1996. Caves: Processes development and management, Blackwell Oxford, p. 324p
- Gunn, J., 2004. Encyclopedia of Caves and Karst Science, Taylor and Francis, p. 928.

III. RELATIVE JOURNALS

- Geomorphology
- Acta carsologica
- Journal of Cave and Karst Studies
- Cave and Karst Science
- International Journal of Speleology

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	SCHOOL OF SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
EDUCATION LEVEL	EQF level 6; NQF of Greece level 6		
CODE	E5208	SEMESTER	5th
TITLE	APPLIED ENVIRONMENTAL OCEANOGRAPHY		

TEACHING ACTIVITIES	HOURS/WEEK	ECTS
Lectures, Lab Exercises and Fieldwork	3	4

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL296

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course the student:

- Defines and formulates the basic concepts and applications of oceanography in the coastal and marine environment
- Understand the processes underlying coastal hydrodynamics with emphasis on wave transformation processes and the generation of coastal currents
- Understand the basic 'operating' principles governing the formation of marine depositional coasts (with emphasis on coastal zones) in relation to coastal hydrodynamics.
- To address specific issues through the acquisition of applied knowledge and methodologies, on coastal erosion issues and in particular coastal zones.
- Identify the relationship between the above processes and the geological evolution of sea basins, the transport and deposition of sediments, as well as the formation of submarine and coastal relief, with particular reference to coastal geomorphs.
- Become familiar with issues related to the management of the coastal marine environment (natural processes, human intervention, institutional framework)
- Reference is made to human activities and interventions in the marine and coastal environment (renewable energy sources).

- Introduce the way (methods) of collecting data related to the coastal zone (e.g. satellite data).
- processes between the marine and atmospheric environment (e.g. wind waves, heat balance, thermoclines) and between the marine and terrestrial environment (e.g. shaping of coastal geomorphs such as river deltas).
- Introduction to the basic concepts of marine pollution by human factors (e.g. oil spills)
- Understanding of the basic principles of the International Law of the Sea

Generic Competences

- Theoretical thinking and the ability to apply knowledge to problem solving.
- Work in an interdisciplinary environment (individual and/or team)
- Respect for the natural marine environment
- Search, analysis and synthesis of data and information, including the use of appropriate technologies
- Promotion of free, creative and deductive thinking

(3) COURSE CONTENT

A. Lectures

- Introductory concepts in environmental oceanography and the methodology (means and instruments) of coastal research (e.g., coordinate systems, hydrographic charts, topography, ship positioning methods, satellite systems)
- Coastal hydrodynamics with emphasis on the coastal zone: Coastal wave conditions, coastal currents of wave origin. Example of application of a coastal hydrodynamic model.
- Dynamic Sedimentology - morphodynamics: Sediment characteristics, dynamics (movement) of bottom sediments, stereotransport, morphodynamic characteristics of coastal zones, coastal engineering investigation of coastal engineering projects related to protection against erosion and enrichment of coastal zones.
- Applied Submarine Sedimentology and Morphology: Methods for mapping of bottom geometry, bottom morphology and identification of bottom habitats, geophysical investigations of the geological infrastructure of the seabed. Application/ Link to the labour market: Geotechnical studies of foundation works, submarine volcanoes, cables and pipelines, shipwrecks, ancient monuments.
- Satellite Oceanography: Marine remote sensing, principles and methods of processing satellite telescopic imagery, uses and applications in the marine environment. Application/ Linking DE4 to the labour market: Use of Satellite Imagery in the coastal system.
- Marine Pollution: sources of pollutants in the marine environment, classification of pollutants, impact of pollutants on the marine environment, pollution response, sediment loading. Application/ with labour market: Examples of marine pollution/ examples of marine pollution/ decontamination studies from the Greek and global area.
- Marine resources: Categories of Natural Resources, Geographical distribution of resources, Exploitation of the marine environment, Global stock status. Application: Example of Natural Resource Exploitation in the Greek Area.
- Uses of the Ocean: Shipping, security, marine facilities, marine engineering works, waste disposal, military use.
- International Maritime Law: International Conventions (UNCLOS), Maritime Zones, Seabed. Example of EEZ delimitation.
- Integrated Coastal Zone Management - European and Greek Legislation. Implementation: Examples of implementation or non-implementation of the legislation in the Greek Area.

B. Lab exercises.

Laboratory Exercises are individual and are graded at the end of the Laboratory.

- Hydrographic Chart Reading, Length and Speed Units, Course Plotting, Position and Depth Determination
- Coastal hydrodynamics
- Granular Analysis of Marine Sediments

- Sediment dynamics (sedimentation, resuspension, sediment transport in the marine environment, interpretation of coastal hydrodynamic model results)
- Morphodynamic characteristics and calculation of longitudinal coastal sediment transport
- Application of Satellite Imagery in Oceanographic Research
- Sea Level Change
- Marine water and sediment quality related to pollution
- Preparation of a response study in case of widespread pollution of the marine environment
- Draft environmental impact assessment of coastal areas of special interest in cases such as highly eroded, with cultural heritage, protected area (NATURA).
- Work Plan: Economic Exploitation of the Marine Environment (e.g. EEZ delimitation dispute, case of exploitation of a deposit).

C. Fieldwork

C1. Visit to Research Vessel AEGAIO.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** — **Student effort** Lectures — 26 hours Practice exercises — 13 hours Fieldwork — 6 hours Tutorials — - Essey writing — 13 hours Autonomous study — 22 hours Final assessment preparation — 20 hours **Total student's effort** — **100** hours
ASSESSMENT METHODS AND CRITERIA	I. LECTURES (**60%**) • Written examination of 2 hours during the examination period of the semester (formative, summative). The examination includes extended or short answer questions. Exams include short or extended answer questions, multiple choice tests, simplified sketches and drawings, simplified cross-sections and maps and stereographic projections. II. LAB EXERCISES (**40%**) • Grading of each exercise at the end of the Workshop (formative, deductive) or 1 hour written examination with multiple questions and/or exercise solution (deductive). III. FIELDWORK Supplementary material for the exams (questions, exercises etc.) is posted on **e-Class** platform

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- S. Poulos and A. Karditsa. Applied and Environmental Oceanography, (EUDOXUS code: 102072814), in Greek.

II. ADDITIONAL READING

- Velegrakis A., 2016. Coastal Geology. Department of Marine Sciences, University of the Aegean (in Greek)
- Ferentinos G., 2002. Ocean Engineering. Department of Geology, University of Patras. Department of Marine Sciences, University of the Aegean (in Greek).

III. RELATIVE JOURNALS

- J. Applied Oceanography
- J. Coastal Management
- J. Marine Policy
- J. Coastal Research
- J. Coastal Engeenering

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	SCHOOL OF SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
EDUCATION LEVEL	EQF level 6; NQF of Greece level 6		
CODE	E5209	SEMESTER	5th
TITLE	ENVIRONMENTAL GEOCHEMISTRY		
TEACHING ACTIVITIES		HOURS/WEEK	ECTS
Lectures, Practical exercises, Laboratory exercises		3	4
TYPE OF COURSE	**ELECTIVE /** Scientific Area		
PREREQUISITES	Y4203 - Geochemistry [recommended]		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL106 http://opencourses.uoa.gr/courses/GEOL1/		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
On successful completion of the course the student will be able to: • Recognize and understand the geochemical interaction processes between anthropogenic activities and natural environment of our planet. • Define the environmental behaviour of potentially toxic elements and compounds in the rock – soil – water – atmosphere system. • Determine the dissolution methods of environmental solid samples and establish the linkage with the release of trace elements to the environment. • Describe the sources, release and dispersion of harmful chemical elements in the environment, focusing on the life cycle of trace elements and nutrients (C, N, P). • Apply geochemical methods for the research and solving of environmental problems, mainly in the urban environment. • Treat in the lab soil samples in order to perform basic soil measurements (pH, organic carbon) and chemical analyses of elements. • Write a comprehensive report of environmental characterization of soil samples including sampling, laboratory analysis, treatment of geochemical data and conclusions.

Generic Competences
• Ability to apply knowledge in practical situations • Ability to work in a team • Ability to search for, process and analyse information with the use of necessary technologies • Ability to undertake research at an appropriate level • Autonomous work

(3) COURSE CONTENT

A. Lectures.

- Introduction, understanding of the subject of the course, environmental sampling media, environmental geochemistry and health.
- Geochemical analysis of solid samples - Dissolution methods.
- Urban geochemistry issues.
- Geochemistry of acid mine drainage.
- Treatment of environmental geochemical data – Instructions for writing of the report from the practical exercise of soil sampling and analyses.
- Geochemical cycles of N-P-C
- Geochemical mapping.

B. Lab exercises

- Concentration units in environmental geochemistry.
- Transport of N and P in surface water systems.
- pH as controlling factor of dissolved C species in natural waters.
- Statistical treatment of geochemical data - Geochemical mapping.

C. Practical exercise of sampling, laboratory treatment and analyses of urban soil samples

- Collection of soil samples from various locations within the Athens urban environment.
- Laboratory preparation of the samples (sieving, weighing, production of geochemical solutions).
- pH and organic carbon measurements.
- Dissolution with appropriate chemical reagents and geochemical determination of elements by atomic absorption spectroscopy.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	18 hours
	Practice exercises	21 hours
	Fieldwork	-
	Tutorials	-
	Essey writing	25 hours
	Autonomous study	20 hours
	Final assessment preparation	16 hours
	Total student's effort	**100** hours

ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted in Greek (there is the possibility of examination in English for Erasmus students). The final grade of the course is formed by a series of tests that include: **I. Writing of a comprehensive essay** of the practical exercise of soil sampling and analysis including abstract, introduction, materials and methods, results, discussion, conclusions and reference list (formative, summative) (**60 % of the final grade**) **II**. Laboratory exercises: Solving handout exercises and problems during the class (formative) (**30 % of the final grade**) **III**. Evaluation test with multiple choices questions regarding the geochemical cycles of N-P during the semester (formative) (**10% of the final grade)**

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Eby, N. G., 2011, Principles of Environmental Geochemistry/ ISBN 9789609985864, [EUDOXUS code: 77115198], in Greek.

II. ADDITIONAL READING

- Plumlee, G. S. and Ziegler, T. L. (2007). The Medical Geochemistry of Dusts, Soils, and Other Earth Materials. Treatise on Geochemistry Volume 9, Chapter 9.07. pp. 1-61.
- Adamo, P., Agrelli, D., Zampella, M., 2018. Chemical speciation to assess bioavailability, bioaccessibility and geochemical forms of potentially toxic metals (PTMs) in polluted soils. Chapter, 9. In De Vivo B., Belkin, H.E., Lima, A., (Eds.). Environmental Geochemistry: site characterization, data analysis and case histories, pp. 153-194.

III. RELATIVE JOURNALS

- Science of The Total Environment, Elsevier
- Applied Geochemistry, Elsevier
- Environmental Pollution, Elsevier
- Journal of Geochemical Exploration, Elsevier
- Environmental Geochemistry and Health, Springer

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E5210**	**SEMESTER**	**5th**
TITLE	**PALAEOBOTANY - CLIMATE RECONSTRUCTION TECHNIQUES**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises, Fieldwork	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	Basic knowledge of Y2205 Paleontology and, Y3206 Climatology
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL158

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

Upon successful completion of the course, students will be able to:

- Define and formulate the basic principles of the evolution and dispersal of plants in geological space and time
- describe various fossil plant and classify them into the major taxonomic categories
- Select appropriate sampling techniques, laboratory processing and study methods for plant fossils from different geological periods and depositional environments
- Process palaeobotanical databases, considering and combining data
- Calculate basic climatic parameters on the basis of palaeobotanical data
- Examine and synthesise the results of laboratory and analytical methods using specialised software
- Apply the scientific knowledge acquired to the measurement and assessment of environmental parameters

Generic Competences

- Ability to apply knowledge in practical situations

• Information and Communication Technology (ICT) skills • Ability to work in a team • Commitment to conservation of the environment •

(3) COURSE CONTENT

An interdisciplinary course designed to offer insights to the study of fossiled plant remains and introduce students to paleoclimate restoration techniques using plant fossils. Plants, as multicellular organisms composed of a significant number of different parts, produce a large number of fossils of varying size, composition and form, which are excellent witnesses both to paleovegetation and to the environmental and climatic conditions that prevailed in the past. In addition, plant fossils are among the most important bioproxy data for the quantitative reconstruction of paleoclimatic parameters. The course includes practical exercises in the preparation laboratory, using microscopes, computers and specialized software (R, C2, Tilia).

A. Lectures:

Introduction to the study of fossil plants:

- structure, systematics, fossils and fossilization processes, peat and coal deposits, petrified forests, methods of fossil collection.

Plant evolution:

- origins, land colonization, evolution mechanism and characteristics, Paleozoic-Mesozoic-Cenozoic plant diversity. Fossil plants of Greece.
- Paleobotanic methodology, contribution to stratigraphy and paleogeography.

Palynology:

- pollen, spores and NPP analysis and their significance in the geoenvironmental research.

Climatic variability and vegetation:

- Quaternary long paleovegetation records, persistent populations, refugia.
- Vegetation history of the Mediterranean region.
- Reconstruction of past climate variables from fossil pollen records - Pollen-climate modelling techniques

B. Practical:

1. Pollen and NPPs identification methodology;
2. Practical exercise in the Laboratory;
3. CLAMP - Climatic reconstitution based on fossilized leaf concentrations
4. Introduction to the programming language and the R environment
5. Quantitative climate reconstruction with the MAT technique (using R).

C. Fieldwork

Field training on Mt Hymettus Aesthetic forest

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	13 hours
	Practice exercises	26 hours
	Fieldwork	4 hours
	Tutorials	- hours

	Essey writing 20 hours Autonomous study 30 hours Final assessment preparation 7 hours **Total student's effort** **100** hours
ASSESSMENT METHODS AND CRITERIA	Assessment language: Greek / English for Easmus or Civis students • Practical exercises -2 in small groups and 2 individual during the semester (**20%**) (formative) • Practical exam with PC in the lab (**25%**) (formative) • Field work assessment (**5%**) (formative) • Final written essay / oral presentation of the selected subject (**50%**) (formative, summative) All above information are available in e-class.

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Bradley, Raymond S. 2015 Paleoclimatology Reconstructing Climates of the Quaternary, Elsevier
- Taylor E., Taylor T., Krings M. 2009. Paleobotany (2nd ed.). Elsevier Science
- Willis K. J., McElwain J. C. 2014. The Evolution of Plants. Oxford University Press.

III. RELATIVE JOURNALS

- Review of Palaeobotany and Palynology
- Journal of Quaternary Science
- Palaeogeography Palaeoclimatology Palaeoecology
- The Holocene

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E5211**	**SEMESTER**	**5th**
TITLE	**ANALYTICAL METHODS OF ROCKS AND ORES - FLUID INCLUSIONS**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Lab exercises and Fieldwork	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	[recommended] Y1203 - Chemistry **Y2202** - Systematic Mineralogy-Mineral Identification Y4203 - Geochemistry.
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL288

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course, the student will be able to:

- **Define** and **apply** the principles of the studied analytical techniques, to determine whole-rock geochemistry, of rocks and ores, in solid or liquid samples.
- **Define** the appropriate sample preparation procedure according to the selected analytical technique.
- **Identify** main minerals in host-rocks and ores with the use of petrographic and metallographic microscope, Raman spectroscopy and X-ray diffraction.
- **Define** and **apply** the appropriate analytical methods used for mineral characterization in rocks and ores.
- **Identify** and **characterize** fluid inclusions with the use of petrographic microscope.
- **Describe** the basic principles of microthermometric analysis of fluid inclusions, **interpret** and **evaluate** the obtained data.

- **Combine** theoretical and applied knowledge to solve complex problems and **evaluate** the appropriate analytical methods to be used for rock/ore characterization.
- **Apply** the appropriate working procedures in the environment of the geochemistry lab, as well as the safety and health rules.

Generic Competences

- Ability to apply knowledge in practical situations.
- Ability to search for, process and analyze information with the use of necessary technologies.
- Decision making.
- Autonomous work.
- Information and Communication Technology (ICT) skills.

(3) COURSE CONTENT

A. Lectures.

- Introduction, sampling and sample preparation for analysis.
- Principles of Optical Microscopy and description of rocks and ores.
- Principles of Electron Microscopy.
- Principles and applications of X-Ray Diffraction.
- Principles and applications of Raman Spectroscopy.
- Geochemical analytical techniques for rocks and solutions.
- Evaluation and selection criteria of analytical methods.
- Introduction to Fluid Inclusions and their importance in mineral exploration.
- Principles and methods of Microthermometric Analysis and optical identification of Fluid Inclusions.
- Interpretation of data from Microthermometric analysis.

B. Lab Exercises

Practice exercises are conducted either individually or in small groups of students and are graded at the end of the exercise.

Exercise 1. Observation and identification of mineral ores under a reflected light microscope.
Exercise 2. Processing of mineral chemical data from an Electron Microprobe and analysis of backscattered electron images (BSE) using the ImageJ software.
Exercise 3. Processing and evaluation of X-ray diffraction data.
Exercise 4. Processing and evaluation of Raman spectra using Crystal Sleuth software.
Exercise 5. Method of sample preparation with aqua regia and determination of chemical composition by atomic absorption.
Exercise 6. Identification of fluid inclusions under a transmitted light microscope.
Exercise 7. Analysis of fluid inclusions using a microthermometric heating-cooling microscope stage.
Exercise 8. Evaluation of microthermometric analysis results with special software (BULK), and geological interpretation.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	20 hours

	Practice exercises 19 hours Fieldwork – Tutorials – Essey writing 13 hours Autonomous study 28 hours Final assessment preparation 20 hours **Total student's effort** **100** hours
ASSESSMENT METHODS AND CRITERIA	• LECTURES **(70%)** • Written examination in the whole syllabus (formative) • The exams include extended or short answer questions, and multiple-choice tests. • II. LAB EXERCISES **(30%)** • Grading of each exercise at the end of the Lab (formative, summative). • Written exercise (summative). • Written examination in all the material covered in the laboratory exercises (summative).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Harris D.C. & Lucy C.A., **Αναλυτική Χημεία**, [EUDOXUS code: 94644882], in Greek.

II. ADDITIONAL READING

- Οικονομου, Μ., 2000. **Μέθοδοι ανάλυσης μεταλλευμάτων**. ΕΚΠΑ, Αθήνα, in Greek.
- Κίλιας, Σ., 2016. Ρευστά εγκλείσματα: Εισαγωγή στη θεωρία και τις βασικές αρχές μικροθερμικής ανάλυσης ρευστών εγκλεισμάτων. Σημειώσεις μαθήματος, ΕΚΠΑ, Αθήνα, in Greek.

III. RELATIVE JOURNALS

- Analytical Methods, Royal Society of Chemistry
- Ore Geology Reviews, Elsevier
- Trends in Analytical Chemistry Articles, Elsevier

COURSE UNITS: 6th Semester

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y6201**	**SEMESTER**	**6th**
TITLE	**APPLIED AND ENGINEERING SEISMOLOGY**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Practical Exercises & Laboratory work and exercises		**4**	**6**
TYPE OF COURSE	**MANDATORY /** Scientific Area		
PREREQUISITES	Y1202 Physics [recommended] Y3203 Seismology [recommended] Y4202 Geophysics [recommended]		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL233		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
Upon successful completion of the course, the student: • **Recognizes** the importance of seismological research as a basic tool for investigating the structure of the earth's crust, seismic planning and seismic risk mitigation. • **Describes** the basic principles of Engineering Seismology. • **Distinguishes** the basic methods that compose modern seismological research. • **Applies** modern methodologies for collecting, managing, processing, analyzing and evaluating seismological data in order to maximize their utilization. • **Calculates** all the seismic parameters that characterize an earthquake, while quantifying and minimizing the errors. • **Evaluates** the different methods of seismic hazard assessment and acquires the necessary knowledge to select the best one per case. • **Distinguishes** the applications of Engineering Seismology in the fields of seismic design, prevention and minimization of impacts, given the high seismicity of Greece.
Generic Competences

- Ability to apply knowledge in practical situations
- Ability to plan and manage time
- Ability to search for, process and analyse information with the use of necessary technologies
- Oral and written communication of scientific issues
- Ability to undertake research at an appropriate level
- Autonomous work
- Information and Communication Technology (ICT) skills

(3) COURSE CONTENT

A. Lectures

- Basic principles for the design of seismic networks and arrays.
- Digital data acquisition and archiving.
- Processing and analysis of digital waveforms.
- Design, compilation and implementation of filters.
- Spectral analysis, calculation of seismic moment. Seismic source time function, rupture modes and seismic radiation.
- Calculation of seismic parameters and velocity models. Basic principles of passive seismic tomography.
- Seismotectonic analysis.
- Recording instruments and strong motion ground characteristics.
- Analysis of accelerograms. Calculation of maximum and spectral ground parameters.
- Seismic Hazard. Vulnerability. Seismic Risk. Seismic hazard assessment methodologies.
- Antiseismic regulations.
- Estimation of soil response to strong seismic motion. Local site conditions.
- Objectives, Content and Methodologies for the elaboration of Microzonation studies.
- Basic stages of seismological studies (Seismic Hazard Studies – Microzonation Studies).

B. Practical Exercises (include data analysis and interpretation using specialized computer software and, preparation of a report).

PART A΄: Processing of digital seismograms (correction of zero level, application of bandpass filter) for the calculation of basic seismic parameters (arrival times, epicentral distance, back-azimuth, origin time). Compilation of travel time curves and Wadati diagram to determine the apparent velocity of P and S waves, Vp/Vs ratio and Poisson's ratio

PART B΄: Determination of microseismic hypocenter using the HYPO algorithm (Geiger method).

PART C΄: Computer -aided spectral analysis and calculation of earthquake magnitude.

PART D': Computer -aided determination of earthquake focal mechanism.

PART E': Determination of the Gutenberg–Richter relationship constants by the use of extreme values method.

PART F': Determination of the response of surface soil formations, through microtremor using the Horizontal to Vertical Spectral Ratio method.

PART G': Analysis of accelerograms

PART H': Management and Visualization of Seismological Data in ArcGIS

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**

	Lectures 26 hours Practice exercises 26 hours Fieldwork - Tutorials - Essey writing 26 hours Autonomous study 52 hours Final assessment preparation 20 hours **Total student's effort** **150** hours
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted in Greek (there is the possibility of examination in English for Erasmus students),. The final grade is formed by a series of tests which include: I. THEORY: **50% of the total grade** • **Final written examination** (**50% of the total grade**) (summative). II. PRACTICE EXERSISES: **50% of the total grade** • A. **Written assignments/activity reports** on practice exercises. (formative) • B. **Final written exam** on practice exercises at the end of the semester consisting of a mixture of multiple-choice and short answer questions. (summative)

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- General seismology vol. B, A. Tselentis [Code EUDOXUS: 77118155], in Greek
- Introduction to seismology. Papazachos B.C., G.F. Karakaisis, P.M. Chatzidimitriou. [Code EUDOXUS: 11254], in Greek

II. ADDITIONAL READING

- I I. Kassaras and G. Kaviris, 2017. Laboratory Seismology, 268 pp., Athens. Available in e-class, in Greek
- Bormann, P. (Ed.) (2012). New Manual of Seismological Observatory Practice (NMSOP-2), IASPEI, GFZ German Research Centre for Geosciences, Potsdam; http://nmsop.gfz-potsdam.de; DOI:10.2312/GFZ.NMSOP-2 urn:nbn:de:kobv:b103-NMSOP-2

III. RELATIVE JOURNALS

- Bulletin of the Seismological Society of America, SSA Journals
- Geophysical Journal International, Oxford University Press
- Journal of Geophysical Research, AGU Publications
- Physics of the Earth and Planetary Interiors, Journal, Elsevier
- Tectonophysics, Journal, Elsevier

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y6202**	**SEMESTER**	**6th**
TITLE	**HYDROGEOLOGY**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Lab exercises, Fieldwork		**6**	**6**
TYPE OF COURSE	**MANDATORY /** Scientific Area		
PREREQUISITES	Y5204 Geology of Greece [recommended]		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL147		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

It is the basic course that negotiates the appearance, flow, storage, exploitation, management and protection of groundwater as well as its connection with surface water. After the successful completion of the course, laboratory exercises and field trips, the student:

- Understands the Water Cycle and determines the parameters involved in the equation of the Hydrological Balance that quantifies the water cycle (atmospheric precipitation, evapotranspiration, surface runoff, infiltration).
- Describes and classifies rocks and geological formations related to their permeability and the ability to store and transmit groundwater.
- Understands, defines and formulates what aquifers are, the types of aquifers, the basic hydraulic properties of aquifers (porosity, effective porosity hydraulic head, hydraulic conductivity, transmitivity, storage coefficient), and the laws of groundwater flow.
- Applies basic techniques for calculating hydraulic parameters and understands their importance for solving various hydrogeological problems.
- Understands everything related to and affects the quality of groundwater, determines the chemical composition of groundwater, evaluates its quality and applies techniques and methodologies for assessing and presenting the quality characteristics of water and its suitability for various uses.

• Collects, combines and evaluates a series of geological, hydrogeological, structural, hydrological, geophysical data and data related to the qualitative characteristics of water, the change in groundwater level, test pumps, and synthesizes the data and observations with the aim of understanding the hydrogeological conditions of an area and solving hydrogeological problems. With all the above, the student now acquires all the knowledge that allows him to satisfactorily answer the following questions: • What is the purpose of Hydrogeology • Where there is underground water • What is its quantity • What is its quality • How both the quality and quantity of groundwater can be preserved • How the "wise" management of water resources is done
Generic Competences
• Ability to search for, process and analyse information with the use of necessary technologies • Ability to apply knowledge in practical situations • Promote free, creative and inductive thinking • Ability to plan and manage time • Autonomous work and ability to work in a team • Decision making • Information and Communication Technology (ICT) skills

(3) COURSE CONTENT

A. Lectures

1. Purposes and objects of hydrogeology. Hydrological cycle (Water Cycle). Analysis of the parameters of the Water Cycle (Atmospheric precipitation. Runoff, Evaporation, Evapotranspiration, Infiltration).
2. Hydrogeological behavior of geological formations. Types of aquifers. Hydraulic head - hydraulic conductivity. Darcy's law. Storage and Trasmitivity of aquifers. Piezometric maps.
3. Pumping works – Pumping wells
4. Flow of groundwater in the pumping wells. Pumping Tests: their interpretations and methodologies for calculating hydraulic parameters.
5. Hydrogeological balance.
6. Springs. Thermometallic springs and hydrothermal fields. Karst springs and coefficient of sterilization.
7. Surface and underground hydrogeological research.
8. Basic concepts of hydrochemistry. Quality of groundwater. Pollution of groundwater. Penetration of seawater. Artificial enrichment of aquifers.
9. Principles of rational management of groundwater.
10. Basic concepts of karst hydrogeology, Isotopic hydrology and traces.
11. Computers and their use in Hydrogeology.

B. Lab Exercises

- Exercises for calculating the parameters of the hydrological balance equation
- Exercises for calculating water infiltration from atmospheric precipitation into the aquifers
- Exercises to understand Darcy's law, hydraulic gradient, hydraulic conductivity and the flow rate of groundwater
- Exercises for calculating the hydraulic parameters of aquifers by processing, (using different methodologies and for different conditions) data derived from pumping tests
- Exercises related to the analysis of the geological structure of an area and the understanding of the mechanism of operation of the springs
- Exercises to assess the Hydrogeological balance, groundwater reserves and inventory management

- Synthetic exercises of geological and hydrogeological interest
- Exercises related to the assessment of groundwater quality and the presentation and interpretation of hydrochemical analyses

C. Field exercises:

- One-day field trip in areas of Central and Eastern Peloponnese, (Environmental hydrogeology – Modern and ancient hydraulic works for water supply – Karst – Springs, coastal brackish springs – Measurement of spring flow – on-site collection of hydrochemical parameters using portable instruments and devices – contribution of geological structure to the movement and storage of groundwater – applications of isotopic hydrology).
- Where appropriate, monitoring of drilling operations for water boreholes.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	See table below
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted, either with progressive exams in separate sections of the course content or with the final examination of the entire course material which includes: I. LECTURES (**40%**) • Oral Examination (formative, summative)and/or • Written Exam with Short Answer Questions and Multiple Choice Test (formative, summative) and/or • Written Exam with Extended Answer Questions II. LAB EXERCISES (**50%**) • Written exam with Solving Exercises and Problems (formative, summative) III. FIELD EXERCISES (**10%**) • Oral examination in the field and with evaluation of deliverables of required Work or Report (formative, summative)

PLANNED LEARNING ACTIVITIES

Activity	Student effort
Lectures	26 hours
Practice exercises	52 hours
Fieldwork	12 hours
Tutorials	hours
Essey writing	20 hours
Autonomous study	20 hours
Final assessment preparation	20 hours
Total student's effort	**150** hours

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Voudouris Kostas S., 2016, Environmental Hydrogeology. Groundwater and Environment, [Ref. EUDOXUS: 18549069]

- Voudouris Kostas S., 2017, Exploitation & Management of Groundwater, [Ref. EUDOXUS: 112690244]

II. ADDITIONAL READING

- Appelo J. A. C. & Postma D., 2005, Geochemistry, Groundwater and Pollution, 2nd ed., by A.A. Balkema Publishers, Netherlands, ISBN: 04 1536 428 0Bonacci O.: Karst Hydrology with special reference to the Dinaric Karst, 1987, by Springer-Verlag, Berlin, ISBN 3-540-18105-9
- Driscoll G. F., 1989, Groundwater and Wells, 2ed ed., by Jonson Filtration Systems Inc, ISBN: 0-9616456-0-1
- Fetter C. W., 2001, Applied Hydrogeology, 4th ed., by Prentice-Hall, Inc. Upper Saddle River, New Jersey 07458, ISBN: 0-13-088239-9
- Freeze R. A. @ Cherry A. J., 1979, Groundwater, by Prentice-Hall, Inc. London, ISBN: 0-13-365312-9
- Hounslow W. A., 1995, Water Quality Data, Analysis and Interpretation, by CRC Press, Taylor & Francis, ISBN: 978-0-87371-676-5
- Kallergis A. G., 1999, Applied - Environmental Hydrogeology. Second edition, TEE Publications, Athens, Volume A and B., ISBN: 960-7018-70-2
- Kresic N & Stevanovic Z. 2010, Groundwater Hydrology of Springs, by Elsevier Inc. ISBN:978-1-85617-502-9
- Kruseman P.C. @ N. A. de Ridder, 1994, Analysis and Evalyation of Pumping Test Data. 2nd ed., by International Instsitute for Land Reclamation and Improvement, Netherlands, ISBN: 90 70754207
- Lekkas S. & Ap. Alexopoulos, 2009: Introduction to Hydrogeology. Student notes of the University of Athens
- Todd K. D. @ Mays W. L., 2005, Groundwater Hydrology, 3nd ed., by Jon Wiley & Sons, ISBN: 0-471-45254-8
- U.S. Department of the Interior, 1981, Ground Water Manual, U.S Government Printing Office

III. RELATIVE JOURNALS

- Hydrogeology Journal, Official Journal of the International Association of Hydrogeologists
- Groundwater
- Water
- Water Resources Research
- Hydrogeology Journal, Official Journal of the International Association of Hydrogeologists
- Groundwater
- Water
- Water Resources Research

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y6203**	**SEMESTER**	**6th**
TITLE	**GEOLOGICAL MAPPING - FIELD COURSE**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Fieldwork (*The weekly teaching hours include 9-day fieldwork training with 10-hour work per day), Lab exercises and Lectures.	**4**	**6**

TYPE OF COURSE	**MANDATORY /** Scientific Area
PREREQUISITES	Y2201 Introduction to Geology Y3205 Structural Geology and Tectonics Y5204 Geology of Greece Y3206 Biogeosciences-Principles of Micropalaeontology **Y5202** Stratigraphy **Y3202** Petrology Of Sedimentary Rocks Y4201 Petrology of Metamorphic Rocks Y3201 Igneous Rocks-Magmatic Processes Y2204 GIS and Introduction to Remote Sensing
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL146 http://opencourses.uoa.gr/courses/GEOL100/

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
It is a synthetic inter-disciplinary course that deals with field work and the techniques of Geological Mapping and the necessary procedures for the composition of a typical geological map, or a specialized type. Upon suceesful completion of the course the student is able to: • Understand and apply the methods of safe field work and safely use all the necessary equipment. • Recognize and describe the natural relief and correlate it with the topographic map. • Recognize, describe, and classify the various rock and formation types, based on their identifiable

characteristics in the field (i.s. paleontological, stratigraphic, sedimentological, mineralogical, petrological, etc.)
- Recognize, describe, and classify the various types of geological contacts, based on their identifiable characteristics in the field.
- Recognize and describe the 3D geological structure and relationship among cartographic units, geological formations, and geotectonic units.
- Recognize, describe, determine, and classify the brittle or ductile deformational structures formed during crustal / lithospheric deformation, at all outcrop scales (micro- to macro-scale).
- Understand, interpret, and explain, in space and time, the geotectonic processes and mechanisms responsible for rock deformation and the present configuration of the geological structures (geological history and evolution).
- Comprehend and apply the methods for field data collection (e.g., structural measurements, sample collection) for further laboratory analysis.
- Understand and apply the methods of field data collection and recording on the field notebook and on the available topographic information (i.e., maps, etc.).
- Comprehend an apply the techniques of geological mapping (both traditional; and digitally-assisted) with or without the use of electronic devices (smartphones, tablets, UAVs) and
- Compose the geological map, by overlaying all necessary geological structural, etc. data on the available topographic background (i.e. map, satellite imagery, etc.).
- Collect, combine, apply, correlate, and evaluate all the collected field data required in various applied geological topics, such as hydrogeology, oil and gas exploration, ore geology, technical works, all of which demand the composition of a detailed geological map.

