HELLENIC REPUBLIC
NATIONAL AND KAPODISTRIAN
UNIVERSITY OF ATHENS

SCHOOL OF SCIENCE
DEPARTMENT OF GEOLOGY AND GEOENVIRONMENT

POSTGRADUATE STUDIES PROGRAM
‘EARTH SCIENCES AND GEOENVIRONMENT’

STUDENT’S HANDBOOK
AND SYLLABUS
2023-2024

ATHENS, 2023

This Guide has been compiled by:

Editors:
Andreas Tzanis, Professor
Stylianos Chailas, Laboratory Technical Staff

Editorial Board:
Konstantinos Eleftheratos, Associate Professor
Stephanos Kilias, Professor
Efterpi Koskeridou, Professor
Nike Evelpidou, Professor
Haralambos Kranis, Associate Professor
Demetrios Kostopoulos, Associate Professor
Georgios Kontakiotis, Laboratory Teaching Staff
Ifigenia Megremi, Laboratory Teaching Staff

***Edition:* 16/11/2023**

CONTENTS

Chapter 1

NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS

1.1 ADDRESS

Central Administration:
30 Eleftheriou Velizelou Av.
106 79, Athens, Greece

website: http://www.uoa.gr

NKUA on the map: http://maps.uoa.gr

1.2 OVERVIEW AND MISSION

The NKUA has recently celebrated 180 years as of its foundation and is the oldest university in Greece, as well as the higher education institution in the Balkans and the Eastern Mediterranean. Given its historical background and through the significant efforts of its human resources, the NKUA has attained recognition as a center of educational and scientific excellence.

The NKUA comprises eight Schools and offers a broad range of study areas; prospective students can choose among 33 undergraduate and 183 postgraduate study programs, as well as pursue doctoral and post-doctoral studies. 39,088 undergraduate students, 11,479 postgraduate students, 14,240 doctoral candidates and 5,654 foreign students pursue their studies and foundation of their careers at the NKUA; all these are taught by 2,104 Professors and other Research and Teaching Staff, and are supported by 1087 administrative and technical staff. The total area spanned by the university's teaching and research facilities is approximately 700,000 square meters.

The NKUA cares about, and to a considerable degree caters for the personal and professional success of its graduates and endeavours to make them highly employable and influential in their respective professional spheres. To this effect, the curricula of the NKUA's departments are constantly upgraded and educational/ research activities are aggressively pursued. Because the NKUA is a research university, all faculty members and researchers are continuously encouraged to push and expand the boundaries of knowledge in their respective fields of expertise. Students are also encouraged to participate and excel in Olympiads and international academic competitions; they are also invited to participate in educational and research activities conducted in the NKUA's laboratories, libraries, and museums.

The internationalization of the NKUS is a priority for both Rectoral Authorities and members of its Academic Community. Decades of cooperation with partner institutions from most European Union and other European countries as well as the participation in international organizations, associations and university networks, have led to a consistent development of the NKUA's international profile and its fundamental role in student and staff mobility. The NKUA strongly believes that cooperation between higher education institutes is essential to the strengthening of bilateral and multi-lateral relations between sovereign countries. The mobility activities foreseen by the ERASMUS+ program for the academic year 2018-19 are based on 655 Erasmus Agreements between the NKUA and 336 universities of 31 European countries. Finally and importantly, the NKUA is involved in 60 scientific cooperation agreements with universities of EU countries, the US, Canada, China, the Russian Federation, Japan, Australia, Israel, Jordan, Korea, Iran , Taiwan and others, as well as with high profile research centres such as CERN (Switzerland), INRIA (France) and A*STAR (Singapore).

1.2.1 SCHOOLS, DEPARTMENTS AND STUDY PROGRAMS

- The NKUA comprises 9 Schools and 43 Departments; detailed information can be found in:
- https://en.uoa.gr/schools_and_departments/
- The NKUA offers 43 Undergraduate Study Programs; detailed information can be found in:
- https://en.uoa.gr/studies/undergraduate_programs/
- The NKUA offers 187 Postgraduate Study Programs in addition to the PSP "Eartch Sciences and the Geoenvironment". Information can be sought in:
- https://en.uoa.gr/studies/postgraduate_programs/
- The NKUA offers several Postgraduate Study programs in languages other than Greek. For information please visit:
- https://en.uoa.gr/studies/master_programs_in_various_languages/

1.2.2 PERSONNEL

- Professors (all ranks): 1,703
- Research associates and other teaching, laboratory and technical staff: 486
- Administrative staff: 1,095

1.2.3 STUDENTS

- 44,658 undergraduates
- 13,257 graduate students at Master level
- 8,015 Ph.D candidates

1.2.4 INTERNATIONALSTUDENTS

- 5,795 Undergraduates
- 211 Graduate Students at Master level
- 121 Ph.D Candidates

1.2.5 ERASMUS+ STUDENT MOBILITY (2018 - 2019)

- 354 Incoming Students
- 755 Outgoing Students

1.3 LANGUAGE POLICIES

The official language of the University of Athens is Greek, which is the official language of the country, as well as one of the 23 languages of the European Union.

The language in which access to knowledge is achieved and the work language of the Postgraduate Programs that leads to obtaining a post graduate specialty degree or to acquiring a doctoral degree is Greek, except if the internal regulation of the Postgraduate Program makes provision for the use of other languages. The writing up of the doctoral dissertation for the Postgraduate Program or the dissertation for the doctoral degree may be realized in Greek or in another language, according to the internal regulations of the Program. The bibliography that is suggested and is currently used in the Postgraduate is in Greek and in other languages and for this reason, the knowledge of foreign languages by the prospective incoming students of the Postgraduate Program of the University of Athens is either obligatory or optional but desired.

1.3.1 TEACHING OF FOREIGN LANGUAGES

The National and Kapodistrian University of Athens, within its instructive and broader educational scope, offers its students the possibility of acquiring, during their studies, the knowledge of one or more foreign languages, which constitute necessary tools for scientific fulfillment.

This important task of foreign language learning is accomplished by the Foreign Language Teaching Centre ('Didaskaleio') of the University of Athens.

Didaskaleio is an independent and autonomous academic teaching unit, which offers high-standard foreign language tuition.

At present, 22 foreign languages of all levels of competence, are being taught at Didaskaleio: English, Albanian, Arabic, Bulgarian, Czech, Chinese, Danish, Dutch, French, Finnish, German, Hindi, Italian, Japanese, Korean, Norwegian, Persian, Portuguese, Russian, Serbian, Spanish, Swedish and Turkish.

In addition, special programs are offered for those wishing to specialize in language skills: language laboratories, translation, law and medical terminology. More analytically:

- IELTS Course (International English Language Testing System) (three-hour sessions three times per week)
- Lab for Written and Spoken English; Levels B1-B2
- Lab for Spoken English (Debating-Public Speaking); Levels C1-C2
- English Lab for Academic Writing; Levels C1-C2
- Medical Terminology in English (Medical School Students - Doctors - Nursing Staff)
- Law Terminology in English
- Translation in the English and Greek Language; B2 level and above
- Lab for Spoken French; Levels B1-B2
- Law Terminology in French
- Institutions, Terminology and Translation of European Union Documents in French
- Lab for Written and Spoken German; Levels C1-C2
- Lab for Written and Spoken Spanish; Levels B2-C1
- Lab for Written and Spoken Italian (Levels B2-C1)

Lessons are conducted either in the city centre, or at the University Campus in Zografou and can be attended not only by home students but also by students of other Greek Universities or of Technological Institutes as well as by anyone interested since tuition fees are particularly low.

Upon successful completion of attendance, the Foreign Language Teaching Centre provides students with the following certificates: a Certificate of Attendance and a Certificate of Studies.

Address: Foreign Language Teaching Center, Hippokratous 7, 106 79, Athens

Telephone: 210–3688204, 210-3688232, 210-3688265, 210-3688266, 210-3688263

e-mail: info@greekcourses.uoa.gr

Website: http://www.didaskaleio.uoa.gr/

1.3.2 GREEK AS A FOREIGN LANGUAGE

The Modern Greek Language Teaching Centre of the National and Kapodistrian University of Athens has been functioning since the 1950s, initially with a very limited number of students. In the decades that followed the number of students increased exponentially. The Modern Greek Teaching Centre is the largest of its kind in the world. Many of its graduates are today teachers of Modern Greek and Philology at Universities throughout the world, members of the diplomatic corps in their own countries, church leaders, renowned scientists, company managers, respected artists and business professionals.

The Teaching Centre is under the auspices of the Interdepartmental Programme for the Teaching of Modern Greek as a second/foreign language along with the similarly titled Master's Degree Programme of The Department of Philology and The Department of Philosophy, Pedagogy and Psychology.

The aims of the Modern Greek Teaching Centre are as follows:

1. The teaching of Modern Greek as a second/foreign language;
2. The certification of the level of knowledge of Modern Greek as second/foreign language;
3. The exposure of foreigners to various facets and themes of the Greek culture;
4. Hands-on practical training of students of the Master's Degree Programme for the Teaching of Modern Greek as a second/foreign language.

Address: Modern Greek Language Teaching Center, University Campus, 157 84 Zografou

Telephone: 210-727 7672, 210 727 7971

E-mail: info@greekcourses.uoa.gr

1.4 ERASMUS+

Erasmus+ is the EU funding programme for education, training, youth and sport 2014-2020. Erasmus+ combines previous funding programmes in the sector, including the Lifelong Learning Programme (Comenius, Leonardo, Erasmus, Grundtvig and Transversal Programmes), Youth in Action and five international cooperation programmes (Erasmus Mundus, Tempus, Alfa, Edul-

ink and the programme for cooperation with industrialised countries. Erasmus+ supports the following main Actions:

- Key Action 1: Learning Mobility of Individuals
- Key Action 2: Co-operation for Innovation and the Exchange of Good Practices
- Key Action 3: Support for Policy Reform

For more information please consult the following web pages:

https://www.iky.gr/en/discover-erasmus (IKY - Erasmus National Agency in Greece), and

http://ec.europa.eu/programmes/erasmus-plus/node_en (European Commission)

Eligible countries are divided into two groups, Programme countries and Partner countries. Although Programme countries are eligible for all actions of Erasmus+, Partner countries can only take part in some, and are subject to specific conditions.

For more information, see:
http://ec.europa.eu/programmes/erasmus-plus/node/3_en

Switzerland at the moment is not participating in Erasmus+ programme on an equal footing with Member States (i.e. as a "Programme Country") but is enjoying the status of other third countries (i.e. as a "Partner Country") and is financing all incoming and outgoing mobilities.

For more, see: http://ec.europa.eu/programmes/erasmus-plus/updates/20140128-participation-switzerland-erasmus-plus_en

The National and Kapodistrian University of Athens participates in the Erasmus+ programme having been awarded the Erasmus Charter for Higher Education: **31475-EPP-1-2014-1-GR-EPPKA3-ECHE**

Institutional Erasmus Code: **G ATHINE01**

PIC NUMBER OF THE UNIVERSITY: **999643007**

Chapter 2

DEPARTMENT OF GEOLOGY AND GEOENVIRONMENT

2.1 CONTACT INFORMATION

Address: Panepistimiopoli, Zografou 15784, Greece

Tel: +30 210 727 4279

Fax: +30 210 727 4051, +30 210 727 4063

Website: http://www.geol.uoa.gr

Info: dpsarris@geol.uoa.gr, kelchor@geol.uoa.gr

The Department of Geology and Geoenvironment is a part of the School of Sciences. It is the oldest Earth Science establishment in Greece – its history can be traced to the establishment of the University in 1839. At present, it is also the biggest academic unit in which Earth Sciences are taught and comprises six departments covering a broad range of earth science subjects. The Department's objective is to prepare students for careers in environmental science, natural hazard assessment and mitigation, geotechnical engineering, exploration and exploitation of mineral and energy resources etc.; it also aims at promoting research that leads to academic careers in universities, research institutes and museums worldwide.

2.2 ADMINISTRATIVE FRAMEWORK

Competent organs for the administration of the Department are the President and Vice President, the Governing Board and the Assembly.

2.2.1 PRESIDENT

The President and Vice President are elected by the complement of the teaching, research, technical and administrative staff of the Department of a two-year terms. The President:

a) Supervises the proper operation of the Department and ensures the observance of the competent laws and regulations.

b) Represents the Department in the Senate of the N.K.U.A. and the Deanery of the School of Sciences, liaises the resolutions of the Department, promotes and negotiates issues related to its needs and operation and communicates the resolutions of Senate or Deanery to the Department.

c) Drafts the agenda of the Assembly, convenes and presides over the Assembly, appoints rapporteurs and ensures the implementation of the Assembly's resolutions.

d) Drafts the agenda, convenes and presides over the Governing Board and ensures the implementation of its resolutions.

e) Ensures the proper implementation of study programs and educational activities in the Department.

f) Manages academic, procedural and administrative issues concerning the personnel of the Department.

g) Establishes committees and boards to study and handle the affairs and activities of the Department.

h) Is responsible for keeping the record of scientific activity and publications of the Department.

The Vice President exercises the duties and responsibilities of the President in their absence or impediment. If the President resigns or expires during the second (last) year of his term, the Vice President assumes their duties to the end of the term.

2.2.2 GOVERNING BOARD

The Governing Board consists of the President, the Vice President, the Directors of the Department's Sections, and one representative of the Research, Teaching and Technical staff. The Board exercises the responsibilities conferred to it by the Assembly as per Article 31 of the Framework Law 4957/2022, so as to ensure the efficient operation of the Department. Accordingly the Board manages issues pertaining to the competence of the Assembly on its behalf, and processes issues referred to it by the Assembly.

2.2.3 THE ASSEMBLY

The Assembly is the ultimate decision-making organ of the Department. The Assembly is composed of **a)** the President and the Vice President, **b)** the Directors of the Department's academic Sections, **c)** faculty members (professors) the number of which is determined by the algorithm specified in Art. 29 of the framework law 4857/2022, **d)** three members of the research/teaching and technical staff and **e)** representatives of the students, whose number corresponds to 15% of the total number of categories (a) to (c) above, with a *minimum* of one student per cycle of studies offered by the Department. The Assembly:

a) Determines the general educational and research policies of the Department and strategies of their improvement within the guidelines set by the University and the School of Sciences.

b) Supervises the implementation or upgrades of all of the curricula in all cycles of studies offered by the Department, assigns teaching duties, approves textbooks and awards academic degrees and certificates of study.

c) Administers all of the academic, procedural and executive matters concerning the personnel of the Department.

d) Administers the finances of the Department.

e) Ensures the seamless physical operation of the Department

f) Supervises the internal evaluation/accreditation of the Department.

g) Establishes committees and boards to study/handle the affairs and activities of the Department and decides upon their recommendations.

2.3 PREMISES

The Department is housed in the building complex of the Faculty of Sciences in Panepistimiopoli (see Appendix V). The premises occupy the southwest quadrant of the complex.

The Department has 3 large amphitheaters (A13, G10, ΦΜ) and 15 smaller classrooms (Γ1-Γ15) equipped with modern image projection and sound reproduction equipment, as well as internet connection. Laboratory space (rooms and halls) is also located in the premises of Academic Sections (see below). Computer rooms and dedicated software for studying, analyzing and processing geological data are also available. Plan views of the Department's premises can be found in Appendix V.

The Library of the Department is part of the Library of the School of Sciences and is housed in the building of the Department of Mathematics on the 1st and 2nd floor (Panepistimiopoli, Zografou). Information can be sought in telephone numbers 2107276599 and 2107276525 (secretariat) or by e-mail in sci@lib.uoa.gr and sci-loan@lib.uoa.gr (loans); the website is www.lib.uoa.gr/sci. Opening Hours: Monday to Friday 08:30-19:30, Sat-Sat: 09:30-14:30. The library remains closed on public holidays.

2.4 ACADEMIC SECTIONS

The Department is organized in 10 academic units comprising six Sections with their dependencies (Laboratories or Museums) and four independent Laboratories:

2.4.1 SECTION OF MINERALOGY AND PETROLOGY

The Department of Mineralogy and Petrology addresses questions pertaining to the description, classification and formation of minerals and rocks. Special emphasis is put on mineral chemistry and structure as well as on igneous, sedimentary and metamorphic processes and their evolution in space and time. The social, environmental and health impact of rocks and minerals and the nature and consequences of volcanism are also examined in detail.

Specific research topics include:

- Geometrical properties and internal structure of crystals
- Formation, growth and systematic classification of minerals
- Generation, evolution and emplacement of magmas
- Volcanoes, their activity and products; volcanic hazards and their management
- Depositional and diagenetic processes, products and environments of sedimentary rocks; tectonic settings of sedimentary deposits; provenance analysis of siliciclastic rocks
- Metamorphism at spreading centers, subduction zones, collisional orogens and the deep interior of the Earth
- Physicochemical conditions and thermodynamic modelling of igneous of metamorphic reactions and processes
- Dating of geological processes through mineral and whole-rock isotopic techniques
- Environmental and applied mineralogy and petrology.
- Archaeometry – Conservation and restoration of monuments.
- Gemmology and medical geology.

Web address: http://minpet.geol.uoa.gr/index.htm

2.4.1.1 LABORATORY OF MINERALOGY AND PETROLOGY

The ***Laboratory of Mineralogy and Petrology*** carries out basic and applied research and projects related to basic and applied research including the development of environmental and industrial applications. Its main activities include sampling and processing of rocks and minerals, determination of the internal structure of minerals, qualitative and quantitative determination of the chemical composition of rocks and minerals as well as chemical analyses of surface and subsurface fluids and gases. Determination of physical properties of geological samples such as crystal dimensions, shape, orientation, and intergrowth also takes place. In addition, the laboratory determines physical/mechanical properties of rocks and minerals and runs gemological analyses to examine the quality of precious and semiprecious stones. The infrastructure is available for research and education to undergraduate and postgraduate students and includes:

- Equipment for sample preparation (jaw crusher, cutting saw, lapping system, polishing system, mortar grinder, ball mill, hydraulic press (25T) and pellet press)
- Various bench top analytical instruments (pH-meter, conductivity meter, colorimeter, microhardness tester)
- X-Ray Diffractometer,
- ED & WD X-Ray Fluorescence Spectrometers
- Direct Current Plasma Atomic Emission Spectrometer,
- Transmitted-light polarizing microscopes equipped with digital cameras
- Dark room for Optically Stimulated Luminescence (infrared).

Web address:
http://minpet.geol.uoa.gr/MINPETesot_files/ergastiria.htm

2.4.2 SECTION OF HISTORICAL GEOLOGY AND PALAEONTOLOGY

The ***Section of Historical Geology and Palaeontology*** studies the scientific topics of Historical Geology, Stratigraphy, Palaeontology and Sedimentology, as well as many other more specialized topics, thus producing important scientific and educational work in the Department of Geology and Geoenvironment. These topics include:

- Invertebrate Palaeontology.
- Micropalaeontology
- Vertebrate Palaeontology, Palaeoanthropology, bone and teeth diagenesis
- Palaeobotany, Palynology
- Fossilization, geochronology, Archaeometry, geoarchaeology
- fossil conservation and preparation, museum studies, Enhancing of geological heritage
- Lithostratigraphy, biostratigraphy, chemostratigraphy, magnetostratigraphy, stratigraphy of alpine and metalpine formations, etc
- Palaeoecology, palaeoclimatology, evolutionary palaeoecology, palaeogeography
- Environmental micropalaeontology, palaeoenvironments
- Sedimentary basin analysis, Marine geology
- History and Philosophy of geosciences, didactics of Geosciences

All the above contribute to the knowledge concerning the evolution of life and biodiversity on the planet, the reconstruction of environmental conditions during the geological past, palaeogeography, climatic changes in older geological periods and their effect on living organisms, the use of microfossils as indices of environmental health in marine environments, monuments of Geological heritage. Palaeontological excavations are also conducted by our Section.

Web address: http://geopal.geol.uoa.gr

2.4.2.1 Laboratory of Historical Geology and Palaeontology

The ***Laboratory of Historical Geology and Palaeontology*** is one of the oldest in the University. To this day, it plays a very important role in education and scientific research of the Section, in topics such as Palaeontology, Micropalaeontology, Stratigraphy, Sedimentology, Historical Geology, Palaeoecology and Ecostratigraphy. The Laboratory facilities include a modern thin section lab, a modern lab for the retrievement and preparation of fossils and microfossils as well as the conservation and creation of moulds/casts. There is also a modern lab for the analysis of sedimentary basins.

For the educational and research needs of the Section, the Laboratory also includes an e-teaching hall/room, with 24 computers and stereoscopes, 5 polarizing microscopes, three of which are connected to computers, and a Scanning Electron Microscope (SEM) connected to an X-ray Microanalysis system (WDS).

The laboratory may provide the following services: a) thin sections of rocks, sediments and fossils; retrievement and preparation of fossils; construction of fossil casts, b) identification of nano-, micro-, macro- fossils, c) analysis of sediments and sedimentary environments with applications in Hydrocarbon and water resources research, d) analysis of texture, composition, granulometry and identification of inorganic and organic composites of sediments, e) preparation of samples for C, O and S stable isotope analysis in sediments, f) digital logging and mapping of aqueous floors, g) stereotransportation (sedimentation) and hydrodynamic parameters measurements and h) protection of Geological Heritage.

Web address: http://labgeopal.geol.uoa.gr

2.4.3 Section of Geography and Climatology

The ***Section of Geography and Climatology*** (SGC) deals with earth surface processes, both terrestrial and marine. It hosts the Laboratory of Physical Geography (LPG) and the Laboratory of Climatology and Atmospheric Environment (LACAE). It offers the Postgraduate course of "Geography and Environment", since 1991; it is also involved in the Postgraduate program "Oceanography and Management of Marine Environment" since 1978 (School of Sciences). The SGC has participated in several national and international (mostly European) research programmes (e.g. MATER, CINCS, PDTD, INTERREG IIIB-CADSES, CAVESNETWORK - INTERREG III C., COST Action C22, INTERREG III B ARCHIMED (ARISTHOT), INTERREG IIIB (MEDOCC), IKYDA and has hosted a Marie-Curie fellowship.

Research topics include:

- The recent geomorphological and geological evolution of the terrestrial and seabed surface.
- The atmosphere and climate change, the processes of extreme weather/climate events and their adverse effects on the natural and social environment
- Coastal and inland waters with emphasis on the management and utilization of aquatic systems
- Coastal erosion and sea level rise effects
- Desertification phenomena and the environmental consequences of extensive forest fires
- The study, analysis, assessment and management of natural hazards and mitigation of impacts
- The management of complex environmental problems of habitats and of the coastal zone
- The development of techniques for digital analysis and modelling of geomorphological processes
- The study, protection and promotion of karst forms
- Land-use planning and regional planning, from a geographical-geomorphological point of view

Web address: geogclim.geol.uoa.gr

2.4.3.1 Laboratory of Climatology and Atmospheric Environment

The ***Laboratory of Climatology and Atmospheric Environment*** (LACAE) specialises in the study of climate change on various time and space scales, urban climatology, studies on the ozone layer, measurements of ultraviolet radiation, meteorological parameters and air quality, climatic effects from aircraft emissions and impacts of weather/climate variability and air quality on human health. The members of LACAE have long experience in teaching in undergraduate and postgraduate courses and have supervised many undergraduate and postgraduate theses in the fields of climatology and the atmospheric environment. It is equipped with:

- One Brewer MK IV monochromator measuring columnar amounts of ozone, SO_2 and NO_2.
- Two Yankee UV-B instruments measuring solar erythermal doses
- Instruments measuring atmospheric pollution (CO, CO_2, NO_2, PM)
- A complete autonomous/automatic meteorological station.
- A portable meteorological station

Web address: http://lacae.geol.uoa.gr

2.4.3.2 Laboratory of Physical Geography

The ***Laboratory of Physical Geography*** (LPG) deals with air-sea-land interactive processes forming the earth's surface morphology (sub-aerial and sub-aqueous), i.e. river deltas, beach zones, fluvial geomorphology, morphotectonic processes, karstification, aeolian processes, geoarchaeological studies, coastal indicators of relative sea level changes, climate change (past, present and future), coastal oceanography, sediment dynamics, photogeology, remote sensing and GIS applications.

It is equipped with:

- autonomous driller of fine-grained sediments,
- sieving analysis (dry and wet),
- autonomous continuous recording tidal gauge,
- manual operated current meter
- thermo-salino-meter,
- portable weather stations,

- GPS
- Tachymeter
- Software: SPS (statistics), MATLAB (incl. fuzzy logic tools), ERDAS (analysis of satellite images) CEDAS (nearshore hydrodynamics), DAVIS (weather station software), ArcGIS (handling, interpreting, presenting geo-data.

Web address: http://pg.geol.uoa.gr

2.4.4 SECTION OF GEOPHYSICS AND GEOTHERMY

The *Section of Geophysics and Geothermy* was established in 1983, as successor to the Chair of Seismology (est. 1931) and the Laboratory of Seismology (est. 1929). The Section underwent rapid and multi-faceted development during the last 25 years, keeping pace with the corresponding rapid development of geophysics and Seismology at the international level. This, in turn has led to the establishment of a second dependent laboratory, the Laboratory of Geophysics (1999).

Throughout its long history, the Section has accumulated extensive experience in practically all aspects of pure and applied geophysics by teaching and researching topics such as: Theoretical and Applied Geophysics, Physics of the Earth's interior, Earth System science, mineral and energy resource prospecting, Engineering and Environmental Geophysics, Seismology, Engineering and Historical Seismology, Seismotectonics and Geodynamics, Physics of the earthquake source, Geomagnetism, Palaeomagnetism, Physical Volcanology and Geothermics, Remote Sensing, Satellite Geodesy and space-borne applications to Earth Sciences and Earth system Science. It has also developed intensive cooperation with numerous international research establishments and academic institutions.

The Section offers under- and post-graduate courses in geophysics, seismology, environmental science and natural disaster analysis, assuming an integrated approach towards the earth system sciences. The educational, research and other activities of the Section of Geophysics are thoroughly presented in the web pages of the Section and its dependent laboratories (see below).

Web address: http://www.geophysics.geol.uoa.gr/

2.4.4.1 LABORATORY OF GEOPHYSICS

The mission of the ***Laboratory of Geophysics*** (est. 1999) is:

- To provide high level practical training (laboratory and field exercises) and modern analytical skills, as part of the geophysics courses offered by the Section, at the under- and post-graduate levels.
- To support research with state-of-the-art instrumentation and analytical facilities.
- To offer advanced geophysical services to public and private sector patrons, requiring the application of state-of-the-art or cutting edge technologies.

During the recent few years, significant effort has been directed towards the development of modern/high resolution exploration technologies and geophysical data analysis software. The hitherto, teaching and research activities of Laboratory can be summarized as follows:

- Methodological developments in near-surface and deep geophysical exploration methods.
- Environmental and Engineering geophysics
- Geothermal and other energy resource exploration
- Mineral resource prospecting.
- Physics of the Earth's interior – determination and analysis of Earth structure at all depth scales.
- Physics of the earthquake source and earthquake prediction
- Geomagnetism, Geoelectromagnetism and Palaeomagnetism
- Space borne applications in the Earth Sciences and Geodynamics (DGPS, SAR/DINSAR, thermal imaging etc.).
- Geophysical software development.
- Earth System Science.

The Laboratory has developed multiple cooperative ties with corresponding national and international research establishments and academic institutions. It is also actively involved in outreach and dissemination of scientific information by organizing seminars, symposia and lectures for scientists and the general public. Moreover, it offers a broad range of geophysical services to public and private sector establishments, with particular reference to engineering and environmental applications, mineral and groundwater resource prospecting and geothermal prospecting.

Web address: http://geophysicslab.geol.uoa.gr

2.4.4.2 LABORATORY OF SEISMOLOGY

The ***Laboratory of Seismology*** was established in 1929 in order to contribute to the education of students attending the Faculties of Physics and Natural Science, as well as in monitoring and researching the seismicity of Greece.

The Scientific and Technical Staff of the Laboratory has frequently been commended by Civil Authorities and the University Administration for its immediate response and major contribution in the relief operations and research of major destructive earthquakes. Their expertise is reflected in numerous publications, a multitude of research and civil protection programmes, extensive collaboration with international research and educational establishments and consultancies of public and private sector companies.

The Laboratory maintains the state-of-the-art ATHENET network, comprising 32 stations in Central Greece and the Cyclades (real time seismicity at Follow this link). It also possesses an extensive inventory of seismometric and accelerometric equipment, as well as data analysis facilities.

The principal teaching and research activities of the Laboratory are:

- Seismicity monitoring.
- Engineering Seismology and earthquake hazard analysis (including microzonation, vulnerability analysis and strong ground motion analysis,).
- Physics of the earthquake source and earthquake prediction.
- Seismotectonics, Geodynamics and Earth System Science.
- Macroseismology, Historical Seismology and Archaeoseismology.
- Preparedness and protection against earthquake disasters, including the training of students, schools and the general public at the SEISMOPOLIS earthquake simulation centre

Web address: http://dggsl.geol.uoa.gr/en_index.html

2.4.5 SECTION OF ECONOMIC GEOLOGY AND GEOCHEMISTRY

Economic Geology and Geochemistry combines the study of geology of ore deposits and geochemistry to describe and understand the processes of mineral resource formation as well as to quantify the environmental impact of mineral and energy resource exploitation. Research in the Section is also focused on the development of techniques and solutions related to sustainable production of mineral resources, quality control of industrial raw materials and assessment of contaminated land and water.

Research topics include:

- Exploration and assessment of mineral resources
- Baseline geochemistry of soils and water
- Biogeochemical processes related to ore deposits
- Environmental impact of mining activities
- Use of mineral resources for environmental protection
- Recycling of by-products from metal mining and metallurgy
- Soil and water pollution assessment and management
- Sustainable reclamation of polluted grounds
- Urban Geochemistry

Web address:
http://geochem.geol.uoa.gr/index_gr.htm

2.4.5.1 LABORATORY OF ECONOMIC GEOLOGY AND GEOCHEMISTRY

The ***Laboratory of Economic Geology and Geochemistry*** supports and facilitates research activities involving sampling and chemical analysis as well as mineralogical analysis of a variety of geological samples (rocks, minerals, ores, soil, sediment, water etc.). Laboratory infrastructure includes:

- Manually operated systems for sample and microscopy specimen preparation (crushing, screening and splitting bulk samples, pulverizing and homogenizing subsamples to prepare them for chemical analysis; thin and polished section preparation)
- Chemical laboratory equipped with various instruments for sample dissolution, microwave digestion, leaching experiments, filtration, high temperature sample treatment, sample storage and incubation etc.
- Atomic Absorption Spectroscopy unit operated in flame and graphite furnace modes
- Scanning Electron Microscopy unit equipped with a SEM-EDS microanalysis system
- X-Ray Diffraction unit
- Flame photometer
- Bench -top and portable spectrophotometers
- Optical microscopes
- Fluid inclusion- microthermometry unit equipped with optical microscope and digital monitor

Web address: http://geochem.geol.uoa.gr/lab_gr.htm

2.4.6 SECTION OF DYNAMIC, TECTONIC AND APPLIED GEOLOGY

The Section ***s***tudies the dynamic interior of the Earth. To this effect, it collects geological data and develops new tools for their analysis and interpretation, complemented by numerical modelling and use of digital technology. The research and educational interests and activities of the Section span a wide range of topics including tectonics and structure of the Earth's crust and lithosphere, seismic hazard, dynamics of plates, engineering geology, hydrogeology, environmental geology and natural disasters. The educational curriculum offered by the Section includes, besides classroom lectures and exercises, a wide range of field exercises which, together with the field course of geological mapping, provide students with the necessary foundations and experience for subsequent scientific development.

Through a wide network of collaborations, both at the national and international level, with educational and research institutions, the Section has developed interdisciplinary research activities, funded mainly by EU research grants and the wider public sector (Ministries, Prefecture and Local Authorities etc.). Many of these programs are innovative and have enjoyed international recognition. Research topics include:

- Development of geotectonic maps (both conventional and offshore),
- Restoration of Uncontrolled Waste Disposal Sites,
- Water Resources Management,
- Geotechnical design of large scale infrastructure projects (roads, dams, foundations of buildings, industrial plants, oil pipelines and natural gas, etc.) in Greece and abroad.

2.4.6.1 LABORATORY OF TECTONICS AND GEOLOGICAL MAPPING

The ***Laboratory of Tectonics and Geological Mapping*** covers the educational and research needs of the Section and the Department in the fields of Tectonics, Structural Geology, Geological Mapping, Hydrology, Hydrogeochemistry and Soil and Rock Mechanics. Within this frame we develop educational curricula and conduct basic and applied research; cooperate and exchange scientific knowledge with other academic or research institutions from Greece and abroad; organize seminars, symposia, conferences, and lectures; provide services to external bodies from the public and the private sector.

Ample laboratory space is available for various activities including full IT support supplemented by modern computing and printing facilities, testing of physical and mechanical properties of rocks and soils and chemical analysis of water samples. Available equipment includes a variety of instruments for field research, a total station, auger corers, triaxial, uniaxial, point and unimpeded loading apparatuses, rock sample corer, portable stations for chemical analysis of water samples, turbidity meters, groundwater samplers, etc. Efforts are constantly made for the upgrading of the existing infrastructure.

2.4.7 LABORATORY OF REMOTE SENSING

The ***Laboratory of Remote Sensing*** (LRS) was established in order to meet the educational and research requirements of the Department of Geology during the early 1990's. Its research interests expand in the fields of modern space-borne Earth Observation Systems associated with the disciplines of Geodesy (Satellite Geodesy), Surveying, Photogrammetry, Digital Cartography and Remote Sensing. In general, the purpose and function

of the LRS within the University of Athens and the Department of Geology and Geoenvironment, is the following:

1. To satisfy under- and post-graduate educational requirements of the Department.
2. To develop teaching and research curricula for the post-graduate study programmes.
3. To pursue basic and applied research aiming at:
   3.1. The development of techniques and applications associated with the Country's needs,
   3.2. The creation of opportunities for collaboration between the Academic staff and the Industry,
   3.3. To pursue and promote collaborative research between researchers of Hellenic Universities and Research Institutions,
   3.4. To provide services in accordance with Law 159/1984.

Current activities of the LRS members, include GPS measurements and Radar Interferometry (both conventional and advanced InSAR (PS and Stacking), including satellite imaging analysis (LANDSAT, ASTER, IKONOS, QUICKBIRD) and Orthorectification.

2.4.8 Laboratory for Prevention and Management of Natural Disasters

The ***Laboratory on Prevention and Management of Natural Hazards*** was established in 2003 within the Department of Geology and Geoenvironment of the University of Athens. The Laboratory participates in a number of research projects financed by national, European or other international and bilateral organizations. Current activities focus on emergency planning, development of action plans, seismic hazard, tsunamis, forest fires, floods, landslides and volcanic hazard. The scientific activities of the Laboratory include the organization of seminars, lectures, symposia and related disseminating scientific activities involving the scientific as well as the social sector. It is an educational and research unit utilized by the undergraduate students of The Department and the Postgraduate Studies Programme on Prevention and Management of Natural Hazards.