Generic Competences

- Ability to search for, process and analyse information with the use of necessary technologies
- Autonomous work
- Oral and written communication of scientific issues
- Ability to work in an interdisciplinary context
- Ability to apply knowledge in practical situations
- Ability to work in a team
- Promote free, creative and inductive thinking
- Adapt to and act in new situations and cope under pressure
- Commitment to conservation of the environment
- Ability to plan and manage time

(3) COURSE CONTENT

A. Lectures, accompanied by Practice Exercises

- GEOLOGICAL MAPPING OUTLINE (Field work and geological mapping; map and observation scales, the geological map: types and categories.
- FIELD WORK EQUIPMENT, ORGANIZATION, SAFETY AND CONDUCT (Equipment necessary for field work, topo maps, satellite images, aerial photographs; field notebook. Health, Safety and Environment (HSE) issues during field work.
- THE FIELD NOTEBOOK AND THE GEOLOGICAL MAP (Field observations; structure and layout of field notebooks; types and categories of geological maps; traditional field notebook vs. tablet PC).
- THE USE OF GEOLOGICAL COMPASS (Types of compasses, settings, measurements of geological and morphological items, hits and tips, Apps, and smartphones vs traditional geological compass).
- TOPOGRAPHC MAPS AND LANDFORMS (Introduction to topography; the topographic map, relief terminology).
- FIELD RECOGNITION OF ROCK TYPES AND GEOLOGICAL FORMATIONS (Rock types, formations, cartographic units).
- THE METAMORPHIC ROCKS OF THE MAPPING AREAS.
- IDENTIFYING FOSSILS, AGES, DEPOSITION ENVIRONMENTS AND FACIES IN THE FIELD.
- RECOGNITION AND MAPPING OF GEOLOGICAL BOUNDARIES (Types of geological boundaries and contacts; field-based recognition of the geometry of geological boundaries; Mapping techniques;

Use of satellite and aerial imagery. – FIELD RECOGNITION OF FAULTING STRUCTURES (Criteria of fault detection, recognition and mapping, fault kinematic criteria. – FIELD RECOGNITION OF FOLDING STRUCTURE (Types of macro-folds; open, tight, isoclinal recumbent). – RECOGNITION AND VISUALISATION OF STRUCTURAL DATA AND FORMS (Primary and secondary structures, visualization of structure on maps). – GROLOGICAL STRUCTURE OF ANO DOLIANA AND MT HYMETTOS AREAS – REPRESENTATIVE GEOLOGICAL CROSS-SECTIONS. – FIELD SAMPLE COLLECTION (Sampling strategy, equipment, sample collection, recording, transport – safety and limitations). – DATA EVALUATION AND COMPOSISITION OF A GEOLOGICAL MAP (data evaluation, petrographic analyses and sample determination, final synthesis, and map composition. – MODERN (DIGITAL) TECHNOLOGY IN GEOLOGICAL MAPPING (Geographical Information Systems, Digital Map composition, digitally-assisted fieldwork). – GEOLOGICAL MAPPING – GEOLOGICAL STRUCTURE AND HYDROGEOLOGICAL CONDITIONS. – GEOPHYSICAL INVESTIGATIONS AND GEOLOGICAL STRUCTURE DETERMINATION. – TECHNICAL REPORTS (City planning, technical works, environmental remediation). – NATURAL RESOURCES, PETROLOGICAL DETERMINATIONS AND CHEMICAL ANALYSES DATA. – CLIMATE CRISIS, RES AND ENVIRONMENTAL PROBLEMS. **B. Field course:** 9-DAY FIELD COURSE ANO DOLIANA, ARCADIA, CENTRAL PELOPONNESE (or at MT HYMMETOS, ATTICA), including daily field work and roundup evening discussions and assessment (up to 10 hrs/day); field data evaluation and laboratory analyses.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** / **Student effort** Lectures: 20 hours Practice exercises: 14 hours Fieldwork: 80 hours Tutorials: - hours Essey writing: 15 hours Autonomous study: 10 hours Final assessment preparation: 11 hours **Total student's effort**: **150** hours
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted, either with progressive exams in separate sections of the course content or with the final examination of the entire course material which includes: I. LECTURES (**10%**) • Oral Examination (formative, summative) II. LAB EXERCISES (**10%**)

	• Written exam with Solving Exercises and Problems (formative, summative) II. FIELD EXERCISES (**80%**) • Oral examination in the field and with evaluation of deliverables of required Work or Report (formative, summative) Auxiliary material (questions, exercises, etc.) for the exams is posted on the online **e-Class** platform (https://eclass.uoa.gr/courses/GEOL146/).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- LOZIOS, S., SOUKIS, K. & ANTONIOU, V., 2015, **Geological Mapping and Field Exercises**, Academic textbooks (Kallipos), Hellenic Academic Libraries, 280 p. (**e-book:** PDF, e-pub, in Greek)[EUDOXUS code: 320091].

II. ADDITIONAL READING

- BENNISON, M., G., OLVER, A., P. & MOSELEY, A., K., C., 2011, **Introduction to Geological Structures and Maps**, 168p., Routlege.
- COE, L. A. (editor), ARGLES, W. T., ROTHERY, A. D., SPICER, A. R., 2010, **Geological Field Techniques**, 323p., Wiley-Blackwell.
- FRY, N., 1997, **The Field Description of Metamorphic Rocks**, 128p., John Wiley & Sons.
- JERAM, D. & PETFORD, N., 2011, The Field Description of Igneous Rocks (Geological Field Guide), 238p., Wiley-Blackwell.
- LISLE, J. R., BRABHAM, P., BARNES, J., 2011, **Basic Geological Mapping**, 217p., Wiley-Blackwell.
- Mc CLAY, K., 1991, **The Mapping of Geological Structures**, 168p., Wiley-Blackwell.
- TRANOS, M., 2011, Geological Mapping – Geological Maps and Geological Cross-Sections, 306 p., University Studio Press. (In Greek)
- TUCKER, E. M., 2011, Sedimentary Rocks in the Field: A Practical Guide (Geological Field Guide), 275p., Wiley-Blackwell.

III. RELATIVE JOURNALS

- Journal of Maps, Online ISSN: 1744-5647, Taylor & Francis Group.

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y6205**	**SEMESTER**	**6th**
TITLE	**GEOLOGY OF MAGMATIC AND HYDROTHERMAL ORE DEPOSITS**		

TEACHING ACTIVITIES	HOURS/WEEK	ECTS
Lectures, Lab Exercises and Fieldwork	**4**	**6**

TYPE OF COURSE	**MANDATORY /** Scientific Area
PREREQUISITES	[recommended] **Y2201** Introduction to Geology **Y2202** Systematic Mineralogy - Mineral Identification **Y3201** Igneous Rocks-Magmatic Processes **Y3202** Petrology Of Sedimentary Rocks **Y4201** Petrology of Metamorphic Rocks **Y4203** Geochemistry **Y5202** Stratigraphy
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL543

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
By the end of the course, the student will be able: • To **define** the fundamental concepts of the occurrence of non-exploitable mineralization and the exploitable deposit, and the classification criteria into deposit types. • To **describe** the most important magmatic and hydrothermal deposits worldwide and in Greece. • To **apply** the principles of General Geology, Mineralogy, Petrology, and Geochemistry to understand the space-time distribution in the crust, and the genetic processes and mechanisms for "Magmatic", "Magmatic-Hydrothermal" and "Hydrothermal" deposit types (MAGM/HYDRO). • To **collect, interpret** and **evaluate** macroscopic and microscopic characteristics of samples.

- To **select** and **apply** the appropriate laboratory methods for the solution of deposit-related problems, and the formulation of genetic models, of magm/hydro deposits.
- To **combine** and **evaluate** the mineralization data for decision-making regarding the exploration and exploitation of mineral raw materials, taking in account the protection of the environment and the sustainable development.

In addition:

- **Realize** the importance and impact of the exploitation of mineral resources to the society, economic growth and sustainability.

Generic Competences

- Ability to search for, process and analyse information with the use of necessary technologies
- Autonomous work
- Oral and written communication of scientific issues
- Ability to apply knowledge in practical situations
- Ability to undertake research at an appropriate level
- Promote free, creative and inductive thinking
- Commitment to conservation of the environment

(3) COURSE CONTENT

A. Lectures.

Lectures are divided in three thematic entities:

- **Non-economic mineralization, and economic ore deposits.** Definition of Reserves and Classification systems. Importance of ore deposits in the world economic and cultural evolution, and mineral industry in everyday life and modern technologies. Legal distinction of types of deposits based on Greek legislation. Geologic and geotectonic environment of ore deposits formation and their distribution in the earth's crust. Genetic models, value chains and stages of mineral exploration programs for ore deposits.
- **"Magmatic Ore deposits" - Genetic Models.**
  Fundamental petrologic and geochemical formation processes of magmatic ore deposits. Chromite ore deposits. Ni–Cu sulphide deposits in basic and ultrabasic rocks. Platinum group metal (PGM) ore deposits. Magmatic and hydrothermal rare earth element (REE) ore deposits. Ore deposits of hydrothermal magnesite in ultrabasic rocks.
- **"Magmatic-Hydrothermal" and "Hydrothermal Ore Deposits" - Genetic Models.**
  Fundamental hydrothermal processes. Genesis of Magmatic-hydrothermal and Hydrothermal ore deposits formed around igneous centres: Skarn-type and carbonate-replacement ores. Porphyry-Cu systems and porphyry-type Cu-Au-Mo ores. High sulfidation and low-sulfidation, epithermal Cu-Au–Ag, and Au–Ag, ore deposits. Genesis of ore deposits on the seafloor: Fundamental principles of hydrothermal seafloor metallogeny.

B. Lab exercises:

A: Metallographic microscopy of sulphide minerals.
B: Macroscopic study, identification and description of hand specimens from magmatic and hydrothermal ores.
C: Combined exercises of macroscopic and microscopic investigation of ores and host-rocks.
D: Correlation between geologic, mineralogical, petrological and geochemical features of magm/hydro deposit types, and their host-rocks.

C. Fieldwork

One-day exercise in the field: (1) Skarn-type metal-sulphide and Fe-oxide mineralization, Porphyry-type Mo mineralization, carbonate-replacement Pb-Zn-Ag ore deposits in the Lavrion area. Identification and analysis of Metallogenic Characteristics (MC), i.e., lithologic, tectonic, morphologic, mineralogic characteristics, ores, gangue minerals. Written Report on the detailed description of the MC, and formulation of the genetic model of the ores in the visited area, with the aid of data from the literature.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	see table below
ASSESSMENT METHODS AND CRITERIA	see text below

PLANNED LEARNING ACTIVITIES

Activity	Student effort
Lectures	24 hours
Practice exercises	24 hours
Fieldwork	12 hours
Tutorials	–
Essey writing	–
Autonomous study	48 hours
Final assessment preparation	42 hours
Total student's effort	**150** hours

ASSESSMENT METHODS AND CRITERIA

I. LECTURES, LABORATORY & FIELD EXERCISES (**60%**) (Summative)

- **Oral Examination of the Syllabus and Practical Examination of Hand Specimens**

  A variety of evaluation techniques are used:

  - **Questions covering the entire curriculum:** The achievement or not of the learning objectives and especially the effort made by the student to achieve them is evaluated
  - **Judgement questions**: The ability of students to think, organize, connect knowledge and express themselves in their own words is evaluated, always using the appropriate scientific terminology.
  - **True or false**: To increase the credibility of this type of question, students are asked to explain and justify their answer. Supporting material (questions, exercises, etc.) for the exams is posted on the electronic platform e-Class (https://eclass.uoa.gr/courses/GEOL543/).

Possible questions or topics for oral examination are analyzed in detail to students during lectures, laboratory exercises or outdoor exercises.

Auxiliary material for the examinations is posted on the electronic platform e-Class

(https://eclass.uoa.gr/courses/GEOL543/).

II. LAB EXERCISES (**20%**) (Formative, Summative)

- Short written examination at the end of each laboratory module (10%).
- Elaboration of projects based on the material of the Laboratory (10%).

III. FIELD EXERCISES (**20%**) (Summative)

- Evaluation of the field notes and individual field report.

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- F. Pirajno, 2009. **Hydrothermal Processes and Mineral Systems**, [EUDOXUS code: 73241410]
- W. L. Pohl, 2011. **Economic Geology – Principles and Practice,** Willey - Blackwell. [EUDOXUS code: 80504203]
- R. Taylor, 2009. **Ore Textures**, Springer [EUDOXUS code: 73249091, electronic resource PDF]

II. ADDITIONAL READING

- J. Ridley, 2013. **Ore Deposit Geology,** Cambridge University Press
- L. Robb, 2004. **Ore Forming Processes,** Blackwell Publishing
- A. M. Evans, 1995. **Introduction to Mineral Exploration,** Blackwell Science

III. RELATIVE JOURNALS

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

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E5205**	**SEMESTER**	**6th**
TITLE	**SOIL AND ROCK MECHANICS**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Laboratory exercises	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL171

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

Upon successful completion of the course, the student:

- **Acquires knowledge** and **becomes familiar** with the control and testing of the physical and mechanical properties of soils and rocks.
- **Understands** the mechanical behavior of geo-materials at different scales and under different loadings.
- **Applies** the methodologies for calculating the physical and mechanical properties of soils and rocks based on laboratory tests.
- **Applies** the results of laboratory tests in the context of a geotechnical investigation and study of an engineering project.
- **Applies** elements of soil mechanics and rock mechanics to solve basic engineering problems.

Generic Competences

- Ability to apply knowledge in practical situations
- Ability to search for, process and analyse information with the use of necessary technologies
- Ability to undertake research at an appropriate level

• Autonomous work • Ability to work in an interdisciplinary context

(3) COURSE CONTENT

A. Lectures

- PHYSICAL CHARACTERISTICS OF THE SOIL (Origin and nature of soil, Phase diagram, Physical properties of soils, relative density , Particle size analysis, Classification of soils, Compaction)
- STRESS AND STRAIN (Definition of stress and strain, Geostatic stress, Effective stress principle).
- SHEAR STRENGTH OF SOILS (Mohr's circle representation of stresses, Stress –strain relationships at failure, Direct shear test, Triaxial test).
- STRESS-STRAIN RELATIONS OF SOIL MATERIALS (Linear isotropic elasticity, Non-linear stress-strain relations, Compressibility: consolidation settlement, time rate consolidation- consolidation test).
- MECHANICAL BEHAVIOR OF INTACT ROCK (Rock strength, Elastic properties, Uniaxial compression test, Point load strength index, Tensile strength, Shear strength (Mohr-Coulomb and Hoek and Brown failure criterions).
- MECHANICAL BEHAVIOR OF ROCKMASS (Rock mass discontinuities: geometrical and mechanical characteristics and their influence on the behavior of the rock mass, Shear strength of discontinuities).

B. Lab Exercises

PART A': Physical properties of soils
PART B': Stress distribution in soil
PART C': Shear strength of soil
PART D': Compressibility and Consolidation of soil
PART E': Characterization of Rock Mechanical Properties Using Lab Tests

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	see below
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted, either with progressive exams in separate sections of the course content or with the final examination of the entire course material which includes: I. LECTURES (**50%**) • Written Exam with Short Answer Questions and Multiple-Choice Test (summative)

Activity	Student effort
Lectures	26 hours
Practice exercises	13 hours
Fieldwork	- hours
Tutorials	- hours
Essey writing	21 hours
Autonomous study	24 hours
Final assessment preparation	16 hours
Total student's effort	**100** hours

	II. LAB EXERCISES (**50%**) • Weekly assessment of lab exercises (formative, summative) and • Written exam with Exercises and Problems Solving

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Barnes G. 2005. **Soil Mechanics: Principles and Practice**. Publisher Klidarithmos [EUDOXUS code: 33153307], in Greek.

II. ADDITIONAL READING

- Kavvadas M. 2009. **Principles of Soil Mechanics,** in Greek. http://users.ntua.gr/kavvadas/Books/books.htm .
- Hoek E. 2007. P**ractical Rock Engineering** https://www.rocscience.com/learning/hoek-s-corner/books
- Braja M. Das. 2019. **Advanced Soil Mechanics,** Fifth Edition 5th Edition. Publisher CRC Press.

III. RELATIVE JOURNALS

- International Journal of Rock Mechanics and Mining Sciences, Publisher: Elsevier BV
- Rock Mechanics and Rock Engineering, Publisher: Springer
- Géotechnique, Publisher: CE Publishing
- Journal of Geotechnical and Geoenvironmental Engineering, Publisher: American Society of Civil Engineers

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E6201**	**SEMESTER**	**6th**
TITLE	**RENEWABLE ENERGY RESOURCES: SOLAR AND WIND ENERGY - GEOTHERMY**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Laboratory exercises	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	Y1202 Physicsς [recommended] Y2203 Climatology and Climate Changes [recommended]
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL142

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course the student:

- **Defines** and **describes** the different categories of renewable energy resources.
- **Comprehends** the physical processes that determine the production of energy from the various examined sources.
- **Comprehends** the usefulness and contribution of renewable energy resources to the daily energy human needs, protecting the natural environment by reducing the emission of greenhouse gases from the burning of fossil fuels, that are linked to modern climate change.
- **Evaluates** the key parameters used in studies for the correct installation of power plants and **understands** their results.
- **Combines** theoretical and practical knowledge obtained from lectures, laboratory exercises and fieldwork and **answers** environmental issues on all fields of Geology and Geoenvironment.

Generic Competences

- Ability to apply knowledge in practical situations
- Promote free, creative and inductive thinking

• Oral and written communication of scientific issues • Autonomous work • Information and Communication Technology (ICT) skills • Commitment to conservation of the environment

(3) COURSE CONTENT

A. Lectures

The content of the course is structured in the following thematic sections:

a) Basic concepts of Meteorology: Execution and utilization of observations. Basic knowledge in weather map analysis. Introduction to weather forecasting, with emphasis on wind and solar potential.

b) Wind Energy: Forces acting on an air mass to move. Introductory concepts for wind (gradient wind, geostrophic wind, wind characteristics). Wind measurements instruments, advantages and disadvantages of wind energy. Calculation of wind power. Representative types of wind turbines. Power generated by a wind turbine. Territorial suitability for the installation of a wind turbine. Utilization of wind systems in Greece.

c) Solar Energy: Introductory concepts for solar radiation (total, direct and diffuse). Instruments for measuring solar radiation (pyranometers, pyrheliometers). Factors affecting solar radiation. Basics on Photovoltaic Cells. Advantages and disadvantages of solar energy. Solar radiation utilization systems. Utilization of solar systems in Greece.

d) Geothermy: Basic geothermal concepts, as well as the contribution of Applied Geophysics to the research and identification of geothermal fields and includes: Geothermal parameters: Temperature, heat, enthalpy, thermal gradient, thermal flow, thermal properties of rocks. Geothermal energy: Heat sources, geothermal gradient, change of heat release with depth, distribution of geothermal potential areas. Geothermal field: Structure model. Classification of geothermal fields. Surface incidence of geothermal fields: Geothermal fluids, geothermometers. Geothermal research: Research strategy (identification, geological and hydrogeological research), Geochemical research, Geophysical research (methods of detection and localization of geothermal fields), measurements and tests within drillings, temperature and pressure charts. Evaluation of geothermal potential. Exploitation of geothermal fields.

B. Laboratory Exercises:

The laboratory exercises include the education of the students in the following subjects:

- **Exercise 1.** Utilization of wind elements of a region for the installation of wind turbines
- **Exercise 2.** Calculation of wind energy
- **Exercise 3.** Utilization of solar radiation elements
- **Exercise 4.** Calculation of electric energy from solar systems
- **Exercise 5.** Definition of obstacle for the suitability of a wind turbine installation location
- **Exercise 6.** Calculation of the maximum available wind power
- **Exercise 7.** Analysis of solar radiation changes
- **Exercise 8.** Effect of aerosols and clouds on solar radiation
- **Exercise 9.** Geothermal field study
- **Exercise 10.** Classification of geothermal fields

C. Fieldwork

One-day field exercise. Visit to the CRES Demonstration Wind Park. The main objective is to understand the use of wind turbines with different operating principles, in conditions of complex topography, which are the main wind turbine installation sites in Greece.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.

COMMUNICATION TECHNOLOGY	
PLANNED LEARNING ACTIVITIES	**Activity** / **Student effort** Lectures: 27 hours Practice exercises: 12 hours Fieldwork: 8 hours Tutorials: - Essey writing: 24 hours Autonomous study: 21 hours Final assessment preparation: 8 hours **Total student's effort**: **100** hours
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted, either with progressive exams in separate sections of the course content or with the final examination of the entire course material which includes: I. LECTURES (**50%**) Written Exam with Short Answer Questions and Multiple-Choice Test and/or Extended Answer Questions (summative) II. PRACTICE EXERCISES (**50%**) Written Essays for every Practical Exercise and evaluation (formative, summative). Auxiliary material (questions, exercises, etc.) for the exams is posted on the online **e-Class** platform (https://eclass.uoa.gr/courses/GEOL142/).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Λιώκη-Λειβαδά Ηρώ,Ασημακοπούλου Μαργαρίτα, 2008, Αιολική και Άλλες Ανανεώσιμες Πηγές Ενέργειας, Βιομάζα - Γεωθερμία, [Κωδ. ΕΥΔΟΞΟΣ: 45451]
- Γεωθερμία, Φυτίκας Μ., Ανδρίτσος Ν. [Κωδ. ΕΥΔΟΞΟΣ: 122074535]
- Ήπιες Μορφές Ενέργειας, Κανελλοπούλου Ε. [Κωδ. ΕΥΔΟΞΟΣ: 45440]
- Ανανεώσιμες Πηγές Ενέργειας, Μπιτζιώνης Β., Μπιτζιώνης Δ. [Κωδ. ΕΥΔΟΞΟΣ: 45440]

II. ADDITIONAL READING

- Twidell, J., 2022, **Renewable Energy Resources**, Fourth Edition, Routledge, [ISBN: 9780415633581].

III. RELATIVE JOURNALS

- Applied Energy, Online, Elsevier
- Solar Energy, Online Elsevier
- Wind Energy, Online, Wiley
- Wind Energy Science, Online, European Academy of Wind Energy
- Geothermal Energy, Online, Springeropen

Additional Reading Material

- Teachers' notes, presentations of the lectures and exercise material posted on the e-Class platform of the course.

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E6202**	**SEMESTER**	**6TH**
TITLE	**MACROSEISMOLOGY**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises, Fieldwork	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	Although no typical admission requirements, students are expected to have mastered knowledge of Seismology covered by the courses Y3203 Seismology Y5203 Engineering Seismology
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL138

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
It is the only elective course that provides knowledge of seismology and engineering for the characterization, according to international practices, of building seismic damage and vulnerability according to EMS98. The methodologies of macroseismic study of modern and historical earthquakes and inversion of intensity distribution for the calculation of macroseismic parameters are presented in detail. On completion of the course the student will be able to: • Recognize and describe the level of damage or earthquake feeling. • Distinguish and explain the differences between buildings of different vulnerability. • Calculate macroseismic parameters by analyzing macroseismic data. • Quantify descriptions of earthquake effects. • Compose macroseismic intensity distributions. • Estimates and evaluate seismic risk using macroseismic data.

Generic Competences
• Search, analysis and synthesis of data and information, using the necessary technologies • Adaptation to new situations • Autonomous work • Respect for the natural environment • Teamwork • Work in an international environment • Work in an interdisciplinary environment • Ability to apply knowledge to problem solving • Decision making • Promotion of free, creative and inductive thinking

(3) COURSE CONTENT

A. Lectures

- Introduction – historical overview
- Macroseismic effects (on people, objects, constructions, the natural environment)
- Macroseismic intensity - scales
- Collection of macroseismic data - questionnaires
- Evaluation of macroseismic intensity
- Intensity – Acceleration – Earthquake velocity
- Destructive intensity
- Macroseismic intensity attenuation relations - isoseismals
- Historical earthquakes – calibration methods
- Macroseismic intensity distributions
- Determination of macroseismic parameters using the inversion method
- Earthquake catalogs – Databases of macroseismic intensities
- Seismic hazard and macroseismic intensity
- Vulnerability of structures – vulnerability curves
- Seismic risk
- Early warning systems – Seismic crisis management
- Large earthquakes

B. Practical Exercises

- Macroseismic intensity assessment from earthquake effects on people, objects, the natural environment and structures
- Overall assessment of macroseismic intensity of historical and modern earthquakes
- Calculation of macroseismic parameters.
- Vulnerability assessment of buildings.
- Construction of isoseismals
- Calculation of macroseismic epicenter, magnitude and depth of an earthquake

C. Fieldwork

One day field trip at areas recently affected by natural disaster(s) that provides insight to the identification and mapping of natural hazards, vulnerability, risk, and analysis of pre- and post-disaster phases and is followed by the writing of a short essay – report.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.

COMMUNICATION TECHNOLOGY	
PLANNED LEARNING ACTIVITIES	**Activity** / **Student effort** Lectures: 26 hours Practice exercises: 13 hours Fieldwork: - Tutorials: 20 hours Essay writing: 12 hours Autonomous study: 14 hours Final assessment preparation: 15 hours **Total student's effort**: **100** hours
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted in Greek (possibility of examination in English for Erasmus students), as follows: I. LECTURES (**50%**) (formative, summative) • Written Exam with Short Answer Questions and Multiple Choice Test and/or • Written Exam with Extended Answer Questions II. FIELDWORK EXERCISES (**50%**) (formative, summative) • Short essay writing for each exercise and for field work activities In the case of an unsuccessful result (<5), the students have the possibility to repeat the exercises. Auxiliary material (questions, exercises, etc.) for the exams is posted on the online **e-Class** platform (http://eclass.uoa.gr/courses/GEOL138).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL
- Kouskouna V. Macroseismology [EUDOXUS code: 86378564]

II. ADDITIONAL READING

- Kouskouna, V., Chailas, S., Makropoulos, K.C., Michalopoulou, D. & J. Drakopoulos, 1996. Simulation of macroseismic field in Central Greece. ESC XXIV General Assembly, Athens, September 19-24, 133 (abstr.), ext. abs. 1681-1683, 'Annali di Geofisica', XXXIX/5, 1115-1124.
- Kouskouna, V. & N. Malakatas, 2000. Correlation between EMS98 with damage reported of the earthquake of 7th September 1999. Annales Géologiques des Pays Helléniques, XXXVIII/B, 187-196.
- Kouskouna, V. & K. Makropoulos, 2004. Historical earthquake investigations in Greece: a journey through time. Investigating the records of past earthquakes. Annals of Geophysics, 47/2-3, 723-731.
- Kouskouna V. & G. Sakkas, 2013. The University of Athens Hellenic Macroseismic Database (HMDB.UoA): Historical Earthquakes. Journal of Seismology, 17/4, 1253—1280.
- Kouskouna V, Kaperdas V, Sakellariou N (2020). Comparing calibration coefficients constrained from early to recent macroseismic and instrumental earthquake data in Greece and applied to eighteenth century earthquakes. JSeismol https://doi.org/10.1007/s10950-019-09874-7
- Kouskouna, V. Updating the macroseismic intensity database of 19th century damaging earthquakes in Greece: a case study in Samos Island. Acta Geophys. 69, 1101–1111 (2021). https://doi.org/10.1007/s11600-021-00608-3.
- Kouskouna, V., Ganas, A., Kleanthi, M. et al. Evaluation of macroseismic intensity, strong ground motion pattern and fault model of the 19 July 2019 Mw5.1 earthquake west of Athens. J Seismol 25, 747–769 (2021). https://doi.org/10.1007/s10950-021-09990-3.

- Stucchi M., A. Rovida, A.A. Gomez Capera, P. Alexandre, T. Camelbeeck, M.B. Demircioglu, P. Gasperini, V. Kouskouna, R.M.W. Musson, M. Radulian, K. Sesetyan, S. Vilanova, D. Baumont, H. Bungum, D. Fäh, W. Lenhardt, K. Makropoulos, J.M. Martinez Solares, O. Scotti, M. Živčić, P. Albini, J. Batllo, C. Papaioannou, R. Tatevossian, M. Locati, C. Meletti, D. Viganò & D. Giardini, 2013. The SHARE European Earthquake Catalogue (SHEEC) 1000–1899. Journal of Seismology, 17/2, 523-544.

III. RELATIVE JOURNALS
- Bulletin of the Seismological Society of America, SSA Journals
- Geophysical Journal International, Oxford University Press
- Journal of Geophysical Research, AGU Publications
- Physics of the Earth and Planetary Interiors, Journal, Elsevier
- Tectonophysics, Journal, Elsevier

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E6203**	**SEMESTER**	**6th**
TITLE	**COASTAL AND SUBMARINE GEOMORPHOLOGY AND COASTAL ZONE MANAGEMENT**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	https://eclass.uoa.gr/courses/GEOL398/

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

Upon the completion of the course, the student:

- **Understand** the factors contributing to coastal geomorphology.
- **Classify** and **describe** the coasts and coastal landforms.
- **Classify** and **describe** underwater units (ditches, deep basins, straits)
- **Describe** the legal context for Greece regarding the coastal zone (definition of foreshore, coast based on the wave regime and old foreshore)
- **Comprehend** the main concepts of coastal zone management.
- **Apply** DPSIR tools for the management of the coastal zone.
- **Combine** and **evaluate** coastal landforms and coastal morphodynamics to identify erosion causes of the coasts.

Generic Competences

- Ability to apply knowledge in practical situations
- Promote free, creative and inductive thinking
- Ability to search for, process and analyse information with the use of necessary technologies

• Ability to undertake research at an appropriate level • Commitment to conservation of the environment

(3) COURSE CONTENT

– **A. Lectures**
– Factors shaping coastal geomorphology - coastal classification.
– Sea level change and coastal landforms as indicators.
– Coastal hydrodynamic conditions (waves, coastal currents, tidal currents).
– Coastal zones (morphology, hydrodynamics and morphodynamics).
– Coastal terraces
– Coastal dunes (morphology, development)
– River delta
– Lagoons and coastal lakes (formation process, description)
– Coastal cliffs - Marine notches
– Beachrocks
– Underwater relief (landforms, mapping techniques).
– Underwater relief of Greece (in relation to its geodynamic evolution).
– Basic concepts of coastal zone management. Institutional framework (DPSIR Tools)
– Foreshore Law (causes of erosion, protection projects)

B. Practical Exercises:

- Characterization of landforms and their classification. Application along the Antirrio - Eratini coastline
- Development of underwater relief for different sea levels during the Flemish trangression (e.g. 18,000, 10,000, 6,000 years). Application in the Saronic Gulf and/or in the Cyclades
- Granulometry
- Calculation of coastal sediment transport (with calculation of wind waves)
- Coastal terraces, identification, mapping, examples from N. Peloponnese and Rhodes
- Morphological study of the sand dune system of the central Gulf of Kyparissia (calculation of the moving sand amount)
- Delta Classification, based on the wave regime and the fluvial runoff.
- Formation and evolution of the lagoon of Korissia (palaeodunes, modern coastal barrier)
- Formation and evolution of the coastal zone of Agios Georgios - Naxos (palaeodunes, beachrocks, closure of a lagoon, modern tombolo, evolving dune fields)
- Use of data from shallow core sampling for the palaeogeographical evolution of the coastal area. Examples from Samos and Paros.
- Exercise with 3D seabed illustration
- Morphological characterization of underwater units (ditches, deep basins, straits)
- Exercise of coastal vulnerability due to sea level rise
- Development of a coastal erosion model with logical rules
- Definition of the boundaries (foreshore, coast based on the wave regime (based on Greek law) and old foreshore

C. Field Trips

Optional field activities

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.

PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	26 hours
	Practice exercises	13 hours
	Fieldwork	10 hours
	Tutorials	-
	Essay writing	-
	Autonomous study	29 hours
	Final assessment preparation	22 hours
	Total student's effort	**100** hours
ASSESSMENT METHODS AND CRITERIA	I. LECTURES (**50%**) (summative) the grade is based on examination at the end of the semester: • Oral or • Written with questions of short answer and multiple choice or • Written with questions of extended answer II. PRACTICE EXERCISES (**50%**) (summative) The laboratory is evaluated as follows: • **20% through participation in weekly exercises in the classroom and/or the fieldwork** • **30%** in final exams	

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Evelpidou N., 2019. Sea level changes. Da Vinci, Athens (in Greek). ISBN: 9789609732321. (Book website) [Code Eudoxus: 86054068]
- Karymbalis E., 2010. Coastal geomorphology. ION editions, Athens [Code Eudoxus: 122081526]

II. ADDITIONAL READING

- **Finkl, C.W., Makowski, C., 2019. Encyclopedia of Coastal Science. Springer, https://link.springer.com/referencework/10.1007/978-3-319-93806-6**
- **Haslett, S., 2009. Coastal Systems. Routledge, London, New York.**

III. RELATIVE JOURNALS

- Continental Shelf Research
- GeoMarine Letters
- Journal of Coastal Research
- Marine Geology

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E6204**	**SEMESTER**	**6th**
TITLE	**APPLIED GEOMORPHOLOGY – URBAN GEOMORPHOLOGY**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises		**3**	**4**
TYPE OF COURSE	**ELECTIVE /** Scientific Area		
PREREQUISITES	NONE		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL119 https://eclass.gunet.gr/courses/LABGU358/		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
Upon successful completion of the course student will: • **Identify** and **describe** the principles of applied geomorphology in hydrological, coastal zone and land use studies, • **Comprehend**, **distinguish** and **interpret** the effects of urbanization and human interventions on changes in the geomorphological environment, on the alteration of the terrain and their effects on the occurrence of natural hazards such as floods, landslides, subsidence, erosion, • **Calculate** physical parameters for the design technical works such as torrent arrangements, dams, roads, settlements as well as factors affecting manifestation of earth movements, floods, erosion, etc. • **Apply** methods of applied geomorphology in the design of technical projects and in the assessment of geomorphological hazards, • **Collect** and **analyze** literature on topics related to applied geomorphology • **Combine** and **compose** examples of studies that have been done internationally and in Greece, • **Explain**, **collect**, **compare** and **evaluate** data in problem solving such as natural hazard assess-

ment (floods, landslides, falls, subsidence, erosion), human interventions, land uses, selection of settlement location based on geomorphological and environmental characteristics, development, planning and management of urban environments. • **Apply** models for natural hazard assessment, such as floods or coastal erosion.
Generic Competences
• Ability to apply knowledge in practical situations • Ability to search for, process and analyse information with the use of necessary technologies • Oral and written communication of scientific issues • Ability to undertake research at an appropriate level • Commitment to conservation of the environment

(3) COURSE CONTENT

A. Lectures

Lectures include:

- Difference between theoretical and applied geomorphology.
- Applications of geomorphology in hydrological studies and in the coastal zone (surface and groundwater, hydrographic networks, deltaic areas, sea level changes).
- Geomorphology and land uses.
- Urbanization and changes in the geomorphological environment.
- Anthropogenic interventions and landscape alteration.
- Geomorphology and design of technical projects (torrent arrangements, dams, roads, town planning etc.).
- Landslides, effect of landslides in an area (landslide zone mapping, landslide classification: frequency, amplitude).
- G.I.S. and applied geomorphology.
- Examples from Greece.
- Technical and environmental issues of urban areas such surface water management, assessment of natural hazards (floods, landslides, falls, subsidence, erosion), development design and urban management.
- Neocatastrophism in the Mediterranean and tsunami.

B. Practical and laboratory exercises

Laboratory exercises are the continuation and practice based on the course lectures. They include Exercises with maps, satellite images, aerial photographs, as well as calculations, measurements and questionnaires for:

- landslide identification, mud flows,
- flood mapping,
- land use mapping,
- runoff erosion,
- landslide modeling and risk assessment
- flood risk modeling and assessment,
- modeling of runoff erosion,
- selection of dam location and settlement location
- sea level indicators and future coastal hazards
- retreat of coastal cliffs,
- study of palaeo-tsunamis

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND	– Use of ICT in teaching (lectures, lab exercises, fieldwork).

COMMUNICATION TECHNOLOGY	– Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** / **Student effort** Lectures: 26 hours Practice exercises: 13 hours Fieldwork: - Tutorials: - Essey writing: 20 hours Autonomous study: 41 hours Final assessment preparation: - **Total student's effort**: **100** hours
ASSESSMENT METHODS AND CRITERIA	I. LECTURES (**50%**) (summative) • oral presentation of a subject selected through a list II. PRACTICE EXERCISES (**50%**) (formative) • Individual reports of laboratory exercises delivered via e-class

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Evelpidou N., 2019. Sea level changes. Da Vinci, Athens (in Greek). ISBN: 9789609732321. (Book website) [Code Eudoxus: 86054068]
- Karymbalis E., 2010. Coastal geomorphology. ION editions, Athens [Code Eudoxus: 122081526]

II. ADDITIONAL READING

- **Finkl, C.W., Makowski, C., 2019. Encyclopedia of Coastal Science. Springer, https://link.springer.com/referencework/10.1007/978-3-319-93806-6**
- **Haslett, S., 2009. Coastal Systems. Routledge, London, New York.**

III. RELATIVE JOURNALS

- Continental Shelf Research
- GeoMarine Letters
- Journal of Coastal Research
- Marine Geology

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E6205**	**SEMESTER**	**6th**
TITLE	**REMOTE SENSING - PHOTOGEOLOGY - MATHEMATICAL GEOGRAPHY**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Lab Exercises and Fieldwork		**3**	**4**
TYPE OF COURSE	**ELECTIVE /** Scientific Area		
PREREQUISITES	Y2204 GIS and Introduction to Remote Sensing [recommended]		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL126		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course the student:

- **Understands** the mechanisms of the electromagnetic radiation recordings from sensors placed on various platforms (airborne, satellite, etc.)
- **Recognizes** structures and textures in earth surface relief, through observation of remote sensing data on a PC and by using a stereoscope
- **Apply** remote sensing data processing techniques with earth observation tools and digital raster data analysis
- **Composes** and **constructs** digital maps using remote sensing data as a basic cartographic background
- **Interprets** cartographic composites with false color band combinations of remote sensing data
- **Evaluates** the new technologies related to the extraction of geo-information about the surface of the earth, from a distance, either long range (satellite images, aerial photographs) or close range (UAS, laser scanner)

Generic Competences

• Ability to search for, process and analyse information with the use of necessary technologies • Ability to work in a team • Autonomous work • Decision making • Information and Communication Technology (ICT) skills

(3) COURSE CONTENT

A. Lectures

Lectures include:

- Difference between theoretical and applied geomorphology.
- Applications of geomorphology in hydrological studies and in the coastal zone (surface and groundwater, hydrographic networks, deltaic areas, sea level changes).
- Geomorphology and land uses.
- Urbanization and changes in the geomorphological environment.
- Anthropogenic interventions and landscape alteration.
- Geomorphology and design of technical projects (torrent arrangements, dams, roads, town planning etc.).
- Landslides, effect of landslides in an area (landslide zone mapping, landslide classification: frequency, amplitude).
- G.I.S. and applied geomorphology.
- Examples from Greece.
- Technical and environmental issues of urban areas such surface water management, assessment of natural hazards (floods, landslides, falls, subsidence, erosion), development design and urban management.
- Neocatastrophism in the Mediterranean and tsunami.

B. Practical and laboratory exercises

Laboratory exercises are the continuation and practice based on the course lectures. They include Exercises with maps, satellite images, aerial photographs, as well as calculations, measurements and questionnaires for:

- landslide identification, mud flows,
- flood mapping,
- land use mapping,
- runoff erosion,
- landslide modeling and risk assessment
- flood risk modeling and assessment,
- modeling of runoff erosion,
- selection of dam location and settlement location
- sea level indicators and future coastal hazards
- retreat of coastal cliffs,
- study of palaeo-tsunamis

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	26 hours

	Practice exercises 13 hours Fieldwork 6 hours Tutorials - Essey writing 24 hours Autonomous study 23 hours Final assessment preparation 8 hours **Total student's effort** **100** hours
ASSESSMENT METHODS AND CRITERIA	I. Course theory (**60%**) • Multiple choice online exams (Summative) II. Laboratory Exercises (**40%**) • Evaluation of each exercise at the end of the class or after it is sent either digitally (remote sensing) or analog (photogeology) to the teachers (Formative). Supplementary material for the exams (questions, exercises etc.) is posted on **e-Class** platform (**http://eclass.uoa.gr/courses/GEOL126**).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL
- LIU JIAN GUO & MASON PHILIPPA, 2023. Image processing and GIS in Remote Sensing, Ed. DISIGMA / 9786182021576, [EUDOXUS code: 122088888]
- Kartalis K.., & Fidas Ch., 2012. Principles and Applications of Satellite Remote Sensing, Ed. TZIOLA & Sons S.A / 9789604184019, [EUDOXUS code: 22767582]

II. ADDITIONAL READING
- Jensen J., 2015. Environmental Remote Sensing, pp.680.
- Hatzopoulos I., 2020. Geospatial-informational topography, pp.704.
- Parcharidis I., 2016 Principles of Satellite Remote Sensing, [EUDOXUS code: 320339]

III. RELATIVE JOURNALS
- Remote Sensing (ISSN 2072-4292)
- International Journal of Remote Sensing (ISSN: 1366-5901)
- Journal of Applied Remote Sensing (ISSN: 1931-3195)

Additional Reading Material
- Additional bibliographic resources and lecture contents are available to students participating in the course through the relevant course website (e-class).

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E6206**	**SEMESTER**	**6th**
TITLE	**INDUSTRIAL MINERALS**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Lab exercises and Fieldwork		**3**	**4**
TYPE OF COURSE	**ELECTIVE /** Scientific Area		
PREREQUISITES	[recommended] **Y2202** Systematic Mineralogy-Mineral Identification, **Y3202** Petrology Of Sedimentary Rocks, Y3201 Igneous Rocks-Magmatic Processes and Y4203 Geochemistry.		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL288		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
Upon successful completion of the course the student will be able to: • **identify** and **describe** the most common industrial minerals, their properties, applications and the methods for their exploration, characterization and evaluation. • **combine** and apply all the knowledge acquired during his/her studies for the exploration, evaluation and utilization of industrial minerals and rocks. • **combine** knowledge for the synthesis of work plans and decision-making on exploration and exploitation of industrial minerals and rocks, taking in account the protection of the environment and the sustainable development. Furthermore: • the student **will be aware of** the importance of the exploitation and utilization of industrial minerals and rocks to the society, the economic growth and the sustainability.

Generic Competences
• Ability to search for, process and analyse information with the use of necessary technologies • Oral and written communication of scientific issues • Ability to apply knowledge in practical situations • Promote free, creative and inductive thinking • Commitment to conservation of the environment • Information and Communication Technology (ICT) skills

(3) COURSE CONTENT

A. Lectures.

– Commodities & Specialties Industrial minerals and rocks. Genesis of deposits, properties, industrial apllications.

– Methods of sampling, mineral exploration, extraction, and processing.

– Exploitation of industrial minerals and impact on the environment

– White carbonates & talc. Fire retardant materials. Vitreous & zeolite tuffs, diatomites. Fly ash. Phosphorites, industrial clays, ways of creation, enrichment, industrial uses, exploration, and mining. Milos, the island of minerals/description of the main industrial minerals of the island: perlite, bentonite, kaolin, poszolans, diatomites. Evaporites, borates, sulfates, and carbonates of sodium, celestine. Ways of formation, methods of research, industrial uses. Quartzofeldspathic. Garnets-Walllastonite. Specialized building materials.

– Cement and concrete raw materials, Green cement.

– Seafloor mining of industrial minerals.

– New trends in the exploration and exploitation of industrial minerals.

B. Lab Exercises:

- White carbonate rocks of Hymettus area.
- Asbestos, talc, onyx, slates-marbles of Hymettus
- Study of geological maps 1: 50,000 of IGME
- Neogene rocks of the island of Aegina
- Development of lightweight Aggregates (Lightweight Aggregates LWA) for use in lightweight concrete (Lightweight Concrete LWC), soil projects and agricultural applications.
- Enrichment of depleted kaolinite deposits. Perlite-vermiculite swelling.
- Determination of CEC.
- Macroscopic identification & description of industrial minerals & rocks

C. Fieldwork

C1. Fieldtrip in Hymettus Mt: Practice in the identification, assessment, mapping and sampling of Industrial Minerals and Rocks

C2. Fieldtrip in a quarry area or in an area of mining interest for industrial minerals: Practice in the identification, first assessment, mapping and sampling of Industrial Minerals and Rocks

C3. Fieldtrip at the Archaeological site of Eleusis: Practice in the recognition of construction materials in antiquity.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	12 hours

	Practice exercises	24 hours
	Fieldwork	14 hours
	Tutorials	–
	Essey writing	–
	Autonomous study	26 hours
	Final assessment preparation	24 hours
	Total student's effort	**100** hours
ASSESSMENT METHODS AND CRITERIA	The final grade results by a series of tests which include: I. Report and Public Presentation (**50%**) (Summative) • Writing a report in the form of a review on issues related to Industrial Minerals and Rocks and its public presentation before all students attending the course. II. Laboratory exercises (**30%**) (Formative) • Problem solving and writing relevant reports during laboratory exercises III. Active participation in field exercises and reporting (**20%**) (Formative, Summative)	

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Παπούλης Δ, Λαμπροπούλου Π., 2016, **Ορυκτολογία: Συστηματική ταξινόμηση των ορυκτών**, [EUDOXUS code: 77112087]

II. ADDITIONAL READING

- Ciullo A.P., 1996. Industrial minerals and their uses. A Handbook & Formulary. Elsevier, 647 pages
- Ι.Γ.Μ.Ε., 2011. Ελληνικός Ορυκτός Πλούτος – Νέες αναπτυξιακές δυνατότητες για βιώσιμες και παραγωγικές επενδύσεις
- Stamatakis M, 2017: Laboratory booklet for the course “Industrial Minerals and Rocks”, (in Greek).
- Stamatakis M. and Katerinopoulos A., 1995. Applied Mineralogy – Petrology. Industrial minerals and rocks and their uses in Greek
- Τσιραμπίδης Α., 2005. **Ο ορυκτός πλούτος της Ελλάδος**. Εκδόσεις Γιαχουδη Ι.Κ.Ε.

III. RELATIVE JOURNALS

- Industrial Minerals,
- Cement and concrete composites, Elsevier
- Clays and clay minerals, Elsevier
- International Journal of Mineral Processing, Elsevier
- Economic Geology, Society of Economic Geologists (SEG)

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E6209**	**SEMESTER**	**6th**
TITLE	**PETROGENESIS OF IGNEOUS ROCKS AND OPHIOLITIC COMPLEXES**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
		3	**4**
TYPE OF COURSE	**ELECTIVE /** Scientific Area		
PREREQUISITES	NONE		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL222		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
On successful completion of the course the student: • **Comprehens in depth** the processes that govern the formation and evolution of magmas. • **Interprets** phase diagrams and **uses** them to construct hypothetical liquid lines of descent. • **Calculates** simple equations to predict the behaviour of trace elements during partial melting and fractional crystallisation. • **Enlarges** his experience of igneous rock types and ophiolitic rocks, **identifies** them in thin section and **deduces** their tectonic association and mode of origin.
Generic Competences
• Ability to apply knowledge in practical situations • Promote free, creative and inductive thinking • Ability to work in a team • Information and Communication Technology (ICT) skills • Ability to search for, process and analyse information with the use of necessary technologies

(3) COURSE CONTENT

Theory:

- Phase Diagrams in Geology - Study of phase equilibrium in one, two, three and four component diagrams as a function of pressure, temperature and water (use of petrology software).
- Petrogenetic processes in the lithosphere and asthenosphere - Partial melting in the crust and mantle - Mantle heterogeneity - Xenoliths and their relationship to the surrounding volcanic rocks - Methodology for studying xenoliths for petrogenetic inference.
- Formation and evolution of magmas - Classes of magmas and their origin - Magma composition - Magma differentiation, fractional crystallization, contamination, magma mixing.
- Introduction to the relationship between magmatism and global tectonics - igneous rocks of mid-ocean ridges, island and continental arcs, back-arc basins, fault zones, etc.)
- Types and members of ophiolite complexes - Tectonites - Cumulate rocks – Isotropic gabbros - Sheeted dyke complex - Basaltic pillow lavas - Ophiolitic mélange. Nomenclature and classification of rocks that make up ophiolitic complexes based on geochemical criteria - Differences and similarities between ophiolitic sequences of divergent and convergent plate boundary environments.
- Lithospheric plate theory and ophiolites - Earliest historical milestones in the development of ideas about the formation and emplacement of ophiolitic complexes - Modern definition of an ophiolitic complex - Current theories of lithospheric plate behaviour and their relationship to ophiolite complexes - Mechanisms controlling ophiolite emplacement - Magmatic processes in back-arc and fore-arc environments.
- Description of the main petrogenetic processes for the formation of ophiolite complexes – Mantle source composition - Formation of primary basaltic magma - Primary magma - Differentiation processes - Geotectonic environment of formation - Petrogenetic modelling (Estimation of degree of partial melting for the creation of primary magma using geochemical data and use of modern petrogenetic methods) - Estimation of physico-chemical conditions (examples of geothermal barometry, ways of calculating oxygen fugacity) - The importance of the presence of primary amphiboles - Conditions of metamorphism and metasomatism of the ocean floor - Phenomena of hydrothermal alteration, rodingitization and carbonation - The role of water and CO2 in metasomatic processes - Serpentinization in subduction zones, relation to volcanism and metasomatism.
- Processing of geochemical models and use of mineral chemical data to determine the geotectonic environment of ophiolite formation - Interpretation of normalized rare earth diagrams and multi-element diagrams - Use of geochemical diagrams for geotectonic classification - Determination of the geotectonic environment using mineral chemical data - Isotopic data as tools for determining the geotectonic environment.
- Description of the main Greek ophiolitic bodies - Examples from the ophiolites of Vourinos, Pindos, Koziakas, Othrys, Euboea, Gevgeli, Halkidiki, Soufli, Samothrace, Lesvos, Cyclades and Crete - Distinguishing the Greek ophiolitic deposits on the basis of their geotectonic environment of formation.
- Reference to typical occurrences of ophiolite complexes in the world - Examples from the Troodos (Cyprus), Mirdita (Albania), Semail (Oman), Liguria (Italy), Western Alps, Nicoya (Costa Rica), Teitao (Chile), Smartville (California, U.S.A.), Smartville (California, U.S.A. (California, USA), Betts Cove (Canada), Zambales (Philippines) - Classification based on their formation environment.

Mineralization in ophiolitic rocks

- Mineralization of PGE group.
- Fe-Cu-Ni-Co sulphide deposits
- Podiform chrome deposits - their relationship to the geotectonic environment of genesis, nickel laterite deposits, talc-magnesite deposits, zinc and tin deposits and their relationship to ocean floor hydrothermal veins.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.

USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	See the activity table below
ASSESSMENT METHODS AND CRITERIA	• Written examination (**80%**) (summative) • Development/examination of the topic of the individual project (**20%**) (formative)

Activity	Student effort
Lectures	26 hours
Practice exercises	13 hours
Fieldwork	8 hours
Tutorials	
Essey writing	
Autonomous study	33 hours
Final assessment preparation	20 hours
Total student's effort	**100** hours

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Igneous and Metamorphic Petrology (Myron G. Best – 2002)
- Μαγματικά Πετρώματα (Κοκκινάκης Ανδρέας , Πανεπιστημιακές Σημειώσεις – 2002)
- Ophiolite Concept and the Evolution of Geological Thought (Yildirim Dilek, Sally Newcomb – 2003– GSA Special Paper 373)
- Ophiolites, Arcs, and Batholiths (James Earl Wright, John W. Shervais – 2008 – GSA Special Paper 438)
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III. RELATIVE JOURNALS

- Lithos (Elsevier)
- Journal of Petrology (Oxford University Press)
- European Journal of Mineralogy,
- Contributions to Mineralogy and Petrology (Springer Link)

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E6210**	**SEMESTER**	**6th**
TITLE	**MICROTECTONICS AND STRUCTURAL ANALYSIS**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Lab Exercises and Fieldwork	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL143 http://opencourses.uoa.gr/courses/GEOL102/

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

It is a specialized course that deals with the study, analysis, and interpretation of tectonic structures and deformation at the small scale of observation, i.e., from the scale of a few meters (layer/fracture level), to the microscopic scale (mineral or mineral assemblage level). The main field of Microtectonics focuses on studying thin sections under the microscope, which are also an essential source of information.

Upon successful completion of the course, the student is able to:

- Understand, describe, and analyze the concepts of flow and deformation, the deformation mechanisms at the microscopic scale (level of mineral or aggregates of minerals and crystal lattice, and the relationship between deformation and metamorphism.
- Recognize, describe, and analyze the primary and secondary foliations and lineations,
- Recognize, describe, and analyze the particular types of rocks microstructures and kinematic indicators associated with faults, fault zones and shear zones in the lithosphere.
- Recognize, analyze and classify microstructures such as porphyroblasts, veins, pressure shadows, pressure fringes, and boudins.
- Process and and combine the data and define the geometric, dynamic kinematic, and temporal

analysis of deformation.
Generic Competences
• Ability to apply knowledge in practical situations • Ability to search for, process and analyze information with the use of necessary technologies • Oral and written communication of scientific issues • Ability to undertake research at an appropriate level • Autonomous work

(3) COURSE CONTENT

A. Lectures

- **Basic concepts and methods**. The working framework of Microtectonics.
- **Flow and deformation**. Brittle, plastic and ductile deformation. Stress and strain.
- **Deformation mechanisms**. Pressure solution, Grain Boundary sliding Subgrain rotation, Grain Boundary migration.
- **Foliations**. Primary and secondary foliations observed in rocks. Bedding, Cleavage, Schistocity, Gneissic foliation.
- **Lineations**. Stretcing, intersection and crenulation lineation
- **Fault Rocks**. Classification of fault rocks based on descriptive criteria. Cataclasites, Mylonites, Gneisses
- **Shear zones**. Definition, Geometry and kinematics of shear zones.
- **Structures in dilation sites**. Porphyroblasts Veins, pressure shadows, pressure fringes, boudins.
- **Sampling** How to sample rock specimens and construct thin sections for a microscopic scale study.

B. Laboratory Exercises

Part I - Identification, description and analysis of structures from petrological samples of various types of deformed rocks (2 weeks).

Part B - Identifying, describing and analyzing microstructures from thin sections under the microscope. Deformation phases and metamorphic events (9-10 weeks)

Part C - Exercises with tectonic maps. Microstructures and structural analysis (1-2 weeks)

C. Field (Outdoor) Exercises

ONE DAY FIELD EXCERCISES: Identification, description and analysis of microstructures and elements of tectonic fabric in the countryside. Taking and processing measurements of structural elements. Taking oriented samples to construct thin sections and study them under the microscope. Construction of geological - tectonic map.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	13 hours
	Practice exercises	26 hours
	Fieldwork	10 hours
	Tutorials	- hours
	Essey writing	15 hours
	Autonomous study	16 hours

	Final assessment preparation	20 hours
	Total student's effort	**100** hours

ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted either with progressive exams in separate sections of the course content or with the final examination of the entire course material, which includes: I. LECTURES (**50%**) (formative, summative) • Oral Examination and/or • Written Exam with Short Answer Questions and Multiple Choice Test and/or • Written Exam with Extended Answer Questions II. LABORATORY EXERCISES (**40%**) (formative, summative) • Written exam with Solving Exercises and Problems(summative) III. FIELD EXERCISES (**15%**) (formative, summative) • Oral examination in the field and with evaluation of required Report or Essay The evaluation criteria of the course and the participation rates are described in the Chapter «**Error! Reference source not found.**» of this syllabus and student handbook. Additional material (questions, exercises, etc.) for the exams is posted on the online e-Class platform (https://eclass.uoa.gr/courses/GEOL143/).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- LOZIOS S and SOUKIS K., 2014. Introduction to Microtectonics, 158 pp (In Greek).
- N.J. Price & J.W. Cosgrove. Analysis of Geological Structures. Cambridge University Press, 1994.
- S. Sengupta. Evolution of Geological Structures in Micro- to Macro-scales. Chapman & Hall. 1997.
- T. Blenkinsop. Deformation Microstructures and Mechanisms in Mineral and Rocks. Kluwer Academic Publishers 2000.
- R. H. Vernon. A practical guide to Rock Microstructure. Cambridge Univ. Press. 2004.
- C.W. Passchier & R.A.J. Trouw. Microtectonics. Springer-Verlag Berlin Heidelberg 2005.
- G. H. Davis & S. J. Reynolds. Structural Geology of Rocks and Regions. John Wiley 7 Sons, Inc. 2012.
- H. Fossen. Structural Geology. Cambridge Univ. Press. 2016.

III. RELATED JOURNALS

- Journal of Structural Geology, Online ISSN: 1873-1201, Print ISSN: 0191-8141, Elsevier.
- Tectonics, Online ISSN:1944-9194, Print ISSN:0278-7407, AGU Publications.

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E6213**	**SEMESTER**	**6th**
TITLE	**ANALYTICAL AND ISOTOPIC GEOCHEMISTRY**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises, Laboratory exercises, Fieldwork	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	Y1203 Chemistry [recommended] Y4203 Geochemistry [recommended]
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL104 http://opencourses.uoa.gr/courses/GEOL103/

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
On completion of the course the student should have the following learning outcomes defined in terms of knowledge, skills and general competence: • Apply the basic knowledge of analytical chemistry methods to the analysis of geological samples. • Implements a rock, soil and water sampling plan and can select appropriate chemical analysis techniques on a case-by-case basis. • Analyses the results of experiments and applies quality control principles to his/her work • Selects the appropriate spectroscopic technique for on-site analysis in geological research and analyses spectral data • Selects the appropriate dating method according to the geological problem and calculates the age of rocks and minerals • uses isotopic ratios of stable and radioactive isotopes as tools for understanding the origin of hydrothermal fluids, magmas and hydrothermal alteration conditions of mineralised rocks
Generic Competences
• Ability to apply knowledge in practical situations

- Promote free, creative and inductive thinking
- Ability to work in a team
- Ability to search for, process and analyse information with the use of necessary technologies
- Communication (written or oral) of scientific issues
- Oral and written communication of scientific issues

(3) COURSE CONTENT

A. Lectures.

Methods and Techniques for the Analysis of Geochemical Samples

- Sampling methods for geochemical surveys
- Introduction to spectrometric techniques; solution analysis (AAS, ICP-AES, NAA, ICP-MS).
- The analytical procedure - Geochemical measurement systems
- Quality assurance and calibration methods.
- Quality control of sampling and chemical analysis steps
- Spectrometric techniques for the analysis of solid samples (XRF, XRD)
- Modern portable spectroscopic techniques for on-site analysis (pXRF, pLIBS, pRAMAN, pWNIR-SWIR)
- Mass spectrometry (TIMS, SIMS)

2. Principles and applications of Isotopic Geochemistry

- Geochronology - Radioactive isotopes (Rb-Sr, Sm-Nd, Lu-Hf, U-Pb decay series)
- Applications of isotope ratios in tracing the origin of magmas and hydrothermal fluids
- Common stable isotopes (O, C, H, S) - Isotope fractionation in geological processes
- Applications of stable isotopes in ore geology
- Applications of stable isotopes in paleothermometry

B. Practice and Laboratory Exercises

- Full hands-on practice in the sampling and analysis of geochemical samples in the chemical laboratory, followed by interpretation of the results and report writing.
- Practical exercises are done as part of each course and are graded at the end of the course. In addition, students hand in two assignments in order to make a final assessment of their performance.
- 1st Assignment. Evaluation of Environmental Geochemistry statistical data - The importance of sampling.
- 2nd Assignment. Applications of radioactive and stable isotope systems in the petrogenesis of igneous rocks and metallogenesis.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** / **Student effort** Lectures: 26 hours Practice exercises: 13 hours Fieldwork: - Tutorials: - Essey writing: 30 hours Autonomous study: 31 hours

	Final assessment preparation - **Total student's effort** **100** hours
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted in Greek (there is the pos-sibility of examination in English for Erasmus students). The final grade of the course is formed by a series of tests that include: I. ASSIGNMENTS FOR THE COURSE EXAM (**75%**) • Completion of two assignments corresponding to the two teaching parts of the course • II. PRACTICAL EXERCISES (**25%**) • Grading of each exercise at the end of the class (formative, deductive). • Supporting material (questions, exercises, etc.) for the exam is posted on the e-class platform

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- K.C. MISRA. Introduction to Geochemistry (translated in Greek), Scientific Editing by A. Argyraki and C. Stouraiti, PEDIO Publishing, p. 576 [Code no. "EUDOXUS": 68406899].
- D.C. Harris, C.A. Lucy. Analytical Chemistry, Broken Hill Publishers (translated in Greek) Scientific editing of the Greek edition: A. Anthemidis, G. Zacahariadis, Ch. Kokkinos, A. Oikonomou, M. Prodromidis, K. Stalikas, M. Fousaki, N. Chaniotakis, Th. Christopoulos. p. 1104., [Code no. "EUDOXUS": 94644882].

II. ADDITIONAL READING

- Gill, G. Modern Analytical Geochemistry. 1997. Taylor and Francis, p. 317.
- Geiger, C. An introduction to spectroscopic methods in the mineral sciences and geochemistry, EMU Notes in Mineralogy, Vol. 6 (2004), Chapter 1, 1–42, https://doi.10.1180/EMU-notes.6.1
- Eby, G. N. Αρχές Περιβαλλοντικής Γεωχημείας (Μετάφραση Λιοδάκης, Δ. Πεντάρη) Εκδόσεις Κωσταράκη, Αθήνα. 2011 [Κωδ. ΕΥΔΟΞΟΣ: 77115198]
- Α. Αργυράκη (2013) Σημειώσεις Αναλυτικής Γεωχημείας, ΕΚΠΑ Αθήνα.
- Allégre, C. J. Isotope Geology. Cambridge University Press, 2008, 1st edition, 512 p.
- Leary, E. P., Crocombe, R. A., Kammrath, B. W. (2021). Introduction to Portable Spectroscopy. Portable Spectroscopy and Spectrometry, –. doi:10.1002/9781119636489. chapter 1

III. RELATIVE JOURNALS

- Applied Geochemistry, Elsevier
- Geochemistry, Exploration, Environment, Analysis, Geosciences World
- Geostandards and Geoanalytical Research, Wiley
- Chemical Geology, Elsevier

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E6214**	**SEMESTER**	**6th**
TITLE	**PETROGENESIS OF SEDIMENTARY ROCKS**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises, Laboratory exercises		**3**	**4**
TYPE OF COURSE	**ELECTIVE /** Scientific Area		
PREREQUISITES	Y2202 Systematic Mineralogy-Mineral Identification [recommended] Y3202 Petrology Of Sedimentary Rocks [recommended]		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL229		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
On successful completion of the course the student: • **Uses** and **applies** the methodology of petrographic analysis in the study of sedimentary rocks. • **Becomes familiar** with specialized techniques used in laboratory research of sedimentary rocks (staining, impregnation, point-counting, mineral separation, etc.) • **Discriminates** on a microscopic scale, and record the primary and authigenic components, textures, structures and particular petrological characteristics of the main types of sedimentary rocks. • **Classifies** and **determines** the main petrological types/ lithotypes by petrographic and chemical methods. • **Applies** the petrofacies/microfacies analysis to the recognition and interpretation of sedimentary depositional processes and environments. • **Recognizes** and **describes** diagenetic products and interpret their diagenetic mechanisms and environments. • **Constructs** paragenetic sequences and describes the evolution of porosity of siliciclastic and car-

bonate rocks.

- **Combines** the depositional and diagenetic characteristics with geochemical data to conduct petrogenetic conclusions of sedimentary rocks.
- **Comprehends** and **evaluates** the role of sedimentary rocks in the study of the paleoenvironments of the Earth's surface, in the research and exploitation of fossil fuels (especially of hydrocarbons) but also in their use in a wide range of chemical and industrial applications.

Generic Competences

- Ability to search for, process and analyse information with the use of necessary technologies.
- Autonomous work.
- Ability to apply knowledge in practical situations.
- Work in a team.
- Promote free, creative, and inductive thinking.
- Ability to plan and manage time.
- Information and Communication Technology (ICT) skills.

(3) COURSE CONTENT

The course is a basic and essential complement to the knowledge of sedimentary petrology, with further deepening in the types and nature of physicochemical and biological processes that are responsible for the formation of sedimentary rocks, as well as the composition of surface-subsurface fluids in which the diagenetic alterations take place, after the deposition, during burial, until final uplift of the rocks. At the same time, it plays a crucial role in the design of a study in the research and exploitation of energy- and mineral resources -which sedimentary rocks themselves may constitute or even host- but also in their various industrial uses and applications.

A. Lectures

- Sedimentary rock-forming minerals (chemistry, physicochemical and optical properties, forms and occurrence).
- Depositional (primary) and diagenetic (secondary) textures and features of sedimentary rocks.
- Diagenetic realms – stages and processes.
- Types and composition of diagenetic fluids and modifications of pore fluids. Solubility and stability fields of the main authigenic minerals.
- Diagenetic sequences – paragenesis (order of diagenetic events in time).
- Evolution of porosity (types, origin, and diagenetic modifications)
- External factors controlling deposition and diagenesis (tectonic setting, climate, sea level changes).
- Petro- / microfacies analysis and depositional environments.
- Depositional and diagenetic models of siliciclastic rocks.
- Methods of study for provenance and tectonic setting of the detrital components of coarse siliciclastic rocks with emphasis on their heavy mineral content.
- Crystal structure, composition, origin, diagenesis, paleoclimatic and economic importance of clay minerals.
- Black shales (formation, distribution, paleogeographical and economic importance).
- Origin, depositional and diagenetic processes, and tectonic settings of volcaniclastic deposits.
- Depositional and diagenetic models of limestones.
- Dynamics of carbonate depositional systems and tectonic settings of carbonate platforms.
- Petrogenesis of dolomites (dolomitization processes, conditions, and models).
- Evaporites (primary and secondary evaporites, mechanisms, and genetic models).
- Cherts (origin of the source, and diagenesis of SiO_2, conditions and depositional environments of bedded cherts)
- Phosphorites (Textural/petrographic classification – conditions, processes, and environments of their formation).
- Occurrence, genetic characteristics and tectonic settings of the most widespread sedimentary

rocks and formations of Greece.

B. Practical and Laboratory Exercises:

Part A: Optical properties and distinctive characters of sedimentary rock-forming minerals. Methodology of petrographic analysis and basic principles of other laboratory methods and techniques.

Part B: Petrographic study of sedimentary constituents (grains/crystals, matrix, cements, authigenic minerals). Depositional textural features and structures. Diagenetic processes (cementation, dissolution, replacement, compaction, recrystallization, transformation, etc.) and their products. Classification, types and modifications (creation-destruction) of porosity.

Part C: Petrographic classifications and nomenclature (determination of lithotypes, and petrofacies/microfacies).

Part D: Geochemical criteria for origin, deposition and diagenesis of sedimentary rocks.

Part E: Application of petro-/microfacies analysis to the interpretation of mechanisms and environments of deposition and diagenesis. Interpretation of the nature and order of diagenetic events (diagenetic history). Depositional and diagenetic patterns.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	See table below
ASSESSMENT METHODS AND CRITERIA	**I. LECTURES** (40%) • Oral final examination (summative). or • Written examination with **short answer questions and multiple choice tests (**summative**).** **II. PRACTICE EXERCISES** (60%) • Written examination through microscopic study of selected thin sections of sedimentary rocks (summative). or • Oral examination of essays on topics given in the laboratory exercises (formative, summative). Supplementary material (tables, exercises, guides, etc.) for the exams of the course is posted on **e-Class** platform • (https://eclass.uoa.gr/courses/GEOL229/).

PLANNED LEARNING ACTIVITIES:

Activity	Student effort
Lectures	21 hours
Practice exercises	18 hours
Fieldwork	-
Tutorials	-
Essey writing	11 hours
Autonomous study	20 hours
Final assessment preparation	30 hours
Total student's effort	**100** hours

(5) RECOMMENDED READING

I. ADDITIONAL READING

- M. Kati, **Petrogenesis of Sedimentary Rocks** (Course text, in Greek).
- Burley, S.D. & Worden, R.H., 2003, **Sandstone diagenesis: Recent and Ancient,** IAS Reprint Series Vol. 4, Blackwell, 649 p.
- Flügel, E., 2004, Microfacies of Carbonate Rocks: Analysis, Interpretation and Applications, Springer, 976 p.
- Moore, C.H. & Wade, W.J., 2013, Carbonate Reservoirs - Porosity and Diagenesis in a Sequence Stratigraphic Framework, Elsevier, 374 p.
- Scholle, P.A. & Ulmer-Scholle, D.S., 2003, **A Color Guide to the Petrography of Carbonate Rocks,** AAPG Memoir 77, 474 p.
- Ulmer-Scholle, D.S., Scholle, P.A., Schieber J. & Raine R., 2014, **A Color Guide to the Petrography of Sandstones, Siltstones, Shales and Associated Rocks,** AAPG Memoir 109, 526 p.

II. RELATIVE JOURNALS

- Journal of Sedimentary Research, Online ISSN: 1938-3681, Print ISSN: 1527-1404, SEPM.
- Sedimentary Geology, Online ISSN: 1879-0968, Print ISSN: 0037-0738, Elsevier.
- Sedimentology (IAS), Online ISSN: 1365-3091, Print ISSN: 0037-0746, IAS, Wiley.
- American Association of Petroleum Geologists Bulletin, Online ISSN: 1558-9153, Print ISSN: 0149-1423, AAPG.