Web address: http://labnathaz.geol.uoa.gr

2.4.9 Laboratory and Centre of Museum Research

The laboratory was founded in 2007, and it assists the research and teaching activities of NKUA on museum studies. The laboratory aims to assist the relevant research projects and teaching activities of the undergraduate and postgraduate programmes of the NKUA courses of the University of Athens. It further aims to the development of the museums of the NKUA, through specialized studies and services. The laboratory promotes the collaboration between the members of the Faculties of the NKUA and the Department of Conservation of Antiquities and Works of Art of the University of West Attica. The laboratory is located at the facilities of the Postgraduate Studies Program of Museum Studies, at the University Campus (Panepistimiopoli).

Tel: 210-7276499, 210-7276465, 210-7276434

2.4.10 Museum of Palaeontology and Geology

The ***Museum of Palaeontology and Geology*** is hosted by the Department of Geology and Geoenvironment. It has a rich collections of vertebrate and invertebrate animal, as well as plant fossils from Greece and abroad. It conducts scientific surveys and excavations throughout the country constantly enriching its collections. It is open daily for school visits and the public and also offers guided tours. The Museum, in collaboration with the local authorities, operates an Annex at Vryssa (Polychnitos, Lesvos Island, Greece). The Annex houses local natural history collections including unique findings such as mammoths, rhinoceroses, antelopes, gazelles, giant tortoises, oversized horses etc.

The Museum of Palaeontology and Geology is hosted in the building of the Department of Geology and Geoenvironment at the University Campus (Panepistimiolpoli).

Although the Museum was founded in 1906, its history can be traced back to 1858 with the foundation of the Natural History Museum of Athens. Its current collection includes fossil vertebrates and invertebrates from Greece, historical specimens, comparative zoological and teaching specimens. It includes approximately 100,000 specimens, making it the largest collection of fossils in Greece. Its main exhibition includes fossils vertebrates from Pikermi, Peloponnesus and Crete.

The museum conducts scientific surveys and excavations throughout the country constantly enriching its collections. It is open daily for school visits and the public and also offers guided tours. The Museum, in collaboration with the local authorities, operates an Annex at Vrissa (Polychnitos, Lesvos Island, Greece). The Annex houses local natural history collections including unique findings of Early Pleistocene vertebrates.

Contact Info:

Mail Address: Department of Geology and Geoenvironment, Zografou University Campus, GR 15784 Telephone: +30 210-727 4086, +30 210-727 4202

Fax: +30 210-724 1888

E-mail: palaeo-museum@geol.uoa.gr

Web address: http://paleo-museum.uoa.gr/paleontology.

Vryssa Annex Telephone: +30 22520 61890

2.4.11 Museum of Mineralogy and Petrology

The rock and mineral collections of ***Mineralogy and Petrology Museum*** were assembled by the Physiographic Society (est. 1835). They are exhibited in a gallery of 1100 m^2 at the premises of the Department. They are not only the oldest in Greece, but also include rare specimens of interest to the international community. The museum is open daily for schools and the general public and also offers guided tours.

Contact Info:

Mail Address: Department of Geology and Geoenvironment, Zografou University Campus

Telephone: +30 210-727 2124, +30 210-727 4112

Fax: +30 210-727 4883

E-mail:

2.5 PERSONNEL

PRESIDENT

- Prof. Dr. Asimina Antonarakou
  Τηλ: 210 727 4166
  e-mail: chair@geol.uoa.gr

VICE PRESIDENT

- Assoc. Prof. Dr. Ioannis Alexopoulos
  Τηλ: 210 727 4106
  e-mail: chair@geol.uoa.gr

SECRETARIAT

Supervisor:	**Demetrios Psarris**

Tel: 210727- 4418
fax: 210727-4051, 210727-4063
e-mail: dpsarris@geol.uoa.gr, kelchor@geol.uoa.gr

Name	Status	E-mail	Telephone
Psarris Demetrios	Administrative Staff	dpsarris@geol.uoa.gr	210 727-4279
Skenteris Taxiarchis	Administrative Staff.	taxskent@geol.uoa.gr	210 727-4062
Stampoliadi Dafne	Administrative Staff	dstabol@geol.uoa.gr	210 727-4682
Chorafopoulou Calliope	Administrative Staff	kelchor@geol.uoa.gr	210 727-4061

FRONT DESK AND MAIL DISTRIBUTION OFFICE

Name	Status	E-mail	Telephone
Sokalis Spyridon	Administrative Staff		210 727-4219

LIBRARY OF THE SCHOOL OF SCIENCES

Tel.: 210 72.76.599 fax: 210 72.76.524
E-mail: sci@lib.uoa.gr Website: http://www.sci.lib.uoa.gr

	Telephone (landline)
Person in Charge: V. Valsamakis	210 727-6527
Secretariat	210 727-6525

SECTION OF MINERALOGY AND PETROLOGY

DIRECTOR: **Dimitrios Kostopoulos, Associate Professor**

Name	Status	E-mail	Telephone
	Secretariat		210 727-4128 fax: 4883
Panayotis Voudouris	Professor, *Head of Museum of Mineralogy and Petrology*	voudouris@geol.uoa.gr	210 727-4129
Athanasios Godelitsas	Associate Professor, *Head of Laboratory of Mineralogy and Petrology*	agodel@geol.uoa.gr	210 727-4689
Dimitrios Kostopoulos	Associate Professor	dikostop@geol.uoa.gr	210 727-4127
Panagiotis Pomonis	Associate Professor	ppomonis@geol.uoa.gr	210 727-4844
Marianna Kati	Assistant Professor	kati@geol.uoa.gr	210 727-4442
Ifigenia Megremi	Research/ Teaching Staff	megremi@geol.uoa.gr	210 727-4112
Efstathios Vorris	Technical/ Administrative Staff – *Museum of Mineralogy and Petrology*	svorris@geol.uoa.gr	210 727-4112
Eleni Moustaka	Technical/ Administrative Staff – *Museum of Mineralogy and Petrology*	emoustaka@geol.uoa.gr	210 727-4112

SECTION OF HISTORICAL GEOLOGY AND PALAEONTOLOGY

HEAD: **Harikleia Drinia, Professor**

Name	Status	E-mail	Telephone
	Secretariat		210 727-4179
Asimina Antonarakou	Professor	aantonar@geol.uoa.gr	210 727-4166
Efterpi Koskeridou	Professor *Director of the Museum of Paleontology and Geology*	ekosker@geol.uoa.gr	210 727-4165
Harikleia Drinia	Professor *Director, Laboratory and Centre for Museum Studies* *Director of Laboratory of Historical Geology and Paleontology*	cntrinia@geol.uoa.gr	210 727-4394
Maria Triantafyllou	Professor	mtriant@geol.uoa.gr	210 727-4893
Margarita Dimiza	Associate Professor	mdimiza@geol.uoa.gr	210 727-4920
Aikaterini Kouli	Associate Professor	akouli@geol.uoa.gr	210 727-4896
Georgios Lyras	Associate Professor	glyras@geol.uoa.gr	210 727-4897
Ioannis Panagiotopoulos	Assistant Professor	ioapanag@geol.uoa.gr	210 727-4467
Socrates Rousiakis	Assistant Professor	srousiak@geol.uoa.gr	210 727-4169
Theodora Tsourou	Assistant Professor	ttsourou@geol.uoa.gr	210 727-4172
Georgios Kontakiotis	Research/ Teaching Staff	gkontak@geol.uoa.gr	210 727-4804
Panagiota Makri	Research/ Teaching Staff	pmakri@geol.uoa.gr	210 727-4259
Elizabeth Stathopoulou	Research/ Teaching Staff	estathop@geol.uoa.gr	210 727-4178
Nikolaos Tsaparas	Research/ Teaching Staff	ntsapar@geol.uoa.gr	210 727-4898
Bakopoulou Athanassia	Research/ Teaching Staff	abakopoulou@geol.uoa.gr	
Demetrios Velitzelos	Technical/ Administrative Staff	veljim@geol.uoa.gr	210 727-4344
Olga Koumoutsakou	Technical/ Administrative Staff	okoumout@geol.uoa.gr	210 727-4178
Vasiliki Lianou	Technical/ Administrative Staff	vlianou@geol.uoa.gr	210 727-4693
Vasileios Karzis	Administrative Staff, *Museum of Paleontology and Geology*	vkarzis@geol.uoa.gr	210 727-4086
Tsili Tefta	Technical Staff, *Museum of Paleontology and Geology*	ttsili@geol.uoa.gr	210 727-4086

SECTION OF GEOGRAPHY – CLIMATOLOGY

HEAD: **Emmanuel Vassilakis, Associate Professor**

Name	Status	E-mail	Telephone
	Secretariat		210 727-4144 fax: 210 7247569
Panagiotis Nastos	Professor *Director of the Laboratory of Climatology and Atmospheric Environment*	nastos@geol.uoa.gr	210 727-4191
Seraphim Poulos	Professor *Director, Laboratory of Natural Geography*	poulos@geol.uoa.gr	210 727-4143
Nike Evelpidou	Professor	evelpidou@geol.uoa.gr	210 727-4297
Konstantinos Eleftheratos	Associate Professor	kelef@geol.uoa.gr	210 727-4133
Emmanuel Vassilakis	Associate Professor	evasilak@geol.uoa.gr	210 727-4400
Paraskevi Nomikou	Associate Professor	evinom@geol.uoa.gr	210 727-4865
Maria Hatzaki	Assistant Professor	marhat@geol.uoa.gr	210-727-4192
Christos Angelopoulos	Research/ Teaching Staff	cangelop@geol.uoa.gr	210 727-4183
Anna Karkani	Research/ Teaching Staff	ekarkani@geol.uoa.gr	210 727-4927

SECTION OF GEOPHYSICS AND GEOTHERMY

HEAD: **Nikolaos Voulgaris, Professor**

Name	Status	E-mail	Telephone
	Secretariat		210 727-4446 fax: 4787
Nikolaos Voulgaris	Professor *Director, Laboratory of Seismology*	voulgaris@geol.uoa.gr	210 727-4431
Vasiliki Kouskouna	Professor	vkouskouna@geol.uoa.gr	210 727-4421
Andreas Tzanis	Professor	atzanis@geol.uoa.gr	210 727-4785
Filippos Vallanatos	Professor	fvallian@geol.uoa.gr	210-727-4360
Ioannis Alexopoulos	Associate Professor *Director, Laboratory of Geophysics*	jalexopoulos@geol.uoa.gr	210 727-4106
Georgios Kaviris	Associate Professor	gkaviris@geol.uoa.gr	210 727-4841
Kyriaki Pavlou	Research/ Teaching Staff	pavlou@geol.uoa.gr	210 727-4791
Vasileios Sakkas	Research/ Teaching Staff	vsakkas@geol.uoa.gr	210 727-4914
Spyridoula Vassilopoulou	Research/ Teaching Staff	vassilopoulou@geol.uoa.gr	210 727-4392
Stylianos Chailas	Technical/ Administrative Staff	schailas@geol.uoa.gr	210 727-4940
Alike-Maria Moumoulidou	Technical/ Administrative Staff	amoumoul@geol.uoa.gr	210 727-4692
Vasileios Nikoles	Technical/ Administrative Staff	vnicolis@geol.uoa.gr	210 727-4426

SECTION OF ECONOMIC GEOLOGY AND GEOCHEMISTRY

HEAD: **Stephanos Kilias, Professor**

Name	Status	E-mail	Telephone
	Secretariat		210 727-4208 fax: 4399
Stephanos Kilias	Professor	kilias@geol.uoa.gr	210 727-4211
Ariadne Argyraki	Professor *Director, Laboratory of Economic Geology and Geochemistry*	argyraki@geol.uoa.gr	210 727-4314
Christina Stouraiti	Associate Professor	chstouraiti@geol.uoa.gr	210-727-4941
Haralambos Vasilatos	Assistant Professor	vasilatos@geol.uoa.gr	210 727-4664
Efstratios Kelepertzis	Assistant Professor	kelepert@geol.uoa.gr	210 727-4867
Zacharenia Kypritidou	Research/ Teaching Staff	zach-kyp@geol.uoa.gr	210 727-4210
Angeliki Papoutsa	Researtch/Teaching Staff	angpapou@geol.uoa.gr	
Vasileios Skounakis	Technical/ Administrative Staff	vskoun@geol.uoa.gr	210 727-4183

SECTION OF DYNAMIC, TECTONIC AND APPLIED GEOLOGY

HEAD: **Stylianos Lozios, Associate Professor**

Name	Status	E-mail	Telephone
	Secretariat		210 727-4414 fax: 4096
Efthymios Lekkas	Professor *Director, Laboratory for Prevention and Management of Natural Hazards.*	elekkas@geol.uoa.gr	210 727-4410
Maria Stavropoulou	Professor	mstavrop@geol.uoa.gr	210 727-4778
Stylianos Lozios	Assistant Professor *Director, Laboratory of Structural Geology and Geological Mapping*	slozios@geol.uoa.gr	210 727-4413
Haralambos Kranis	Associate Professor	hkranis@geol.uoa.gr	210 727-4862
Emmanuel Skourtsos	Assistant Professor	eskourt@geol.uoa.gr	210 727-4863
Konstantinos Soukis	Assistant Professor	soukis@geol.uoa.gr	210 727-4869
Varvara Antoniou	Research/ Teaching Staff	vantoniou@geol.uoa.gr	210 727-4223
Georgios Danamos	Research/ Teaching Staff	gdanamos@gmail.com	210-727-4859
Demetrios Theocharis	Research/ Teaching Staff	dtheocharis@geol.uoa.gr	210 727-4866
Emmanouel Andreadakis	Technical/ Administrative Staff	eandreadk@geol.uoa.gr	210 727-4861
Eleni Kapourani	Technical/ Administrative Staff	elkap@geol.uoa.gr	210 727-4861
Ioannis Bantekas	Technical/ Administrative Staff	mpantekas@geol.uoa.gr	210 727-4866
Christina Lekka	Administrative Staff	xlekka@geol.uoa.gr	210 727-4783
Soterios Marcelos	Technical Staff	smarselos@geol.uoa.gr	210 727-4783
Paraskevi Tsiouma	Administrative Staff	ptsioum@geol.uoa.gr	210 727-4783

MUSEUM OF PALEONTOLOGY AND GEOLOGY

DIRECTOR:	**Efterpi Koskeridou, Professor**

Tel.: 210 7274086
E-mail: palaeo-museum@geol.uoa.gr

Governing Board:

Name	Status	E-mail	Telephone
Harikleia Drinia	Professor	cntrinia@geol.uoa.gr	210 727-4394
Asimina Antonarakou	Professor	aantonar@geol.uoa.gr	210 727-4166
Socrates Rousiakis	Assistant Professor	srousiak@geol.uoa.gr	210 727-4169

MUSEUM OF MINERALOGY AND PETROLOGY

DIRECTOR:	**Panagiotis Voudouris, Professor**

Tel.: 210 7274124
E-mail: : voudouris@geol.uoa.gr

Governing Board:

Name		E-mail	Telephone
Panagiotis Voudouris	Professor	voudouris@geol.uoa.gr	210 727-4129

Chapter 3

ORGANIZATIONAL AND REGULATORY FRAMEWORK

3.1 SUMMARY

The PSP "Sciences of the Earth and the Environment" operates as of academic year 2018, following the decision 772/29/07/2018 of the Senate of the N.K.U.A., published in the Government Gazette Part B' Issue 3434/17/08/2018, as amended by the decision 652/26/05/2021 of the Senate. The PSP awards a **Diploma of Postgraduate Studies (DPS)** in one of the Specializations:

1. **Applied Geology - Geophysics**.
2. **Mineral Resources- Petrology and Environmental Management**.
3. **Climatic Variations and Impact on the Environment**

Duration: 4 academic semesters – 2 academic years

ECTS cdedits: 30 per semester; 120 total.

National and European Qualifications Framework: Level 7

Field of Education (ISCED – F):

0521 Environmental sciences

0532 Earth sciences

Scope and objectives: The Modern Era is characterized by rapid economic and technological development, rapid growth of population and population movement/immigration, as well as increasing urbanization. Such conditions entail an increase in the demand of raw materials and energy resources, increased construction activities, generalize environmental degradation and increased exposure to natural and technological risks. Earth Sciences are called to contribute in the confrontation of the complex problems arising thereof while acknowledging that their understanding, as well as the safeguarding of sustainable development demands a broad and trans-disciplinary perception of science together with a comprehensive combination of knowledge and skills. With these principles in mind, the PSP "Earth Sciences and the Environment" is designed to address the necessity of producing highly qualified scientific personnel that can successfully cope with the complexity of the problems arising in every sector of contemporary activity and concern Earth Sciences and the Environment.

Learning Outcomes:

- Measurement, research, analysis and synthesis of data and information, using appropriate technologies.
- Self-contained (individual/autonomous) work.
- Advancement of free, creative and inductive thinking.
- Decision making.
- Teamwork.
- Respect for the natural environment.
- Application of knowledge/skills to the solution of problems.
- Trans-disciplinary scientific work.
- Creative thinking and ability to convert theoretical concepts into practical results.
- Adaptation to new conditions and situations.
- Project design and management.
- Critical thinking and constructive self-appraisal.
- Generation of new ideas in pure and applied research.

Attendance: Full time only.

Grading scale: The DPS is graded on a 0 to 10 scale and follows:

Excellent (8,5-10)

Very well (6,5-8,49)

Well (5-6,49)

Obligatory or selective mobility window: Not foreseen

Internships Program: Presently not available.