COURSE UNITS: 7th Semester

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**			
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**			
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**			
CODE	**Y7201**	**SEMESTER**	**7th**	
TITLE	**ENVIRONMENTAL GEOLOGY**			
TEACHING ACTIVITIES			**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises, Fieldwork			**4**	**6**
TYPE OF COURSE	**MANDATORY /** Scientific Area			
PREREQUISITES	[recommended] Y2201 Introduction to Geology Y6203 Geological Mapping - Field Course			
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English			
AVAILABILITY TO ERASMUS STUDENTS	YES			
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL132			

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
The course covers the basic principles of environmental geology and its applications to solve important environmental problems of the planet. On completion of the course the student will have the following learning outcomes defined in terms of knowledge and skills: • **distinguish** the philosophical, theoretical, and practical approaches for the subject of Environmental Geology, • can **recognize**, **describe**, **identify** and **classify** the geo- as well as the anthropogenic environment, • **summarize** basic principles of environmental law and international environmental policies. • can **collect**, **compare**, **combine**, **apply**, **synthesize** and **evaluate** the data required for the various environmental issues, and **use** the necessary technologies, • can **combine** data, **evaluate** and **communicate** possible solutions to environmental problems, • **understand** the multi-thematic dimension of the subject. • **identify** and **resolve** problems in real time in areas of high environmental
Generic Competences
• Ability to search for, process and analyse information with the use of necessary technologies • Autonomous work • Ability to apply knowledge in practical situations

- Decision making
- Promote free, creative and inductive thinking
- Commitment to conservation of the environment
- Information and Communication Technology (ICT) skills

(3) COURSE CONTENT

A. Lectures

Philosophical Principles/Fundamental Concepts about the Environment: Environmental ethics - economic and political systems - aesthetic preference and judgment - impact of religion - the earth as a closed system – earth's limited resources - intensity and frequency of natural processes - natural disasters - land use and water resources planning - importance of geosciences

Institutional framework - Environmental management / licensing (authorisation): Institutional / Legislative framework - Waste management institutional framework - Water institutional framework - Atmospheric pollution - Natural Environment protection - Environmental licensing of infrastructure projects.

Disposal – Waste management: Waste management - hazardous chemical waste management - radioactive waste management - ocean disposal.

Assessment of natural environment - Land Uses: Land use planning - geoenvironmental mapping - emergency response planning - environmental impact study - zoning - landscape aesthetics.

Energy and the environment: Lignite - oil and natural gas - non-renewable fuels - nuclear energy - geothermal energy - renewable energy sources - energy and water requirements – hydrogen.

Water resources management: History of water management - Sustainable development and introduction to water resources management - Water pollution and monitoring - Water resources protection.

Impact of Disasters on the Environment: Introduction to the theory of Disaster Management: Basic Terminology, Hazard, Vulnerability, Risk, the Cycle of Disaster Management, Disaster Classification - Manmade disasters and environmental impact: Environmental Impact of human activity, environmental impact of manmade disasters (Technological disasters etc) - Natural disasters and environmental impact: Geological disasters, Hydrometeorological disasters, Biological threats, NaTech - Emergency management and Environmental Impact Assessment.

Soil pollution: Soil as a natural resource – soil loss – soil contamination by potentially toxic elements – natural and anthropogenic sources of elements

Water system pollution: Water pollution – point and diffuse sources of pollution – anthropogenic sources of pollution – water pollutants – acid drainage – eutrophication – water salinization - hexavalent chromium.

Air pollution: Structure and composition of atmosphere – air pollutants and classification – particulate matter – sources of aerosols – SO_2 – NO_x – Chemistry of rainwater – acid rain - photochemical smog – greenhouse gases.

Environmental Risk Assessment: Methodology – Risk characterization – Human health risk assessment - Consequence of pollutants on human health.

B. Practical Exercises

- Environmental quality of water systems
- Environmental soil quality
- Air pollution
- Human health risk assessment
- Tracing the origin of open water pollution in the Evrotas river
- Impact distribution in Vrisa Lesvos from the earthquake of 12-6-2017
- Simulation of an industrial accident in Bhopal
- Risk assessment - Environmental rehabilitation of Uncontrolled Waste Disposal Areas
- Zonation of Sanitary Burial Areas
- Energy and Climate Change
- Environmental Permission: Mining Drilling Case

C. Fieldwork

- Identification of geographical, geological, climatic, hydrological and hydrogeological characteristics of the area, identification of land uses, approximation of water-irrigation needs.
- Overview of environmental pressures on the atmosphere, soil, and water element as well as identification of natural and man-made hazards.
- Group work with the aim of collecting rural data through the recording of the flood risk in a riverbed with anthropogenic interventions. Development of dynamic discussion among groups.
- Visit to waste disposal and wastewater treatment sites to determine environmental pressures.
- Evaluation of the knowledge acquired through a questionnaire on the e-class platform.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	See table below
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted in Greek (there is the possibility of examination in English for Erasmus students), as follows: I. LECTURES (**50%**) (summative) • Written Exam with Short Answer Questions and Multiple Choice Test and/or • Written Exam with Extended Answer Questions II. LAB EXERCISES (formative) The final grade for the practical exercises is determined at the end of the semester and includes: • Questionnaires or small essays to evaluate the exercises carried out during the semester, **at a rate of 40%**. • Questionary to evaluate fieldwork activities, **at a rate of 10%**. In the case of an unsuccessful result (<5), the students have the possibility to attend the Semester's period exercises. Auxiliary material (questions, exercises, etc.) for the exams is posted on the online **e-Class** platform (https://eclass.uoa.gr/courses/GEOL132/).

PLANNED LEARNING ACTIVITIES

Activity	Student effort
Lectures	26 hours
Practice exercises	26 hours
Fieldwork	12 hours
Tutorials	- hours
Essey writing	- hours
Autonomous study	48 hours
Final assessment preparation	38 hours
Total student's effort	**150** hours

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Lekkas E. (1998) Geology and the Environment. ISBN 960-90329-2-3, 274p. (in Greek). pdf
- Lekkas, E., Andreadakis, E. & Kapourani, E. (2015). Natural and Technological Disasters Impact on the Environment.235p. (in Greek). pdf
- European Environment Agency (2020). The European environment — state and outlook 2020/Knowledge for transition to a sustainable Europe. ISBN 978-92-9480-090-9, doi: 10.2800/96749, 496 p.

III. RELATIVE JOURNALS

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COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y7203**	**SEMESTER**	**7th**
TITLE	**APPLIED GEOPHYSICS**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises, Fieldwork		**3**	**2**
TYPE OF COURSE	**MANDATORY /** Scientific Area		
PREREQUISITES	[recommended knowledge] Y1202 – Physics Y3205 - Structural Geology and Tectonics Y4202 – Geophysics Y3205 - Engineering Geology Y6203 - Hydrogeology		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL249		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

Through the successful completion of this lesson, the trainee:

- **Reproduces** the necessary knowledge and skills regarding the different methods of subsurface geophysical investigation applied nowadays.
- **Lists** examples for the identification of several targets (e.g. ores, hydrocarbons, subsurface water) or for technical-geological issues (determination of the mechanical properties of surface geological formations for construction purposes), or even for investigating complex geological structures and geoenvironmental issues.
- **Defines** the conditions, **plans** the geophysical experiment by choosing the appropriate method and **estimates** the expected results.
- **Describes** the basic instrumentation and acquisition field procedures.
- **Applies** the main geophysical methods and techniques for data processing.

- **Discovers** the subsurface "targets", after **corelating** their lithological/geological/geophysical characteristics.
- **Concentrates** on the "discreet resolution" of the geophysical method/technique, since he/she **examines** the dimensions of the target and **adjusts** it with the acquisition procedure.
- **Handles** the combination of geophysical and geological data, **evaluates** and **interprets** the results.

Generic Competences

- Ability to work in an interdisciplinary context
- Ability to apply knowledge in practical situations
- Decision making
- Ability to search for, process and analyse information with the use of necessary technologies
- Information and Communication Technology (ICT) skills
- Ability to undertake research at an appropriate level
- Ability to be critical and self-critical

(3) COURSE CONTENT

A. Lectures/seminars

Introduction, basic principles of geophysical prospecting.

Seismic methods. Theory of seismic refraction, reflection, seismic tomography and surface seismic waves. Measurements, processing, evaluation and interpretation. Applications and examples on geoenviromental and geotechnical problems, oil investigation and geodynamics.

Geo-electrical methods. Principles, theory. Vertical and lateral distribution of the electrical resistivity, geoelectrical tomography. Measurements, processing, evaluation and interpretation. Applications and examples on geoenviromental and geotechnical problems etc.

Geo-electromagnetic methods. Propagation and attenuation of electromagnetic fields. EM methods of controlled sources, methods of frequency domain (VLF, HLEM), time-domain (TDEM), Geo-Radar. Measurements, processing, evaluation and interpretation. Applications and examples.

Well-logging. Methodologies, acquisition techniques, processing, evaluation and interpretation. Applications and examples.

Nuclear magnetic resonance method. Principles, theory. Instruments, arrays, data acquisition and processing. Applications and examples.

B. Practical Exercises

Practice exercises are taught in small groups of students and are graded at the end of the exercise. Including processing, evaluation and interpretation of geophysical data with specialized software and report analysis. The trainees present and support assigned projects of engineering and environmental geophysics.

Exercise 1. Transient electromagnetic sounding.
Exercise 2. Ground conductivity.
Exercise 3. Vertical Electrical sounding.
Exercise 4. Geoelectrical profile.
Exercise 5. Electrical resistivity tomography.
Exercise 6. Seismic refraction.
Exercise 7. Seismic refraction tomography.
Exercise 8. Seismic reflection.
Exercise 9. Seismic test in borehole (down-hole, cross-hole).
Exercise 10. Well logging.

C. Fieldwork

Exercise 11. One-day field exercise. It involves demonstration of the geophysical instrumentation and field geophysical measurement techniques and their qualitative processing and interpretation

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	

Activity	Student effort
Lectures	39 hours
Practice exercises	22 hours
Fieldwork	6 hours
Tutorials	-
Essay writing	-
Autonomous study	44 hours
Final assessment preparation	39 hours
Total student's effort	**150** hours

ASSESSMENT METHODS AND CRITERIA	The students are evaluated in Greek language (in English for the Erasmus students). The final degree is based on: The **written examination** (summative) at the exam periods, regarding the • (a) theoretical knowledge, • (b) Laboratory work • (c) the fieldwork, With **50%** percentage of the **final degree**, from short-answer questions. All the **written reports/homework essays of the practical exercises**, with **50% percentage** of the **final degree** (formative, summative).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Applied Geophysics, Tselentis Akis, Paraskeyopoulos P. [Κωδ. ΕΥΔΟΞΟΣ: 50659068]
- Papazachos K.,Papazachos V., 2013. «Introduction to Applied Geophysics» [Κωδ. ΕΥΔΟΞΟΣ: 11261]

II. ADDITIONAL READING

- Everett, M.K., 2013. *Near-surface Applied Geophysics*, Cambridge University Press
- Milsom J. & Eriksen A., 2011. *Field Geophysics*, Vol. 36, Wiley - John Wiley & Sons, 287p. ISBN: 978-0-470-74984-5
- Reynolds, J, M., 2011. *An Introduction to Applied and Environmental Geophysics*, 2nd Edition, ISBN: 978-0-471-48535-3.
- Telford, W.M., Geldart, L.P. and Sheriff, 1990, R.E., *Applied Geophysics*, 2nd Edition, Cambridge University Press.

III. RELATIVE JOURNALS

- Geophysics Online ISSN: 1942-2156, Print ISSN: 0016-8033, SEG
- Geophysical Prospecting Online ISSN: 1365-2478, Print ISSN: 0016-8025, EAGE
- Reviews of Geophysics Online ISSN: 1944-9208, Print ISSN: 8755-1209, AGU
- Surveys in Geophysics Online ISSN: 1573-0956, Print ISSN: 0169-3298, Springer

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y7204**	**SEMESTER**	**7th**
TITLE	**GEOLOGY OF SEDIMENTARY AND SUPERGENE DEPOSITS**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Lab Exercises and Fieldwork	**4**	**6**

TYPE OF COURSE	**MANDATORY /** Scientific Area
PREREQUISITES	[recommended] Y2201 Introduction to Geology **Y2202** Systematic Mineralogy - Mineral Identification Y3201 Igneous Rocks-Magmatic Processes **Y3202** Petrology Of Sedimentary Rocks Y3205 Tectonic Geology Y4201 Petrology of Metamorphic Rocks Y4203 Geochemistry **Y5202** Stratigraphy Y6205 Geology of Magmatic and Hydrothermal Ore Deposits
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL544

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
By the end of the course, the students will be able: • To **describe** the most important sedimentary and supergene deposits worldwide and in Greece. • To **apply** the principles of General Geology, Mineralogy, Petrology, and Geochemistry to understand the space-time distribution in the crust, and the genetic processes and mechanisms for sedimentary and supergene deposit types. • To **collect appropriate** samples and to **interpret** and **evaluate** their macroscopic and microscopic

characteristics.
- To **select** and **apply** the applicable laboratory methods to resolve deposit-related issues, and to formulate the genetic models for sedimentary and supergene deposits.
- To **combine** and **evaluate** the mineralization data for decision-making regarding the exploration and exploitation of mineral raw materials, taking in account the protection of the environment and the sustainable development.

In addition:

- **they will have realize** the importance and impact of the exploitation of mineral resources to the society, the economic growth and the sustainability.

Generic Competences
• Ability to search for, process and analyse information with the use of necessary technologies • Autonomous work • Oral and written communication of scientific issues • Ability to apply knowledge in practical situations • Ability to undertake research at an appropriate level • Promote free, creative and inductive thinking • Commitment to conservation of the environment

(3) COURSE CONTENT

A. Lectures

Course content consists of the following thematic units:

- **Deposit characteristics and models of sedimentary deposits.** Chemical sedimentation – Banded iron formations (BIF). Clastic sedimentation and concentration of heavy minerals – alluvial deposits (placer). Deposits of Evaporites. Brines. Magnesite deposits
- **Deposit characteristics and Genetic Models of Residual Deposits.** Surface and supergene processes – Fundamental chemical weathering processes. Lateritic deposits Ni-Fe(–Co). Bauxite deposits-Karst Bauxites. The creation and deposit significance of Gossans.
- **Models of Genesis of Industrial Mineral Deposits**. Geology and Genesis of Industrial Minerals Deposits: Perlite, Bentonite, Zeolites, Phosphorites.

B. Lab Exercises:

A: Metallographic microscopy of oxide and hydroxide minerals.
B: Macroscopic study, identification and description of hand specimens from sedimentary and supergene ores.
C: Combined exercises of macroscopic and microscopic investigation of ores and host-rocks.
D: Correlation between geologic, mineralogical, petrological and geochemical features of sedimentary and supergene deposit types, and their host-rocks.

C. Fieldwork

One-day field exercise on Lateritic Ni-Fe–Co) deposits and Bauxite deposits-Karstic Bauxites. Identification and description of metallogenic characteristics (MC) in the field, i.e., lithologic, tectonic, morphologic, mineralogic characteristics of ores –gangue minerals. Written Report on the detailed description of the MC, and formulation of the genetic model of the ores in the visited area, with the aid of data from the literature.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.

<table>
<tr><td rowspan="1">PLANNED LEARNING ACTIVITIES</td><td>
<table>
<tr><th>Activity</th><th>Student effort</th></tr>
<tr><td>Lectures</td><td>24 hours</td></tr>
<tr><td>Practice exercises</td><td>24 hours</td></tr>
<tr><td>Fieldwork</td><td>12 hours</td></tr>
<tr><td>Tutorials</td><td>–</td></tr>
<tr><td>Essay writing</td><td>–</td></tr>
<tr><td>Autonomous study</td><td>48 hours</td></tr>
<tr><td>Final assessment preparation</td><td>42 hours</td></tr>
<tr><td>Total student's effort</td><td>150 hours</td></tr>
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</td></tr>
<tr><td>ASSESSMENT METHODS AND CRITERIA</td><td>
I. <u>LECTURES, LABORATORY & FIELD EXERCISES</u> (60%) (Summative)
• Oral Examination of the Syllabus and Practical Examination of Hand Specimens
A variety of evaluation techniques are used:
Questions covering the entire curriculum: The achievement or not of the learning objectives and especially the effort made by the student to achieve them is evaluated
Judgement questions: The ability of students to think, organize, connect knowledge and express themselves in their own words is evaluated, always using the appropriate scientific terminology.
True or false: To increase the credibility of this type of question, students are asked to explain and justify their answer. Supporting material (questions, exercises, etc.) for the exams is posted on the electronic platform e-Class (https://eclass.uoa.gr/courses/GEOL543/).

The possible questions or topics for oral examination are analyzed in detail to students during lectures, laboratory exercises or outdoor exercises.

Auxiliary material for the examinations is posted on the electronic platform e-Class (https://eclass.uoa.gr/courses/GEOL543/).

II. <u>LAB EXERCISES</u> (20%) (Formative, Summative)
• Short written examination at the end of each laboratory module (10%).
• Elaboration of projects based on the material of the Laboratory (10%).

III. <u>FIELD EXERCISES</u> (20%) (Summative)
• Evaluation of the field notes and individual field report.
</td></tr>
</table>

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- F. Pirajno, 2009. **Hydrothermal Processes and Mineral Systems**, [EUDOXUS code: 73241410]
- W. L. Pohl, 2011. **Economic Geology – Principles and Practice,** Willey - Blackwell. [EUDOXUS code: 80504203]
- R. Taylor, 2009. **Ore Textures**, Springer [EUDOXUS code: 73249091, electronic resource PDF]

II. ADDITIONAL READING

- J. Ridley, 2013. **Ore Deposit Geology,** Cambridge University Press
- L. Robb, 2004. **Ore Forming Processes,** Blackwell Publishing
- A. M. Evans, 1995. **Introduction to Mineral Exploration,** Blackwell Science

III. RELATIVE JOURNALS

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

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E7201**	**SEMESTER**	**7th**
TITLE	**NATURAL DISASTERS**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Lab Exercises and Fieldwork		**4**	**4**
TYPE OF COURSE	**ELECTIVE /** Scientific Area		
PREREQUISITES	Although no typical admission requirements, students are expected to have mastered knowledge of natural phenomena covered by previous obligatory and/or elective courses Y2201 Introduction to Geology E5203 Volcanology Y3203 Seismology Y5203 Engineering Geology		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL175		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
The course covers the fundamental principles of natural disasters study and management, both in national and global level. On completion of the course the student is able to: • distinguishe the different aspects of natural disasters management in national and global level, • recognize, describe and classify the types and scales of natural disasters • clarify the relation between natural and technological disasters and the environment. • research, analyze, combine, compare and evaluate all data and information relevant to the estimation of risk of any given natural hazard, • summarize the principles of the environmental legislation and International Policies for disaster management. • manage and communicate the risks of natural disasters

• apply technological tools that assist in the prevention of natural disasters
Generic Competences
• Ability to search for, process and analyze information with the use of necessary technologies • Autonomous work • Ability to apply knowledge in practical situations • Decision making • Information and Communication Technology (ICT) skills

(3) COURSE CONTENT

A. Lectures

- Introduction to Natural Disasters: The problem on a local, national and international level - social and economic impact - types of Natural Disasters
- Technological and NaTech Disasters: Basic terms and principles
- Flood Hazard: Description – management steps – action and intervention by step – national and international management framework – the role of International Organizations and NGOs
- Seismic Hazard: Description – damage distribution zones - management steps – action and intervention by step – national and international management framework – the role of International Organizations and NGOs
- Landslide (mass movement) Hazard: Description – damage distribution zones - management steps – action and intervention by step – national and international management framework – the role of International Organizations and NGOs
- Wildfire Hazard: Description – damage distribution zones - management steps – action and intervention by step – national and international management framework – the role of International Organizations and NGOs
- Volcanic Hazard: Description – damage distribution zones - management steps – action and intervention by step – national and international management framework – the role of International Organizations and NGOs
- Desertification Hazard: Description – damage distribution zones - management steps – action and intervention by step – national and international management framework – the role of International Organizations and NGOs

B. Practical Exercises

The students work on a GIS platform to determine the vulnerability factors and the natural disaster(s) risk(s) of a given Greek Municipality. Specifically, they determine the disaster risk of

- flooding,
- mass movement phenomena,
- an earthquake,
- a volcanic eruption,
- wildfires and
- desertification.

C. Fieldwork

One day field trip at areas recently affected by natural disaster(s) that provides insight to the identification and mapping of natural hazards, vulnerability, risk, and analysis of pre- and post-disaster phases and is followed by the writing of a short essay – report.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.

PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	13 hours
	Practice exercises	39 hours
	Fieldwork	12 hours
	Tutorials	- hours
	Essey writing	- hours
	Autonomous study	20 hours
	Final assessment preparation	16 hours
	Total student's effort	**100** hours
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted in Greek (there is the pos-sibility of examination in English for Erasmus students), as follows: I. LECTURES (**50%**) (summative) • Written Exam with Short Answer Questions and Multiple Choice Test and/or • Written Exam with Extended Answer Questions II. LAB EXERCISES (**50%**) (formative) • Short essay writing for each exercise and for field work activities In the case of an unsuccessful result (<5), the students have the possibility to repeat the exercises. Auxiliary material (questions, exercises, etc.) for the exams is posted on the online **e-Class** platform (https://eclass.uoa.gr/courses/GEOL175/).	

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Lekkas, E. (2000). Natural and Technological disasters. ISBN 960-90329-0-7, 278p. (in Greek)

III. RELATIVE JOURNALS

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COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E7202**	**SEMESTER**	**7nd**
TITLE	**SATELLITE TECHNIQUES AND GIS IN GEOSCIENCES**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Lab Exercises and Fieldwork	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL313

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course the student

- **Define** and **formulate** the basic satellite techniques used in Geosciences
- **Describe** and **determine** the main characteristics and principles of the new satellite based techniques.
- **Define** the type of satellite data that can be used in different geological environments and applications
- **Define** and **describe** how to process satellite data using Geographical Information Systems (GIS)
- **Apply** new processing techniques to analyze satellite Radar Interferometic and geodetic GNSS data
- **Combine** and **evaluate** various satellite and ground-based data to interpret different geological and tectonic characteristics and address modern geological, environmental and technical issues

Generic Competences

- Ability to apply knowledge in practical situations
- Promote free, creative and inductive thinking
- Decision making

- Ability to undertake research at an appropriate level
- Information and Communication Technology (ICT) skills
- Ability to work in an interdisciplinary context

(3) COURSE CONTENT

A. Lectures.

- Satellite systems for Earth Observations (EO): Historical review and basic concepts of space based EO systems
- Elements of the EM theory, atmospheric effects on the radiation, Energetic and passive EO satellite recording systems, Characteristics of satellite images
- Earth Observation Satellite Systems: Orbit and satellite characteristics; Spatial, temporal, spectral discrete analysis; Type of sensors
- Processing and analysis of satellite images, type of corrections.
- Satellite Images photo-interpretation – tectonic, geological, geomorphological and other data recognition.
- Interpretation of satellite data with open source software packages (i.e. interpretation of optical images LANDSAT, IKONOS, QUICKBIRD, SPOT etc.)
- Geographical Information Systems (GIS) and Web GIS in geological and geophysical research and geoenvironmental problems – natural hazards. Data base organization and processing of geodata, thematic layers, maps and diagrams creation. Time series creation.
- Digital Elevation Models and terrain analysis data. Uses in geological and geophysical research as well as in geoenvironmental problems – natural hazards.
- Satellite Radar Systems. Basic principles of satellite Synthetic Aperture Radar (SAR) Interferometry. Techniques of processing satellite radar images (ie Differential interferometry, Permanent Scatterer interferometry). Applications of radar interferometry for ground deformation observations caused by natural and anthropogenic processes, and mapping flood areas.
- Global Navigation Satellite System (GNSS/GPS): basic principles; type of GNSS constellations; type of measurements; processing of raw data, error reduction, processing strategies, data collection and data management, use of commercial and open-source s/w to process raw GNSS data.

B. Lab exercises.

Practice exercises are taught in small groups of students using s/w packages

Exercise 1. Introduction to the use and display of digital satellite data. (ArcGIS PRO / Image Analysis)

Exercise 2. Satellite images processing, image classification & photo-interpretation (ArcGIS PRO / Image Analysis).

Exercise 3. Managing and geo-processing geodata in ArcGIS PRO. Digital elevation models and terrain analysis data creation using ArcGIS PRO and specific s/w GENIMA.

Exercise 4..Map composition, formation of diagrams etc using database organization on GIS environment, practice with ArcGIS PRO

Exercise 5. Web GIS – data processing – web maps – web applications (ArcGIS Online).

Exercise 6. Processing GNSS data using Leica – Infinity s/w. Part 1. Importing raw data to the s/w, downloading and incorporate supplementary data and files on the s/w

Exercise 7. Processing GNSS data using Leica – Infinity s/w. Part 2. Processing GNSS data, ambiguity strategies. Compilation of GNSS products. Processing GNSS data from the field campaign

Exercise 8. Processing Satellite Radar Interferometric data using the open source s/w SNAP of European Space Agency (ESA). Part1: Downloading and processing radar interferometic data to calculate ground deformation. Differential Interferometry (DInSAR)

Exercise 9. Processing Satellite Radar Interferometric data using the open source s/w SNAP of European Space Agency (ESA). Part 2: Mapping flood areas.

Exercise 10 .Downloading, understanding and using interferometric products from the European Ground Motion Service.

C. Fieldwork

C1. One day field excursion collecting GNSS data on the broad area of the University campus .

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** / **Student effort** Lectures: 26 hours Practice exercises: 10 hours Fieldwork: 3 hours Tutorials: - Essey writing: 20 hours Autonomous study: 20 hours Final assessment preparation: 21 hours **Total student's effort**: **100** hours
ASSESSMENT METHODS AND CRITERIA	I. LECTURES (**20%**) • Short oral or written test at the end of each lecture (formative). Exams include short or extended answer questions, and/or multiple choice tests. II. LAB EXERCISES (**20%**) • Weekly assessment of lab exercises (formative, summative). • or/and • Written examination by solving a specific problem (summative). II. FINAL WRITTEN ESSAY (**60%**) • Final written essay presenting processing and interpretation results (formative, summative). Supplementary material for the exams (questions, exercises etc.) is posted on **e-Class** platform (**https://eclass.uoa.gr/courses/GEOL313/**).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- GPS and Geodetic Applications. Fotiou AI, Pikridas Ch. [EUDOXUS code: 22768688], in Greek.
- Applications of Geographic Information systems and Remote Sensing in Geological and Geo-Environmental Studies. S. Vassilopoulou (e-book: pdf) [EUDOXUS code:: 33239672], in Greek.

II. ADDITIONAL READING

- GPS Theory and practice» Hofmann-Wellenhof, Lichtenegger H., Collins J., Springer
- Sattellie InSAR Data, Reservoir monitoring from Space», Ferretti, A., EAGE, ISBN 978-90-73834-71-2
- InSAR Principles: Guidelines for SAR Interferometry Processing and Interpretation» E-book, European Space Agency, https://esamultimedia.esa.int/multimedia/publications/TM-19/TM-19_InSAR_web.pdf

III. RELATIVE JOURNALS

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COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E7203**	**SEMESTER**	**7nd**
TITLE	**EARTHQUAKE PREDICTION**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises, Laboratory exercises		**3**	**4**
TYPE OF COURSE	**ELECTIVE /** Scientific Area		
PREREQUISITES	[recommended] Y3203 Seismology Y6201 Applied and Engineering Seismology		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL234		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
On successful completion of the course the student: • **Identifies** and **describes** the applicable earthquake prediction method. • **Distinguishes** and **explains** the differences between the different earthquake prediction methods. • **Classifies** the earthquake prediction methods as long-term, medium-term, and short-term. • **Calculates** by data analysis the parameters used in the earthquake prediction methods. • **Combines** different methods that have been applied in successful earthquake prediction case studies. • **Composes** and **suggests** which earthquake prediction method(s) is (are) appropriate, depending on the available data. • **Evaluates** the results of studies published in international scientific journals and **concludes** whether the earthquake prediction methods are applicable and in which cases.
Generic Competences
• Ability to apply knowledge in practical situations

- Ability to search for, process and analyse information with the use of necessary technologies
- Ability to undertake research at an appropriate level
- Autonomous work
- Ability to work in an international context

(3) COURSE CONTENT

A. Lectures:

- Long-term, medium-term and short-term earthquake prediction. Minimization of effects and protection measures.
- Earthquake Early Warning Systems.
- Seismic cycle. Statistical forecast and estimation of the probability of occurrence of a strong earthquake. Precursory phenomena, mechanisms of deformation of the Earth's crust – dilatation theory.
- Seismic zones, extreme values method, seismic gaps (type A and B), seismic quiescence, chaos theory.
- Seismic anisotropy and temporal changes of shear-wave splitting parameters in tectonic and volcanic environments.
- Foreshocks, migration of seismic activity, variations of the seismic wave's velocity.
- Ground deformation maps, tsunamis, groundwater level and temperature changes, electromagnetic field fluctuations, chemical changes and radon release.
- Changes in seismic activity in space and time, methods of estimating static stress changes, models of decelerating - accelerating seismicity.
- Application of earthquake prediction methods in volcanic environments.

B. Practical and Laboratory Exercises:

PART A: Seismotectonic analysis exercises in active areas of Greece
PART B: Exercises for determining the constants a and b of the Gutenberg-Richter law using the entire earthquake catalogue and the extreme values method, using the least squares method.
PART C: Exercises for calculating the probability of occurrence of a future earthquake and determination of ground deformation.
PART D: Stress transfer determination exercises (static Coulomb stress changes).
PART E: Estimation of earthquake occurrence by means of shear-wave splitting

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	

Activity	Student effort
Lectures	26 hours
Practice exercises	13 hours
Fieldwork	-
Tutorials	-
Essey writing	26 hours
Autonomous study	20 hours
Final assessment preparation	15 hours
Total student's effort	**100** hours

ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted in Greek with a final examination of the entire syllabus and presentation of individual work on a specific earthquake forecasting methodology and includes: **I. LECTURES (50%)** • Individual Report and Oral Presentation per Student (formative, summative) **II. PRACTICE EXERCISES (50%)** • Written exam with Solving Exercises and Problems (formative)

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Introduction to seismology. Papazachos B.C., G.F. Karakaisis, P.M. Chatzidimitriou. [Code EUDOXUS: 11254], in Greek
- General seismology vol. A, A. Tselentis [Code EUDOXUS: 59395397], in Greek

II. ADDITIONAL READING

- G. Kaviris, P. Papadimitriou, Ph. Kravvariti, V. Kapetanidis, A. Karakonstantis, N. Voulgaris and K. Makropoulos, 2015. A detailed seismic anisotropy study during the 2011-2012 unrest period in the Santorini Volcanic Complex. Physics of the Earth and Planetary Interiors, 238, 51-88
- S. Wiemer and M. Wyss, 1994. Seismic Quiescence before the Landers (M = 7.5) and Big Bear (M = 6.5) 1992 Earthquakes. Bulletin of the Seismological Society of America, Vol. 84, 3, 900-916.

III. RELATIVE JOURNALS

- Bulletin of the Seismological Society of America, SSA Journals
- Geophysical Journal International, Oxford University Press
- Journal of Geophysical Research, AGU Publications
- Physics of the Earth and Planetary Interiors, Journal, Elsevier
- Tectonophysics, Journal, Elsevier

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E7206**	**SEMESTER**	**7th**
TITLE	**EVOLUTIONARY PALAEONTOLOGY - PALAEOANTHROPOLOGY**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Laboratory exercises	**4**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	Y2205 Macropalaeontology [recommended]
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL297

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
On completion of the course the student: • Shall have understood the evolutionary theory of Darwin, the mechanisms of natural selection and the Neodarwinian theory. • Shall have understood the cladistic methodology and use it to arrive on phylogenetic results. • Shall have the ability to recognize microevolutionary and macroevolutionary events that occurred in the past. • Analyzing available data, shall synthesize and interpret the evolutionary history of a taxonomic group. • Shall have understood the phylogenetic relationships between the various primate groups, their evolutionary history, and shall have the ability to recognize the taxonomic group where a fossil primate belongs and its biostratigraphic significance. • Shall have the knowledge for the interpretation of the osteological characters of the primates, especially those that are related with the bipedal locomotion. • Shall have the knowledge of the basic methodology for the recognition of the sex on a human skeleton and the age estimation based on morphometric parameters.

Generic Competences
• Autonomous work • Ability to apply knowledge in practical situations • Promote free, creative and inductive thinking • Ability to search for, process and analyse information with the use of necessary technologies • Information and Communication Technology (ICT) skills

(3) COURSE CONTENT

A. Lectures:

- Basic principles of the Darwinian theory, natural selection.
- Basic principles of the Neodarwinian theory (Evolutionary Synthesis).
- What is Phylogeny, methodology of the cladistics, cladograms.
- Events and trends in the evolutionary lines.
- Speciation and species concepts.
- Evolutionary changes, rate of evolution, models and results of the natural selection.
- The fossil record, microevolution and macroevolution.
- The primates in the evolutionary frame. Taxonomy of the primates. “Lower” and “higher” primates, haplorrhines, catarhines.
- Hominidae. Most important stages of the hominid evolution (early Hominini, australopithecines,).
- Introduction to the human osteology, adaptations for bipedalism.
- The evolution of *Homo.*
- Homo neanderthalensis.
- The evolution of *Homo* in islands.

B. Practical and Laboratory Exercises:

- Cladistic analysis based on palaeontological morphometric data. Application of cladistics methodology for the interpretation of phygenetic relationships. Recognition of characters (derived characters, synapomorphies, apomorphies, autoaapomorfies, convergent evolution), recognition of sister taxa.
- The evolutionof the Equidae through the study of their dentions. Measurements, making diagrams, interpretation of the diagrams relative to geographic and temporal history of the Equidae, interpretation relative to the environment and possible climatic changes.
- Convergence evolution based on examples in the evolutionary history of carnivores.
- Island Evolution.
- Introduction to the human anatomy. Recognition of the sex and the age.
- Exercises based on the specimens of the Museum and recognition of the most important primate groups.
- Lemurs and tarsiers, Platyrhines, Catarhines.
- Australopithecines
- Homo

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	26 hours

	Practice exercises	26 hours
	Fieldwork	-
	Tutorials	-
	Essey writing	16 hours
	Autonomous study	16 hours
	Final assessment preparation	16 hours
	Total student's effort	**100** hours
ASSESSMENT METHODS AND CRITERIA	I. THEORETICAL PART (summative) • Oral or written examination (**60%**). II. LABORATORY PART (formative, summative) • At the practical examination the students are evaluated according to their results on the laboratory exercises and according to their results (**40%**).	

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Ankel-Simons F. (2007). Primate Anatomy. An Introduction. Elsevier.
- Delson E., Tattersall I., Van Couvering J. A. & Brooks A.S. (2000). Encyclopedia of human evolution and prehistory. Garland Publishing.
- Fleagle J.G. (1998). Primate adaptation and evolution. Academic Press, 1-595.
- Futuyma D.J. (2005). Evolution. Sinauer Associates, 1-603.