Director: Prof. Dr. Harikleia Drinia

Professional profile of graduates: Graduates can be employed in a very broad spectrum of private and public sector enterprises, as well as in relevant to their specialty positions in organizations/services of the central or decentralized government.

Access to further studies: Graduates are entitled to apply for Level 7 and Level 8 postgraduate programs

3.2 ADMINISTRATIVE FRAMEWORK

Competent organs for the administration of the PSP in hierarchical order are:

1. **The Assembly of the Department** (henceforth "the Assembly"). This is the ultimate administrative ans academic decision maker and exercises general command over the PSP.
2. **The Coordination Committee (CC).** Staffed by 5 members of The Department appointed by the Assembly for a two-year term. Members of the CC offer their services pro bono. Chairman of the CC is the Director of the PSP and can serve for a maximum of two terms (four years). The CC is responsible for the seamless administration of the PSP and its duties include:
   a. The drafting of the budget and management of resources and expenses related to the PSP.
   b. The compilation and dissemination of the yearly state of affairs of the PSP.
   c. The appointment of the three-member ad hoc Selection Boards for the evaluation of applications of admission, the administtation of the admission process and the compilation of the list of entrants.
   d. The administration of the awards of excellence and associated waiver of tuition fees foreseen by Article 12 of the Regulation of the PSP.
   e. The allocation of teaching duties and the management of the educational process.

f. The management of the Curriculum of the PSP, including updates and upgrades.

g. The appointment of Academic Advisors to new students.

f. The appointment of Supervisors and Examination Boards of Postgraduate Dissertations.

h. The examination and solution of all student-related issues, such as applications for exemption from fees, suspension or extension of studies, mobility between this and other related PSPs, substitution of courses of this PSP with courses of other related PSPs, etc.

i. The examination of all issues related to the dematriculation of postgraduate students according to the provisions of the Regulation of the PSP and the legislation in force.

3. **The Director of the PSP** is a member of The Department, preferably at the level of Professor or Associate Professor. He is also Chairman of the CC and is appointed by the As-sembly. The duties of the Director, who is expected to offer his services *pro bono*, include:
   a. To draft the agenda, convene and preside the meetings of the CC.
   b. To submit the decisions of the CC to the Assembly for approval and defend their basis.
   c. To execute the budget, be responsible for the resources and expenses of the PSP and liaise all pertinent information to the Assembly.
   d. To supervise the execution of the decisions of the organs of the PSP and to ensure compliance with the Regulation of the PSP and the legislation in force.
   e. To exercise any other responsibility foreseen by the Act of Establishment of the PSP.
4. **Secretariat.** The seamless operation of the PSP is supported by the *Secretariat of the PSP* (henceforth "Secretariat") which is located in the premises of The Department and is supervised by the Secretariat of The Department.

3.3 Prospective Applicants

Admissible students are primarily graduates of Earth Science schools from Greece, as well as graduates of *accredited* foreign Earth Science schools *recognized* by the Hellenic National Academic Recognition Information Centre (NERIC). Also admissible are graduates of relevant or complementary to Earth Sciences schools, either Greek or foreign accredited and recognized by NERIC. Non-exclusive example of the latter class of admissible students are Physicists, Chemists, Oceanographers, Biologists, Geographers, Archaeologists, Topographers, Civil Engineers, Mining Engineers, Environmentalists, Environmental Engineers, Agricultural Engineers etc. Finally, Greek or foreign scholarship fellows or grantees of the State of Greece are admissible by default .

Applications are accepted from all who have graduated, or certifiably completed their studies up to, and including the deadline set for the submission of applications.

The maximum number of admissions is set to forty-five (45) per academic year. Each Specialization admits up to fifteen (15) students. The number of students in one Specialization can be increased to *mostly* eighteen (18) if, and only if, there are fewer than fifteen admissions in other Specializations and strictly up to the completion of the maximum number of admissions.

3.4. Admission Criteria and Process

Those interested in submitting an application for admission to the PSP should carefully note the following prerequisites and criteria.

1. ***Only*** one application for ***only*** one specialization is possible.
2. Eligible candidates should be able to demonstrate undergraduate or (previous) postgraduate degree ranking at the top 40% of the scale by which their institution of origin ranks their graduates or, equivalently, Level C of the European Credit Transfer and Accumulation System (ECTS). For example, Greek institutions rank their graduates on a scale from 5 to 10; therefore, Greek candidates must have a grade of at least 6/10 so as to qualify. Failure to meet this requirement is *incontestable presumption* for the rejection of an application. It is also to be emphasized that the rank or grade of the first degree has significant specific gravity and weighs by approx. 30% in the final decision on the application.
3. Eligible applicants should be able to demonstrate functional knowledge of English (level B2 and above). Applicants are required to submit copies of the relevant titles and/or certificates. These include certificates from accredited English language secondary schools and degrees from accredited English language institutions of higher education.
4. Knowledge of a second or more languages is desirable and is taken into consideration. However, these languages must be extensively used in the international scientific literature and can *only* be one or more of the following: French, German, Italian, Spanish, Russian, Japanese and Chinese Mandarin.
5. The personality and composure of the candidates, as is appraised by a personal interview in front of a student selection board, weighs heavily. In order to qualify for admission an applicant should be able to *secure* at least one third 1/3 of the maximum credit points allocated to the interview, that is 100 credit points, or 10% of the maximum achievable number of credit points (see Appendix I of the Guide). Failure to do so constitutes *incontestable presumption* for the rejection of an application.

In addition to the above, the following credentials and qualifications weigh significantly and may decide the outcome of an application:

- Additional studies or training demonstrated by appropriate certificates, diplomas or awards. These include professional/technical seminars, professional/technical studies and undergraduate/postgraduate degrees from accredited institutions of higher education.
- Research activity (if any), demonstrated by publications in scientific journals and conference proceedings, certificates of participation in conferences and officially documented participation in research projects.
- Professional experience, formally certified by former employers or/and documentation from private or public professional pension funds. Experience in Earth-scientific fields and its rele-

vance to the application has major specific gravity; experience in other fields has minor specific gravity.
- The motivation letter which candidates must attach to their application and in which the applicants explain their professional objectives in relation to the PSP and their choice of specialization.
- Recommendation letters (two are required).

The evaluation of the applications is carried out by *ad hoc* three-member Selection Boards (SB), one per Specialization. Each Board is exclusively staffed by faculty members teaching in the Specialization. The SB's are appointed by the CC at the beginning of each academic year and always prior to the deadline for the submission of applications; their mandate expires automatically after the Assembly confirms the admission of the qualifying applicants. The evaluation process must be completed within fifteen (15) working days from the deadline for the submission of applications.

The evaluation is based on the criteria specified above and is quantified on the basis of the grading system detailed in Appendix I of this Guide. Upon completion of the evaluation process, the competent SE's submit their assessments to the Coordination Committee, which reviews them and compiles a list of *eligible* applicants per Specialization, ranking them by order of merit so that tied applicants occupy the same place in the list.

Entrants (per Specialization) are those applicants who, in the merit list occupy places up to the maximum number of admissions per Specialization. *Runners-up* (per Specialization) are applicants listed below the maximum number of admissions. A Specialization is not offered if the number of Entrants is less than, or equal to two (2). The list of Entrant and *Runner*-up applicants is submitted to the Assembly for final approval and to the Secretariat of the PSC for further action.

3.5 Matriculation

Entrants are notified immediately after the Assembly confirms their admission. The notification is forwarded by the Secretariat by e-mail and telephone. Entrants are required to matriculate within an *exclusive* deadline of seven (7) working dates from notification. Entrants cannot matriculate before their attendance fees have been paid and are required to produce the necessary evidence (e.g. receipts, transaction records etc.). An Entrant who does not matriculate within the 7-day deadline and cannot justify the delay, or does not pay, or refuses to pay attendance fees, is automatically disqualified. If so, the first Runner-up is invited to matriculate within seven working days, subject to the same procedure. If he/she fails to matriculate, the second Runner-up in invited, and so on until the list of eligible applicants is exhausted. Within 10 days of matriculation, entrant students must apply for their institutional research and e-mail accounts.

Entrants who consider themselves eligible for exemption from attendance (tuition) fees must submit an application, necessarily accompanied by documents that demonstrate their disposable income, within an *exclusive* deadline of seven (7) working dates from notification. The terms of exemption are listed in Section 3.9.1 of this Guide and references therein. The CC will examine the application and select eligible applicants (beneficiaries), listing them in order of increasing income. Beneficiaries whose number *cannot* exceed 30% of the total number of Entrants are exempted from the fees. Supernumerary beneficiaries, as well as non-beneficiaries can only matriculate if they pay their attendance fees.

Academic Advisor (AA)

To each entrant an Academic Advisor is assigned, whose duty is to counsel and academically support them in organizing and successfully conducting their studies. By permanent decree of the Assembly, the AA is always that member of the CC, which is responsible for coordinating the academic activities of the Specialization to which the entrant has been admitted. The so appointed AA's support their advisees during the first three semesters of their studies or/and up to the point at which they begin working on their Postgraduate Dissertation; upon this time, the acting AA's are replaced by the Supervisors of the Dissertations (see Section 3.8 below).

3.6 Duration, Suspension and Resumption of Studies

- The duration of studies is set to four (4) academic semesters, including the time required for production of a Postgraduate Dissertation.
- Full-time attendance is required – there is no option for part-time studies
- Extension of studies beyond the 4-semester term is allowed after a reasoned application and approval by the CC and the Assembly. However, the maximum term allowed for completion of one's studies cannot exceed five (5) academic semesters.
- In cases of serious personal, familial, professional or economic adversities, PG students may request temporary suspension of their studies. To this end, they submit a reasoned application that is appraised by the CC and forwarded to the Assembly for final decision. Temporary suspension may be granted for one only academic semester. The duration of the suspension is not counted in the maximum term allowed for the completion of studies.
  a. Upon suspension, a student must return to the Secretariat all documents declarative of their Student Status, on the basis of which they have been awarded the privileges arising thereof.
  b. Temporarily suspended students do not forfeit their rights on the subject of their Postgraduate Dissertation, if one has been assigned to them.
  c. Temporarily suspended students who do not resume their studies immediately upon the expiration of their term of suspension are automatically disqualified and expelled from the PSP.

3.7 Teaching Methods and Student Evaluation

Courses commence at the beginning of the winter semester of each academic year. The courses are organized in two academic semesters: the winter semester (October to mid-February) and

the spring semester (mid-February to June). Each comprises 13 week of teaching and 2 weeks of examinations. A total of 120 ECTS credits is required for successful completion: 30 credits for each of the first three semesters and 30 credits for the Postgraduate Dissertation (4th semester).

Courses may comprise of lectures, practical exercises, laboratory exercises, tutorials, field exercises and excursions/visits to areas or facilities of specific interest. The basic mode of teaching involves conventional face-to-face lectures and practical and laboratory exercises conducted in the premises of The Department. However in cases of emergency or other extenuating circumstances, synchronous remote teaching methods may be implemented. The same holds for the teaching of additional, auxiliary or special purpose classes. Asynchronous remote learning methods (specific to each course) are also implemented via the dedicated web-based platform of the NKUA.

PG students are encouraged to attend seminars by research groups of The Department and other Institutions, bibliography briefings, and conferences, meetings and seminars relevant to their specialization. If, for any reason, lectures or exercises cannot be conducted as scheduled, they are replenished at a place and time agreed between the students and the instructors.

If, for any reason, a course lasts for less than 10 weeks, it is presumed to *have not been taught* and a solution to the emerging problem is given by the Assembly following a reasoned opinion by the CC.

- Details about the Specializations and related courses are provided in Chapter 3.

The official language of the PSP is Greek, although it is possible for courses to be taught in English if deemed necessary (and subject to approval by the Assembly). Foreign students, who participate in the PSP through the European Programs Erasmus+, Marie Skłodowska-Curie and CIVIS, or through bilateral cooperation agreements of the NKUA with foreign universities, or through bilateral cooperation agreements between Greece and other countries, or through exchange programs of the United Nations Organization, are entitled to be taught in English.

Attendance of classes, exercises etc. is obligatory and is certified with an attendance sheet signed by the Instructors. Attendance of a course is deemed *inadequate* if a student *absents* for more than 30% of the total number of scheduled lectures, exercises etc. A student charged with inadequate attendance is referred to the CC for evaluation and may be subject to dematriculation.

As part of the PSP, The Department ensures that all students are entitled to:

- Access to the Internet and World Wide Web through the infrastructures of the NKUA: for details please see http://www.noc.uoa.gr/syndesh-sto-diktyo.html.
- Access to e-mail facilities and personal webpage development: for details see http://www.noc.uoa.gr/hlektroniko-taxydromeio.html.
- Access to the computing facilities of the NKUA and through those, to the services and computing infrastructure of the Hellenic Network for Research and Technology (GRNET, https://grnet.gr/).
- Access to all libraries of the NKUA through the library of the School of Sciences (http://sci.lib.uoa.gr/), as well as their digital document collections. For details please see http://www.lib.uoa.gr/ypiresies/katalogos-opac.html).
- Access to international literature though the electronic libraries infrastructure of the NKUA: For details please see http://www.lib.uoa.gr/ypiresies/periodika.html

Examinations

Students are evaluated at the end of each semester with written or oral examinations. Alternatively, evaluation can be based on the compilation of (a series of) assignments and essays throughout the semester. Evaluation techniques differ between courses and are specified in the description of the courses provided in Chapter 4.

In cases of emergency or other extenuating circumstances, examinations may be held by the synchronous or asynchronous remote evaluation techniques supported by remote teaching and learning platforms of the NKUA. In addition, and subject to approval by the CC and the Assembly, disabled students may sit in specially designed live or remote examinations. The same is foreseen for cases of temporary disability, e.g. following serious illness or accident.

- Performance is graded on a scale of one to ten and a minimum of 6/10 is required to pass.

Regardless of semester, a student failing the examination of a course is entitled to two follow-up evaluations that *always* take place at the beginning of the next academic year and *always* in the month of September. In case of third failure, the Student is entitled to request re-examination by a three-member board whose area of expertise is the same, or closely related to the subject of the course. The board is appointed by the CC and its composition excludes the instructors of the course in question. In case of fourth failure, the Student is deleted from the registry of the PSP (dematriculated).

At the end of each semester, the students are required to evaluate every course they took in that semester, the performance of the instructors and the services provided by the PSP.

3.8 POSTGRADUATE DISSERTATION

A Postgraduate Dissertation (henceforth PD) by research must be compiled during the fourth semester. PD subjects are assigned in one of the following ways:

a. PG student may enters into direct negotiations with the prospective supervisors. If an agreement is reached, it may be written and may include the provision of paragraphs 9.6 and 9.7 of the Regulation of the PSP.
b. Any Instructor with qualifications compliant with Article 14.8 of the Regulation of the PSP, (i.e. eligible to supervise a PD), may propose a PD subject through the "Announcements" section of the PSP's *and* the Department's web sites; the announcement must include the title, a brief description of the subject matter, the name of the proposer and an invitation for the expression of interest. This is followed by negotiations between the prospective supervisor and interested students. If an agreement is concluded, it may be written and may include the provision of paragraphs 9.6 and 9.7 of the Regulation of the PSP.
c. Any PG student with ideas they consider sufficient to support

postgraduate level research may submit an application which must clearly state the prospective title, the name of a prospective supervisor and a brief description of the subject matter. The application is forwarded through the CC to the prospective supervisor and is followed by negotiation with the student. If an agreement is concluded, it may be written and may include the provision of paragraphs 9.6 and 9.7 of the Regulation of the PSP.

In all cases above, the agreement is followed by an application of the PG student which includes the title, the name of the Supervisor and a brief description of the subject matter. The CC examines the application and submits a reasoned opinion to the Assembly, for final approval and appointment of a *three-member Dissertation Examination Board* (DEB). Necessarily, one of the members of the DEB is the Supervisor.

According to paragraphs 9.6 of the Regulation, the agreement between Supervisor and Student may be written and include a mutually acceptable section in which they clarify the intellectual property of the "scientific idea" behind the subject, as well as the ownership of any intellectual and marketable rights that may arise from the results of the PD. The agreement is validated by two witnesses and signed in three original copies, one of which is held by the Student, one by the Supervisor and one is kept in the archives of the Secretariat. According to paragraphs 9.7 of the Regulation, if the PD is compiled with data that are *not* originally produced by the Student, or *has not* been mined form public domain/free access data bases but are provided by the Supervisor or *any* third party, the agreement must include a declaration in which the Student, clarifies that he/she does not, and will not claim or contest the ownership and usage of the data, either in full or in part

- A DEB cannot be appointed if a Student has not successfully completed the first, second and third semesters of their studies and has outstanding academic obligations to the PSP.
- A DBE cannot be appointed if a Student has not paid the fees of the first, second and third semester, and has outstanding financial obligations to the PSP, unless fees have previously been waived by decision of the Assembly.

The PD can be written in the official language of the PSP (Greek), or in English. The size of the PD must not exceed fifty thousand words

- Postgraduate Dissertations are products of original scientific research, or original application of scientific knowledge. To this effect, all students are obliged to sign a declaration of non-infringement of intellectual property, which must be attached to the PD. The form of this declaration is given in Appendix II of this Guide.

The PD must be completed within five months from the date of its assignment by the Assembly. In special circumstances, this term can be extended but only after a reasoned application by the Student and subject to the consent of the Supervisor and approval of the Assembly. The duration of the extension is decided on a case-by-case basis and is proportional to the need that necessitated it. If, upon expiration of the extension a Student has not finished the PD, he/she is referred to the Assembly with the question of expulsion from the PSP as he/she will have exceeded the maximum allowed duration of studies.

Postgraduate Dissertations are examined publically in front of the Dissertation Examination Board, preferably toward the end of the winter or spring semester. The DEB considers the originality of the PD, the validity of the methodological approach and the planning and results of its implementation. The PD is graded on a scale of zero (0) to ten (10) with a *base* of six (6). If deemed necessary, the DEB may request additional corrections and adaptations of the text and/or explanations of the analytical procedures and results and set a deadline for their completion. For a decision of the DEB to be valid, the assent of at least two of its members is necessary.

3.9 Additional Important Information

The NKUA To ΕΚΠΑ ensures that all students disabled, or with special needs, will have access to the classes of the PSP. Details can be found in the web site of the Access Service of the NKUA, https://access.uoa.gr/. In addition, the Student Support Service of the NKUA provides counseling on issues related to the studies and professional future of students; details can be found in the URL https://www.career.uoa.gr/ypiresies.

After the first semester of their studies all PG Students are entitled to apply for participation in European academic mobility programs such as ERASMUS+, Marie Skłodowska -Curie and CIVIS, as well as in bilateral student exchange programs. It is important to mention that in such cases the *maximum* number of transferable ECTS credits is limited to thirty (30). Conversely, the PSP is open to PG Students from European mobility and bilateral or multilateral student exchange programs concluded between the NKUA and foreign academic institutions.

The students of the PSP "Earth Sciences and the Environment" may register for courses offered by other PSP's of the NKUA or equivalent, domestic or foreign academic institutions. This, however, is permissible only in the context of academic or research cooperation programs and always under the conditions specified in the legislation in force.

Finally, the students of the PSP "Earth Sciences and the Environment" are permitted to enroll and study in *one other* undergraduate and *one other* postgraduate study programs, or in *two (2) other* PSP's. The "other" study programs can be offered by the Department or other departments the NKUA or homologous domestic or foreign academic institutions.

3.9.1 Attendance Fees

Enrollment and participation in the PSP "Earth Sciences and the Environment" is subject to an *attendance fee* (tuition fee) of six hundred (600) € per academic semester. The following important points should also be noted:

- The payment of the fee can be made, either in full at the beginning of each academic semester, or in three instalments of two hundred (200) € payable in the first ten days of the months October, December, February, March, May and June.
- Attendance fees are not refundable under any circumstances.
- Students who have been granted temporary suspension of studies (see Par. 3.6) do not have to pay attendance fees for the duration of their suspension. However, if the suspension is granted in the midst of a semester any fee that may have been paid is non-refundable.

Attendance fees can be waived for students who can demonstrate academic excellence in combination with low personal and family income. Thus, necessary conditions are:

- The grade of the first circle of higher studies (Level 6 of the National and European Qualifications Framework) must be within the top 25% of the grading system implemented in the student's country of origin. For example, in Greece this translates to a grade equal to, of higher than 7.5/10.
- For students under 26 years of age, the average of the incomes all of his/her family members during the last two years does not exceed the 70% of the national median equivalised per capita disposable income. In this case, special provisions are made of certain cases of families with multiple children, single-parent families and families with disabled members.
- For students above 26 years of age, the average of the incomes of all of his/her family members during the last two years does not exceed 100% of the national median equivalised per capita disposable income.

The national median disposable income is obtained from the most recently published data of the Hellenic Statistical Authority (HELSTAT).

- Entrant students who wish to apply for exemption from attendance are strongly advised to carefully study Art. 86 of Law 4597/2022 which specifies the conditions and required documentation.

Exemption from attendance fees is granted for participation in one and only one PSP. Under *no* circumstances can the number of exempted students exceed 30% of the total number of students admitted to the PSP. If the number of eligible applicants is greater than this threshold, the applicants are listed in order of increasing income and beneficiaries are selected according to their position in the list.

Students holding grants, fellowships or scholarships from all sources, as well as citizens of countries *not* belonging to the European Union, are *may not* apply for waiver or reduction of attendance fees.

Awards of Excellence

At the end of each academic semester and following the examinations, the first ranking of all students of all Specializations is exempted from the fees for the *next* academic semester.

Students awarded with distinctions or honours of academic competence, such as written commendations in international scientific conferences, prizes from accredited domestic or foreign scientific societies etc., are honoured with a written commendation by the Director of the PSP and the Chairman of the Department and are exempted from paying fees for the *next* academic semester.

All exemptions are limited to the amount of 600 € (fees of one academic semester). Furthermore, if more than one students qualify in the first place, the prize is equally divided between them.

3.9.2 Violations of Academic Integrity

The sanction of *temporary expulsion* from the PSP for the *next academic semester* is imposed to students who willingly infringe or violate the written and customary rules of academic integrity, scientific conduct and applicable legislation on the protection of intellectual property. Such infringements are:

a. To voluntary cheat in the examinations or infringe the fairness of examinations in any way.
b. To copy, reproduce or paraphrase intellectual products of fellow students in any way.
c. To infringe on Intellectual Property, i.e. to reproduce, paraphrase, plagiarize or appropriate copyrighted text, figures and diagrams without authorization by the copyright holders.
d. To falsify the results of experiments or computations in any way and contrary to internationally accepted scientific practice and rules of scientific conduct.

All actors of the PSP have an obligation to report such violations to the CC. Any actor with a legitimate interest that is infringed by such violations may also file a complaint. The report/complaint must be in writing, eponymous, signed and always include documentation of the infringement (from the complainant's point of view). The complainant and respondent student are invited to a hearing by the CC, which subsequently drafts a reasoned opinion and submits it to the Assembly for a final decision.

3.9.3 Loss of Student Status

Definition 1: *Unjustifiably Absent Student* (UAS) is one who without having been granted temporary suspension of studies, abstains from the activities of the PSP and severs communication with the educational and administrative agents of the PSP.

At the beginning of each academic year, the Secretariat reviews the postgraduate student registry for UAS and compiles a report which it submits to the CC. Advisors and/or Supervisors may also report UAS cases directly to the CC. Subsequently, the CC compiles a reasoned opinion on the basis of which the Assembly may declare a student to be UAS.

- UAS students are immediately notified and given a deadline of 30 calendar days to respond in writing and declare their intention. Inability to communicate with UAS in their home address, fixed/mobile telephone lines and electronic mail addresses are interpreted as unwillingness of them to continue their studies and entails their expulsion from the PSP.
- If, after the expiration of the 30-day deadline plus 15 calendar days the UAS does not respond, they are automatically de-matriculated. If, however they respond and declare willingness to continue with their studies, they are invited to submit an application of re-instatement. The application is evaluated by the CC which determines the terms and conditions of re-instatement, drafts a reasoned opinion and submits it to the Assembly for a final decision.

The Assembly may de-matriculate or expel PG students from the PSP following a reasoned opinion by the CC under the following circumstances:

a. They exceed the maximum duration of studies (Section 3.6).
β. They abstain from courses by more than 30% of the scheduled hours of attendance (Section 3.7).
c. They fail four times in the examination of a given course (Section 3.7)
d. Having been awarded temporary suspension of studies, they do not resume their studies immediately upon expiration of

the term of suspension (Section 3.6)

e. Violate the Law (specifically under the provisions of Art. 197 and 198 of Law 4957/2022).

f. Do not pay attendance fees.

g. Resign of their own volition (declaration required).

3.10 DIPLOMA OF POSTGRADUATE STUDIES

The PSP awards a *Diploma of Postgraduate Studies* (DPS) in one of the Specializations:

1. *Applied Geology - Geophysics*.
2. *Mineral Resources, Petrology and Environmental Management*.
3. Climatic *Variations and Impact on the Environment*

The DPS is awarded on successful completion of the full course of studies (four academic semesters) and accumulation of 120 credit units of the European Credit Accumulation and Transfer System (30 per semester).

The DPS is graded on a one (1) to ten (10) scale. Its computation considers the relative importance of each course as expressed by its ECTS value (number of ECTS credit units). Accordingly, the grade *B* of the DPS is obtained from the weighted average

$$B = \frac{1}{120}\sum_{\nu=1}^{N} \beta_\nu \cdot \pi_\nu \ ,$$

where β_ν, and π_ν respectively are the grade and ECTS value of the *ν*-th course, including the Postgraduate Dissertation.

The DPS is written in the Greek language; its format is common for all PSP's of the N.K.U.A. and is specified in the relevant "Regulation of Postgraduate and Doctoral Studies" of the N.K.U.A. On the DPS, the grade is written to an accuracy of two decimal points and is classified as «*καλώς*» (*well*) for *B* lower than six and one half tenths (6,5), «*λίαν καλώς*» (*very well*) for *B* between six and one half tenths (6,5) and eight and one half tenths (8,5), and «*άριστα*» (excellent) for *B* higher than eight and one half tenths.

- A DPS is not awarded unless *all* financial obligations to the PSP have been resolved.

All graduate students are entitled to a *DPS Supplement* that analytically presents their track record and specifies cardinal information about the PSP. The supplement is issued on request and provided free of charge, in the Greek or English languages.

Chapter 4

CURRICULUM

4.1 SPECIALIZATION: APPLIED GEOLOGY - GEOPHYSICS

4.1.1. LIST OF COURSES

1ST SEMESTER

Mandatory Courses		Hours per week	ECTS
ΕΠΓ-Υ01	ADVANCED ELEMENTS OF STRUCTURAL GEOLOGY	4	10
ΕΠΓ-Υ02	ADVANCED ELEMENTS OF ENGINEERING GEOLOGY	4	10
ΕΠΓ-Υ03	GEOLOGICALLY APPLIED GEOPHYSICS	4	10
	Total	**12**	**30**

2ND SEMESTER

Mandatory Courses		Hours per week	ECTS
ΕΠΓ-Υ04	GEO-INFORMATICS - MAPPING	4	10
ΕΠΓ-Υ05	APPLIED HYDROGEOLOGY	4	10
ΕΠΓ-Υ06	SEISMOLOGY – ENGINEERING SEISMOLOGY	4	10
	Total	**12**	**30**

3RD SEMESTER

Elective Courses (3 to be selected)		Hours per week	ECTS
ΕΠΓ-Ε01	ENGINEERING AND ENVIRONMENTAL GEOPHYSICS	4	10
ΕΠΓ-Ε02	ADVANCED ELEMENTS OF SOIL AND ROCK MECHANICS	4	10
ΕΠΓ-Ε03	SEISMOTECTONICS	4	10
ΕΠΓ-Ε04	GEOLOGY OF PUBLIC WORKS	4	10
ΕΠΓ-Ε05	ADVANCED ELEMENTS OF CONTEMPORARY SEISMOLOGY	4	10
ΕΠΓ-Ε06	DATA ANALYSIS AND GEOSTATISTICS	4	10
ΕΠΓ-Ε07	TECTONIC STRUCTURES AND GROUNDWATER	4	10
	Total	**12**	**30**

4TH SEMESTER

Postgraduate Dissertation		30
	Total	**30**

4.1.2. OUTLINES

4.1.2.A. MANDATORY COURSES

ΕΓΓ-Υ01 ADVANCED ELEMENTS OF STRUCTURAL GEOLOGY

Instructors: S. Lozios (slozios@geol.uoa.gr); H. Kranis; K. Soukis

LEVEL/ SEMESTER: 7 / 1st

TYPE: Scientific, Specialized background, Skills development

LECTURES AND PRACTICAL EXERCISES

Lectures, Practice exercises, Laboratory exercises

4 hours of lecturing per week, 10 ECTS credits.

Prerequisites: No

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The knowledge to be acquired by the postgraduate students is related to the deformation of the lithosphere at all scales of observation, with particular emphasis on brittle deformation, the types of the resulting structures and the forces and stresses that lead to their formation, and structural analysis (geometrical, kinematic, dynamic and temporal aspects). The role of Structural Geology and Tectonics in applied fields of Geology, such as Hydrogeology, Petroleum Geology, Engineering Geology, Ore Geology, etc., is also covered within this course, as well the study of certain environmental problems and natural disasters (landslides, active faults, waste management, etc.), all of which call for solid knowledge of the structure and the parameters that define it.

The skills and abilities that the postgraduate students will acquire trough lectures, practical exercises and application exercises are related both to the basic and the applied research and the complete understanding and consolidation of the following topics and notions:

- Geometry and kinematics of rock-deforming structures, the mechanism(s) responsible for their inception and development, parameters of deformation, including definitions and mathematical descriptions.
- Deformation measuring techniques, in 2 and 3D.
- Paleostress inversion: determination of forces and stresses, stress ellipsoid, state of stress, stress field.
- Techniques for the determination of stresses related to active faulting and current stress regime in the lithosphere
- The characteristics and mechanisms responsible for the formation of brittle structures (faults, joints) in the upper lithosphere, as deduced both from field and experimental data (rock mechanics).
- The role of brittle structures in the subsurface fluid flow (water, hudrocarbons), magma ascent, ore precipitation, as well in technical works.
- The identification of active faults, based on their geometrical, kinematic, dynamic and morphotectonic characteristics, and their relationship to seismic activity and hazard.
- Geological mapping and 3D representation of the tectonic macrostructure in all tectonic regimes (extensional, contractional and strike-slip).
- The use of modern software packages, devices and equipment (UAVs, Lased Scanners, tablets or smartphones, etc.) for data acquisition and processing.

General Competencies

- Research, analysis and synthesis of data and information, through the use of necessary technological tools.
- Self-employment.
- Team working.
- Work in multidisciplinary environment.
- Ability to apply knowledge in problem solving.
- Decision-making.
- Promoting free, creative and inductive thinking.
- Respect for the natural environment.

CONTENT:

INTRODUCTION

Structural Geology and Tectonics. Observation scales. Structural analysis. Field data and collection methodology. Geological and Structural mapping. Remote Sensing and Geodesy. Digital Terrain Models. Geographical Information Systems. Satellite data and Google Earth. Seismic gravimetric and magnetic data. Experimental data. Analog and digital modelling.

DEFORMATION

Definition and components of deformation. Reference systems. Homogeneous vs inhomogeneous deformation. Mathematical description of deformation. Progressive deformation and flow parameters. Deformation compatibility and marginal conditions in shear zones. Correlation between stress and deformation. Deformation measuring methods.

FORCE AND STRESS

Definitions, magnitudes and units. Composition of rock bodies. Mechanical state. Stress on a surface and stress at a point. Stress ellipsoid. Stress tensor. Deviatoric and mean stress. Mohr diagram and circle. Methods and techniques for measuring stress in the lithosphere. State of stress and stress fields. Reference states of stress. Origin of lithospheric stresses, types of stress, tectonic stress.

ROCK MECHANICS

Stress-deformation curve for rocks. Elastic, plastic, viscus behavior. Combined models. Experimental data. The role of P-T-t conditions and the presence of fluids. Definition of plastic, ductile and brittle deformation. Rheology of the lithosphere.

FRACTURES AND BRITTLE DEFORMATION

Brittle deformation mechanisms. Types of fractures. Failure

and fracture criteria. Coulomb, Griffith and von Misses criteria. Mohr failure envelope. Fracture termination and interaction. Reactivation and frictional sliding. Fluid pressure, effective stress and poroelasticity. Deformation bands and fractures in porous rocks.

JOINTS AND VEINS

Definitions. Characteristics and kinematics of joints. How, why and where joints form. Joint distribution. Growth and morphology of joints. Joint interaction and relative age. Joints, permeability and fluid flow. Vein fill and growth mechanisms. Vein arrangement.

FAULTS

Definitions and terminology. Displacement, slip and separation. Fault anatomy. Fault related rocks. Displacement distribution. Identifying faults in an oil field setting. Birth and growth of faults. Fault growth and seismicity. Growth of fault populations. Fault linkage and relay structures. Faults, communication and sealing properties.

KINEMATICS AND FAULT PALEOSTRESS ANALYSIS

Kinematic criteria. Conjugate sets of faults. Complex fault populations. Wallace-Bott hypothesis. Paleostress from fault slip inversion. Focal mechanisms and stress.

THRUST FAULTING AND LITHOSPHERIC SHORTENING

Reverse and thrust fault. Nappe terminology. Ramps, thrusts and folds. Thin- and thick-skinned tectonics. Orogenic wedges.

LITHOSPHERIC STRETCHING AND NORMAL FAULT SYSTEMS

Definitions and characteristics. Models and mechanisms of normal faulting. Low-angle normal faults. Metamorphic core complexes. Faulting in continental rifts, passive margins and mid-ocean ridges. Orogenic and post-orogenic extension and collapse.

STRIKE-SLIP FAULTING

Strike-slip faults. Transform, transfer and transcurrent faults. Secondary structures in strike-slip zones. Development and anatomy of strike-slip faults. Fault bends and stepovers. Strike-slip duplexes and flower structures. Fault tips and termination minor structures. Transtension and transpression.

TEACHING METHODS:

- In person (in lectures and practice exercises)
- Using computers, tablets, smartphones and specialized software (in lectures and practice exercises).
- Fieldwork for structural measurements and data collection.

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

IN TEACHING:

- Presentation with multimedia content (images, animation and video) uploaded on the course website (NKUA e-class). The data used in practice exercises and other useful material (i.e., guidelines for the use of specialized software) are available through the e-class platform.

IN COMMUNICATION WITH STUDENTS:

- Support of the learning process through the electronic platform e-Class (announcements, information, messages, documents, tasks, questionnaires, exercises, multimedia, links, scorecard, e-book etc.).

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	2 hours × 13 weeks
Practical Training	2 hours × 13 weeks
Homework – includes preparation for final examinations.	9 hours × 13 weeks
Evaluation preparation	81
Total	**250** hours

STUDENT EVALUATION/GRADING

The evaluation process are conducted in Greek (there is the possibility of examination in English for Erasmus students), either with progress in separate sections of the material or with the final examination of the whole material and includes:

I. LECTURES (50%)

- Answer to questions after the lectures or presentation of individual project.