III. RELATIVE JOURNALS

- Journal of Human Evolution, Online ISSN: 0047-2487
- American Journal of Physical Anthropology, Online ISSN: 1096-8644
- International Journal of Primatology, Online ISSN: 0164-0291

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E7207**	**SEMESTER**	**7th**
TITLE	**VERTEBRATE PALAEONTOLOGY**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Laboratory exercises	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	Y2205 Macropalaeontology [recommended]
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL216

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
On completion of the course the student: • Shall have the ability to define and understand the position of the Vertebrates in the animal kingdom and describe the basic characters of the Chordata and Vertebrata, the relationships between the Invertebrates and Vertebrates and the mechanism of Vertebrate origin. • Shall have developed the ability to recognize and describe the more important diagnostic characters of the various Vertebrate groups (Fishes, Amphibians, Reptiles, Mammals, Birds), elucidate and analyze their adaptive significance depending their living environment. • Shall have recognized and classified (in family/generic level) the most common fossils of the Greek fossil record. • Shall have developed the ability to infer about the relative geological age based on the fossils. • Based on the characters of a vertebrate palaeofauna shall be deduce about the palaeoenvironment. • Can interpret possible relationships between vertebrate faunas of different geographic areas and infer about the palaeogeography, interpreting relative bibliography. • Shall have the ability to work with the bibliography.

Generic Competences
• Autonomous work • Ability to apply knowledge in practical situations • Work in a team • Promote free, creative and inductive thinking • Ability to search for, process and analyse information with the use of necessary technologies

(3) COURSE CONTENT

A. Lectures:

- Introduction to the most important subject of Vertebrate Palaeontology.
- Relationship between Invertebrates and Vertebrates, origin of the Vertebrates, anatomical features of the Vertebrates.
- Taxonomy of the Vertebrates, Fishes, Amphibians, Reptiles, Mammals, Birds. Phylogenetic relationships between the Birds and the Reptiles especially the dinosaurs.
- Evolutionary radiation of the Vertebrates. Major features of the various phylogenetic groups of vertebrates.
- Major events to the Vertebrate evolution. Evolution of the skeleton, the fins, theories about the evolution of the jaws, evolution of the teeth, evolution of the limbs, etc.
- The transition from the sea to the land, from the land to the air. The first amphibians, the first flying vertebrates.
- Anatomical adaptations for the life in the water, on the land, on the air.
- General anatomical characters of the tetrapods. The skeleton of the tetrapods, the cranial of the cranium, the axial skeleton, the appendicular skeleton (with emphasis on the Mammals).
- The Greek fossil record of Vertebrates. The faunal synthesis of the most important vertebrate fossiliferous localities of Greece, biostratigraphy, palaeoenvironment.
- Geographical distribution of the past vertebrates and its relation with the palaeogeography, with emphasis to the palaeogeography of the Aegean.
- Introduction to the excavational methodology and preservational practices.

B. Practical and Laboratory Exercises :

- Familiarity with the basic anatomy of the vertebrates, practice on skeletons of living vertebrates as well as on fossils.
- Practice on the osteological characters of amphibians, reptiles, birds and mammals.
- The skeleton of Mammals. The osteological characters of the most important mammalian groups for Greece. Recognition of such groups from their fossil remains based on their anatomical characters. From the anatomy of the modern groups to that of the fossil ones. Application of statistical software on the determination.
- Odontology of the most important mammalian groups (Hyracoidea, Proboscidea (Deinotheres, Elephants, Gomphotheres), Tubulidentata, Rodentia, Primates, Carnivora, Equidae, Rhinocerotidae, Ancylopoda, Bovidae, Suidae, Cervidae, Giraffidae, Hippopotamidae).
- Introduction to Ecomorphology. Inferring the mode of life from the anatomical characters of the vertebrates.
- Essay writing.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.

PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	26 hours
	Practice exercises	13 hours
	Fieldwork	-
	Tutorials	-
	Essay writing	20 hours
	Autonomous study	21 hours
	Final assessment preparation	20 hours
	Total student's effort	**100** hours
ASSESSMENT METHODS AND CRITERIA	I. THEORETICAL PART (summative) • Oral or written examination (**50%**). II. LABORATORY PART (summative) • At the practical examination the students are evaluated on exams where they have to recognize vertebrate skeletal parts and recognize/classify vertebrate fossils and infer their relative geological age (**40%**). • Additionally, they are evaluated according to their results on the laboratory exercises and bibliographical exercises (**10%**).	

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Benton M.J. (2005). Vertebrate Palaeontology. Blackwell Publishing, 1-455.
- Kardong K.V. (1995). Vertebrates. Comparative Anatomy, Function and Evolution. Wm. C. Brown, Dubuque, 1-777.
- Kemp T.S. (2005). The Origin and Evolution of Mammals. Oxford University Press.
- Prothero D.R. (2022). Vertebrate Evolution. From Origins to Dinosaurs and Beyond. C.R. Press, 1-448.
- Rose K.D. (2006). The Beginning of the Age of Mammals. The John Hopkins University Press, Baltimore, 1-431.
- Schmid E. (1972). Atlas of Animal Bones. Elsevier Publishing Company, Amsterdam, 1-159.

III. RELATIVE JOURNALS

- Journal of Vertebrate Paleontology, Online ISSN: 1937-2809, Print ISSN: 0272-4634.
- Geobios, Online ISSN: 1777-5728, Elsevier.
- Quaternary, Online ISSN: 2571-550X.

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E7208**	**SEMESTER**	**7th**
TITLE	**MARINE GEOLOGY**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Laboratory exercises		**3**	**4**
TYPE OF COURSE	**ELECTIVE /** Scientific Area		
PREREQUISITES	Y2205 Macropalaeontology [recommended]		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL216		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
On successful completion of the course the student: • **Is aware of** the fundamental concepts of Marine Geology. • **Fully understands** the outstanding contribution of Marine Geology to the Earth Sciences during the last and current century as well as all revolutionary research achievements of this continuously evolving dynamic scientific field, which have been greatly providing a better knowledge of the advancing geomorphological, geodynamic and geoenvironmental processes on our planet. • **Is sufficiently qualified to deal with** the basic acoustic and visual inspection methods/techniques that are widely used for the collection, processing and interpretation of the Marine Geology data. The relevant data are commonly obtained from the performance of shallow- and deep-water geophysical surveys (which mainly include bathymetric/geomorphological mapping, seismic-reflection sub-bottom profiling, side-scan sonar mosaicing of the seabed and visual inspections using autonomous or remotely-operated underwater vehicles) as well as from sampling of seabed sediments using piston or gravity corers and grab samplers • **Comprehends** the major submarine geomorphological, geodynamic and sedimentological processes, which determine the seabed structure and affect the physical, chemical and biological

composition of bottom sediments.

- **Conceives** the dominant processes of marine sediment transport and deposition on the continental shelf, continental slope and abyssal plain as well as the natural factors that influence them, such as geodynamics, climatic trends and regional/global oceanographic processes.
- **Compares** and **correlates** past and modern sedimentary sequences.
- **Identifies** distinct geomorphological, tectonic and sedimentological surface and sub-surface features of the seabed.
- **Integrates** geophysical and sedimentological data in order to interpret the evolution of submarine paleoenvironments in the geological time scale and the evolutionary stages of analogous modern depositional systems in the near and distant future.

Generic Competences

- Ability to apply knowledge in practical situations.
- Promote free, creative and inductive thinking
- Autonomous work.
- Ability to search for, process and analyse information with the use of necessary technologies.
- Ability to undertake research at an appropriate level.

(3) COURSE CONTENT

A. Lectures

- Characteristic geomorphological structures of the seafloor - Structure of oceanic crust and sedimentary cover - Submarine modern tectonic processes - Active and Passive continental margins - Types of submarine basins.
- Sedimentation processes in marine environments - Modern distribution of clastic, biogenic and chemical sediments on the seafloor - Variability of lithostratigraphy in the oceans.
- Milankovich cyclicity - Sea level changes and their impact on marine sedimentation.
- Extreme oceanographic events and sedimentation.
- Paleomagnetic stratigraphy in marine sediments.
- Biostratigraphy and methods of isotope stratigraphy.
- Methods of geochronology and correlation of marine sedimentary sequences.
- Ocean circulation.
- Marine geology of the Aegean Sea: Bottom geomorphology - Tectonic evolution and deformation - Sea level changes - Prehistoric relief.
- Marine geology of the Red Sea: Brine lakes.
- Methodology and description of the main instrumentation for submarine geophysical surveys.
- Methodology and description of the equipment for bottom sediment sampling.
- Methodology and description of the main instrumentation for the measurement of physical, chemical and biological parameters of the seawater column.

B. Laboratory Exercises

- Practice exercises are taught to each individual student and are graded prior to the start of the next Laboratory.
- **Exercise 1, 2.** Origin-morphology of ocean basins.
- **Exercise 3.** Origin-morphology of ocean margins.
- **Exercise 4, 5.** Impacts of waves and currents on seabed sediments.
- **Exercise 6, 7.** Seabed geophysical exploration techniques: Identification of representative geomorphological, tectonic and sedimentological features from the analysis of bathymetric data.
- **Exercise 8, 9.** Seabed geophysical exploration techniques: Identification of representative geomorphological, tectonic and sedimentological features from the analysis of seismic-reflection sub-bottom profiling.
- **Exercise 10, 11.** Seabed geophysical exploration techniques: Identification of representative geomorphological, tectonic and sedimentological features from the analysis of side-scan sonar data.

- **Exercise 12, 13.** Macroscopic description of sediment cores and performance of magnetic susceptibility measurements along the cores.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	see table below
ASSESSMENT METHODS AND CRITERIA	I. THEORETICAL PART (**60%**) • The student's evaluation is based on the preparation of a selected topic for presentation, related to the coastal and sub-marine geological processes (Formative, Summative). or • Oral/written final examination (Summative). II. PRACTICAL PART (**40%**) • The student's evaluation is accomplished through weekly exercises concerning the understanding of the topics taught. These topics may include the origin-morphology of ocean basins, the origin-morphology of ocean margins, the influence of wave-currents on the sedimentary seabed, the identification of geomorphological, tectonic and sedimentological micro- and macro-structures via the analysis of geophysical data and sedimentary facies (Formative, Summative).

PLANNED LEARNING ACTIVITIES

Activity	Student effort
Lectures	26 hours
Practice exercises	13 hours
Fieldwork	–
Tutorials	–
Essey writing	15 hours
Autonomous study	30 hours
Final assessment preparation	16 hours
Total student's effort	**100** hours

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Harff J., Meschede M., Petersen S., Thiede J. (2016). Encyclopedia of Marine Geosciences. Springer: Netherlands.
- Kennett J.P. (1981). Marine Geology. Prentice Hall: New Jersey, USA.
- Seibold E., Berger W. (2017). An Introduction to Marine Geology, 4th Edition. Springer International Publishing: Switzerland.

III. RELATIVE JOURNALS

- GeoMarine Letters, ISSN: 02760460, 14321157, Springer Verlag.
- Marine Geology, ISSN: 00253227, Elsevier.

- Marine and Petroleum Geology, ISSN: 02648172, 18734073, Elsevier.

III. RELATIVE JOURNALS

- Journal of Vertebrate Paleontology, Online ISSN: 1937-2809, Print ISSN: 0272-4634.
- Geobios, Online ISSN: 1777-5728, Elsevier.
- Quaternary, Online ISSN: 2571-550X.
- Quaternary International, Online ISSN: 1873-4553.

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	SCHOOL OF SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
EDUCATION LEVEL	EQF level 6; NQF of Greece level 6		
CODE	E7209	SEMESTER	7th
TITLE	PETROGENESIS OF METAMORPHIC ROCKS AND ELEMENTS OF THERMODYNAMICS		

TEACHING ACTIVITIES	HOURS/WEEK	ECTS
Lectures, Practical exercises, Laboratory exercises	3	4

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	[recommended] Y2202 Systematic Mineralogy - Mineral Identification Y3201 Igneous Rocks - Magmatic Processes Y3202 Petrology Of Sedimentary Rocks Y4201 Petrology of Metamorphic Rocks
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL378

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
On successful completion of the course the student: • rigorously **describes** the mechanisms of metamorphic mineral genesis within the Earth when physical and chemical conditions change. • **evaluates** the consequences of metamorphic reactions on magmatism, seismicity, and ore deposit formation in different geological environments. • accurately **calculates** the temperature and pressure conditions of rock metamorphism within the Earth and the times required for metamorphic events to take place at both macro (e.g., orogenic) and micro (e.g., chemical zoning in minerals) scales. • **combines** physicochemical information from subducted lithospheric plates and proposes their spatiotemporal evolution, **argues** for the possibility of volatile recycling, earthquake genesis and

magmatism generation, **supports** his arguments, **revises** current views, and generate new knowledge. • **evaluates** the diamond potential of kimberlite provinces.
Generic Competences
• Ability to apply knowledge in practical situations • Promote free, creative and inductive thinking • Ability to work in a team • Information and Communication Technology (ICT) skills • Ability to search for, process and analyse information with the use of necessary technologies

(3) COURSE CONTENT

A. Lectures:

The content of the lectures includes five thematic units:

- HEAT FLOW IN THE EARTH (Heat sources in the crust and mantle, heat transfer mechanisms, heat flow-Fourier's law, heat production from radioactive isotope decay, mantle adiabat, continental and oceanic crustal geotherms, surface heat flow and Moho temperature as functions of crustal and lithospheric thickness, lithostatic pressure, thermodynamic pressure and tectonic overpressure, spatial distribution of pressure and temperature in crustal shear zones, mineral stratification in the upper mantle, geotectonic environments and geothermal gradients, heat transfer during continental collision and thermal evolution of thickened crust, migmatite genesis).
- INTRACRYSSTALINE ION DIFFUSION, CLOSURE TEMPERATURE AND COOLING RATES OF OROGENS (Fick's laws, diffusivity, concentration gradients, hierarchy of diffusivities in metamorphic minerals, effect of mineral chemical composition and oxygen fugacity on diffusivity, chemical zoning and elemental maps of minerals, evaluation of the potential of minerals in geochronology and trace-element thermometry, closure temperature and cooling rates of orogens).
- OCEANIC LITHOSPHERE SUBDUCTION ZONES (young vs. old lithosphere, fast vs. slow subduction, dry/humid/wet rheology, spatial distribution of isotherms, global water flow rates, metamorphic facies and parageneses in dry/hydrated/enriched/depleted mantle peridotite, hydrothermally altered volcanics, pelitic/quartzose/carbonaceous sediments; dehydration reactions and melting, mantle-wedge metamorphism and electrical conductivity, spatial distribution of metamorphic facies, density and seismic wave propagation velocities).
- APPLICATIONS OF THERMODYNAMICS TO PETROLOGY (laws of thermodynamics, enthalpy, entropy, heat capacity, compressibility, expansivity, chemical potential, Gibbs and Helmholtz free energy, constitutive equations, Clausius-Clapeyron equation, excess free energy, thermodynamic models of minerals, boundaries of metamorphic reactions, equilibrium constant, water phase diagram, density and relative dielectric constant of water under geological conditions, metamorphic reactions as geological thermometers and barometers).

B. Practice Exercises

The content of the practice exercises includes four thematic modules:

PART A. Heat flow in the crust and mantle. Calculation of radiogenic heat production rate and radioactive isotope content in the crust and mantle, calculation of mantle adiabat, calculation of oceanic lithosphere geotherms, calculation of steady-state continental lithosphere geotherms as a function of surface heat flow.

PART B. Intracrystalline ion diffusion and closure temperature. Effects of mineral geometry and chemical composition, oxygen fugacity and orogenic cooling rate. Calculation of chemical zoning in minerals and investigation of the suitability of minerals as chronometers and thermometers.

PART C. Thermodynamics. Calculation of metamorphic reaction boundaries (ideal endmembers and solid solutions, water-absent and water-present reactions, investigation of the importance of compressibility and heat capacity in the calculations), aluminosilicate boundaries and triple point, upper mantle facies boundaries, high – ultrahigh-pressure metamorphism boundary, applications of geothermobarometers in the crust and mantle.

C. Laboratory Exercises

Application of transmitted/polarized light optical microscopy methods for the identification of metamorphic minerals and metamorphic rocks of Greece and the Scottish Highlands derived from different igneous and sedimentary protoliths.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** / **Student effort** Lectures: 26 hours Practice exercises: 9 hours Laboratory exercises: 4 hours Tutorials: Essay writing: Autonomous study: 31 hours Final assessment preparation: 30 hours **Total student's effort**: **100** hours
ASSESSMENT METHODS AND CRITERIA	I. LECTURES (**40%**) (summative) • Oral Examination and/or • Written Exam with Short Answer Questions and Multiple Choice Test and/or • Written Exam with Extended Answer Questions II. PRACTICE EXERCISES AND FIELD EXERCISES (**60%**) (summative) • Written exam with Solving Exercises and Problems in the Practice Exercises (**40%**) and • Oral examination Laboratory exercises (**20%**)

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Frank S. Spear, 1993. Metamorphic Phase Equilibria and Pressure-Temperature-Time Paths. Monograph, Mineralogical Society of America
- Anthony R. Philpotts & Jay J. Ague, 2009. Principles of Igneous and Metamorphic Petrology (2nd Edition) Cambridge University Press
- John D. Winter, 2014. Principles of Igneous and Metamorphic Petrology (2nd Edition) Pearson Education Limited
- Jibamitra Ganguly, 2008. Thermodynamics in Earth and Planetary Sciences. Springer-Verlag
- Roger Powell, 1978. Equilibrium thermodynamics in Petrology. An introduction. Harper & Row Ltd.

III. RELATIVE JOURNALS

- Journal of Petrology (Oxford University Press)
- Journal of Metamorphic Geology (Wiley)
- Lithos (Elsevier)

- Contributions to Mineralogy and Petrology (Springer Link)

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E7210**	**SEMESTER**	**7th**
TITLE	**NEOTECTONICS**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Lab Exercises and Fieldwork		3	4
TYPE OF COURSE	**ELECTIVE /** Scientific Area		
PREREQUISITES	[recommended] Y3205 Structural Geology and Tectonics Y3203 Seismology Y5201 Geomorphology		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL133		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

The main course objectives are the understanding of the deformation of the earth's crust that has been taking place with the Current Tectonic Regime. On completion of the course the student should have the following learning outcomes defined in terms of knowledge, skills and general competence. Specifically, the student is able to:

- recognize and describe the main elements of neotectonic structure, the elements of a neotectonic map, and the controlling mechanisms of the tectonically-controlled landforms
- understand, interpret and explain the controlling mechanisms
- determine and classify the dynamic parameters of neotectonic and active faults.
- combine, compare and assess the tectonic elements and data, through neotectonic analysis, of applied geological problems, such as natural disasters, earthquake planning, assessment of earthquake fault potential, natural resources, response of earth relief to tectonic activity, etc.

Generic Competences

• Ability to search for, process and analyse information with the use of necessary technologies • Autonomous work • Oral and written communication of scientific issues • Ability to apply knowledge in practical situations • Ability to undertake research at an appropriate level

(3) COURSE CONTENT

A. Lectures

- **Methods of neotectonic research**: Descriptive (geometrical), Dynamic, Kinematic and temporal analysis of neotectonic structures.
- **Tectonic Geomorphology**: presentation, analysis and description of morphotectonic relief-evolution indices
- **Active Tectonics, Earthquake Geology and Palaeoseismology**: Neogene and Quaternary deformation rates- Active faulting and earthquake geology – trenching and dating of deformed quaternary strata.
- **Neotectonics of Greece**: Main neotectonic structures of the Hellenic territory – Neotectonic basins and marginal faults – Kinematic and deformational models of the Greek territory – Submarine/offshore neotectonic structures in the Aegean and the Eastern Mediterranean.
- **Case studies**: The Gulf of Corinth Rift, the North Aegean Basin, the Peloponnese and Ionian Islands, the Neogene-Quaternary terrestrial basins of central and NW Greece.

B. Laboratory Exercises

Part A΄: Study and analysis of neotectonic maps.
Part B΄: Descriptive, kinematic and dynamic analysis of neotectonic structures.
Part C΄: Tectonic Geomorphology.
Part D΄: Palaeoseismology and Quaternary dating methods.

C. Fieldwork

ONE-DAY FIELD TRIP IN CORINTH – ARGOLIS AREA: Neotectonic-active structures of eastern Corinthian Gulf

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	26 hours
	Practice exercises	13 hours
	Fieldwork	12 hours
	Tutorials	-
	Essey writing	12 hours
	Autonomous study	15 hours
	Final assessment preparation	22 hours
	Total student's effort	**100** hours
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted, either with progressive exams in separate sections of the course content or with the final examination of the entire course material which includes:	

	I. LECTURES (**45%**) (formative, summative) • Oral Examination and/or • Written Exam with Short Answer Questions and Multiple Choice Test and/or • Written Exam with Extended Answer Questions II. LAB EXERCISES (**45%**) (formative, summative) • Written exam with Solving Exercises and Problems III. FIELD EXERCISES (**10%**) (formative, summative) • Oral examination in the field and with evaluation of required Report or Essay

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- ΠΑΥΛΙΔΗΣ, Σ., 2007. Γεωλογία των σεισμών. University Studio Press, 380 σ.
- BULL, W., 2009, Tectonically active landscapes, Wiley-Blackwell.
- BURBANK, D., ANDERSON, R., 2001. Tectonic Geomorphology, Blackwell
- DAVIS, G. H., REYNOLDS, S. J. & KLUTH, Ch. F., 2011, Structural Geology of Rocks and Regions, Wiley, 839 p.
- FOSSEN, H., 2016, Structural Geology, Cambridge, 510 p.
- McCALPIN, J. 2009. Paleoseismology, Academic Press
- ΚΙΛΛΙΑΣ, Α., 2009, Εισαγωγή στην Τεκτονική Γεωλογία, http://www.geo.auth.gr/537/

III. RELATED JOURNALS

- Tectonophysics, Online ISSN: 1879-3266, Print ISSN: 0040-1951, Elsevier.
- **Geomorphology,** Online ISSN: 1872-695X, Print ISSN: 0169-555X
- Earth-Surface Dynamics, eISSN: ESurf 2196-632X, ESurfD 2196-6338, EGU publication –open access
- Journal of Structural Geology, Online ISSN: 1873-1201, Print ISSN: 0191-8141, Elsevier.
- Tectonics, Online ISSN:1944-9194, Print ISSN:0278-7407, AGU Publications.
- Solid Earth, eISSN: SE 1869-9529, SED 1869-9537, EGU publication –open access

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E7213**	**SEMESTER**	**7th**
TITLE	**GROUND HYDRAULICS**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Practical Exercises, Fieldwork	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	Y6202 Hydrogeology [recommended]
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL129

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

Groundwater Hydraulics is an advanced course that negotiates the flow of groundwater: a) in saturated zones, b) towards pumping works, c) towards springs and d) in coastal aquifers. After the successful completion of the course, the exercises, and the field trip, the student:

- Creates, describes, analyzes and evaluates flow nets and evaluate leakages and water pressures under various structures,
- Recognize, describe and apply a variety of methodologies for processing test pumping data and chooses the most appropriate methodology for a wide range of conditions that can be found in a hydrogeological basin,
- Determines discharge of springs, and generally utilizes and interprets hydrographs of springs, calculates important hydraulic parameters and the water resources in karst systems, and interprets the mechanisms of manifestation and discharge of springs,
- Analyzes, interprets and evaluates complex graphs of the change in the groundwater level as a function of the time logarithm and draw conclusions about the presence of hydraulic boundaries, source areas, and generally identify the causes responsible for changing the rate of level drop in an aquifer system,
- Identifies and defines the relationships between sea water and the groundwater in coastal aqui-

fers.
Generic Competences
• Ability to apply knowledge in practical situations • Promote free, creative and inductive thinking • Ability to search for, process and analyse information with the use of necessary technologies • Autonomous work and ability to work in a team • Decision making

(3) COURSE CONTENT

A. Lectures of the course

1. The porous media, fractured media, karstic media.
2. The flow in porous media. Darcy Law and Laplace Equation.
3. Flow to pumping wells.
4. Hydraulic parameters and characteristics, head losses and test pumps.
5. Flow nets.
6. Hydraulics of pumping works in a fractured media.
7. The karstic media (flow, hydraulics, karstic models, pumping works).
8. Hydrodynamic analysis of springs discharges. Time series and hydrograms. Maillet, Tison, etc. equations.
9. Hydraulic models. Hydraulics of the salinization fronts. Hydraulic of two-phase flows (hot springs).
10. Draining, pumping, reconfigurations, combined water management.

B. Lab Exercises

- Lab exercises and problems aimed at consolidating concepts taught in lectures: Application of Darcy Law, Construction of Flow Nets, Test pumps and calculation of hydraulic parameters of aquifers, Time series and hydrograms of spring discharges, hydrograms of karst springs
- Processing of data collected from field work.

C. Field Exercises (Outdoors**)**

Monitoring of test pumps in a location in Attica.
Practice in the on-site measurement of springs, gutters, pumped boreholes, and data collection for their processing in the Practice Exercises.
Where appropriate, monitoring of drilling works.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	26 hours
	Practice exercises	13 hours
	Fieldwork	10 hours
	Tutorials	4 hours
	Essey writing	12 hours
	Autonomous study	20 hours
	Final assessment preparation	15 hours

	Total student's effort **100** hours
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted in Greek, either with progressive exams in separate sections of the course content or with a final examination of the entire syllabus and includes: I. LECTURES (**45%**) (formative, summative) • Oral Examination and/or • Written Exam with Short Answer Questions and Multiple Choice Test and/or • Written Exam with Extended Answer Questions II. LAB EXERCISES (**45%**) (formative, summative) • Written exam with Solving Exercises and Problems III. FIELD EXERCISES (**10%**) (formative, summative) • Oral examination (in-situ) and by evaluating deliverables of compulsory Assignment or Report

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Voudouris Kostas S., 2016, Technical Hydrogeology, [Ref. EUDOXUS: 112690244]
- Voudouris Kostas S., 2017, Exploitation & Management of Groundwater, [Ref. EUDOXUS: 102070929]

II. ADDITIONAL READING

- Batu V., 1998: Aquifer Hydraulics: A quifer Comprehensive Guide to Hydrogeologic Data Analysis, by John Wiley & Sons, Inc. ISBN: 978-0-471-18502-4
- Driscoll G. F.: Groundwater and Wells, 2ed ed. 1989, by Jonson Filtration Systems Inc, ISBN: 0-9616456-0-1
- Dawson J. K. & Istok D. J., 1991, Aquifer Testing, Design and Analysis of Pumping and Slug Tests, by Lewis Publisher, Inc., ISBN: 0-87371-501-2
- Kresic N & Stevanovic Z.: Groundwater Hydrology of Springs, 2010, by Elsevier Inc. ISBN:978-1-85617-502-9
- Kruseman P.C. @ N. A. de Ridder: Analysis and Evalyation of Pumping Test Data. 2nd ed., 1994, by International Instsitute for Land Reclamation and Improvement, Netherlands, ISBN: 90 70754207
- Stallman, R.W., 1968, Aquifer-test design, observation and data analysis: U.S. Geological Survey Techniques of Water-Resources Investigation of the United States Geological Survey
- Lekkas S. & Ap. Alexopoulos: Introduction to Hydrogeology. 2009, Student notes of the University of Athens

III. RELATIVE JOURNALS

- Water Resources Research
- Hydrogeology Journal, Official Journal of the International Association of Hydrogeologists
- Groundwater

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E7214**	**SEMESTER**	**7TH**
TITLE	**GEOPHYSICAL FLUIDS AND INDUCED SEISMICITY**		

TEACHING ACTIVITIES	HOURS/WEEK	ECTS
Practical exercises, Laboratory exercises	4	4

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	Y1202 Physics Y4202 Geophysics [Knowledge of Basic Principles] Y3203 Seismology [Knowledge of Basic Principles]
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL517

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

Through the successful completion of this lesson, the trainees will be able to:

- Obtain the necessary knowledge and skills regarding fluid diffusion in the lithosphere.
- Study induced seismicity and how impoundment of dams could trigger it
- To calculate shear wave splitting parameters
- To evaluate fluids influence on shear wave splitting parameters
- Analyze microseismic observations related with hydraulic fracture
- To evaluate scientific results on the connection of seismicity with fluids diffusion on geoenergy resources fields

Generic Competences

- Ability to apply knowledge in practical situations
- Ability to search for, process and analyse information with the use of necessary technologies
- Oral and written communication of scientific issues
- Ability to undertake research at an appropriate level

- Autonomous work
- Ability to work in an interdisciplinary context

(3) COURSE CONTENT

A. Lectures/seminars

- An introduction to linear elasticity, seismic waves and microseismicity
- Linear elasticity and seismic waves
- Geomechanics and Seismicity (fractures in Solids)
- Microseismicity monitoring
- Principles of linear poroelasticity
- Fractures and Fluids
- Fluids and poroelasticity
- Elements of non linear effects in poroelesticity
- Seismicity and fluids diffusion
- KTB drilling project as a case study
- Pore pressure relaxation
- Seismic front waves and poroelasticity
- Seismicity , fluids and inhomogeneous media
- Seismicity and impoundment of dams
- Fluids and seismic anisotropy
- Basic principles of seismic anisotropy and shear-wave splitting
- Measuring shear waves splitting parameters
- Effects of fluids to shear-wave splitting parameters
- Variability of shear-wave splitting parameters

B. Practical and Laboratory Exercises

PART A: Spatiotemporal analysis of microseismic observations
PART B: Seismicity and fluid diffusion
PART C: Fluids and seismic anisotropy
PART D: Seismicity and hydraulic fracture

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	39 hours
	Practice exercises	13 hours
	Fieldwork	-
	Tutorials	-
	Essey writing	-
	Autonomous study	44 hours
	Final assessment preparation	4 hours
	Total student's effort	**100** hours

ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted in Greek (there is the possibility of examination in English for Erasmus students) with the final examination of the entire course material and presentation of individual work in a specific case study: I. LECTURES (**50%**) (formative) • Written Exam with Short Answer Questions and • Written Essay II. PRACTICE EXERCISES (**50%**) (formative) • Written exam with Solving Exercises and Problems The evaluation criteria of the course and the participation rates are described in the Chapter «**Error! Reference source not found.**» of this syllabus and student handbook.

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- A. Τσελέντης, Σύγχρονη σεισμολογία, [Κωδ. ΕΥΔΟΞΟΣ: 9774]
- B. Κ. Παπαζάχος, Γ.Φ. Καρακαΐσης, Π. Μ. Χατζηδημητρίου, Εισαγωγή στη σεισμολογία, [Κωδ. ΕΥΔΟΞΟΣ: 11254]

II. ADDITIONAL READING

- S. Shapiro, 2015. Fluid-Induced Seismicity. Cambridge: Cambridge University Press, doi : 10.1017/CBO9781139051132
- D. J. Furbish, 1997. Fluid Physics in Geology. Oxford University Press
- H.K. Gupta and B.K. Rastogi, 1976. Dams and earthquakes. Elsevier Scientific Publishing Co., 229.
- H.K. Gupta, 2018. Review: Reservoir Triggered Seismicity (RTS) at Koyna, India, over the Past 50 Yrs, Bull. Seism. Soc., 108 (5B): 2907-2918.
- G. Michas , F. Vallianatos Modelling earthquake diffusion as a Continuous-Time Random Walk with Fractional Kinetics: The case of the 2001 Agios Ioannis earthquake swarm (Corinth Rift), Geophysical Journal International 215(1), 2018 , DOI: 10.1093/gji/ggy282
- G. Michas, F. Vallianatos, Scaling properties and anomalous diffusion of the Florina micro-seismic activity: Fluid driven?, Geomechanics for Energy and the Environment, 2019, doi : 10.1016/j.gete.2019.100155
- G. Kaviris, I. Spingos, V. Kapetanidis, P. Papadimitriou, N. Voulgaris and K. Makropoulos, 2017. Upper crust seismic anisotropy study and temporal variations of shear-wave splitting parameters in the western Gulf of Corinth (Greece) during 2013. Physics of the Earth and Planetary Interiors, 269, 148–164.
- G. Kaviris, C. Millas, I. Spingos, V. Kapetanidis, I. Fountoulakis, P. Papadimitriou, N. Voulgaris and K. Makropoulos, 2018. Observations of shear-wave splitting parameters in the Western Gulf of Corinth focusing on the 2014 Mw=5.0 earthquake. Physics of the Earth and Planetary Interiors, 282, 60-76. doi: 10.1016/j.pepi.2018.07.005
- K. Pavlou, G. Kaviris, K. Chousianitis, G. Drakatos, V. Kouskouna and K. Makropoulos, 2013. Seismic hazard assessment in Polyphyto Dam area (NW Greece) and its relation with the “unexpected” earthquake of 13 May 1995 (Ms = 6.5, NW Greece). Nat. Hazards Earth Syst. Sci., 13, p. 141–149.
- K. Pavlou, Drakatos G, Kouskouna V, Makropoulos K, Kranis H., 2016. Seismicity study in Pournari reservoir area (W. Greece) 1981-2010. J Seismol. 2016;DOI:10.1007/s10950-016-9552-1.
- K. Pavlou, 2019. Relationship between Observed Seismicity and Water Level Fluctuations in Polyphyto Dam Area (North Greece). Journal of Geography, Environment and Earth Science International, 1-10.
- I. Spingos, G. Kaviris, C. Millas, P. Papadimitriou and N. Voulgaris, 2019. Pytheas: An open-source software solution for local shear-wave splitting studies. Computers & Geosciences, in press. https://doi.org/10.1016/j.cageo.2019, 104346.