II. PRACTICE EXERCISES (50%)

- Written short tests and problem solving.

SUGGESTED LITERATURE

I. BIBLIOGRAPHY

- ANDREA Billi, A. (Herausgeber) & FAGERENG, A. (Herausgeber), 2019, *Problems and Solutions in Structural Geology and Tectonics* (Developments in Structural Geology and Tectonics, Volume 5, Band 5), Elsevier Publ., 316 pp.
- BOSE, N. (Autor) & MUKHERJEE, S. (Mitwirkende), 2017, *Map Interpretation for Structural Geologists*: Volume 1 (Developments in Structural Geology and Tectonics, Volume 1, Band 1), Elsevier Publ., 142 pp.
- DAVIS, G. H., REYNOLDS, S. J. & KLUTH, Ch. F., 2011, *Structural Geology of Rocks and Regions*, Wiley, 839 p.p.
- FOSSEN, H., 2016, *Structural Geology*, Cambridge, 510 p.p.
- FOSSEN, H., 2016, Structural Geology (e-modules),
- http://folk.uib.no/nglhe/StructuralGeoBookEmodules2ndEd.html
- HATCHER Jr, R. D. & BAILEY, C. M., 2019, *Structural Geology: Principles, Concepts, and Problems*, Oxford University Press, 531 p.p.
- ΚΙΛΛΙΑΣ, Α., 2009, *Εισαγωγή στην Τεκτονική Γεωλογία*, http://www.geo.auth.gr/537/
- ΚΟΥΚΟΥΒΕΛΑΣ, Ι., 1998, *Τεκτονική Γεωλογία*, Leader Books, 303 σελ.
- ΚΟΥΚΟΥΒΕΛΑΣ, Ι., ΚΟΚΚΑΛΑΣ, Σ. & ΖΥΓΟΥΡΗ, Β., 2020, *Γεωλογία και Σεισμοί*, ΕΚΔ. ΔΙΣΙΓΜΑ, 444 σελ.
- MOORES, M., E. & TWISS, J., R., 1995, *Tectonics*, W. H. Freeman and Company, 415 p.p.
- MUKHERJEE, S., 2019, Teaching Methodologies in Structural Geology and Tectonics, Springer, 251 p.p.
- ΠΑΠΑΝΙΚΟΛΑΟΥ, Δ. & ΛΟΖΙΟΣ, Σ., 2015, *Τεκτονική Γεωλογία,* Εκδόσεις Da Vinci, 479 σελ.
- POLLARD, D. D. & MARTEL. S. J., 2020, *Structural Geology: A Quantitative Introduction*, Cambridge University Press, 450 p.p.
- RAMSAY, J. G. & HUBER, M. I., 1983, The techniques of modern structural geology, v. 1: Strain analysis, Academic Press, 307 p.p.

- RAMSAY, J. G. & HUBER, M. I., 1987, The techniques of modern structural geology, v. 2: Folds and fractures, Academic Press, 392 p.p.
- ROWNALD, S. M., DUEBENDOFER, E. M. & PSCHIEFELBEIN, I. M., 2007, *Structural analysis & syntheses*, Blackwell Publishing, 301 p.p.
- SCARSELLI, N., ADAM, J., CHIARELLA, D., ROBERDS, G. D. & BALLY, A. (Editors), 2020, *Regional Geology and Tectonics. Principles of Geologic Analysis*, Elsevier, 878 p.p.
- VAN DER PLUIJM, B. & MARSHAK, S., 2004, *Earth Structure. An Introduction to Structural Geology and Tectonics*, W.W. Norton & Company, 674 p.p.

II. JOURNALS

- *Journal of Structural Geology*, Editor-in-Chief: Cees Passchier, Elsevier
- *Tectonics*, AGU Publications

Website:

https://eclass.uoa.gr/courses/GEOL448/

ΕΓΓ-Υ02 ADVANCED ELEMENTS OF ENGINEERING GEOLOGY

Instructors: M. Stavropoulou (mstavrop@geol.uoa.gr).

LEVEL/ SEMESTER: 7 / 1st

TYPE: Scientific, Specialized background, Skills development

LECTURES AND PRACTICAL EXERCISES

Lectures, Practice exercises

4 hours of lecturing per week, 10 ECTS credits.

Prerequisites: No

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The course will give to the students an in-depth understanding of engineering geological investigations, planning, design and stability analysis related to various engineering projects (tunnels, slopes, dams, foundations, etc.)

Upon successful completion of the course, the student:

- Will be able to apply the learned concepts and knowledge to solve practical problems in engineering geology.
- Will be able to combine and evaluate details and data from geotechnical field and laboratory research aiming to the geotechnical classification of soil and rock formations and the assessment of geotechnical parameters of the design of a project.
- Will understand the various stages of design and construction of important engineering projects. (tunnels, dams, foundations, etc).
- Will be able to perform geological investigation, rock mass classification, perform tunnel stability analyses and evaluate support requirement.
- Will be able to apply slope stability analytical methods including assessment of computer softwares. Learning about the practical methods for slope stability investigation, assessment, and reinforcement of slopes.
- Will be able to select appropriate models and analysis methodologies for a range of foundation engineering problems
- Will be able to independently evaluate and analyze engineering geological problems, and will be able to to work in a team and cooperate for multidisciplinary solutions of such challenges to provide long-term stable and sustainable development of structures in rock and soil mass.

General Competencies

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Self-employment.
- Team working.
- Ability to apply knowledge in problem-solving.
- Decision-making.
- Promoting free, creative and inductive thinking.
- Respect for the natural environment.

CONTENT:

A. Lectures

- **PHYSICAL AND MECHANICAL PROPERTIES OF GEOMATERIALS** (Physical and mechanical properties of rocks, Stress and strain- geostatic stresses, strength and mechanical behavior of rocks , Discontinuities and mechanical behavior of rock masses, Geotechnical classification of rock mass, Physical properties of soils, Classification of soils, Mechanical properties of soils).
- **GEOTECHNICAL SITE INVESTIGATION** (Study stages of the various engineering projects and designs, Engineering geological-geotechnical maps, sampling, in-situ testing).
- **FOUNDATIONS** (General principles of engineering project foundations, Shallow and deep foundations, Design parameters, bearing capacity and settlement analysis).
- **LANDSLIDES – SLOPE STABILITY** (Classification of landslides, slope stability analyses, cases of landslide hazards, landslide investigation, uncertainties in slope stability analysis, landslip preventive measures and design, case studies and actual examples)
- **UNDERGROUND STRUCTURES** (Influence of geological conditions on the choice of slotting in the design and construction of underground structures, tunnels in soil and rock formations, construction methods and support systems, empirical design methods, stability and support of tunnels, computation stability analysis based on the finite element method)
- **DAMS** (Types of dams, selection of a dam location, tightness of dams, related and accompanying projects, design criteria, geo-technical requirements , construction methods).

B. Practice exercises

(Classification and characterization of rock mass, Classification of soil, Selection of geotechnical design parameters, Software workshop for the analysis of strength data RSData, Preparation of geotechnical sections and geotechnic reports, Slope stability exercises: Slope stability softwares workshop SLIDE/ROCPLANE/SWEDGE/ROCFALL, Tunnel stability and design exercises: Softwares workshop for tunnel stability and support analysis RS2/RocSupport/UNWEDGE,. Shallow and deep foundations: Bearing capacity and settlements).

TEACHING METHODS:

- In person (in lectures and practice exercises)
- Using computers, tablets, and smartphones specialized software (in lectures and practice exercises).

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

IN TEACHING:

- Presentation with multimedia content (images, animation, video).
- Specialized geotechnical analysis software.

IN COMMUNICATION WITH STUDENTS:

- Support of the learning process through the electronic platform e-Class (announcements, information, messages, documents, tasks, questionnaires, exercises, diary, user groups, multimedia, links, scorecard, e-book etc.).

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	2 hours × 13 weeks
Practical Training	2 hours × 13 weeks
Homework – includes preparation for final examinations.	16 hours × 13 weeks
Total	**260** hours

STUDENT EVALUATION/GRADING

The evaluation process are conducted in Greek (there is the possibility of examination in English for Erasmus students), either with progress in separate sections of the material or with the final examination of the whole material and includes:

I. LECTURES (**50%**)

- Written exam with short answer questions and Multiple choice test and/or
- A written examination with extended Answer questions

II. PRACTICE EXERCISES (**50%**)

- A written examination with exercises and problem solving

SUGGESTED LITERATURE

I. RECOMMENDED-BIBLIOGRAPHY

- Luis Gonzalez de Vallejo, Mercedes Ferrer. 2011. Geological Engineering, Publisher CRC Press.
- 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 Geotechnical Engineering Publisher: Cengage Learning (7th edition, 2010).

II. JOURNALS

- ENGINEERING GEOLOGY - Title: Engineering Geology, Publisher: Elsevier BV, Editors in chief: G.B. Crosta, R.J. Shlemon, Frequency: 7 Volumes Annually
- International Journal of Rock Mechanics and Mining Sciences, Publisher: Elsevier BV.
- Rock Mechanics and Rock Engineering, Publisher: Springer.
- 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

Website:

https://eclass.uoa.gr/courses/GEOL524/

ΕΠΓ-Υ03 GEOLOGICALLY APPLIED GEOPHYSICS

Instructors: F. Vallianatos (fvallian@geol.uoa.gr); A. Tzanis; I Alexopoulos; V. Sakkas, S. Chailas

LEVEL/ SEMESTER: 7 / 1st

TYPE: Specialization, Specialized Background, Skill Development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing and 2 hours of practical exercises per week, 10 ECTS credits.

Prerequisites: No formal pre-requisites. However, students are expected to have successfully completed under-graduate courses in Physics and Mathematics (especially Calculus and Linear Algebra) in their respective school of origin. Knowledge and skills acquired by successful completion of under-graduate courses in Geophysics, Geology and Structural Geology are particularly welcome and will be appreciated.

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

Geologically Applied Geophysics (GAG) is a trans-disciplinary science that examines the internal structure and the dynamics/evolution of the Earth by studying the magnitudes, changes and interdependencies of physical parameters and phenomena generated by the activity and interaction of the host of the dynamic subsystems that comprise the crust and interior of the Planet. In addition, it engages in the exploration and appraisal of mineral, energy and other natural (e.g. water) resources, with the appraisal and prediction of hazards related to natural/geological processes or/and anthropogenic industrial activity, with the investigation and study of geotechnical problems related to construction and built environments and, finally, with the investigation and appraisal of environmental problems due to natural/geological or/and industrial activity. In the modern socio-economic setting, GAG attempts to generate multidisciplinary knowledge and skills suitable for tackling theoretical and practical earth-scientific problems. The course is designed to maintain a fairly high scientific and technical level and emphasize the applied aspects of geophysical sciences, so as to equip the students with skills deemed necessary by contemporary employers and job markets.

On completion of the course the students should have acquired:

- Comprehension of the place of Earth in the Cosmos and the consequences on the evolution of its inanimate and animate sub-systems thereof.
- Sufficient understanding of the structure and evolution of the Planet, i.e. of the complex processes that formed its internal constitution and continuously reconfigure its surface.
- Sufficient understanding of the physical principles by which it is possible to image and study the interior of the Earth, as well as recognition that these principles are applicable to the remote observation of the oceans and atmosphere of the Earth and other planets
- Sufficient understanding of the basic geophysical methods used in studying the interior of the Earth and hands-on experience of the methods and techniques used in the interpretation of geophysical observations (and quantitative scientific observations for that matter).
- Comprehension of how to combine, compare and critically appraise data and results from different lines (trans-disciplinary) of inquiry, as for instance geological, petrological, geophysical et al., in order to extract information about the structure and evolution of the interior of the Earth.
- Understanding of how to compile and present scientific reports.
- A host of practical skills necessary in addressing different aspects of the problems engaged by Applied Geophysics and related earth-scientific disciplines (economic, environmental, technical etc.).

General Competencies

- Measurement, research, analysis and synthesis of data and information, using the necessary technologies.
- Advancement of free, creative and inductive thinking.
- Critical thinking and constructive self-appraisal.
- Adaptation to new conditions and situations.
- Self-contained (individual) work.
- Teamwork.
- Trans-disciplinary scientific work.
- Respect for the natural environment.
- Project design and management
- Decision making.

CONTENT:

Theoretical background of Geologically Applied Geophysics (lectures).

- **Role and Contribution of Geophysical Sciences in the** study of the lithosphere and the interior of the Earth.
- **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 radio-activity, 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.
- **Gravity and Gravity Exploration:** Gravity potential and the gravity field of the Earth. Shape of the Earth: the geoid and the ellipsoid. Isostasy. The concept of the "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 magnetic field – consequences on the surface of the Planet. Field reversals and utilization – elements of Paleomagnetism. The concept of "magnetic anomaly" and its application to the exploration of the Earth's inte-

rior – measurements, processing, 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 response functions.
- **Electromagnetic Exploration:** Overview. Natural field exploration methods (Magnetotelluric, Magnetovariational/ GDS). Controlled source exploration methods in the frequency and time domains (emphasis on Slingram and TDEM). Data analysis and interpretation.
- **Geoelectric Exploration:** Basic Principles. Geoelectric stratification. Electric current diffusion in an electrically stratified Earth. Equipment and measurement layouts. Earth Resistivity Tomography. Self–potential and induced polarization. Measurements, processing, analysis, interpretation of geoelectric sounding curves.
- **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.
- **Geophysical Well Logging:** Well logging techniques. The environment around boreholes. Data interpretation and appraisal. Examples and applications.
- Multi- and Trans-disciplinary geophysical investigation of the Earth's interior – structural and geodynamic analysis with geophysical methods: Examples and applications.

B. Practical exercises: Familiarization with geophysical equipment; field measurements; data analysis and interpretation with specialized/dedicated software; compilation of technical reports.
- Qualitative interpretation – appraisal of **gravity anomalies**. Introduction to geophysical modelling and quantitative interpretation of local and regional gravity anomalies.
- Qualitative and quantitative interpretation of **magnetic anomalies** – magnetometric detection of buried structures and objects.
- **Electromagnetic exploration of buried geological structures:** Qualitative appraisal and interpretation of magnetotelluric soundings. Introduction to the concepts of geophysical inversion and quantitative interpretation of magnetotelluric surveys.
- **Electromagnetic exploration of buried geological structures**: Qualitative and quantitative interpretation of SLINGRAM and TDEM surveys.
- **Geoelectric exploration:** Familiarization with the relevant equipment. Field measurements. Processing, interpretation and appraisal of geoelectric soundings and ERT tomograms.
- **Seismic exploration:** Familiarization with the relevant equipment. Field measurements. Processing and interpretation of seismic refraction and reflection data.
- Multi-parametric exploration of the Earth's interior.

TEACHING METHODS:

- Face-to-face lecturing.
- Face-to-face practical exercises in the analysis and interpretation of geophysical data.
- Utilization of the e-class facility of the NKUA (blogging and discussion functions) for additional dissemination of information, distribution of educational material, answering of questions etc.

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Lecturing:
- PowerPoint presentations available through the course's web site in the e-class facility of the NKUA; they incorporate educational videos relevant to the lectures.

In Practical exercises:
- Instructional part: PowerPoint presentations available through the course's web site in the e-class facility of the NKUA; they incorporate educational videos with relevant content.
- Executional part: Specialized educational or/and professional software. The educational software is available through the course's web site. The professional software resides in dedicated computers of the Section of Geophysics – Geothermy, or the Computing Centre of the NKUA.

In the Communication with Students:
- Personal interfacing and utilization of the communication and blogging functions of the e-class facility (24/7 availability).

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	4 hours × 13 weeks
Practical exercises	2 hours × 13 weeks
Homework – includes preparation for final examinations.	12 hours × 13 weeks
Total	**234** hours

STUDENT EVALUATION/GRADING

Examinations are conducted in Greek. Foreign students, or students from European Union countries (Erasmus Programme), can be examined in English.

The final grade is formed through a series of tests that include:
- Reports prepared and submitted as part of the practical exercise program. The mean of the grades of all reports **amounts to 50% of the final grade**.
- Written examination on the theoretical concepts of GAG. This takes place at the end of the 1st semester (main examination), or/and in the month of September (auxiliary examination). The written examination **amounts to 50% of the final grade.**

SUGGESTED LITERATURE

- Lowrie, W., 2007, Fundamentals of Geophysics Cambridge University Press.
- Telford, W.M., Geldart, L.P. and Sheriff, R.E., Applied Geophysics, *2nd Edition*, Cambridge University Press.
- Λούης, Ι., 2004. «Εισαγωγικά Μαθήματα στην Διερευνητική Γεωφυσική», ανέκδοτο βιβλίο, 245 σελ., διανέμεται δωρεάν.
- Purucker, M.E. and Whaler, K.A., 2007. Crustal Magnetism, in Gerald Schubert (ed.) *Treatise in Geophysics*, vol. 5, 195-235, Elsevier.
- Hinze, W.J. et al., 2013. Gravity and Magnetic Exploration, Cambridge University Press.

- Τζάνης, Α., 2020. «Στοιχεία Γενικής και Εφαρμοσμένης Γεωφυσική», Εκδόσεις Νέον, [Κωδ. ΕΥΔΟΞΟΥ: 94645607]
- Τσελέντης, Γ-Α., και Παρασκευόπουλος, Π., Εφαρμοσμένη Γεωφυσική, [Κωδ. ΕΥΔΟΞΟΣ: 50659068]

Optional literature for further study: All books are accessible in the Library of the School of Sciences, or available in electronic form:

- Fowler, C.M.R., 2005. The Solid Earth: An introduction to Global Geophysics, Cambridge University Press.
- Poirier J.-P., 2000. Introduction to the Physics of the Earth's Interior, Cambridge University Press.
- Stacey, F.M. and Davies, P.M., 2008, Physics of the Earth, 4th edition, Cambridge University Press
- Simpson, F. and Bahr, K., 2005. Practical Magnetotellurics, Cambridge University Press.
- Everett, M.K., 2013. Near-surface Applied Geophysics, Cambridge University Press

Website:

https://eclass.uoa.gr/courses/GEOL448/

ΕΓΓ-Υ04 GEO-INFORMATICS - MAPPING

Instructors: V. Sakkas (vsakkas@geol.uoa.gr); N. Voulgaris; I. Alexopoulos; S. Lozios; Ch. Kranis; E. Skourtsos; K. Soukis; V. Antoniou; S. Vassilopoulou

LEVEL/ SEMESTER: 7 / 2nd

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 10 ECTS credits.

Prerequisites: No

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

This course focuses on the acquisition of state-of-the-art knowledge, with the view to providing students with the ability of critical thinking and combination of various topics, within the broad spectrum of the applications of Geology (i.e. Engineering Geology, Hydrogeology, Ore Geology, Hydrocarbon exploration, etc.) the Geoenvironment and Natural Disasters.

The analysis, processing, and management of large amount of data from remote sensing techniques (i.e. Satellite, UAV, LiDAR data), as well as data collected from field work, call for the use of Geographical Information Systems and other related software. Based on these, the topics included in this course are:

- Cartographic projections (projection systems) and Geodetic Reference Frames, co-ordinate transformation. These topics are deemed necessary for the uniform processing of several different types of data.
- Modern satellite technologies and methodologies from space based platforms that can be used as tools in Geosciences and help the students become familiar with Satellite Earth Observation data, and the Global Navigation Satellite Systems (GNSS).
- Lecturing and practicing on several commercial and open-source software packages used in the Image Processing and GIS (i.e. Generic Mapping Tool, MATLAB, ArcGIS, SNAP-ESA, Pix4D, Agisoft Metashape, FieldMOVE, FieldMOVE Clino, RockWare etc). Thus, students become capable of developing and organizing digital geo-data bases, 2D and 3D thematic maps, such as geological, tectonic, seismological, digital terrain and elevation models and their derivatives, and qualitative and statistical data processing
- Geological mapping techniques, use of field instruments, sampling methods, recognition and characterization of geological structures with the aid of remote-sensing data.
- Field work for the recognition and classification of rocks and rock formations within the framework of the Hellenic orogenic system. Recognition and determination of the geometry and kinematics of structures at outcrop scale. Age and facies classification of sedimentary rocks.
- Field work for the compilation of standard geological maps at various scales, as well as specialized one (e.g. neotectonic, hydrogeological, etc..) and purpose-oriented map types en-

dorsed by the Greek State for engineering works, waste management, etc..
- Construction of geological cross sections and compilation of stratigraphic columns for the presentation of the structure and geometrical characteristics of the geological formations.
- Applications of Geological mapping on issues related to Hydrogeology (ground water flow, springs, etc.), Engineering Geology (i.e. landslides, dams, tunnels, etc.), Ore Geology, Hydrocarbon exploration, and so forth.

Students process and analyze airborne- or space-data (GNSS, satellite and radar images), ground-based data (geological, tectonic, seismological, geophysical, etc.) of various types and forms (i.e., vector, raster, grid) with the aid of GIS. Thus, they get accustomed to geospatial data management and the development or related geo-databases, which are essential decision-making tools.

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

- Process and manage satellite and ground-based data on a Geographical Information System.
- Know the basic principle of the main satellite-related techniques that pertain to Earth observation.
- Get accustomed the geological mapping methods and techniques, the use of field instruments and field sampling.
- Distinguish and characterize geological and geomorphological structures with the aid of remote sensing.
- Make combined use of satellite and ground-based data.
- Produce various types of geological maps, at all desired scales.
- Represent in two and three dimensions the geological structure of a given area, down to depths depending on the mapping scale.
- Make use of geological mapping data in various aspects and fields of Geology.

General Competencies

- Data mining, analysis, and combination of multi-parametric data and information with the use of state-of-the-art techniques
- Adjustment to new conditions and situations
- Individual work.
- Team work
- Work in inter-scientific environment
- Design ang management of technical works
- Respect for the natural environment
- . Decision making

CONTENT:

Theoretical background (lectures).

- GIS in Geological Research - Applications
- Space Based Earth Observation Systems, Technical characteristics and theory
- Satellite Images: Processing, optical interpretation, analysis
- Global Navigation Satellite System (GNSS). Principles, modern day satellite constellations, ground and satellite parts of the GNSS system. Processing procedures, software, use and applications of GNSS data to Geoenvironmental and Neotectonic issues
- Satellite radar Interferometry. Basic principles, processing procedures, software practicing. on Geological and geophysical applications
- Managing ground and satellite data on a GIS environment: Creating data bases, creation of thematical and synthetic information layers, forming graphs, 2D and 3D maps.
- The work environment of Geological mapping (field work, use of equipment, data collection, map compilation)
- Recognition and mapping of geological boundaries and rock types.
- Field-based recognition of faults, folds and related structures.
- Structural measurements and readings of geometrical and kinematic field data.
- Data processing techniques and compilation of geological maps.
- Geological cross-sections, stratigraphic columns, panoramas and 3D representation of geological structure.
- Hydrogeological and geotechnical characteristics of rocks and geological formations
- Field sampling techniques
- Digitally assisted geological mapping
- Geological and technical reports

Practical exercises: (incl. analysis and software-assisted interpretation and field work).

Introduction to management and visualization of digital satellite data
Image processing using ArcPro commercial software, and the free disseminated SNAP s/w from the European Space Agency
Field work, collection of geological data
Field work, collection of satellite geodetic data.
Management, processing, and data analysis in ArGISm ArcPRo, Rockware software packages.

Ten-day field course, where students practice standard and modern techniques of data acquisition, compilation of geological maps and their applications in various geoscientific fields (e.g. Hydrogelogy, Engineering, Geology, Mineral and Natural Resources, Environmenta Geology, Natural Disasters, etc

TEACHING METHODS:

- Interactive face-to-face lecturing.
- Introduction
- Questions and Answers
- Brainstorming
- Practical exercise on analysis and interpretation of satellite data.
- Field work

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

IN TEACHING:
- PowerPoint presentations and other visual material uploaded on the course website (NKUA e-class)

IN PRACTICAL EXERCISES:
- Power Point presentations for the demonstration of the software used in the course.
- Use of software for the applied part of the exercises,
- Use of portable and other purpose-built devices (handheld GPOS, UAV, LiDAR, Tablets and smartphones) and related

software and applications (FieldMove Cline, ArcGIS, etc.) in fieldwork and map compilation.

IN COMMUNICATION WITH STUDENTS:

- face-to-face, messaging via the e-class platform, for the distribution of course material, interviews, tutoring, etc.

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	4 hours × 13 weeks
Field work	80 hours
Home study – includes work on practical exercises	6 hours × 13 weeks
Preparation for final examinations.	40 hours
Total	**250** hours

STUDENT EVALUATION/GRADING

Examinations are conducted in Greek. Foreign students, or students from European Union countries (Erasmus Programme), can be examined in English.

The final grade comprises written examination on:

- Theory; amounts to **35%** of the final grade.
- Practicals; amount to **15%** of the final grade
- Geological Mapping Report and GIS-based map compilation, after the completion of the 10-day field course; amounts to **50%** of the final grade.

SUGGESTED LITERATURE

- Fotiou A. and Pikridas Ch., 2012. GPS and its Geodetic applications, Ziti Puplications, 479pp, ISBN 978-960-456-346-3 (in Greek).
- Βασιλοπούλου, S., 2014. Εφαρμογές Συστημάτων Γεωγραφικών Πληροφοριών και Τηλεανίχνευσης σε Γεωλογικές και Γεωπεριβαλλοντικές Μελέτες, 272pp, (κωδ. "Εύδοξος" 33239672).
- Lecture notes by S. Vassilopoulou.
- Ferreti, A., 2014. Satellite InSAR Data – Reservoir Monitoring from Space, EAGE publications, 160pp, ISBN 978-90-73834-71-2
- Skianis, G., Nikolakopoulos, K. and Vaiopoulos, D., 2012. Remote Sensing, Ion Puclications, 336pp, ISBN 978-960-508-027-3 (in Greek).
- Γωλογική Χαρτογράφηση και Ασκήσεις Υπαίθρου. Σ. Λόζιος, Κ. Σούκης και Β. Αντωνίου. 2015. Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών (Κάλλιπος), 280 σελ., ISBN: 978-960-603-200-4.
- Γεωλογικές Χαρτογραφήσεις – Γεωλογικοί Χάρτες και Τομές. Μ. Τρανός, 306 σελ., University Studio Press, ISBN 978-960-12-2040-6.
- Εισαγωγή στους Γεωλογικούς Χάρτες και τις Γεωλογικές Τομές. Χ. Κράνης και Β. Αντωνίου. 111 σελ.
- Coe, L.A. (editor), Argles, W.T., Rothery, A. D. & Spicer, A., R. (2010). Geological Field Techniques. 323p., Wiley-Blackwell.
- Lisle, J., R., Brabham, P. & Barnes, J. (2011). Basic Geological Mapping. 217p., Wiley-Blackwell.
- Φασουλάς, Χ. (2001). Ανάδειξη και προστασία γεωλογικών μνημείων της Κρήτης. Πρακτικά Διεθνούς Συμποσίου Μνημεία της φύσης και Γεωλογική κληρονομιά. Λέσβος 1997, 260-268.
- Φασουλάς, Χ. (2011). Δυνατότητες Προστασίας και Καταγραφής της Γεωλογικής κληρονομίας κληρονομιάς κατά την εκπόνηση Μελετών Γεωλογικής Καταλληλότητας (ΜΓΚ) http://goo.gl/RO5yBt.
- «Sedimentary Rocks in the Field: A Practical Guide». Tucker, E., M. (εκδόσεις WileyBlackwell, 2011).
- «The Field Description of Igneous Rocks». Jeram, D. & Petford, N. (εκδόσεις Wiley-Blackwell, 2011).
- The Field Description of Metamorphic Rocks. Fry, N. (1997). 128p., John Wiley & Sons.
- «The Mapping of Geological Structures». Mc Clay, K. (εκδόσεις Wiley-Blackwell, 1991).
- «Introduction to Geological Structures and Maps». Bennison, M., G., Olver, A., P. & Moseley, A., K., C. (εκδόσεις Routlege, 2011).
- Γεωγραφικά Συστήματα Πληροφοριών. Ν. Ευελπίδου & Β. Αντωνίου. 2015. Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών (Κάλλιπος), ISBN: 978-960-603-164-9.

Website:

NA

ΕΠΓ-Υ05 APPLIED HYDROGEOLOGY

Instructors: E. Skourtsos (eskourt@geol.uoa.gr); Ch. Filis; A. Alexopoulos (Prof. Emeritus)

LEVEL/ SEMESTER: 7 / 2ND

TYPE: Scientific, Specialized background, Skills development

LECTURES AND PRACTICAL EXERCISES

Lectures, Practice exersices, Field work

4 hours of lecturing per week, 10 ECTS credits.

Prerequisites: No

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The course negotiates the 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 exercises, the student:

- He will be able to understand the water cycle and to calculate the amount of water that from the precipitation of an area infiltrates into the geological formations and is added to the groundwater.
- He will be able to become aware of the basic properties of rocks and geological formations related to their permeability and the ability to store and transmit groundwater.
- He will be able to understand 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.
- He will be able to apply basic techniques for calculating hydraulic parameters and understands their importance for solving various hydrogeological problems.
- He will know everything related to and affects the quality of groundwater and learns ways to assess its quality,
- He is trained in using instruments and devices that help him to measure physical, chemical, biological and radiological properties and parameters of groundwater.
- He will be able to apply techniques and methodologies for assessing and presenting the quality characteristics of water and its suitability for various uses.
- He will become familiar with the concepts of water resources management and is taught ways of rational management.
- He is initiated into the use of computers and appropriately selected software to solve hydrogeological problems.
- He is taught the collection, processing, and evaluation of geological, hydrogeological, tectonic, 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

General Competencies

The course of Applied Hydrogeology aims to:

- The search, analysis and synthesis of data and information, using the necessary technologies
- Its adaptation to new situations and scientific quests
- In decision-making
- In autonomous work
- In teamwork
- Working in an interdisciplinary environment
- The production of new research ideas
- The design and management of projects related to the exploitation of groundwater
- Respect for the natural environment
- The promotion of free, creative and inductive thinking

CONTENT:

A. Lectures (Lectures) of the course

The science of Hydrogeology, Hydrological Balance and Groundwater, Aquifers and their properties, Principles of the movement of groundwater, Movement of groundwater in the insatiable zone, Pumping Tests, Springs – classifications of springs Hydrodynamic analysis of springs, Aquifer in porous media, Karstic Hydrogeology, Karst aquifers, Hydrogeology of fractured Rocks. Discontinuities and ruptures in geological formations, Flow of groundwater in fractured rocks. Development and management of groundwater. Water drilling technique, Water Resources Management.

B. Exercises

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 test draws

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

Field exercise in areas of Attica, Voiotia and Peloponnese (Environmental hydrogeology – Modern and ancient pumping works – Marathon dam and other engineering works for water supply for Athens – Springs, coastal brackish springs – Measurement of spring flow – in situ collection of hydrochemical parameters using portable instruments and devices – contribution of the

geological structure to the flow and storage of groundwater – applications of isotopic hydrology.
Where appropriate, monitoring of drilling works.

TEACHING METHODS:

- Face-to-face (in The Lectures, Practice Exercises and Field Exercises).
- With the use of computers, tablets, smartphones and specialized software (in Lectures, Practice Exercises and Field Exercises).
- By demonstrating the use of maps, specialized instruments and data-taking devices, measurements and samples (in the Field Exercises).
- By demonstrating the way of working and the techniques used in rural work (in the Field Exercises).

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

IN TEACHING:

- Presentations using multimedia (images, animation, video).
- Use of computers and specialized hydrogeology software and / or the use of Microsoft programs (mainly ECXEL).
- Completion of questionnaires.
- Ανάρτηση PowerPoints (ppt) στο e-class

IN COMMUNICATION WITH STUDENTS:

- Support of the learning process through the electronic platform e-Class (announcements, information, messages, documents, tasks, questionnaires, exercises, diary, user groups, multimedia, links, scorecard, e-book etc.), and through personal contact with a reception of students in my office for discussion, analysis, and solving problems and exercises, borrowing foreign language books, indicating bibliography, etc.

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	26 hours
Practice Exercises	26 hours
Field work	36 hours
Unguided study	65 hours
Evaluation properation	45 hours
Familiarization of students with instruments - devices - analyzes of water samples	16 hours
Total	**214** hours

STUDENT EVALUATION/GRADING

The evaluation process is conducted in Greek, either with advances in separate parts of the course outline or with a final examination of the course outline and includes:

I. LECTURES (**45%**)

- 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 (**45%**)

- Written exam with Solving Problems

III. FIELD EXERCISES (**10%**)

- Oral examination in the field and with evaluation of deliverables of required Work or Report

SUGGESTED LITERATURE

I. RECOMMENDED-BIBLIOGRAPHY

- 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
- Βουδούρης Σ. Κ., 2015, Εκμετάλλευση και διαχείριση υπόγειου νερού, Εκδόσεις Τζιόλα, ISBN: 978-960-418-469-9
- 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
- Καλλέργης Α. Γ., 1999, Εφαρμοσμένη - Περιβαλλοντική Υδρογεωλογία. Δεύτερη έκδοση, Εκδόσεις ΤΕΕ, Αθήνα, Τόμος Α και Β., 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
- Λέκκας Σ. & Απ. Αλεξόπουλος, 2009: Εισαγωγή στην Υδρογεωλογία. Φοιτητικές σημειώσεις του Παν/μίου Αθηνών
- 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

II. JOURNALS

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

Website:

https://eclass.uoa.gr/courses/GEOL147/

ΕΠΓ-Υ06 SEISMOLOGY – ENGINEERING SEISMOLOGY

Instructors: G. Kaviris (gkaviris@geol.uoa.gr); N. Voulgaris; V. Kouskouna; P. Papadimitriou (Prof. Emeritus), V; Sakkaw

LEVEL/ SEMESTER: 7 / 2ND

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 10 ECTS credits.

LEVEL/ SEMESTER: 7 / 1st

TYPE: Specialization, Specialized Background, Skill Development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing and 2 hours of practical exercises per week, 10 ECTS credits.

Prerequisites: No formal pre-requisites. However, students are expected to have successfully completed under-graduate courses in Physics and Mathematics (especially Calculus and Linear Algebra) in their respective school of origin. Knowledge and skills acquired by successful completion of under-graduate courses in Geophysics, Geology and Structural Geology are particularly welcome and will be appreciated.

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The purpose of the course is to familiarise students with the theory and applications of modern seismology. Upon completion of the semester, students will be able to use seismological data to calculate seismic parameters by solving both the forward and inverse problem, the propagation of seismic waves in the Earth's interior, prevention and decision making in emergency situations as well as to participate in scientific research groups. The course emphasizes both in theory and applications, so that postgraduate students have the necessary knowledge for modern job markets and enhances the possibility of professional rehabilitation. Upon successful completion of the course, the student should have a satisfactory background:

On completion of the course the students should have acquired:

- In the analysis and interpretation of seismological data
- On the physical processes in the Earth's interior and the methodologies required to solve the related problems
- In the design and management of projects
- In decision making

General Competencies

- Search, analysis and synthesis of data and information, using necessary technologies
- Use of specialised software related to the course
- Analysis of seismological, geological, morphological data
- Evaluation and interpretation of results
- Ability to apply knowledge to problem solving
- Independent work
- Teamwork

CONTENT:

Theoretical background of Geologically Applied Geophysics (lectures).