III. RELATIVE JOURNALS

- Bulletin of the Seismological Society of America, SSA Journals

- Geophysical Journal International, Oxford University Press
- Journal of Geophysical Research, AGU Publications
- Physics of the Earth and Planetary Interiors, Journal, Elsevier
- Tectonophysics, Journal, Elsevier

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E7215**	**SEMESTER**	**7th**
TITLE	**HYDROGEOCHEMISTRY**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises, Laboratory exercises, Fieldwork		**3**	**4**
TYPE OF COURSE	**ELECTIVE /** Scientific Area		
PREREQUISITES	Y4203 - Geochemistry [recommended].		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL141		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
Upon successful completion of the course the student will be able to: • **identify** and **describe** energy mineral resources (EMR), their properties and characteristics, their uses as well as research methods to identify and evaluate them. • **combine** and **use** all the knowledge acquired during his/her studies for the exploration, evaluation and utilization of EMR. • **estimate** the environmental footprint of the exploitation of energy mineral deposits. • **combine** knowledge for the synthesis of work plans and decision-making on research and sustainable exploitation of the EMRs during the Energy Transition in harmony with environmental protection Furthermore, • **will be aware** of the importance and impact of the utilization of the renewable energy resources for the Energy Transition, the economic development, the environment and the sustainability.
Generic Competences

• Ability to apply knowledge in practical situations • Ability to plan and manage time • Ability to work in a team • Ability to search for, process and analyse information with the use of necessary technologies • Oral and written communication of scientific issues

(3) COURSE CONTENT

Lectures and practical exercises in the laboratory and on computers. – Units of measurement in hydrogeochemistry – Chemical analysis of water in the laboratory – Water sampling - Chemical analysis of water in the laboratory – Chemical analysis of water in the laboratory – Processing - Interpretation of chemical analysis data – Controlling factors on the chemical composition of water systems – Interpretation of chemical analysis data - Case study of acid mine drainage – Principles of hydrogeochemical modeling with the open software aqion – Processing of hydrogeochemical data with the open software aqion – Nanomaterials in the marine environment

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** — **Student effort** Lectures — 13 hours Practice exercises — 24 hours Fieldwork — 03 hours Tutorials — - Essey writing — 30 hours Autonomous study — 30 hours Final assessment preparation — - **Total student's effort** — **100** hours
ASSESSMENT METHODS AND CRITERIA	• The final grade is determined by a series of assessments which include: • I. REPORT WRITING (Summative) • Preparation of a comprehensive technical report presenting and evaluating the results of water chemical analysis (**70% of the final grade**) • II. LABORATORY EXERCISES (Formative) • Active participation in the process of collecting and chemically analyzing water samples and performing calculations (**30% of the final grade**)

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Eby, G. N. Αρχές Περιβαλλοντικής Γεωχημείας (Μετάφραση Λιοδάκης, Δ. Πεντάρη) Εκδόσεις Κωσταράκη, Αθήνα. 2011 [Κωδ. ΕΥΔΟΞΟΣ: 77115198] (*σύγγραμμα μαθήματος*)

II. ADDITIONAL READING

- Aquatic Chemistry, chemical equilibria and rates in natural waters. Stumm & Morgan, 1996, John Wiley and Sons
- Broder J. Merkel • Britta Planer-Friedrich Authors Groundwater Geochemistry A Practical Guide to Modeling of Natural and Contaminated Aquatic Systems Edited by Darrell Kirk Nordstrom 2nd Edition, 2008 Springer

III. RELATIVE JOURNALS

- Applied Geochemistry, Elsevier
- Geochemistry, Exploration, Environment, Analysis, Geosciences World
- Geostandards and Geoanalytical Research, Wiley

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E7216**	**SEMESTER**	**7th**
TITLE	**ATMOSPHERIC POLLUTION**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Laboratory exercises	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	[recommended] Y1202 Physics Y2203 Climatology and Climate Changes
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL536

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course the student:

- **Defines** and **describes** the basic principles and phenomena of atmospheric pollution.
- **Comprehends** the factors that shape the quality of the atmospheric environment and the ways to protect it.
- **Comprehends** and **interprets** the human impact on air pollution and the ways with which air pollution and particles affect various sectors such as the environment, health, agriculture, aquatic and terrestrial ecosystems, energy, etc.
- **Combines** the acquired knowledge and critically **evaluates** the problems to which Atmospheric Pollution is called upon to respond.
- **Applies** the specialized techniques used by Atmospheric Pollution.
- **Combines** theoretical and practical knowledge and answers environmental issues in all fields of Geosciences.

Generic Competences

- Ability to apply knowledge in practical situations
- Promote free, creative and inductive thinking
- Oral and written communication of scientific issues
- Autonomous work
- Information and Communication Technology (ICT) skills
- Commitment to conservation of the environment

(3) COURSE CONTENT

A. Lectures:

- The layers of the Earth's atmosphere.
- Factors and mechanisms shaping atmospheric air quality.
- Sources, types, measuring methods of atmospheric pollutants and their effects on health.
- Air pollution units and standards.
- Effect of air pollution on the microclimate of an area.
- The atmospheric dispersion cycle and dispersion scales.
- The role of meteorology in air pollution.
- Self-cleaning mechanisms of the atmosphere.
- Control techniques to combat air pollution.
- Air pollution models.
- Pollution of the upper atmosphere and the greenhouse effect.

B. Laboratory Exercises:

The laboratory exercises include the education of the students in the following subjects:

- **Exercise 1.** Sulfur oxide pollution – acid rain
- **Exercise 2.** Particulate pollution – smog
- **Exercise 3.** Carbon dioxide pollution – greenhouse effect
- **Exercise 4.** Nitrogen oxides pollution – photochemical smog
- **Exercise 5.** The role of wind in the distribution of air pollution concentrations
- **Exercise 6.** The vertical structure of the atmosphere and its role in the distribution of pollutants
- **Exercise 7.** Influence of topographic and other factors on the distribution of pollution of the lower atmosphere
- **Exercise 8.** Air pollution models

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.

PLANNED LEARNING ACTIVITIES

Activity	Student effort
Lectures	27 hours
Practice exercises	12 hours
Fieldwork	-
Tutorials	-
Essey writing	24 hours
Autonomous study	25 hours
Final assessment preparation	12 hours
Total student's effort	**100** hours

ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted, either with progressive exams in separate sections of the course content or with the final examination of the entire course material which includes: I. LECTURES (**50%**) Written Exam with short Answer Questions and Multiple-Choice Test and/or Extended Answer Questions (summative). II. PRACTICE EXERCISES (**50%**) Written Essays for every Practical Exercise and evaluation (formative, summative). Auxiliary material (questions, exercises, etc.) for the exams is posted on the online **e-Class** platform https://eclass.uoa.gr/courses/GEOL536.

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Ατμοσφαιρική Ρύπανση, επιπτώσεις, έλεγχος και εναλλακτικές τεχνολογίες, Ι. Γεντεκάκης, [κωδ. ΕΥΔΟΞΟΣ: 28017]
- Ατμοσφαιρική Ρύπανση με Στοιχεία Μετεωρολογίας, Μ. Λαζαρίδης, [κωδ. ΕΥΔΟΞΟΣ: 18548841]
- Αέρια Ρύπανση, Α. Τριανταφύλλου, [κωδ. ΕΥΔΟΞΟΣ: 68396375]
- Ρύπανση και τεχνολογίες προστασίας περιβάλλοντος, Τ. Αλμπάνης, [κωδ. ΕΥΔΟΞΟΣ: 18548776]
- Περιβαλλοντική Μηχανική, Α. Κούγκολος, [κωδ. ΕΥΔΟΞΟΣ: 94688998]
- Περιβαλλοντική Επιστήμη, Miller G. T., Spoolman E. S., (Επιμέλεια: Π. Δημητρακόπουλος, Κ. Γαβριλάκης), [κωδ. ΕΥΔΟΞΟΣ: 59386824]

II. ADDITIONAL READING

- Jacobson, M. Z., 2012, **Air Pollution and Global Warming: History, Science, and Solutions**, Second Edition, Cambridge University Press, [ISBN: 9781107691155].
- Tiwary, A. Williams, I., 2019, **Air Pollution: Measurement, Modelling and Mitigation**, Fourth Edition, [ISBN: 9781498719452].

III. RELATIVE JOURNALS

- Atmospheric Chemistry and Physics, Online, European Geosciences Union.
- Atmospheric Environment, Online, Elsevier.

Additional Reading Material

- Teachers' notes, presentations of the lectures and exercise material posted on the e-Class platform of the course.

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E7217**	**SEMESTER**	**7th**
TITLE	**MINERAL RESOURCES AND ENERGY TRANSITION**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Lab exercises and Fieldwork	**4**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	[recommended] **Y2202** Systematic Mineralogy-Mineral Identification **Y3202** Petrology Of Sedimentary Rocks Y4203 Geochemistry. Y3201 - Igneous Petrology.
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL534

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

Upon successful completion of the course the student will be able to:

- **identify** and **describe** energy mineral resources (EMR), their properties and characteristics, their uses as well as research methods to identify and evaluate them.
- **combine** and **use** all the knowledge acquired during his/her studies for the exploration, evaluation and utilization of EMR.
- **estimate** the environmental footprint of the exploitation of energy mineral deposits.
- **combine** knowledge for the synthesis of work plans and decision-making on research and sustainable exploitation of the EMRs during the Energy Transition in harmony with environmental protection

Furthermore,

- **will be aware** of the importance and impact of the utilization of the renewable energy resources

for the Energy Transition, the economic development, the environment and the sustainability.
Generic Competences
• Ability to search for, process and analyse information with the use of necessary technologies • Oral and written communication of scientific issues • Ability to apply knowledge in practical situations • Promote free, creative and inductive thinking • Commitment to conservation of the environment • Information and Communication Technology (ICT) skills

(3) COURSE CONTENT

A. Lectures.

- Introduction to international energy resources. What is the situation in Greece. Definitions and terminology.
- Energy Raw Materials and Energy Metals. Energy Transition and zero CO2 balance.
- Energy raw materials and changes in the exploitation of mineral resources after the Energy Transition.
- Coal. Coal exploration. Lignite genesis in Greece. Inorganic & organic constituents in coals. Gases in coal. Desulfurization. CCS technologies. Composition & evaluation of sterile materials and coal-burning by-products.
- Hydrocarbons. Structure of oil industry. Oil Genesis and migration. Geological features of oil basins. Reservoirs of oil and gas. Hydrocarbon exploration in Greece. Shale-derived oil and gas. Oil sands.
- Deposits and exploitation of radioactive ores - Occurrences of radioactive minerals in Greece.
- Exploration, evaluation and exploitation of geothermal fields. Geochemistry of geothermal fluids. Geothermal energy in Greece.
- Large and small hydroelectric projects and reservoirs.
- The role of Geology in the energy utilization of Biomass.
- Blue, brown and green hydrogen – Fuel cells
- Requirements of Renewable Energy Sources in Mineral Raw Materials.
- The geology of energy metal deposits.
- Environmental issues of Renewable Energy Resources and social acceptance.

B. Laboratory Exercises:

Exercises on: the calculation of the reserves of deposits; the determination of the potential of the exploitation of an energy mineral deposit; the design of deposit sections based on geological data; the determination of areas for exploration based on geological criteria; the macroscopic identification of various types of coal; the identification and possible applications lignite mining by-products, as well as its combustion by-products: fly ash and synthetic gypsum; mass calculations of wastes; desulphurisation and CCS; geochemical methods in hydrocarbon exploration.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

<table>
<tr><td>MODE OF DELIVERY</td><td colspan="2">– Face to face.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGY</td><td colspan="2">– Use of ICT in teaching (lectures, lab exercises, fieldwork).
– Use of ICT in communication with students.</td></tr>
<tr><td rowspan="3">PLANNED LEARNING ACTIVITIES</td><td>Activity</td><td>Student effort</td></tr>
<tr><td>Lectures</td><td>26 hours</td></tr>
<tr><td>Practice exercises</td><td>26 hours</td></tr>
</table>

	Fieldwork - Tutorials Essey writing - Autonomous study 20 hours Final assessment preparation 28 hours **Total student's effort** **100** hours
ASSESSMENT METHODS AND CRITERIA	The final grade is formed by a series of tests which include: I. REPORT AND PUBLIC PRESENTATION (**50%** of the final grade) • Writing a report in the form of a review on issues related to Industrial Minerals and Rocks and its public presentation before all students attending the course. (Summative) II. LABORATORY EXERCISES (**50%** of the final grade) • Problem solving and writing relevant reports during laboratory exercises. (Formative, Summative)

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Παπούλης Δ, Λαμπροπούλου Π., 2016, **Ορυκτολογία: Συστηματική ταξινόμηση των ορυκτών**, [EUDOXUS code: 77112087]

II. ADDITIONAL READING

- Ciullo A.P., 1996. Industrial minerals and their uses. A Handbook & Formulary. Elsevier, 647 pages
- Ι.Γ.Μ.Ε., 2011. Ελληνικός Ορυκτός Πλούτος – Νέες αναπτυξιακές δυνατότητες για βιώσιμες και παραγωγικές επενδύσεις
- Stamatakis M, 2017: Laboratory booklet for the course "Industrial Minerals and Rocks", (in Greek).
- Stamatakis M. and Katerinopoulos A., 1995. Applied Mineralogy – Petrology. Industrial minerals and rocks and their uses in Greek
- Τσιραμπίδης Α., 2005. **Ο ορυκτός πλούτος της Ελλάδος**. Εκδόσεις Γιαχουδη Ι.Κ.Ε.

III. RELATIVE JOURNALS

- Industrial Minerals,
- Cement and concrete composites, Elsevier
- Clays and clay minerals, Elsevier
- International Journal of Mineral Processing, Elsevier
- Economic Geology, Society of Economic Geologists (SEG)

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E7218**	**SEMESTER**	**7th**
TITLE	**APPLIED AND ENVIRONMENTAL MINERALOGY AND PETROLOGY**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Lab Exercises and Fieldwork	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	Y1205 Mineralogy-Crystallography [recommended] Y2202 Systematic Mineralogy-Mineral Identification [recommended]
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL232

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
On successful completion of the course the student: • **Define** and **formulate** the basic principles, methods and applications of Applied and Environmental Mineralogy and Petrology. • **Classify** and **describe** minerals as carriers of critical metals, gemstones, hydrothermal alteration minerals, industrial minerals and rocks, their formation conditions and uses, as well as minerals related to the environment, ecosystems, microbes and the human organism. • **Comprehend** the applications and uses of minerals and rocks, and the interaction between minerals and the natural environment and living organisms. • **Apply** the techniques of Mineralogy-Petrology, and of optical microscopy with the aim of developing mental and practical skills that include identification of minerals and rocks used in construction, road construction, industry, jewelry, technology, and in commerce, both macro- and microscopic, as well as using free software for the classification of minerals and rocks from their chemical analyses. The visit to the Lithos center and the field exercise carried out are aimed at identify-

ing minerals and rocks in the field.

Generic Competences

- Ability to search for, process and analyze information with the use of necessary technologies.
- Autonomous work.
- Ability to apply knowledge in practical situations.
- Work independently.
- Promote free, creative, and inductive thinking.
- Ability to plan and manage time.
- Information and Communication Technology (ICT) skills.

(3) COURSE CONTENT

A. Lectures

- Metallic minerals as carriers of critical metals. Mineralogy, Mineral-Chemistry, depositional environment, application. Occurences in Greece and elsewhere.
- Introduction to Gemology. Gemstones, Categories of Gemstones, mineral-chemistry and formation conditions. Gemstones in Greece –Crystallization environments.
- Hydrothermal alterations – Zones of hydrothermal alteration, Mineralogy/Mineral-Chemistry – Conditions of formation and occurences in Greece – Uses of hydrothermal alteration minerals (alunite, alumino-phosphate-sulfate minerals, kaolinite, smectite, zeolites, borates, etc.)
- Limestones, Marbles and Granites as structural and decorative stones. – Inert materials – Archaeometry and Petrology.
- Classifying minerals and rocks by use (filtration, ceramics and refractory materials, abrasives, fertilizers, single crystals, insulating materials, additives, binding materials - powders, glassmaking). Formation of minerals deposits and exploitation areas of industrial minerals and rocks in Greece.
- Introduction to Environmental and Medical Mineralogy. Minerals and mineraloids in living organisms.
- Minerals and natural ecosystems (soils, waters). Bio-mineralogy. Mineralogy of anthropogenically modified environment.
- Minerals and Environmental Pollution in mining areas.

B. Lab exercises.

Practice exercises are taught in small groups of students and are graded at the end of the exercise.

Exercise 1. Macroscopic and microscopic identification of critical metal bearing minerals (I).

Exercise 2. Macroscopic and microscopic identification of critical metal bearing minerals (I).

Exercise 3. Macroscopic and microscopic identification of hydrothermal alteration minerals (I).

Exercise 4. Macroscopic and microscopic identification of hydrothermal alteration minerals (II).

Exercise 5. Macroscopic and microscopic identification of gemstones (I).

Exercise 6. Macroscopic and microscopic identification of gemstones (II).

Exercise 7. Macroscopic and microscopic identification and properties of industrial minerals (asbestos, feldspar, graphite, sulfur, kyanite, magnesite, garnet, micas, olivine, talc, fluorite, barite, quartz).

Exercise 8. Macroscopic and microscopic identification and properties of industrial rocks (limestone, marble, granite, bauxite, evaporite, perlite, emery).

Exercise 9. Visit to the Lithos Center and to a factory of processing and sale of structural/decorative stones.

Exercise 10. Visit to the Mineralogy-Petrology Museum of NKUA and identification of critical metal bearing minerals.

Exercise 10. Visit to the Mineralogy-Petrology Museum of NKUA and identification of industrial minerals.

Exercise 12. Visit to the Mineralogy-Petrology Museum of NKUA and identification of industrial rocks.

Exercise 13. Fieldtrip to Lavrion area and recognition of hydrothermal alteration zones in the field.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	see table below
ASSESSMENT METHODS AND CRITERIA	I. LECTURES (**60%**) • Oral or written final examination (summative). Exams include short or extended answer questions, multiple choice tests. II. LAB EXERCISES (**40%**) • Written final examination of classification of minerals and rocks by uses. Macroscopic and microscopic identification of hydrothermal alteration minerals and critical metals bearing minerals (summative).

Activity	Student effort
Lectures	26 hours
Practice exercises	13 hours
Laboratory exercises	9 hours
Tutorials	–
Essey writing	–
Autonomous study	37 hours
Final assessment preparation	18 hours
Total student's effort	**100** hours

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Godelitsas, A. & Papoulis, Δ., 2021, **Nanogeosciences**, Publ. Gotsi.
- Collins, T., 2023, **Applied Mineralogy Handbook**, ISBN-10: 1641167920, CALLISTO REFERENCE.
- Dixon, J.B. & Schulze, D.G., 2018, **Soil Mineralogy with Environmental Applications**, ISBN: 978-0-891-18891-9, Wiley.
- Götze, J. & Göbbels, M., 2023, **Introduction to Applied Mineralogy**, Springer.
- Voudouris, P., Karampelas, S., Melfos, V. & Graham, I., 2020, **Mineralogy and Geochemistry of Gems**. Minerals MDPI, 528p, https://doi.org/10.3390/books978-3-03928-077-3 2020
- Wenk, H.R, Bulakh, A., 2004, **Minerals, their constitution and origin**. Cambridge University Press.

III. RELATIVE JOURNALS

- American Mineralogist, Online ISSN: 1945-3027, Print ISSN: 0003-004X, Mineralogical Society of America.
- Mineralogical Magazine, Online ISSN: 1471-8022, Print ISSN: 0026-461X, Mineralogical Society of Great Britain and Ireland.
- European Journal of Mineralogy, Online ISSN: 1617-4011, Print ISSN: 0935-1221, DMG-SEM-SIMP-SFM.
- Minerals, Online ISSN: 2075-163X, MDPI.

COURSE OUTLINE

(1) GENERAL INFORMATION

<table>
<tr><td>FACULTY</td><td colspan="3">SCHOOL OF SCIENCE</td></tr>
<tr><td>DEPARTMENT</td><td colspan="3">GEOLOGY AND GEOENVIRONMENT</td></tr>
<tr><td>EDUCATION LEVEL</td><td colspan="3">EQF level 6; NQF of Greece level 6</td></tr>
<tr><td>CODE</td><td>E7219</td><td>SEMESTER</td><td>7th</td></tr>
<tr><td>TITLE</td><td colspan="3">APPLIED CLIMATOLOGY</td></tr>
<tr><td colspan="2">TEACHING ACTIVITIES</td><td>HOURS/WEEK</td><td>ECTS</td></tr>
<tr><td colspan="2">Lectures, Laboratory exercises</td><td>3</td><td>4</td></tr>
<tr><td>TYPE OF COURSE</td><td colspan="3">ELECTIVE / Scientific Area</td></tr>
<tr><td>PREREQUISITES</td><td colspan="3">Y1202 Physics [recommended]
Y2203 Climatology and Climate Changes [recommended]</td></tr>
<tr><td>LANGUAGE OF INSTRUCTION AND ASSESSMENT</td><td colspan="3">Greek- English</td></tr>
<tr><td>AVAILABILITY TO ERASMUS STUDENTS</td><td colspan="3">YES</td></tr>
<tr><td>WEBPAGE (URL)</td><td colspan="3">http://eclass.uoa.gr/courses/GEOL542</td></tr>
</table>

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
Upon completion of the course, the student: • **Defines** and **describes** specific climatic parameters • **Understands** and **interprets** the ways in which climate affects different sectors of human activity such as agriculture, forestry, hydrology, human health, transport, energy, etc, • **Distinguishes** and **explains** the impact of human activity on climate • **Combines** the knowledge acquired and critically evaluate the issues addressed by applied climatology • **Applies** the specialised techniques used in applied climatology • **Combines** theoretical and practical knowledge and **answers** to environmental issues in the field of earth sciences
Generic Competences
• Ability to apply knowledge in practical situations • Oral and written communication of scientific issues • Autonomous work • Information and Communication Technology (ICT) skills

• Commitment to conservation of the environment •

(3) COURSE CONTENT

A. Lectures

- Climate data processing.
- Climate Classifications.
- Climate indicators.
- Climate impact on humans and bioclimatic indicators.
- Climate and hydrology, soils, agriculture, forestry, energy.
- Methods of climate modification.
- Climatic elements and natural disasters.
- Climate change and impact assessment.
- Climate Models and Future Projections..

B. Laboratory exercises:

Laboratory exercises are conducted in class and individual assignments are submitted weekly.

Exercise 1. Regression, correlation and trend of climate time series
Exercise 2. Smoothing and interpolation of climate data
Exercise 3. Evapotranspiration and surface water balance
Exercise 4. Recurrence intervals of extreme hydrological events and probabilities of exceeding thresholds
Exercise 5. Climatogram & Thermohyetogram
Exercise 6. Precipitation climate maps
Exercise 7. Estimating rainfall in catchments (Thiessen method)
Exercise 8. Köppen climate classification
Exercise 9. Bioclimatic indicators
Exercise 10. Use of dendroclimatological data to reconstruct climate time series

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** — **Student effort** Lectures — 27 hours Practice exercises — 12 hours Fieldwork — - Tutorials — - Essey writing — 24 hours Autonomous study — 25 hours Final assessment preparation — 12 hours **Total student's effort** — **100** hours
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted, either with progressive exams in separate sections of the course content or with the final examination of the entire course material which includes:

	I. LECTURES (**50%**) Written Exam (summative) The exams include Short and Extended Answer Questions and Multiple Choice Test II. PRACTICE EXERCISES (**50%**) Written Essays for every Practical Exercise (formative, summative) Supplementary material (questions, exercises, etc.) for the exams is posted on the online **e-Class** platform https://eclass.uoa.gr/courses/GEOL542.

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Kanellopoulou E., **Applied Climatology,** Symmetria [EUDOXUS Code:45439] in Greek
- Ahrens Donald, Henson Robert, **Meteorology Today**, 13th ed., Floca Helena, Anagnostopoulou C., Tolika K., Hatzaki M. (Scientific editors), Tziolas [EUDOXUS Code:102072114] in Greek

II. ADDITIONAL READING

- **Perry A., Thompson R., 1997, Applied Climatology: Principles and Practice, Routledge, 384 p.**
- **Hobbs J.E., 1980, Applied Climatology: A Study of Atmospheric Resources, Elsevier**

III. RELATIVE JOURNALS

- **Nature Climate Change, Online ISSN** 1758-678X, Springer Nature
- **Journal of Climate, Online** eISSN: 1520-0442, Print: ISSN: 0894-8755; American Meteorological Society
- **International Journal of Climatology, Online ISSN:1097-0088, Print ISSN:0899-8418, Royal Meteorological Society**
- **Theoretical and Applied Climatology Print** ISSN: 0177-798X, Springer

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E7220**	**SEMESTER**	**7th**
TITLE	**ENVIRONMENTAL MICROPALAEONTOLOGY - PALAEO-CLIMATOLOGY**		

TEACHING ACTIVITIES	HOURS/WEEK	ECTS
Lectures, Practical exercises	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	Y3206 BioGeosciences- Principles of Micropalaeontology [recommended]
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL253

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

Upon successful completion of the course the student:

- Describes, analyses and correlates rocks from the stratigraphic sequences of the Hellenides
- Comprehends the lithological, biostratigraphical and sedimentological features of the stratigraphic sequences as well as their development in space and time
- Inserts the stratigraphic sequences within the geodynamic context of the orogenic cycles
- Combines stratigraphic, paleontological and sedimentological data for the interpretation of depositional environments and the related paleoenvironmental evolution
- Synthesizes the paleogeography of the Hellenides, in correlation with molassic and postalpine sequences

Generic Competences

- Ability to apply knowledge in practical situations
- Promote free, creative and inductive thinking
- Ability to work in a team
- Ability to search for, process and analyse information with the use of necessary technologies
- Decision making
- Autonomous work

- Ability to work in an international context
- Ability to work in an interdisciplinary context

(3) COURSE CONTENT

A. Lectures:

Environmental Micropaleontology- applications in environmental research

- Aims and basic principles
- Qualitative and quantitative methods and tools of Industrial and Environmental Micropaleontology
- Case Studies

Paleoceanographic-Paleoclimatic micropaleontological applications

- Aims and basic principles
- Qualitative and quantitative methods and tools of Micropaleontology paleoceanographic and paleoclimatic applications
- Case Studies

Paleoclimatology

- Paleoclimatic indices
- Paleoclimatic data (proxy data).
- Physical methods of paleoclimatic data determination

B. Practical and Laboratory Exercises :

Laboratory Exercises 1-2. Calcareous nannofossils. Biostratigraphic analysis of geological samples under polarizing microscope. Analysis of micropaleontological range charts from drilling datasets and developing skills for biostratigraphic estimations.

Laboratory Exercises 3-4. Benthic foraminifera. Data processing and analysis, structure and composition of the assemblages and developing skills for the application of bioindices a) for the assessment of water quality in the context of environmental monitoring of coastal marine ecosystems, b) for estimation of paleo-productivity and oxygen content at the bottom water-sediment interface, widely applied in paleoceanographic/paleoclimatic research.

Laboratory Exercises 5-6. Planktonic foraminifera. Applications in paleoceanographic/paleoclimatic research

Laboratory Exercises 7-8. Spectral analysis techniques in Paleoclimatology

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	see below

Activity	Student effort
Lectures	26 hours
Practice exercises	13 hours
Fieldwork	8 hours
Tutorials	-
Essey writing	21 hours
Autonomous study	16 hours
Final assessment preparation	16 hours
Total student's effort	**100** hours

ASSESSMENT METHODS AND CRITERIA	For the lab: • Lab essays with bibliographic or practical objectives (**50%)** (formative, summative) For the theoretical part: • written team work essays assessment and oral presentation (**50%**) (formative, summative)

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Malinverno, E., Dimiza, M.D., Triantaphyllou, M.V., Dermitzakis, M.D., Corselli, C., 2008. Coccolithophores of the eastern Mediterranean Sea: a look into the marine micro world. ION Publications, Athens, 188, (ISBN 97-960411-660-7).

II. ADDITIONAL READING

- Triantaphyllou M.V., Dimiza M.D., 2012. Micropaleontology and Geoenvironment. ION Publications, 168 pp., ISBN 978-960-508-058-7.
- Aubry, M.-P. (1984-1999). Handbook of Cenozoic Calcareous Nannoplankton, Book 1-4, Micropaleontology Press American Museum of Natural History, New York.
- Cimerman, F., Langer, M.R., 1991. Mediterranean foraminifera. Academia Scientarium et Artium Slovenica, Dela, Opera 30, Classis IV, Historia Naturalis, 118 pp.
- Sgarrella, F., Moncharmont Zei, M. 1993. Benthic foraminifera of the Gulf of Naples (Italy): systematics and autoecology. Bollettino della Società Paleontologica Italiana, 32: 145–264.
- Milker, Y., Schmiedl, G. 2012. A taxonomic guide to modern benthic shelf foraminifera of the western Mediterranean Sea. Palaeontologia Electronica, 15(2), 16A: 134 pp.
- Murray, J., 2006. Ecology and Applications of Benthic Foraminifera. Cambridge University Press, p. 426.
- Dermizakis, M.D., Georgiades-Dikaioulia, E., 1985, Introduction to Marine Micropaleontology. 720 pp., Eptalofos Publications, Athens.
- Zambetakis-Lekkas, A., Antonarakou, A.,Drinia, H., Tsourou, Th., Di Stefano, A., Baldassini, N. 2015. Micropaleontology and applications (e-book: pdf, e-pub) [Eudoxus code: 320254]

III. RELATIVE JOURNALS

- **Marine Micropaleontology,** Online ISSN: **1872-6186**
- **BioGeosciences,** Online ISSN: 1726-4189
- **Revue de Micropaleontologie,** Online ISSN: 1873-4413

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E7221**	**SEMESTER**	**7th**
TITLE	**GEOTECHNICAL PROJECTS**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Lab Exercises, Fieldwork	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	https://eclass.uoa.gr/courses/GEOL539/

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

Upon successful completion of the course, the student:

- **Knows** the different stages of engineering structures studies.
- **Analyses, ccombines and applies** the essential geological and geotechnical criteria for construction feasibility and selecting the best design.
- **Acquires skills** in planning and executing geological and geotechnical investigations and evaluating geo-research programs for assessing geotechnical parameters for the design of engineering structures.
- **Becomes familiar** with preparing geotechnical maps and geotechnical models in the context of designing engineering structures.
- **Acquires specialized knowledge** in the calculations of: slopes stability, underground excavations and ground support design and bearing capacity of foundations.
- **Comprehends** the various types of settlement of a structure and **applies** methods to estimate them
- **Knows** the role of geomaterials as a construction material and their improvement techniques.

Generic Competences

• Ability to apply knowledge in practical situations • Ability to work in a team • Ability to search for, process and analyse information with the use of necessary technologies • Oral and written communication of scientific issues • Decision making

(3) COURSE CONTENT

A. Lectures

- TUNNELS (Geotechnical site investigation, Rock Mass Classification systems, Design principles and construction methods – NATM and TBM, Ground support methods, Stability analysis, Ground support interaction analysis, Design in special situations, Monitoring systems, Failures and emergency measures).
- UNDERGROUND AND SURFACE MINING (Underground and Surface Mines, Quarries, Mining Methods, Geotechnical factors in the design of underground and surface mining projects).
- TRANSPORTATION INFRASTRUCTURE – ROAD CONSTRUCTION (Geotechnical site investigation and reports, Pavements, Embankments, Cut&Covers, Retaining walls, Bridges).
- SLOPES (Soil and rock slope stability analysis using PC: plane and wedge failure, rockfall, methods of slices, probabilistic analysis, stability of slopes under seismic loading, Design considerations for slopes, Technologies for slope stabilization, Monitoring systems).
- FOUNDATIONS (Foundations: functions and requisites, shallow and deep foundations, choice of foundation type, general principles of design, Bearing capacity of shallow foundations: types of failures, bearing capacity analysis, shallow foundation design using Eurocode 7, Settlement analysis, Deep foundations: type of piles, load carrying capacity of single piles and pile groups, settlement of single piles and pile groups).
- EARTH STRUCTURES (Embankments, Compaction, Preloading, Soil reinforcement, Geosynthetics).

B. Lab Exercises

PART A: Site investigation including evaluation of soil and rock mass properties for design.
PART B: Ground support interaction analysis for tunnel design.
PART C: Rock and soil slope stability analysis.
PART D: Bearing capacity of shallow foundations.
PART E: Settlement analysis of shallow foundations.
PART F: Individual project writing and presentation

C. Fieldwork

Visit to important engineering projects in progress.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** / **Student effort** Lectures: 26 hours Practice exercises: 13 hours Fieldwork: 8 hours Tutorials: - hours Essey writing: 21 hours Autonomous study: 16 hours

	Final assessment preparation 16 hours **Total student's effort** **100** hours
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted, either with progressive exams in separate sections of the course content or with the final examination of the entire course material which includes: I. LECTURES (**50%**) • Written Exam with Short Answer Questions and Multiple Choice Test (summative) • and/or • Written Exam with Extended Answer Questions (summative). II. LAB EXERCISES (**50%**) • Weekly assessment of lab exercises (formative, summative) (**25%**) and • Individual Project Evaluation (formative, summative) (**25%**).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Kostopoulos S. 2008. **Geotechnical Constructions, Vol. I.** Publisher ION [EUDOXUS code: 122079916],in Greek.

II. ADDITIONAL READING

- Καββαδάς Μ. 2009. Σημειώσεις Σχεδιασμού Υπογείων Εργων. http://users.ntua.gr/kavvadas/Books/books.htm.
- Hoek E. 2007. Practical Rock Engineering https://www.rocscience.com/learning/hoek-s-corner/books
- Braja M. Das. 1983. Principles of Foundation Engineering Publisher: Cengage Learning (7th edition, 2010).

III. RELATIVE JOURNALS

- Géotechnique, Publisher: CE Publishing
- Soils and Foundations, Publisher: Elsevier BV.
- Journal of Geotechnical and Geoenvironmental Engineering, Publisher: American Society of Civil Engineers
- International Journal of Rock Mechanics and Mining Sciences, Publisher: Elsevier BV.
- Rock Mechanics and Rock Engineering, Publisher: Springer.
- Tunnelling and Underground Space Technology, Publisher: Elsevier BV.
- Journal of Geotechnical and Geoenvironmental Engineering, Publisher: American Society of Civil Engineers.

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E8207**	**SEMESTER**	**8th**
TITLE	**MINERAL RESOURCES AND THE ENVIRONMENT**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures and Lab Exercises	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	Y6205 Geology of Magmatic and Hydrothermal Ore Deposits Y4203 Geochemistry
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	https://eclass.uoa.gr/courses/GEOL504/

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
On successful completion of the course the student will be able to: • **Comprehend** the environmental challenges arising from the exploitation of mineral resources • **Identify** and **describe** the environmentally friendly technologies of mineral resources utilization • **Evaluate** the environmental issues that are associated with the mining sector • **Compare** and **propose** new technologies for the exploitation of mineral resources • **Search for** the current mining and environmental legislative framework
Generic Competences
• Ability to be critical and self-critical • Oral and written communication of scientific issues • Ability to apply knowledge in practical situations • Work in a team • Promote free, creative and inductive thinking

(3) COURSE CONTENT

A. Lectures

- Introduction to mineral resources and sustainability. The United Nations Framework for Mineral Resources Categorization (UNFC). Geoethics in mining sector.
- Legislative framework regarding the exploration and exploitation of mineral resources. Hellenic Mining Activities Code. Environmental impact studies. Exploitation in Natura 2000 areas.
- Mining methods, type of mining wastes and environmental impacts.
- Mineral processing methods, types of wastes and environmental impacts.
- Utilization of mining wastes in cyclic economy and sustainable development. Secondary resource of mineral resources.
- Remediation and rehabilitation of mining sites, and management of mining wastes of historical mining activities.
- Sea-bed mining and blue development. New challenges in the exploitation of mineral resources and their environmental consequences.
- Green minerals. Introduction. Environmental applications.
- Mineral resources and Renewable Energy Sources. Environmental challenges.

B. Lab exercises.

- Pen-and-paper exercises in class
- Laboratory exercise using green minerals in the treatment of monometallic aqueous solutions.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** / **Student effort** Lectures: 24 hours Practice exercises: 15 hours Fieldwork: - Tutorials: - Essey writing: 11 hours Autonomous study: 20 hours Final assessment preparation: 30 hours **Total student's effort**: **100** hours
ASSESSMENT METHODS AND CRITERIA	I. <u>LECTURES</u> (**80%**) • Oral final examination by presentation of a scientific topic (summative). • Participation of students in the discussion of the lecture topics (formative). II. <u>LAB EXERCISES</u> (**20%**) • Problem solving during practice exercises, delivery of laboratory report in the form of activity reports with calculations (summative). Supplementary material for the exams (questions, exercises etc.) is posted on **e-Class** platform (https://eclass.uoa.gr/courses/GEOL504/).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Eby, G. N. **Principles of Environmental Geochemistry**, 500 p. [EUDOXUS code: 77115198], in Greek.

II. ADDITIONAL READING

- Lottermoser B., 2003, **Mine Wastes**, Springer, 280 p.
- Marker, B.R., Petterson, M.G., McEvoy, F., Stephenson, M.H., 2005, **Sustainable Minerals Operations in the Developing World**, Geological Society, London, Special Publication, 250 p.

III. RELATIVE JOURNALS

- Elements, Online ISSN: 1811-5217, Print ISSN: 1811-5209, Mineralogical Society of America
- Waste management, Online ISSN: 1879-2456, Print ISSN: 0956-053X, Elsevier B.V.
- Applied Geochemistry, Online ISSN: 1872-9134, Print ISSN: 0883-2927, Elsevier B.V.

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**ΠΑ001**	**SEMESTER**	**7th & 8th**
TITLE	**INTERNSHIP**		

TEACHING ACTIVITIES	HOURS/WEEK	ECTS
Internship	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	https://www.geol.uoa.gr/foitites/praktiki_aksisi/ https://eclass.uoa.gr/courses/GEOL457/

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On completion of the internship, the student:

- **Understands** the range of options for planning his educational or professional career, starting from his undergraduate studies.
- **Applies** the knowledge and skills developed while studying to the workplace.
- **Evaluates** whether the subject of his work placement is a possible career choice.
- **Estimates** his knowledge, skills and general education in relation to the professional field in which he is trained.

Generic Competences

- Ability to apply knowledge in practical situations
- Promote free, creative and inductive thinking
- Ability to plan and manage time
- Ability to work in a team
- Ability to search for, process and analyse information with the use of necessary technologies

(3) COURSE CONTENT

This course includes a 2-month work placement in institutions/companies relevant to the subjects taught in the Department. Students are free to choose the institution (located anywhere in the country) where they would like to do their placement. They will be given specific tasks and responsibilities by their assigned Supervisor at the institution/company. Internship hours are full-time, aligned with the Host Institution's working hours. The internship provides students with the opportunity to experience the modern working environment and to apply their scientific knowledge in a real-world setting. It also helps them to enhance their scientific training by acquiring professional skills and qualifications. In addition, the internship provides networking opportunities with institutions/companies and executives, allowing students to gain valuable professional experience.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	<table><tr><th>Activity</th><th>Student effort</th></tr><tr><td>Internship (assignment of work by the Host entity)</td><td>2 Months (Full time job)</td></tr><tr><td>Total student's effort</td><td>2 Months</td></tr></table>
ASSESSMENT METHODS AND CRITERIA	Language of Evaluation: greek. Student deliverables: • Detailed activity report • Daily attendance and activity schedule of the student trainee • Certificate of Completion of the Student Activity and Activity Report of the Host Organisation • Student Performance Report from the Student Work Supervisor at the Host Organisation. The final mark is determined by the Student Performance Report. However, it will not be taken into account for the final grade of the degree.

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Internship Regulation of the Department of Geology and Geoenvironment (in greek)
- Guide and answers to frequently asked questions (in greek)
- Internship Guide 2023-2024 (in greek)

- Indicative index of organisations/companies to search for placements

III. RELATIVE JOURNALS

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COURSE UNITS: 8th Semester

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y8202**	**SEMESTER**	**8th**
TITLE	**DISSERTATION-RESEARCH**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
1. Subject and methodology analysis, bibliographic information. 2. Guidance from the supervisor. 3. Field work and data collection (sampling, instrumental measurements, mapping, etc.) *. 4. Processing and analysis, in the laboratory of fieldwork samplings and/or laboratory-research material (sample or data preparation, laboratory analyses, laboratory determinations, statistical analysis, simulations, analogue or numerical models, computational processing, etc.). 5. Writing of diploma thesis and compilation of maps, tables, diagrams, etc. * if applicable	**-**	**20**

TYPE OF COURSE	**MANDATORY /** Scientific Area
PREREQUISITES	All courses (compulsory or elective) that support the subject of the dissertation.
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

The elaboration and writing of the diploma thesis represents a typical project that a graduate Geologist will need to compile, in the fields of basic or applied research.

The intended result is that the student is able to cope with all the stages required for the thesis to be qualified for either published in a journal or presented at a conference. Thus, through this process, the following outcomes are expected:

- Understanding of the research subject and the methodology required to achieve it

- Clear definition of the research objective in the field and specialization chosen by the trainee; which should cover a subject of modern research fields
- Ability to search, find, understand and evaluate available bibliographic data
- Familiarization with fieldwork (if applicable) and application of all required techniques and methodologies, depending on the various research subjects. Where appropriate, the trainees become familiarized with: a) the way they should proceed on research, use the equipment with safety during geological work in a rural environment, b) the identification and mapping of geological data and structures that interest them, c) the way they should organize and plan the information collected in the Fieldwork notebook, d) the procedures and techniques required for sampling from rocks, soils, water or air, e) the use of specialized instruments and devices and the instrumental measurements procedure and f) the use of electronic devices and the specialized software that accompanies them.
- Adaptation with the techniques and methodologies applied, related to the laboratory processing and analysis of all data (either collected in the field or already available for processing), as well as with the use of all available laboratory devices and instruments together with the appropriate specialized software. On a case-by-case basis, the trainee becomes familiar with: a) the preparation of samples and their analysis in the appropriate laboratory device, b) the processing of measurements and other data and the construction of appropriate tables, diagrams, c) the digital mapping and organization of data on maps, in databases, etc., d) statistical analyses, computer simulations and construction of analogue or numerical models and e) the use of necessary specialized software required.
- Development of the trainee's competence to combine, synthesize, compare and evaluate all available data and results, which have emerged from the previous stages, in order to reach solid scientific conclusions, highlighting the project's contribution in the geological sciences.
- Complience with the scientific writing technique (structure, bibliography evaluation, definition of research objective, methodology analysis, evaluation of primary data and data collected or resulting from processing, discussion-conclusions), so that it can be published in a journal or presented at a conference.

Generic Competences

- Ability to apply knowledge in practical situations
- Promote free, creative and inductive thinking
- Ability to plan and manage time
- Ability to work in a team
- Ability to search for, process and analyse information with the use of necessary technologies
- Adapt to and act in new situations and cope under pressure
- Ability to be critical and self-critical
- Oral and written communication of scientific issues
- Decision making
- Ability to undertake research at an appropriate level
- Autonomous work
- Information and Communication Technology (ICT) skills
- Ability to work in an international context
- Commitment to conservation of the environment
- Ability to work in an interdisciplinary context

(3) COURSE CONTENT

The content of this "course" (Diploma Thesis) varies and depends on the scientific field and specialization chosen by the trainee and corresponds to the content of the compulsory courses and elective courses related to it.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.

USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	<table><tr><th>Activity</th><th>Student effort</th></tr><tr><td>Subject and methodology analysis, bibliographic information.</td><td>75 hours</td></tr><tr><td>Fieldwork and data collection (sampling, instrumental measurements, mapping, etc.)</td><td>75 hours</td></tr><tr><td>Processing and analysis, in the laboratory of fieldwork samplings and/or laboratory-research material (sample or data preparation, laboratory analyses, laboratory determinations, statistical analysis, simulations, analogue or numerical models, computational processing, etc.)</td><td>150 hours</td></tr><tr><td>Guidance from the supervisor and self-dependent study.</td><td>100 hours</td></tr><tr><td>Writing of Diploma Thesis and compilation of maps.</td><td>100 hours</td></tr><tr><td>Total student's effort</td><td>500 hours</td></tr></table>
ASSESSMENT METHODS AND CRITERIA	The evaluation process takes place continuously at all stages of the preparation and writing of the thesis (formative), based on the student's response to the supervisor's guidance and instructions, as well as the student's initiatives for the successful thesis completion. The synthesis of all the data collected, the accurate research results, but also the success of the final venture, i.e. the correct and complete writing of the Diploma Thesis, are of great importance (summative). The acceptance for either presentation of the thesis at a conference or publication in a journal also plays an important role. The evaluation process is conducted in Greek, while the language of writing can be Greek or English. For Erasmus students, guidance and assessment is in English.

(5) RECOMMENDED READING

The recommended bibliography varies depending on the subject, specialization and subject area of the dissertation, **covering all courses of the Undergraduate Studies Program.**

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**Y8203**	**SEMESTER**	**8th**
TITLE	**DISSERTATION-LITERATURE REVIEW**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
1. Subject and methodology analysis, bibliographic information, identification of scientific questions. 2. Guidance from the supervisor 3. Literature review and data collection 4. Theoretical data processing, critical review of methods, presentation of a new method and/or theory, critical study. 5. Writing of diploma thesis	**-**	**12**

TYPE OF COURSE	**MANDATORY /** Scientific Area
PREREQUISITES	All courses (compulsory or elective) that support the subject of the dissertation.
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
The elaboration and writing of the diploma thesis represent a typical project that a graduate Geologist will need to compile, in the fields of basic or applied research. The intended result is that the student is able to cope with all the stages required for the thesis to be qualified for either published in a journal or presented at a conference. Thus, through this process, the following outcomes are expected: • Understanding of the research subject and the methodology required to achieve it • Clear definition of the research objective in the field and specialization chosen by the trainee; which should cover a subject of modern research fields • Ability to search, find, understand and evaluate available bibliographic data • Familiarization with critical literature review. The trainees become familiarized with: a) biblio-

graphic research in various bibliographic databases, b) select proper publications concerning the inquired scientific topic, c) the way they should organize and plan the information collected. • Development of the trainee's competence to combine, synthesize, compare and evaluate all available data and results, which have emerged from published research, in order to reach solid scientific conclusions, highlighting the project's contribution in the geological sciences. • Compliance with the scientific writing technique (structure, bibliography evaluation, definition of research objective, methodology analysis, evaluation of primary data and data collected or resulting from processing, discussion-conclusions), so that it can be published in a journal or presented at a conference.
Generic Competences
• Ability to apply knowledge in practical situations • Promote free, creative and inductive thinking • Ability to plan and manage time • Ability to work in a team • Ability to search for, process and analyse information with the use of necessary technologies • Adapt to and act in new situations and cope under pressure • Ability to be critical and self-critical • Oral and written communication of scientific issues • Decision making • Ability to undertake research at an appropriate level • Autonomous work • Information and Communication Technology (ICT) skills • Ability to work in an international context • Commitment to conservation of the environment • Ability to work in an interdisciplinary context •

(3) COURSE CONTENT

The content of this "course" (Diploma Thesis) varies and depends on the scientific field and specialization chosen by the trainee and corresponds to the content of the compulsory courses and elective courses related to it.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** — **Student effort** Subject and methodology analysis, bibliographic update. — 75 hours Bibliographic data collection — 50 hours Critical study, data evaluation. — 50 hours Guidance from the supervisor — 50 hours Writing of Diploma Thesis — 75 hours **Total student's effort** — **300** hours
ASSESSMENT METHODS AND CRITERIA	The evaluation process takes place continuously at all stages of the preparation and writing of the thesis (formative), based on the student's response to the supervisor's guid-

	ance and instructions, as well as the student's initiatives for the successful thesis completion. The synthesis of all the bibliographic data collected, but also the success of the final venture, i.e. the correct and complete writing of the Diploma Thesis, are of great importance (summative). The acceptance for either presentation of the thesis at a conference or publication in a journal also plays an important role. The evaluation process is conducted in Greek, while the language of writing can be Greek or English. For Erasmus students, guidance and assessment is in English.

(5) RECOMMENDED READING

The recommended bibliography varies depending on the subject, specialization and subject area of the dissertation, **covering all courses of the Undergraduate Studies Program.**

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E8206**	**SEMESTER**	**8th**
TITLE	**DIDACTICS OF GEOLOGY AND ENVIRONMENTAL SCIENCES**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, experiential workshops, presentation of projects		**4**	**6**
TYPE OF COURSE	**MANDATORY /** Skills Development		
PREREQUISITES	NONE		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL200		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
It is the main course in the teaching of geology and environmental sciences in order to train young scientists in learning theories, teaching practice, and the use of appropriate methods for the design and integration of teaching interventions. In particular, at the end of the semester, students will be able to: • distinguish the basic definitions of Didactics • recognise and summarise the different theories of learning • formulate and classify teaching aims and objectives • compare and select different teaching approaches • distinguish and use different teaching techniques • formulate lesson plans • plan activities for group work in the classroom • prefer and adopt experiential teaching • organise and develop different forms of assessment
Generic Competences

• Ability to apply knowledge in practical situations • Ability to work in a team • Oral and written communication of scientific issues • Adapt to and act in new situations and cope under pressure • Ability to undertake research at an appropriate level • Promote free, creative and inductive thinking • Autonomous work

(3) COURSE CONTENT

A. Lectures of the course:

- History of Geology
- General concepts of teaching of science and Curricula
- Learning theories
- Good Practices in the Teaching of Earth Sciences I
- Good Practices in the Teaching of Earth Sciences II
- Behaviourism, Cognitivism learning theory
- Socio-cognitive learning theory and Humanistic learning theory
- Theories of Jarvis, Mezirow, and Illeris
- Lave & Wenger theory, Kegan theory
- Theories of Kolb & Fry, Engestrom, Erikson
- Assessments
- Presentation of lesson plans

B. Experiential Workshops:

- Getting to know each other and creating a positive atmosphere, defining groups and drafting the class contract
- Use of imagination in education, evaluation fo teachers by students: Who is the ideal teacher?
- group dynamics, group role-playing, role-playing conflict resolution using role-playing
- Introduction to Communication Science: Theory and Practice
- Techniques of Brainstorming, Jigsaw Puzzle, Peer to peer teaching
- Monologue, Interviewing, questions and answers, discussion, debate
- Brainstorming and concept mapping techniques
- Experiments and simulations on geoscience topics, 6 thinking hats technique
- Field study and environmental trail
- Education through art, role play, drama
- Gamification and play-based learning
- Case studies, project method and evaluation

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** — **Student effort** Lectures — 26 hours Practice exercises — 26 hours Fieldwork — 6 hours Tutorials — –

	Essey writing 30 hours Autonomous study 42 hours Final assessment preparation 20 hours **Total student's effort** **100** hours
ASSESSMENT METHODS AND CRITERIA	The evaluation process with a final examination in the entire material includes: I. Lectures and experiential workshops (**33,3%**) • Written examination with short-answer, extended-answer and problem-solving questions and objective-type questions. (formative, summative) II. DELIVERY OF A WRITTEN ASSIGNMENT WITH A COMPLETE COURSE OUTLINE (66,6 %) (**66,6%**) (formative, summative)

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Geoscience Teaching and Learning 122339309, https://repository.kallipos.gr/handle/11419/10589

II. ADDITIONAL READING

- https://opencourses.uoa.gr/modules/document/file.php/MATH18/Διδακτικό%20Πακέτο/Ενότητα%20Γ/Παρουσιάσεις/Θεωρίες%20μάθησης.pdf
- https://www.nu.edu/blog/theories-of-learning/
- https://geography.org.uk/ite/initial-teacher-education/geography-support-for-trainees-and-ects/learning-to-teach-secondary-geography/students-learning-in-geography/learning-theories-and-geography/
- https://adulteduc.gr/wp-content/uploads/attachments/koulaouzidis.pdf
- https://adulteduc.gr/wp-content/uploads/attachments/mm_aisthitiki_empeiria-7.pdf

III. RELATIVE JOURNALS

- Διάλογοι! Θεωρία και Πράξη στις Επιστήμες Αγωγής και Εκπαίδευσης

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E8201**	**SEMESTER**	**8th**
TITLE	**ENGINEERING AND ENVIRONMENTAL GEOPHYSICS**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises, Fieldwork		**3**	**4**
TYPE OF COURSE	**ELECTIVE /** Scientific Area		
PREREQUISITES	Recommended knowledge of: Y3205 - Structural Geology and Tectonics Y4202 - Geophysics Y5203 - Engineering Geology Y6202 - Hydrogeology Y6203 - Geological mapping-Field course Y7201 - Environmental Geology Y7203 - Applied Geophysics		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL184		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
Through the successful completion of this lesson, the trainee: • **Reproduces** the necessary knowledge and skills for the connection of geophysics-engineering structures-geoenvironment. • **Distinguishes** the basic geophysical terminology of investigating geotechnical and geoenvironmental issues. • **Summarizes** the basic geophysical instrumentation and field measurement techniques • **Discriminates** the physical parameters and techniques for their application on geotechnical and geoenvironmental issues. • **Combines** geophysical, geological/lithological and geotechnical data.

- **Adjusts** the procedure of planning – execution – processing – presentation of a geotechnical-geoenvironmental research, according to international standards.
- **Evaluates** and **justifies** the results.

Generic Competences

- Ability to work in an interdisciplinary context
- Ability to apply knowledge in practical situations
- Ability to search for, process and analyse information with the use of necessary technologies
- Information and Communication Technology (ICT) skills
- Decision making

(3) COURSE CONTENT

A. Lectures/seminars

- **Seismic methods:** Seismic tomography, mapping fault zones and bedrock, correlation of seismic velocities-elastic constants-density and geotechnical indices in geotechnical research, geotechnical soil characterization. Seismic method in boreholes: Techniques, application and examples in engineering. Applications and examples.
- **Resistivity methods:** Electrical resistivity tomography, mapping fault zones and bedrock, mapping polluted areas and industrial pollution, determination of water-saturated zones, landslides, locating fractures and caves, investigation and evaluation of aquifer zones, mapping of industrial pollution, subsurface water flow adumbration. Applications and examples.
- **Electromagnetic methods:** Frequency methods, time-domain methods. Ground Penetrating Radar. Detection of buried objects, fractures, bedrock identification, mapping polluted areas, archaeology etc. Applications and examples.
- **Geophysical tests in boreholes: Cross-hole, up-hole, down-hole, cross-hole & electrical resistivity tomography tests. Application and examples.**
- **Well logging.** Near surface methodologies, acquisition techniques, processing, evaluation and interpretation. **Application and examples**.

B. Laboratory work

- Including processing, evaluation and interpretation of geophysical data with specialized software and report analysis.
- The trainees present and support assigned projects of engineering and environmental geophysics.

C. Fieldwork

One-day field exercise. Field exercises at locations of geoenvironmental and geotechnical interest.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.

PLANNED LEARNING ACTIVITIES

Activity	Student effort
Lectures	26 hours
Practice exercises	13 hours
Fieldwork	8 hours
Tutorials	-
Essey writing	13 hours
Autonomous study	25 hours

	Final assessment preparation	15 hours
	Total student's effort	**100** hours
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted in Greek (there is the possibility of examination in English for Erasmus students. The final grade is based on: I. LECTURES (**50%**) (Summative) • Oral examination II. LABORATORY WORK (**50%**) • Oral examination for supporting their assigned projects (formative, summative)	

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Tselentis, G.-A. & Paraskeyopoulos P., Applied Geophysics, [Κωδ. ΕΥΔΟΞΟΣ: 50659068]

II. ADDITIONAL READING

- Everett, M.K., 2013. *Near-surface Applied Geophysics*, Cambridge University Press
- Milsom J. & Eriksen A., 2011. *Field Geophysics*, Vol. 36, Wiley - John Wiley & Sons, 287p. ISBN: 978-0-470-74984-5
- Reynolds, J, M., 2011. *An Introduction to Applied and Environmental Geophysics*, 2nd Edition, ISBN: 978-0-471-48535-3.
- Telford, W.M., Geldart, L.P. and Sheriff, 1990, R.E., *Applied Geophysics*, 2nd Edition, Cambridge University Press.

III. RELATIVE JOURNALS

- Near-Surface geophysics, Online ISSN: 1873-0604, Print ISSN: 1569-4445, EAGE
- Journal of Environmental & Engineering Geophysics, Online ISSN: 1943-2658, Print ISSN: 1083-1363, EEGS
- Journal of Geophysics and Engineering, Online ISSN: 1742-2140, Print ISSN: 1742-2132, Oxford Academic
- Journal of Applied Geophysics, Online ISSN: 1879-1859, Print ISSN: 0926-9851, Elsevier

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E8203**	**SEMESTER**	**8th**
TITLE	**STRATIGRAPHY AND PALAEOGEOGRAPHY OF GREECE**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises	**4**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	[recommended] Y5202 Stratigraphy Y4206Sedimentary Environments and Processes
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL310

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

Upon successful completion of the course the student:

- Describes, analyses and correlates rocks from the stratigraphic sequences of the Hellenides
- Comprehends the lithological, biostratigraphical and sedimentological features of the stratigraphic sequences as well as their development in space and time
- Inserts the stratigraphic sequences within the geodynamic context of the orogenic cycles
- Combines stratigraphic, paleontological and sedimentological data for the interpretation of depositional environments and the related paleoenvironmental evolution
- Synthesizes the paleogeography of the Hellenides, in correlation with molassic and postalpine sequences

Generic Competences

- Ability to search for, process and analyse information with the use of necessary technologies
- Ability to work autonomously.
- Ability to apply knowledge in resolving problems.
- Ability to make reasoned decisions.
- Ability for free, creative and inductive thinking.
- Commitment to the conservation of the environment

• Ability to work in an interdisciplinary context

(3) COURSE CONTENT

A. Lectures:

- Methods of description and analysis of stratigraphic sequences.
- Pre-alpine, alpine and post-alpine deposits.
- Microfacies analysis of stratigraphic sequences of the External and non-metamorphosed Internal Hellenides, detailed stratigraphic analysis and biostratigraphic corellations
- Identification of units from the study of the evolution of their stratigraphic sequences.
- Paleogeographic integration of the stratigraphic sequences of the Hellenides, in the margins and in the oceanic areas of Tethys.

B. Practice exercises:

Exercises 1-2 Laboratory preparation of samples from the stratigraphic series of the Hellenides.
Exercises 3-6 Microscopic study of characteristic facies from the sedimentary sequences of the various units of the Hellenides. Characteristic biofacies and lithofacies of the various series - determination of age and paleoenvironment, paleogeographic integration
Exercises 7-8 construction of lithostratigraphic columns from geological maps, deepening in the knowledge of the Stratigraphy of Hellenides and the development of digital skills.
Exercises 9-10 Critical study of the original bibliographic sources.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	see table below
ASSESSMENT METHODS AND CRITERIA	For the lab: • Lab essays with bibliographic or practical objectives (**50%**) (formative, summative) For the theoretical part: • written team work essays assessment and oral presentation (**50%**) (formative, summative)

Activity	Student effort
Lectures	26 hours
Practice exercises	13 hours
Fieldwork	8 hours
Tutorials	-
Essey writing	21 hours
Autonomous study	16 hours
Final assessment preparation	16 hours
Total student's effort	**100** hours

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Renz, C., 1955. Stratigraphie Griechenlands
- Jacobshagen V., Geologie von Griechenland. Berlin, Stuttgart (Gebruder Borntraeger), 363 p.
- Katsikatsos G., 1992. Geology of Greece. University of Patras, 451 pp.
- Mountrakis, D., 2010. Geology and geotectonic evolution of Greece. University studio press, Thessaloniki, 373 pp.
- Παπανικολάου, Δ., 2015. Γεωλογία της Ελλάδας. Εκδόσεις Πατάκη, 443 σ.
- Karakitsios V., 2017. Stratigraphy and Paleogeography of Greece.Publications of the National and Kapodistrian University of Athens.
- Papanikolaou, D. I., 2021. *Regional Geology Reviews The Geology of Greece*. http://www.springer.com/series/8643.

III. RELATIVE JOURNALS

- Episodes, Online ISSN: 2586-1298
- Newsletter on Stratigraphy, Online ISSN: 2363-6122

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	SCHOOL OF SCIENCE		
DEPARTMENT	GEOLOGY AND GEOENVIRONMENT		
EDUCATION LEVEL	EQF level 6; NQF of Greece level 6		
CODE	E8211	SEMESTER	8th
TITLE	GEOLOGY OF EUROPE		
TEACHING ACTIVITIES		HOURS/WEEK	ECTS
Lectures, Lab exercises		4	4
TYPE OF COURSE	**ELECTIVE /** Scientific Area		
PREREQUISITES	Basic knowledge from Structural Geology and Tectonics - Y3205 and Dynamic Geology - E4202 [recommended]		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL252		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

It is a specialized course that offers students a basic knowledge of the geological structure and evolution of the European continent, particularly the orogenies that shaped it in geological time.

With the lab exercises, students construct geological maps depicting the basic geological units involved in the orogenies of the European continent. Overall, the final aim is for the student to understand the European geotectonic structure.

Upon successful completion of the course, the student is able to:

- Distinguish, recognize and comprehend the orogenic episodes that led to the assembly of the European continent and describe their geotectonic evolution.
- Analyze and evaluate of the lithospheric-scale structure of an orogenic domain, compare and correlate with other examples
- Analyze and interpret a continental scale geological map and construct geological cross-sections that depicts the geological structure.
- Compare and correlate the geological units and paleogeographic domains of Greece to neighbor-

ing domains and identify the geological units as parts of the Variscan and the Alpine cycle. • Comprehend In-depth the Wilson cycle, the orogenic processes and the mechanisms of continent accretion and the creation and demise of oceans.
Generic Competences
• Promote free, creative and inductive thinking • Ability to plan and manage time. • Oral and written communication of scientific issues • Autonomous work • Information and Communication Technology (ICT) skills

(3) COURSE CONTENT

A. Lectures

- BASIC CONCEPTS AND METHODS. The geographical and geological dimension of Europe. Early views on the geology of Europe. Tectonic plates theory and the structure of Europe.
- TYPICAL POST-OROGENIC BASINS OF EUROPE. Description of the post-organic basin from the Russian platform to the Pannonian basin.
- ARCHEAN EUROPE: Baltic Shield and Fennoscandia, Karelian, Sveconorwegian, Svecofennian, Timanides.
- PALEOZOIC EUROPE: Scandinavian and British Caledonides.
- VARISCAN EUROPE: Variscides, Variscan (Paleotethyan) Hellenides, Uralides.
- ALPINE EUROPE: Betics, Pyrenees, Alps, Carpathians, Balkanides, Apennine, Dinarides, Albanides, Hellenides, Caucasus, Pontides Taurides Anatolides.

B. Lab Exercises

- Construction of simplified and relatively complex maps depicting the large-scale structure of specific areas of Europe. Construction of a Geological map of the entire European continent using ArcGIS Pro.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** / **Student effort** Lectures: 26 hours Practice exercises: 13 hours Fieldwork: - hours Tutorials: - hours Essey writing: 25 hours Autonomous study: 11 hours Final assessment preparation: 25 hours **Total student's effort**: **100** hours
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted, either with progressive exams in separate sections of the course content or with the final examination of the entire course material which includes:

	I. LECTURES (**50%**) (summative) • Oral Examination and/or • Written Exam with Short Answer Questions and Multiple Choice Test and/or • Written Exam with Extended Answer Questions Questions are based on course lectures deliveries II. LAB EXERCISES (**50%**) (formative, summative) • Construction of segments of the Geological Map of Europe and submission of the final map by the end of the semester The evaluation criteria of the course and the participation rates are described in the Chapter «**Error! Reference source not found.**» of this syllabus and student handbook. Auxiliary material (questions, exercises, etc.) for the exams is posted on the online e-Class platform (https://eclass.uoa.gr/courses/GEOL252/).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Sideris Ch., (2004), Geology of Europe, 96p. (In Greek)
- AGER, D. (1980): The Geology of Europe. McGraw – Hill Book Company Ltd, 527 pp.
- TORSVIK T.H., and COKS L.R.M., (2017). Earth History and Palaeogeography. Cambridge University Press 332 pp.
- ZWART H.J. et al., (1973): Geological Map of Europe 1:2.500.000 (13 sheets), UNESCO.

III. RELATIVE JOURNALS

- Gondwana-Research,Online ISSN: 1878-0571, Print ISSN: 1342-937X, Elsevier.
- Tectonics, Online ISSN:1944-9194, Print ISSN:0278-7407, AGU Publications.
- International Journal of Earth Sciences Electronic ISSN 1437-3262, Print ISSN 1437-3254, Springer

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E8215**	**SEMESTER**	**8th**
TITLE	**APPLIED GEOPHYSICS IN GEOLOGY**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	Recommended knowledge of Y3205 - Structural Geology and Tectonics Y4202 - Geophysics Y4202 – Hydrogeology Y6203 - Geological Mapping - Field Course Y6205 - Geology of Magmatic and Hydrothermal Ore Deposits **Error! Reference source not found.** - Applied Geophysics
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL533

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
Through the successful completion of this lesson, the trainee: • **Defines** the appropriate approach of a geological problem with the contribution of applied geophysics, starting from the understanding of the issue. • **Recognizes** and **distinguishes** the different geophysical approaches of subsurface investigation used for applied geological examines (gravity, magnetics, electromagnetic, resistivity, seismic methodologies and techniques). • **Mentions** the correct and safe acquisition procedure. • **Implements** qualitatively and quantitatively processing of geophysical data. • **Plans** a geophysical research and **chooses** the appropriate method.

- **Combines** and **correlates** geological and geophysical data.
- **Predicts** and **solves** any problems during the geophysical field acquisition procedure.
- **Judges** the quality of the field data.
- **Evaluates** and **interprets** the combination of geophysical and geological data.
- **Selects** and **proposes** a complete study for solving geological problems based on the application of geophysical methods.

Generic Competences

- Ability to work in an interdisciplinary context
- Ability to apply knowledge in practical situations
- Ability to search for, process and analyse information with the use of necessary technologies
- Information and Communication Technology (ICT) skills
- Decision making

(3) COURSE CONTENT

A. Lectures/seminars

- **The role and applications of applied geophysics** in geology and geoenvironment. Presentation of geological issues that geophysics can contribute to their investigation.
- **Data acquisition**. Presentation of portable instruments, appropriate acquisition procedure for qualitative data, depending on the method and study area. Safety rules, solving problems.
- **Correlation** of geological-lithological formations/properties with measured physical parameters. Examples and analysis of the variation of the physical properties based on local geological characteristics. Geologically calibrating the measured physical parameters.
- **Choosing** the appropriate geophysical method/technique. Principles and restrictions of geophysical techniques. Representative examples for solving geological issues.
- **Processing, evaluation and presentation** methods of the geophysical results, depending on the geological problem. Evaluating the data quality.
- **Case studies:** Presenting geophysical research applied on geological problems, analyzing and evaluating the applied methods, processing, evaluation and presentation of the data and corresponding results.
- **Examples** of **combining and correlating** the application of geophysical techniques. Combined and comparative geological approach and interpretation of different geophysical parameters. Selection of the most suitable data and geophysical methods for the best result.

B. Laboratory work

Including processing, evaluation and interpretation of geophysical data with specialized software, combined interpretation based on geophysical and geological data and report analysis.

C. Fieldwork

One-day field exercise. Field exercise at locations of geological interest.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	26 hours
	Practice exercises	13 hours
	Fieldwork	8 hours

	Tutorials - Essey writing 13 hours Autonomous study 25 hours Final assessment preparation 15 hours **Total student's effort** **100** hours
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted in Greek (there is the possibility of examination in English for Erasmus students. The final grade is based on: I. LECTURES (**50%**) (summative) • Oral examination II. LABORATORY WORK (**50%**) • Oral examination for supporting their assigned projects (formative, summative)

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Tselentis, G.-A. & Paraskeyopoulos P., *Applied Geophysics*, [Κωδ. ΕΥΔΟΞΟΣ: 50659068]

II. ADDITIONAL READING

- Fairhead J.D., 2015. *Advances in Gravity and Magnetic Processing and Interpretation*. EAGE Publications, The Netherlands, 338p. ISBN 978-94-6282-175-0
- Hinze, W.J., Von Frese, R.R., Saad, A.H., 2013. *Gravity and Magnetic Exploration*, Cambridge University Press.
- Milsom J. & Eriksen A., 2011. *Field Geophysics*, Vol. 36, Wiley - John Wiley & Sons, 287p. ISBN: 978-0-470-74984-5
- Reynolds, J, M., 2011. *An Introduction to Applied and Environmental Geophysics*, 2nd Edition, ISBN: 978-0-471-48535-3.
- Long L.T. & Kaufmann R.D., 2013. *Acquisition and Analysis of Terrestrial Gravity Data*. Cambridge University Press, 169p. ISBN: 978-1-107-02413-7

III. RELATIVE JOURNALS

- Journal of Applied Geophysics, Online ISSN: 1879-1859, Print ISSN: 0926-9851, Elsevier
- Pure and Applied Geophysics, Online ISSN: 1420-9136, Print ISSN: 0033-4553, Springer
- Acta Geophysica, Online ISSN: 1895-7455, Springer
- Interpretation, Online ISSN: 2324-8866, SEG

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**			
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**			
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**			
CODE	**E8216**	**SEMESTER**	**8th**	
TITLE	**VOLCANIC SEISMOLOGY**			
TEACHING ACTIVITIES			**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises			**3**	**4**
TYPE OF COURSE	**ELECTIVE /** Scientific Area			
PREREQUISITES	The standard knowledge obtained by the courses of Y3203 Seismology Y6201 Applied and Engineering Seismology and Y4202 Geophysics are necessary to follow the course			
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English			
AVAILABILITY TO ERASMUS STUDENTS	YES			
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL532			

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On successful completion of the course, the student:

- **Categorizes** and **describes** the different types of seismic signals of tectonic/volcanotectonic earthquakes (VT-A, VT-B), volcanic tremors and other signals related to the stages of the evolution of the paroxysmal phase of a volcano (LP, VLP, DLP, hybrid earthquakes, tornillos), volcanic eruptions and associated phenomena (e.g. lahars, pyroclastic flows, landslides), through spectral analysis of seismic recordings.
- **Describes** how the stages of a volcanic crisis evolve through a series of physical processes associated with the ascent of magma from a deep magmatic chamber to the surface.
- **Distinguishes** the stage of activity of a volcanic center through seismicity patterns and seismic signals, based on established empirical models.
- **Identifies** alterations in the physical properties around a volcanic center associated with magmatic intrusion, through local changes in stresses and seismic wave propagation velocities.

• **Interprets** the Earth's structure in volcanic environments through tomographic images of seismic velocities and damping. • **Correlates** changes in the spatio-temporal evolution of seismicity, seismic noise level, focal mechanisms, seismic anisotropy, seismic wave propagation velocities and other parameters, with the probability of a volcanic eruption. • **Combines** and **evaluates** results of studies on volcanic seismology published in international scientific journals.
Generic Competences
• Ability to search for, process and analyse information with the use of necessary technologies • Ability to apply knowledge in practical situations • Ability to be critical and self-critical • Ability to undertake research at an appropriate level • Information and Communication Technology (ICT) skills •

(3) COURSE CONTENT

A. Course Lectures

- **Introduction to Volcanic Seismology.**
- **Spatio-temporal patterns of seismicity in volcanic environments.**
- **Spectral analysis of seismic signals from tectonic and volcanic environments.**
- **Classification of volcanic seismic signals based on waveforms and frequency content.**
- **Differentiations between open and closed volcanic systems.**
- **Stress field variations in volcanic environments.**
- **Focal mechanisms in volcanic environments (ISO, CLVD).**
- **Seismic anisotropy in volcanic environments.**
- **Fundamentals of seismic tomography (data selection, parameterization, evaluation, interpretation).**
- **Applications of passive seismic tomography in volcanic environments.**
- **Time-varying (4D) seismic tomography in volcanic environments.**
- **Seismic wave attenuation tomography.**
- **Methods of volcanic crisis prediction and management.**
- **Early warning systems and their integration in an operational context.**

B. Practice exercises

- Relations between seismicity and active volcanoes in the Pacific Ocean, Atlantic Ocean and Indonesia.
- Relations between seismicity and active volcanoes in the Central and Eastern Mediterranean.
- Analysis of seismological data with the SeisGram2K software.
- Analysis of signals from volcanic and tectonic environments.
- Identification of volcanic seismic signals based on their frequency content and focal depth.
- Interpretation of seismic tomograms in volcanic environments.
- Monitoring, analysis and categorization of current seismic activity in volcanic centers.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.

<table>
<tr><td rowspan="9">PLANNED LEARNING ACTIVITIES</td><td>Activity</td><td>Student effort</td></tr>
<tr><td>Lectures</td><td>26 hours</td></tr>
<tr><td>Practice exercises</td><td>13 hours</td></tr>
<tr><td>Fieldwork</td><td>-</td></tr>
<tr><td>Tutorials</td><td>-</td></tr>
<tr><td>Essey writing</td><td>26 hours</td></tr>
<tr><td>Autonomous study</td><td>13 hours</td></tr>
<tr><td>Final assessment preparation</td><td>22 hours</td></tr>
<tr><td>Total student's effort</td><td>100 hours</td></tr>
<tr><td>ASSESSMENT METHODS AND CRITERIA</td><td colspan="2">The assessment process is conducted, either with progressive exams in separate sections of the course content or with the final examination of the entire course material which includes:
I. LECTURES (50%)
• Individual Report and Oral Presentation per Student (formative, summative)
II. PRACTICE EXERCISES (50%)
• Written exam with Solving Exercises and Problems (formative)</td></tr>
</table>

(5) RECOMMENDED READING

I. ADDITIONAL READING

- Chouet, B., 2003. Volcano Seismology. Pure Appl. Geophys. 160, 739–788.
- Gasparini, P., Scarpa, R., Aki, K. (Eds.), 1992. Volcanic Seismology, IAVCEI Proceedings in Volcanology. Springer Berlin Heidelberg, Berlin, Heidelberg.
- Gudmundsson, A., 2020. Volcanotectonics, Volcanotectonics. Cambridge University Press.
- Wassermann, J., 2012. Volcano Seismology. In: Bormann, P. (Ed.), New Manual of Seismological Observatory Practice 2 (NMSOP-2), Potsdam : Deutsches GeoForschungsZentrum GFZ, 1-77.
- Zobin, V.M. (2003), Introduction to Volcanic Seismology. Amsterdam: Elsevier Science.

II. RELATIVE JOURNALS

- Bulletin of the Seismological Society of America, SSA Journals
- Physics of the Earth and Planetary Interiors, Journal, Elsevier
- Tectonophysics, Journal, Elsevier
- Journal of Volcanology and Geothermal Research, Elsevier
- Volcanica, Presses universitaires de Strasbourg.

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E8217**	**SEMESTER**	**8th**
TITLE	**NEW VENTURE CREATION**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Practical exercises, Case studies	**2**	**4**

TYPE OF COURSE	**MANDATORY /** Skills Development
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/BA118

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

The aim of the course is to provide students with the necessary knowledge to create new businesses (startup). The course offers a comprehensive approach on how to turn an idea into a product and in turn a product into a sustainable business, based on the lean startup methodology. The goal is for students to embrace an entrepreneurial mindset as a key element in creating a new business, in addition to developing entrepreneurial skills. More specific, in the framework of the course, students will:

- gain basic knowledge about forming an entrepreneurial team
- be able to recognize and develop a business model
- create Minimum Viable Products (MVPs) and in turn conduct “real life experiments"
- be able to capture their entrepreneurial idea in a coherent and well-documented business plan
- be able to communicate their business idea in the form of an elevator pitch to investors.
- As part of the course, students will be divided into groups and will work on their own business ideas. It should be noted that the course will also be offered in other departments of NKUA. The aim is for the groups to be created to have an interdisciplinary character.

Generic Competences

• Ability to work in a team • Ability to make reasoned decisions • Ability to design and manage projects Ability to adapt to in new situations • Ability to search for, analyze and synthesize data and information Ability for free, creative and inductive thinking • Ability to be critical and self-critical • Work in an interdisciplinary environment

(3) COURSE CONTENT

A. Lectures. 1. Introduction to lean startup methodology. 2. The entrepreneurial idea (ideation workshop) 3. The business model (the business model canvas, business model innovation). 4. Customer discovery I (defining the problem, analyzing competition, and selecting the target market – beachhead market). 5. Customer discovery II (customer profiles, problem interviews, and identifying customer needs) 6. The entrepreneurial team (team development and communication, forming teams, and team manifesto). 7. Customer discovery III (defining the solution, creating an MVP (Minimum Viable Product), executing real-life experiments). 8. Business plan basics 9. Business plan financials 10. Presentation skills for startups (elevator pitch) 11. Start-up funding (bootstrapping, Friends, family and fools, business angels, venture capital/corporate venture capital, crowdfunding, initial coin offerings).

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**
	Lectures	39 hours
	Elaboration and presentation of study deliverables	70 hours
	Independent Study	41 hours
	Total student's effort	**150** hours
ASSESSMENT METHODS AND CRITERIA	Students will be divided into groups of 3-5 people. Each group will work on its own business idea. In the context of developing their business idea, groups will have to mature their entrepreneurial idea through the application of tools and techniques taught in the course. The final grade is formed by a series of exercises/deliverables that will be submitted gradually throughout the semester. Specifically, the grade will be formed as follows: • **5%** Three similar offers • **8%** Competitive analysis • **10%** Business model canvas	

	• **15%** Report from the findings of problem interviews • **10%** Minimum Viable Product design • **15%** Report from the findings of experiments based on the MVP • **22%** Business plan • **15%** Elevator Pitch (Final presentation)

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Bill Aulet, B. (2021) Επιχειρηματικότητα με Αρχές, Εκδόσεις Utopia
- Osterwalder, A. Pigneur, Y. (2017) Ανάπτυξη Επιχειρηματικών Υποδειγμάτων, Εκδόσεις Broken Hill
- Ρις, E. (2013) Λιτή επιχειρηματική εκκίνηση, Αθήνα, Εκδόσεις Λιβάνη
- Livieratos, A. (ed) 2017. Saint Startup: From the idea to the market. Berlin: Pubbuh publications (ελεύθερη πρόσβαση στο internet)
- Λιβιεράτος, Α. (2013) Οδηγός καινοτομίας για μικρές επιχειρήσεις, Αθήνα, ΙΜΕ ΓΣΕΒΕΕ
- Kawasaki, G. (2015). The art of the start 2.0: the time-tested, battle- hardened guide for anyone starting anything Portfolio; Revised edition
- Maurya A., (2012) Running Lean: Iterate from Plan A to a Plan That Works, O'Reilly Media; 2nd edition
- Osterwalder A., Pigneur Y., Bernarda G., and Smith A., (2015) Value Proposition Design How to Create Products and Services Customers Want, Wiley; 1st edition
- Aulet, B.(2013), Disciplined Entrepreneurship: 24 Steps to a Successful Startup. 1. Hoboken: Wiley.
- Horowitz, B. (2014) The Hard Thing About Hard Things, HarperCollins Publishers Inc
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III. RELATIVE JOURNALS

- Harvard Business Review
- Sloan Management Review
- Entrepreneurship, Theory and Practice
- Journal of Business Venturing
- Strategic Entrepreneurship Journal

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E8218**	**SEMESTER**	**8th**
TITLE	**PALAEOECOLOGY**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Laboratory exercises	**4**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	[recommended] Y2205, Macropalaeontology Y3206 Micropalaeontology **Error! Reference source not found.** Vertebrate Palaeontology Y4206 Sedimentary Environments and Processes
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL200

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
Upon successful completion of the course the students: • **Define** the basic concepts and terms of paleoecology. • **Understand** the methods and techniques used in palaeoecology to study palaeoecosystems. • **Identify** the characteristics of paleoecological data and their sources. • **Apply** analytical methods to reconstruct paleoecosystems and climate conditions. • **Formulates** hypotheses and theories about the evolution of ecosystems through geological time. • **Combines** information from a variety of sources and disciplines for a comprehensive understanding of paleoecological phenomena. • **Determines** the relationship between environmental changes and evolutionary processes in past organisms. • **Evaluates** the effects of natural and anthropogenic factors on changes in paleoecological condi-

tions and ecosystems •
Generic Competences
• Ability to apply knowledge in practical situations • Promote free, creative and inductive thinking • Ability to search for, process and analyse information with the use of necessary technologies • Oral and written communication of scientific issues • Decision making

(3) COURSE CONTENT

A. Lectures:

Marine Paleoecology

- Introduction to Marine Paleoecology - Applied Marine Paleoecology
- Paleoclimatic indices in marine deposits
- The benthic foraminifera as paleoecological indices
- Ostracodes as paleoecological indices
- Paleoecological indices-quantitative analysis / management of assemblages
- Paleoecology of invertebrate fauna

Terrestrial Paleoecology

- Island Ecology and Biogeography
- Ecomorphology of carnivorous mammals
- Ecological predators guilds
- Ecology and nutrition
- Introduction to Taphonomy
- Taphonomic processes
- Bone and tooth diagenesis I and II

B. Practicals

Marine Paleoecology

Exercise 1 Palaeobathymetric analysis
Exercise 2 Estimation of paleotemperatures using stable oxygen and trace element isotopes
Exercise 3 Paleoenvironmental evolution of a semi-enclosed marine basin using paleoecological indicators: Benthic Foraminifera
Exercise 4 Paleoenvironmental evolution of a semi-enclosed marine basin using paleoecological indicators: Ostracodes
Exercise 5 Paleoenvironmental evolution of a semi-enclosed marine basin using paleoecological indicators: Synthesis
Exercise 6 Marine invertebrate benthic biocommunities - Paleoenvironmental indicators

Terrestrial Palaeoecology

Exercise 1 Calculation of vertebrate body weight. Application of values to the island rule
Exercise 2 Calculation of craniodental characteristics of carnivorous mammals
Exercise 3 Calculation of changes in mammalian carnivore guilds during the Cenozoic
Exercise 4 Measurement of primate brains and estimation of required feeding time
Exercise 5 Application of taxonomic analysis
Exercise 6 Study of fine bone-tooth sections

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.

COMMUNICATION TECHNOLOGY	
PLANNED LEARNING ACTIVITIES	**Activity** / **Student effort** Lectures: 39 hours Practice exercises: 13 hours Fieldwork: - Tutorials: - Essay writing: 18 hours Autonomous study: 20 hours Final assessment preparation: 10 hours **Total student's effort**: **100** hours
ASSESSMENT METHODS AND CRITERIA	EVALUATED: small individual practice projects (**20%**) (formative, summative) as well as the submission-presentation of two major compositional assignments: • one on marine ecosystems (**40%**) (formative, summative) and • one on terrestrial ecosystems (**40%**) (formative, summative)

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Triantaphyllou M.V. & Dimiza M.D. 2012. Micropaleontology and Geoenvironment. ION, ISBN 978-960-508-058-7. [EUDOXUS CODE: 22769096]
- Zampetaki Lekka A., Antonarakou A., Drinia H., Tsourou T., Di Stefano A., & Baldassini N. 2015. Micropaleontology and its applications [Undergraduate textbook]. Kallipos, Open Academic Editions. (e-book: pdf, e-pub) (EUDOXUS CODE 320254)

II. ADDITIONAL READING

- Murray, J., 2006. Ecology and Applications of Benthic Foraminifera. Cambridge University Press, p. 426.
- Boudagher-Fadel, M.K., 2008. Evolution and geological significance of larger benthic foraminifera. Elsevier B.V., p. 540.

III. RELATIVE JOURNALS

- Frontiers in Ecology and Evolution, Frontiers, Online ISSN 2296-701X
- Journal of Paleontology, Paleontological Society, Online ISSN 1937-2337
- Palaeogeography, Palaeoclimatology, Palaeoecology, Elsevier, ISSN: 0031-0182

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E8219**	**SEMESTER**	**8th**
TITLE	**OIL EXPLORATION - SEDIMENTARY BASINS AND PETROLEUM SYSTEMS**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Laboratory exercises	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	[recommended] Y3205 Tectonic Geology Y4206 Sedimentary Environments and Processes **Error! Reference source not found.** Applied Geophysics
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL250

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
On successful completion of the course the student: • **Identifies** and **describes** the components of petroleum systems and petroleum plays. • **Integrates** surface, subsurface and remote sensing data in order to **evaluate** geological formations with respect to their involvement in petroleum plays. • **Organizes**, **synthesizes** and **assesses** data, which can lead to a viable plan for the exploration and potential exploitation of an oil/gas field and to a decision-making process regarding the stages of exploration, assessment and development of a hydrocarbon reservoir. • **Describes** the stratigraphic and tectonic structure of a sedimentary basin as well as the stages of its evolution, which are responsible for the formation of parent rocks, reservoirs, caprocks and hydrocarbon traps. • **Classifies** the hydrocarbon source rocks according to the type of organic material and the degree

of its maturity.
- **Interprets** and **explains** the causes of the accumulation and preservation of organic material necessary for the formation of hydrocarbons.
- **Understands** the concept of the unconventional hydrocarbon reservoirs (e.g., tight sandstone oil/gas, shale oil/gas, gas hydrates) and their importance in the global hydrocarbon reserves.
- **Integrates** all available data and **interprets** the stages of evolution of a sedimentary basin with the ultimate aim of estimating its oil/gas potential.

Generic Competences

- Ability to apply knowledge in practical situations.
- Promote free, creative and inductive thinking.
- Autonomous work.
- Ability to search for, process and analyse information with the use of necessary technologies.
- Ability to undertake research at an appropriate level.

(3) COURSE CONTENT

A. Lectures

- The crucial role of Sequence Stratigraphy in the oil/gas exploration.
- Introduction to the value chain in the exploration and exploitation of hydrocarbons - The role and involvement of the Petroleum Geologist in the stages of exploration, appraisal, development, production, reserve addition and growth.
- Introduction to the concept of the petroleum play and petroleum system.
- Research and exploration methods and tools: Remote sensing data, geophysical survey techniques (e.g., stratigraphy using seismic data), exploration well loggings, core and cuttings logging, mapping.
- Introduction to unconventional hydrocarbon reservoirs: Types, reserves, prospects, environmental impact of exploitation.
- Hydrocarbon formation and accumulation.
- Parent/source rocks: Maturation time and associated processes.
- Reservoir rocks (e.g., sandstones, carbonate rocks).
- Caprocks.
- Primary and secondary migration, migration pathways, accumulation and trapping of hydrocarbons in the reservoir rock.
- Types of hydrocarbon traps: Stratigraphic, tectonic, mixed traps and traps associated with salt tectonics (diapirism).
- The importance of maturation time of the parent/source rock in relation to the time of trap formation.
- Hydrocarbon exploration in Greece and, generally, in the Eastern Mediterranean Basin.

B. Laboratory Exercises

Practice exercises are taught to each individual student and are graded prior to the start of the next Laboratory.

- **Exercise 1, 2, 3.** Study of geological maps in order to estimate the hydrocarbon potential of a region. Identification and assessment of parent/source rocks, reservoirs, caprocks, traps and potential hydrocarbon accumulations.
- **Exercise 4, 5.** Subsurface geology: Construction of subsurface tectonic maps and their interpretation.
- **Exercise 6, 7, 8.** Well logs: Spontaneous potential, Gamma-Ray, resistivity, porosity, density, dipmeter logs.
- **Exercise 9, 10, 11.** Interpretation of geological structures via the analysis of geophysical data.

- **Exercise 12, 13.** Reserve estimation: Economic analysis and investment viability study - Estimation of return on investment.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** / **Student effort** Lectures: 26 hours Practice exercises: 13 hours Fieldwork: – Tutorials: – Essey writing: 15 hours Autonomous study: 30 hours Final assessment preparation: 16 hours **Total student's effort**: **100** hours
ASSESSMENT METHODS AND CRITERIA	I. THEORETICAL PART (**50%**) • Oral/written final examination (Summative). • or • Written test on a part of the syllabus with short-answer questions and a multiple-choice test (Formative, Summative) • or/and • Written test on a part of the syllabus with extended-answer questions (Formative, Summative). • or • Presentations, by groups of three students, of synthetic topics of oil interest from the Mediterranean Region (Summative). II. PRACTICAL PART (**50%**) • Written examination with solving exercises and problems (Formative, Summative). • or • Individual practice assignments and group work/presentations (Formative, Summative).

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Bjorlykke K. (2010). Petroleum Geoscience: From Sedimentary Environments to Rock Physics. Springer Verlag: Berlin, Heidelberg.
- Gluyas J., Swarbrick R. (2004). **Petroleum Geoscience**. Blackwell Publishing: Oxford, UK.

III. RELATIVE JOURNALS

- Bulleting of the American Association of Petroleum Geologists , ISSN: 01491423, AAPG.

- Basin Research, ISSN: 0950091X, 13652117, John Wiley and Sons Inc.
- Oil and Gas journal, ISSN: 00301388, PennWell Corporation.
- Marine and petroleum geology, ISSN: 02648172, 18734073, Elsevier.
- Journal of Petroleum Science and Engineering, ISSN: 09204105, Elsevier.
- Mediterranean Geoscience Reviews, ISSN: 2661863X, 26618648, Springer Nature.
- Journal of Petroleum Exploration and Production Technology, ISSN: 21900558, 21900566, Springer Verlag.
- Journal of Petroleum Geology, ISSN: 01416421, 17475457, John Wiley and Sons Inc.

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E8220**	**SEMESTER**	**8th**
TITLE	**GEOLOGICAL HERITAGE AND GEOCONSERVATION**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Lectures, Laboratory exercises	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL183

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

Upon successful completion of the course students will be able to:

- **define** geotopes and geological monuments and categorize them according to their importance
- **know** the institutional framework for their protection
- **determine** the conditions for the recognition of a Geopark
- **identify** the geotourism potential of a geotope
- **plan** and **propose** ways of tourist exploitation of a geotope
- **plan** geographical routes in areas of interest
- **assess** the value of geotopes
- **support** the promotion and protection of geotopes
- **cultivate** a sense of protection of geological monuments

Generic Competences

- Ability to apply knowledge in practical situations
- Promotion of free, creative and inductive thinking
- Searching, analysing and synthesising data and information, using the necessary technologies
- Decision-making

• Ability to conduct research at an appropriate level

(3) COURSE CONTENT

A. Lectures

- Introduction to Geological Heritage - Institutional Framework - Geoethics
- Natural Monuments and Geological Heritage – Classification of Geotopes - Geotope Assessment Systems
- Design and Operation of Geoparks
- Basic principles of Geoconservation-inventory, conservation and protection of the Geological Heritage -Conservation methods and promotion
- Basic principles of Geotourism
- Environmental education and training.

B. Practicals

- Geotrail Layout
- Determining a Geotrail in a Geopark

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	see table below
ASSESSMENT METHODS AND CRITERIA	The assessment of students is performed through: • Laboratory Projects **(30%)** (formative, summative) • Presentation of group projects **(30%)** (formative, summative) • Written Assignments, Reports **(40%)** (formative, summative)

Activity	Student effort
Lectures	26 hours
Practice exercises	13 hours
Fieldwork	-
Tutorials	-
Essey writing	24 hours
Autonomous study	24 hours
Final assessment preparation	13 hours
Total student's effort	**100** hours

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Zafeiropoulos G., Drinia H., Antonarakou A., Zouros N. 2021. From Geoheritage to Geoeducation, Geoethics and Geotourism: A Critical Evaluation of the Greek Region. Geosciences 11(9), 381.
- Zouros N. 2004. The European Geoparks Network. Episodes 27, 165–171
- Dowling R., Newsome D. (Eds.) 2006. Geotourism; Elsevier/Heineman: Oxford, UK.

- Gray, M. 2004. Geodiversity: Valuing and Conserving Abiotic Nature; John Wiley: Chichester, UK.
- Sharples C. 2002. Concepts and Principles of Geoconservation. Tasmanian Parks and Wildlife Service. Available online: http://www.dpipwe.tas.gov.au/Documents/geoconservation.pdf

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E8221**	**SEMESTER**	**8th**
TITLE	**METHODS IN MINERAL EXPLORATION**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Lab Exercises and Fieldwork		**3**	**4**
TYPE OF COURSE	**ELECTIVE /** Scientific Area		
PREREQUISITES	[recommended] E6205 - Geology of Magmatic and Hydrothermal Ore Deposits **Error! Reference source not found.** - Geology of Sedimentary and Supergene Deposits Y4203 - Geochemistry		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	https://eclass.uoa.gr/courses/GEOL387		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
On successful completion of the course the student will be able to: • **Define** the economic, social and environmental factors and modern applications of raw materials that determine their demand and exploitability. • **Describe** the investments required for the exploitation of ore deposits, for their rational evaluation and their sustainable exploitation planning. • **Define** and **formulate** the stages required for the exploitation of mineral resources from the identification of the deposit to the development planning of the mining/quarrying operations. • **Define** and **describe** the research methodology for the identification of deposits, **combine** and **evaluate** the techniques required at each stage of exploration and their data.

Generic Competences
• Ability to be critical and self-critical • Oral and written communication of scientific issues • Ability to apply knowledge in practical situations • Work in a team • Promote free, creative and inductive thinking

(3) COURSE CONTENT

A. Lectures.

- Introduction, raw materials exploitability factors, definitions.
- Economic evaluation of mineral resources, stages of mineral exploration.
- Satellite Remote Sensing in mineral exploration.
- Aerial and in situ geophysical surveys in mineral exploration.
- Introduction to geochemical environments, geochemical processes of metal dispersion.
- Geochemical prospecting methods in mineral exploration.
- Statistical analysis and processing of geochemical data - Data Mining.
- Principles and applications of geochemical mapping in mineral exploration.
- Petrographic survey and methods of core logging.
- Mineralogical prospecting and the importance of mineralogy in the identification and evaluation of mineral resources.
- Geological modelling applications in mineral exploration.
- International Reference Codes for mineral exploration results (CRIRSCO, UNFC).

B. Laboratory Exercises:

The Laboratory Exercises are carried out individually or in small groups of students and are graded at the end of the Lab.

Exercise 1. Exercises for the calculation of economic indices for the evaluation of mining investment (Net Smelter Return- Net Present Value).

Exercise 2. Processing of satellite data from Sentinel 2 using SNAP and ArcMap software and construction of a pseudocolor map of spectral ratios in hydrothermal deposits to detect alterations and mineralization.

Exercise 3. Construction of a geophysical map using ArcMap with aerial magnetic prospecting data in an area of magmatic-hydrothermal deposits and comparison with satellite data.

Exercise 4. Statistical processing of geochemical data and determination of geochemical background values, threshold values, determination of geochemical anomalies and geochemical trackers.

Exercise 5. Construction of a geochemical map using ArcMap, determination of distribution of geochemical trackers and evaluation of possible mineralization sites in magmatic hydrothermal-REE-Y-U systems.

Exercise 6. Observation of textural changes and alteration under a petrographic microscope of transmitted/reflected light in host rocks and Skarn mineralization samples.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.	
PLANNED LEARNING ACTIVITIES	**Activity**	**Student effort**

	Lectures	24 hours
	Practice exercises	15 hours
	Fieldwork	–
	Tutorials	–
	Essay writing	20 hours
	Autonomous study	31 hours
	Final assessment preparation	10 hours
	Total student's effort	**100** hours
ASSESSMENT METHODS AND CRITERIA	I. LECTURES (**80%**) • Group written assignment in a topic related to mineral prospecting and oral presentation at the end of the semester (summative). II. LAB EXERCISES (**20%**). • Application of analytical methods and completion of relevant exercises during the semester (formative, summative).	

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- S. Decree & Robb, L. (2019). **Ore Deposits: Origin, Exploration, and Exploitation**. Wiley, ISBN 978-1-119-29055-1. [EUDOXUS code: 91721713]
- R. Marjoribanks, (2010). **Geological Methods in Mineral Exploration and Mining** [electronic resource]. Springer, ISBN 978-3-540-74370-5. [EUDOXUS code: 73239486]

II. ADDITIONAL READING

- F.W. Wellmer, M. Dalheimer, &M. Wagner (2008). **Economic evaluation in exploration**-By - Springer 2nd edition
- M. Bustillo Revuelta (2018). Mineral Resources from Exploration to Sustainability Assessment, Springer

III. RELATIVE JOURNALS

- Minerals & Energy,Taylor and Francis Online
- Ore Geology Reviews, Elsevier
- Remote Sensing, MDPI
- Journal of Applied Geophysics, Elsevier

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**E8222**	**SEMESTER**	**8th**
TITLE	**WATER RESOURCES MANAGEMENT - VULNERABILITY**		
TEACHING ACTIVITIES		**HOURS/WEEK**	**ECTS**
Lectures, Lab exercises, Fieldwork		**4**	**4**
TYPE OF COURSE	**ELECTIVE /** Scientific Area		
PREREQUISITES	Y6202 Hydrogeology [recommended]		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English		
AVAILABILITY TO ERASMUS STUDENTS	YES		
WEBPAGE (URL)	http://eclass.uoa.gr/courses/GEOL251		

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
The course "Water Resources Management - Vulnerability" is an advanced (specialized) course that deals with issues of "wise" water resource management, pollution, and decontamination of aquifers, the assessment, with various methodologies, of the susceptibility to pollution (vulnerability) of formations hosting groundwater and the assessment of the risk against pollution. • Prepares, evaluates and review in collaboration with other scientists Drainage Basin Management Plans, as required by European (Directive 2000/60) and Greek law, • Designs and executes in collaboration with other scientists aquifer decontamination projects, • Evaluates vulnerability with different methodologies for different types of aquifers, constructs vulnerability maps and calculates the risk from pollution of aquifers.
Generic Competences
• Promote free, creative and inductive thinking • Ability to plan and manage time. • Oral and written communication of scientific issues • Autonomous work • Information and Communication Technology (ICT) skills

(3) COURSE CONTENT

A. Lectures of the course

1) Water Resources Managemen

Basic concepts and definitions related to management. Legislative framework for water resources management in the European Union and Greece. Water resources and water districts of Greece. Water and its relationship with the environment, urban development, energy and sustainable development, spatiotemporal distribution of supply (availability) and demand. Water supply, water demand, water demand management. Combined management of surface and groundwater resources. Water resources management plans. Decision support systems in water resource management problems. Water resources development projects. Processing of used water, desalination.

2) Vulnerability

1. The aquatic environment. Fluctuations in the level of surface water and groundwater. Combined water management (in general, parameters of the problem, fundamental principles, general planning of water development).
2. Changes in the quality of water bodies. Water receivers. Anthropogenic burdens on water recipients.
3. Mechanisms for the transfer of pollutants. Mechanisms for dealing with pollutants.
4. The vulnerability of water bodies. Internal and Special Vulnerability. Vulnerability assessment and mapping.
5. Water abstraction protection zones.
6. Greek, European, and Global legislation and practice

B. Lab Exercises

- Part A: Laboratory exercises and solving exercises and problems aimed at consolidating concepts taught in lectures (lectures).
- Part B: Execution of software programs and training of mathematical models using computers
- Processing of data collected from field (field) work.

C. Field Exercises (Outdoors)

Field exercise, usually going to areas of Attica or the Tripoli Plateau, or the industrial zone of Oinofyta, for the understanding of the concepts and the work that must be done in order to draw up the Drainage Basin Area Management Plans, in accordance with Directive 2000/60 of the European Union and national legislation and for the collection of data to be used to assess the vulnerability and risk of degradation of the groundwater quality.
This is followed by processing of the collected data in the Practice Exercises

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	

Activity	Student effort
Lectures	13 hours
Practice exercises	26 hours
Fieldwork	10 hours
Tutorials	- hours
Essey writing	16 hours
Autonomous study	20 hours
Final assessment preparation	15 hours

	Total student's effort **100** hours
ASSESSMENT METHODS AND CRITERIA	The assessment process is conducted in Greek, either with progressive exams in separate sections of the course content or with the final examination of the entire course material which includes: I. LECTURES (**45%**) (formative, summative) • Oral Examination and/or • Written Exam with Short Answer Questions and Multiple Choice Test and/or • Written Exam with Extended Answer Questions II. LAB EXERCISES (**45%**) (formative, summative) • Written exam with Solving Exercises and Problems III. FIELD EXERCISES (**10%**) (formative, summative) • Oral examination in the field and evaluation of required report.

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

- Voudouris K., 2016, Environmental Hydrogeology. Groundwater and Environment, [EUDOXUS Code: 18549069] (in Greek)
- Voudouris K., 2017, Groundwater Exploitation & Management, Voudouris K., 2015, Exploitation and management of Groundwater. Tziola Publications, ISBN: 978-960-418-469-9 [EUDOXUS Code: 112690244] (in Greek)

II. ADDITIONAL READING

- Chapelle H. F., 1992, Ground-Water Microbiology and Geochemistry, by John Wiley & Sons, Inc., New York., ISBN:0-471-52951-6
- Domenico A. P. & Scbwartz W. F., 1998, Physical and Chemical Hydrogeology, second ed., by John Wiley & Sons, Inc., New York, ISBN: 0-471-59762-7
- Driscoll G. F.: Groundwater and Wells, 2ed ed. 1989, by Jonson Filtration Systems Inc, ISBN: 0-9616456-0-1
- Fetter C. W.: Applied Hydrogeology, 4th ed. 2001, by Prentice-Hall, Inc. Upper Saddle River, New Jersey 07458, ISBN: 0-13-088239-9
- Hem J. D.,1985, Study and intepretation of the chemical characteristics of natural water. U. S. Geological Survey Water-Supply Paper 1473
- Hounslow W. A., 1995, Water Quality Data, Analysis and Interpretation, by CRC Press, Taylor & Francis, ISBN: 978-0-87371-676-5
- Kallergis A. G., 1999,: Applied - Environmental Hydrogeology. Second edition, TEE Publications, Athens, Volume B., ISBN: 960-7018-70-2 (in Greek)
- Kresic N., 2007 Hydrogeology and Groundwater Modeling, second ed. by CRC Press and Taylor & Francis. ISBN: 978-0-8493-3348-4
- Lamb C. J., 1985, Water Quality and its control, by John Wiley & Sons, Inc., New York., ISBN: 0-471-83735-0
- Richter C. B. & Kreitler W. C., 1993, Geochemical Techniques for Identifying Sources of Ground-Water Salinization, by C. K. Smoley, CRC Press, Inc.
- Zaporozec A. & Vrba J., 1994, Guidebook on Mapping Groundwater Vulnerability. International Association of Hydrogeologists, V.16.
- Various Directives of the European Union concerning the protection of water resources

III. RELATIVE JOURNALS

- Water
- Hydrogeology Journal
- Groundwater
- Water Resources Reseach

COURSE OUTLINE

(1) GENERAL INFORMATION

FACULTY	**SCHOOL OF SCIENCE**		
DEPARTMENT	**GEOLOGY AND GEOENVIRONMENT**		
EDUCATION LEVEL	**EQF level 6; NQF of Greece level 6**		
CODE	**ΠΑ001**	**SEMESTER**	**7th & 8th**
TITLE	**INTERNSHIP**		

TEACHING ACTIVITIES	**HOURS/WEEK**	**ECTS**
Internship	**3**	**4**

TYPE OF COURSE	**ELECTIVE /** Scientific Area
PREREQUISITES	NONE
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek- English
AVAILABILITY TO ERASMUS STUDENTS	YES
WEBPAGE (URL)	https://www.geol.uoa.gr/foitites/praktiki_aksisi/ https://eclass.uoa.gr/courses/GEOL457/

(2) LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences

On completion of the internship, the student:

- **Understands** the range of options for planning his educational or professional career, starting from his undergraduate studies.
- **Applies** the knowledge and skills developed while studying to the workplace.
- **Evaluates** whether the subject of his work placement is a possible career choice.
- **Estimates** his knowledge, skills and general education in relation to the professional field in which he is trained.

Generic Competences

- Ability to apply knowledge in practical situations
- Promote free, creative and inductive thinking
- Ability to plan and manage time
- Ability to work in a team
- Ability to search for, process and analyse information with the use of necessary technologies

(3) COURSE CONTENT

This course includes a 2-month work placement in institutions/companies relevant to the subjects taught in the Department. Students are free to choose the institution (located anywhere in the country) where they would like to do their placement. They will be given specific tasks and responsibilities by their assigned Supervisor at the institution/company. Internship hours are full-time, aligned with the Host Institution's working hours. The internship provides students with the opportunity to experience the modern working environment and to apply their scientific knowledge in a real-world setting. It also helps them to enhance their scientific training by acquiring professional skills and qualifications. In addition, the internship provides networking opportunities with institutions/companies and executives, allowing students to gain valuable professional experience.

(4) LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	– Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	– Use of ICT in teaching (lectures, lab exercises, fieldwork). – Use of ICT in communication with students.
PLANNED LEARNING ACTIVITIES	**Activity** / **Student effort** Internship (assignment of work by the Host entity) / 2 Months (Full time job) **Total student's effort** / **2** Months
ASSESSMENT METHODS AND CRITERIA	Language of Evaluation: greek. Student deliverables: • Detailed activity report • Daily attendance and activity schedule of the student trainee • Certificate of Completion of the Student Activity and Activity Report of the Host Organisation • Student Performance Report from the Student Work Supervisor at the Host Organisation. The final mark is determined by the Student Performance Report. However, it will not be taken into account for the final grade of the degree.

(5) RECOMMENDED READING

I. EUDOXUS PORTAL

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II. ADDITIONAL READING

- Internship Regulation of the Department of Geology and Geoenvironment (in greek)
- Guide and answers to frequently asked questions (in greek)
- Internship Guide 2023-2024 (in greek)

- Indicative index of organisations/companies to search for placements

III. RELATIVE JOURNALS

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