Elasticity Theory and seismic waves: Study of the theory of elasticity analysis of Stress, strain and propagation equation of seismic waves – the seismic wave equation. Modern applications to large earthquakes.

Body waves and ray theory Seismic waves propagation, introduction to attenuation and dispersion and their effect to imaging of earthquakes in various tectonic regimes.

Seismogram interpretation: Identification of various seismic wave phases due to reflection and refraction, methods for hypocentral determination, introduction to generalised inverse theory.

Determination of earth structure: Determination of earth structure from seismic waves phases on records, introduction to ray detection and seismic tomography with simultaneous interpretation of the results, in relation to the chemical properties, the geological structure and the tectonic regime.

Earthquake catalogues: Types of earthquake catalogues (parametric, descriptive). Purpose of catalogue use (e.g. seismic hazard assessment and/or seismic risk, study of seismic sequence, study of active fault, microzoning study of an area, a town or a specific site of interest, seismic tomography, seismotectonic study, study of tectonic plates motion). Description of catalogue data, time and magnitude window, catalogue completeness.

Seismic hazard: Detailed description of key definitions such as seismic hazard, risk, vulnerability and value at risk and their relation. Description of basic seismic hazard assessment methods (probabilistic/deterministic). Analysis of extreme value theory and semi-statistical method of seismic hazard assessment. Basic description of the R-CRISIS software for probabilistic seismic hazard assessment using the semi-statistical method.

Engineering Seismology: Basic principles of design of seismological networks and arrays. Design, development and application of filters. Spectral analysis, seismic moment calculation. Seismic source function, rupture modes. Accelerogram analysis. Calculation of maximum and spectral soil parameters. Assessment of soil response to strong seismic motion. Effect of local conditions. Objectives, Content and Methodologies of preparing Microzoning studies.

B. Practical training: Analysis of seismological data with modern software and interpretation of results.

- Hypocenter determination with modern interactive algorithms.
- Identification of seismic phases from earthquakes recorded at different distances (local, regional, teleseisms)
- Calculation of the seismic moment tensor
- Seismic ray propagation in the earth's interior and calculation of velocity models
- Calculation of synthetic waves and determination of seismic parameters
- Compilation and interpretation of the earthquake catalogue of an area

- Calculation of maximum expected values of ground acceleration, velocity and displacement for recurrence periods of 475 and 950 years
- Determining the response of surface soil formations using the Horizontal-to-Vertical Spectral Ratio method

TEACHING METHODS:

- Face-to-face lecturing.
- Face-to-face practical training in the analysis and interpretation of seismological data, using computers, tablets, smartphones and specialised software.
- Utilization of the e-class facility of the NKUA (blogging and discussion functions) for additional dissemination of information, distribution of educational material, answering of questions etc.

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Lecturing:

- Multi-media lectures (PowerPoint, image, animation, video). Use of specialized seismological analysis software.

In Practical Training:

- Powerpoint presentations. Use of specialized seismological analysis software.

In the Communication with Students:

- Personal interfacing and utilization of the communication and blogging functions of the e-class facility (24/7 availability).

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	4 hours × 13 weeks
Practical exercises	2 hours × 13 weeks
Homework – includes preparation for final examinations.	12 hours × 13 weeks
Total	**234** hours

STUDENT EVALUATION/GRADING

- Examinations are conducted in Greek. Foreign students can be examined in English.
- The final grade is formed by a series of written personal assignments/reports on specialized topics including the theoretical background and the analysis and interpretation of data.

SUGGESTED LITERATURE

- Lay, T. and T. Wallace (1995). Modern Global Seismology. Academic Press.
- Shearer, P.M. (2009). Introduction to Seismology (2nd ed.). Cambridge: Cambridge University Press.
- Stein, S. and M. Wysession (2008). An Introduction to Seismology, Earthquakes, and Earth Structure. Wiley-Blackwell; 1 edition (June 9, 2008).

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, Elsevier
- Tectonophysics, Elsevier
- Journal of Seismology, Springer
- Pure and Applied Geophysics, Springer
- Bulletin of Earthquake Engineering, Springer
- Journal of Seismology, Springer
- Applied Sciences, MDPI
- Annals of Geophysics, Istituto Nazionale di Geofisica e Vulcanologia (INGV)

Website:

https://eclass.uoa.gr/courses/GEOL585

4.1.2.B. ELECTIVE COURSES

ΕΓΓ-Ε01 ENGINEERING AND ENVIRONMENTAL GEOPHYSICS

Instructors: I. Alexopoulos (jalexopoulos@geol.uoa.gr); N. Voulgaris; A. Tzanis; F. Vallianatos; V. Sakkas.

LEVEL/ SEMESTER: 7 / 3RD

TYPE: Specialized Background; Development of skills and competencies

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, practical exercises, field exercises, 10 ECTS credits.

Prerequisites: Course ΕΓΓ-Υ03 (Geologically Applied Geophysics).

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

Objective of near-surface geophysical sounding is the precise as possible determination of the configuration of the physical properties of the subsurface and its association with geological or man-made structures. This information can be applied to the analysis and handling of problems related to the exploration and evaluation of mineral, energy and other natural (e.g. water) resources, the appraisal of natural/geological and technological hazards, the study of geotechnical problems related to construction and built environments and, finally, to the analysis and appraisal of environmental problems arising from natural/geological or/and industrial activity. On successful completion of this course the students are expected to:

- Be familiarized with the basic principles of near surface geophysics and its applications.
- Be able to select and apply those near-surface applied geophysical methods, which are appropriate in confronting a given problem.
- Appreciate the basic principles of geophysical instrumentations and its utilization.
- Be familiar with the design and execution of near-surface geophysical field operations, as well as with procedures related to the processing and interpretation of the resulting data.
- Have acquired knowledge and skills necessary in interrelating geophysical, geological and environmental information.
- Have acquired skills in combining and evaluating transdisciplinary information (geophysical, geological, geotechnical, remote sensing etc.).

General Competencies

- Measurement, research, analysis and synthesis of data and information, using the necessary technologies.
- Advancement of free, creative and inductive thinking.
- Adaptation to new conditions and situations.
- Self-contained (individual) work
- Teamwork.
- Trans-disciplinary scientific work.
- Critical thinking and constructive self-appraisal.
- Respect for the natural environment.
- Decision making.

CONTENT

- **Gravity/ Magnetic Prospecting:** Fault detection; stripping of overburden; micro-gravimetric monitoring of aquifer depletion; detection of buried metallic objects; magnetometric applications in archeology
- **Seismic sounding in engineering geophysics and geology:** Elastic constants and their relationship to the velocity of seismic waves and mechanical properties of materials; seismic sounding in geotechnical and environmental problems; detection and characterization of (seismic) bedrock; seismic sounding in boreholes; seismic surface waves in geotechnical problems.
- **Resistivity, Self-Potential and Induced Polarization methods:** Imaging of near-surface structures; detection, evaluation and monitoring of near-surface aquifers, including the spread of pollution and coastal salinization; applications in geotechnical engineering (landslides, ground evaluation, void, karst and fracture detection, etc.); applications in archeology.
- **Electromagnetic Sounding:** Controlled source EM methods in the frequency and time domains; imaging of near-surface structures; evaluation and monitoring of aquifers (spread of pollution, coastal salinization etc.); exploration of mineral resources; geotechnical engineering (landslides, ground evaluation etc.); archeological prospecting.
- **Ground Probing Radar:** High resolution imaging of near-surface structures; high resolution detection of buried objects; UXO detection; applications in archeological prospection and environmental studies; structural integrity of pavements and buildings.
- **Geophysical Well Logging:** Acquisition, processing appraisal/ interpretation of borehole geophysical data; examples and applications.
- **Geophysical methods in seismic micro-zonation studies; e**valuation of ground response to seismic loading; characterization/ mapping of the mechanical and geotechnical properties of grounds and foundation sites.

Practical exercises:

Familiarization with the equipment of geophysical exploration.
Processing/ reduction of geophysical data; interpretation and appraisal.
Compilation of technical reports.

Field Exercises

Utilization of portable geophysical equipment – familiarization with data acquisition procedures.
On-site qualitative and quantitative evaluation of geophysical measurements including compilation of field reports.

TEACHING METHODS

- Face-to-face lecturing.
- Face-to-face practical exercises in the analysis and interpretation of geophysical data.

- Utilization of the e-class facility of the NKUA (blogging and discussion functions) for additional dissemination of information, distribution of educational material, answering of questions etc.

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Lecturing:

- PowerPoint presentations available through the course's web site in the e-class facility of the NKUA; they incorporate educational videos relevant to the lectures.

In Practical exercises:

- Instructional part: PowerPoint presentations available through the course's web site in the e-class facility of the NKUA; they incorporate educational videos with relevant content.
- Executional part: Specialized educational or/and professional software. The educational software is available through the course's web site. The pro-fessional software resides in dedicated computers of the Section of Geophysics – Geothermy, or the Computing Centre of the NKUA.

In the Communication with Students:

- Personal interfacing and utilization of the communication and blogging functions of the e-class facility (24/7 availability).

BREAKDOWN OF WORKLOAD:

Activity	Workload/Semester
Lectures and Practical exercises	4 h × 13 weeks
Field Exercises	12 h × 1 weeks
Homework – includes work on practical exercises and	12 h × 13 weeksδ
Total	**220** hours

STUDENT EVALUATION/GRADING

Examinations are conducted in Greek. Foreign students, or students from European Union countries (Erasmus Programme), can be examined in English.

The final grade is formed through a series of tests that include:

- Written examination which amounts to **30% of the final grade.**
- Reports prepared and submitted as part of the practical exercise program. The mean of the grades of all reports amounts to **70% of the final grade**.

SUGGESTED LITERATURE

- 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, R.E., Applied Geophysics, 2nd Edition, Cambridge University Press.
- Everett, M.K., 2013. Near Surface Applied Geophysics, Cambridge University Press
- Τζάνης, Α., 2016. «Στοιχεία από τον Γεωηλεκτρομαγνητισμό», ανέκδοτο βιβλίο, 222 σελ., διανέμεται δωρεάν.
- Milsom, J., 1996. Field Geophysics, 2nd Edition, Wiley, ISBN 0-470-84347-0
- Claerbout, J., 1996. Imaging the Earth's interior, http://sepwww.stanford.edu/sep/prof/iei2/
- Claerbout, J., 1996. Fundamentals of Geopysical Data Processing, Blackwell, ISBN 0-86542-305-9, http://sepwww.stanford.edu/sep/prof/fgdp5.pdf
- Daniels, D.J., 2004. Ground Penetrating Radar, 2nd Edition, ISBN 0-86341-360-9
- Τσελέντης, Γ-Α., και Παρασκευόπουλος, Π., Εφαρμοσμένη Γεωφυσική, [Κωδ. ΕΥΔΟΞΟΣ: 50659068]

WEBSITE:

NA

ΕΠΓ-Ε02 ADVANCED ELEMENTS OF SOIL AND ROCK MECHANICS

Instructors: M. Stavropoulou (mstavrop@geol.uoa.gr).

LEVEL/ SEMESTER: 7 / 3RD

TYPE: Scientific, Specialized background, Skills development

LECTURES AND PRACTICAL EXERCISES

Lectures, Practice exercises, Laboratory exercises

4 hours of lecturing per week, 10 ECTS credits.

Prerequisites: No

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

This course is devoted to the understanding of the properties and mechanical behavior of geo-materials, soils and rocks, with the aim of a realistically complete geo-technical assessment of the subsoil and the safe design of engineering projects. It focuses on advanced aspects of soil and rock behaviour, related theoretical frameworks and their application to the solution of geotechnical problems.

Upon successful completion of the course the student:

- Will be able to understand the mechanical behavior of geo-materials at different scales and under different types of loading.
- Will be able to apply the appropriate methodologies for the calculation of the physical and mechanical properties of soils and rocks based on laboratory test data.
- Will be able to understand the selection and application of the appropriate laboratory tests in the context of a engineering research and study of engineering project.
- Will be able to apply fundamental principles of soil mechanics and rock mechanics to solve some basic engineering problems.

General Competencies

- Search, analysis and synthesis of data and information using the necessary technologies.
- Self-employment.
- Team working.
- Ability to apply knowledge in problem solving.
- Decision-making.
- Promoting free, creative and inductive thinking.
- Respect of the natural environment.

CONTENT:

This class presents the application of principles of soil and rock mechanics. It considers the following topics: the origin and nature of soils; soil classification; the effective stress principle; hydraulic conductivity and seepage; stress-strain-strength behavior of cohesionless and cohesive soils and application to lateral earth stresses; bearing capacity and slope stability; consolidation theory and settlement analysis; rock strength; mechanical behavior of rock mass; laboratory and field methods for evaluation of soil and rock properties in design practice.

A. Lectures

- **PHYSICAL CHARACTERISTICS OF THE SOIL:** Origin and nature of soil, Physical properties of soils, Classification of soils, Compaction.
- **DRY SOIL:** Mohr Circle, Stress Paths, Elastic Stress Distribution, Stress-Strain and Strength Behavior of Sand, Rankine Earth Pressures, Infinite Slopes, Retaining Walls, Bearing Capacity of Sands, Settlement of Sands.
- **SATURATED SOIL:** Effective Stress Principle, One- and Two-Dimensional Flow, Coefficient of Permeability, Stress-Strain and Strength Behavior of Clays, Drained Shear Behavior, Undrained Shear Behavior of Clays, Consolidation of Cohesive Soils, Lateral Earth Pressures, Slope Stability and Bearing Capacity.
- **ROCK:** Rock strength, Elastic properties, Uniaxial compression test, Point load strength index, Tensile strength, Shear strength, Mohr-Coulomb and Hoek and Brown failure criterions, Rock mass discontinuities: geometrical and mechanical characteristics and their influence on the behavior of the rock mass, Shear strength of discontinuities.

B. Practice exercises and laboratory exercises

(Physical properties of soils, Stress distribution in soil, Shear strength of soil, Compressibility and Consolidation of soil, Characterization of Rock Mechanical Properties Using Lab Tests, Slope Stability and Bearing Capacity problems).

TEACHING METHODS:

- In person (in lectures and practise exercises)
- Using computers, tablets, smartphones and specialized software (in lectures and practice exercises).
- Laboratory exercises in the laboratory of soil and rock mechanics.

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

IN TEACHING:

- Presentation with multimedia content (images, animation, video).

IN COMMUNICATION WITH STUDENTS:

- Support of the learning process through the electronic platform e-Class (announcements, information, messages, documents, tasks, questionnaires, exercises, diary, user groups, multimedia, links, scorecard, e-book etc.).

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	2 hours × 13 weeks
Practical Training	2 hours × 13 weeks
Homework – includes preparation for final examinations.	16 hours × 13 weeks
Total	**260** hours

STUDENT EVALUATION/GRADING

The evaluation process are conducted in Greek (there is the possibility of examination in English for Erasmus students), either with progress in separate sections of the material or with the final examination of the whole material and includes:

I. LECTURES (**50%**)
- Written exam with short answer questions and Multiple choice test

II. PRACTICE EXERCISES (**50%**)
- A written examination with exercises and problem solving

SUGGESTED LITERATURE

I. RECOMMENDED-BIBLIOGRAPHY
- Barnes G. 2005. Εδαφομηχανική: Αρχές και Εφαρμογές. Εκδόσεις Κλειδάριθμος Ε.Π.Ε.
- Lambe, T. William, and Robert V. Whitman. Soil Mechanics. New York: Wiley, 1969
- Holtz and Kovacs, Prentice-Hall An Introduction to Geotechnical Engineering, , 1981.
- Καββαδάς Μ. 2009. Στοιχεία εδαφομηχανικής. http://users.ntua.gr/kavvadas/Books/books.htm .
- Hoek E. 2007. Practical Rock Engineering https://www.rocscience.com/learning/hoek-s-corner/books

II. 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

Website:

https://eclass.uoa.gr/courses/GEOL527/

ΕΓΓ-Ε03 SEISMOTECTONICS

Instructors: G. Kaviris (gkaviris@geol.uoa,gr); H. Kranis; P. Papadimitriou; K. Pavlou.

LEVEL/ SEMESTER: 7 / 3RD

LECTURES AND PRACTICAL EXERCISES

Lectures and Practical Exercises. Credit units are awarded uniformly over the whole course

4 hours of lecturing per week, 10 ECTS credits.

Prerequisites: There are no standard prerequisite courses, but postgraduate students are expected to have successfully completed undergraduate courses in Geology, Physics and Mathematics at their School of Origin. Of great importance and recommended are knowledge gained from the successful attendance of undergraduate courses in Seismology and Geophysics.

Language of instruction and examinations: Greek

The course is offered to Erasmus students in English

LEARNING OUTCOMES

Learning Outcomes: The aim of the course is to acquaint students with applications of seismotectonic analysis and interpretation. Upon completion of the semester, students will be able to use specialized software and participate in research teams. The course emphasizes to the applied part of Science in a way that equips students with skills necessary for modern job opportunities and enhances the possibility of vocational rehabilitation.

General Competencies
- Carrying out tasks at individual and group level
- Understanding specialized topics of seismotectonic research
- Use of special software related to the subject of the course
- Analysis of seismological, geological, morphological data
- Evaluation and interpretation of results
- Applications, evaluation of socially sensitive information (such as seismic hazard assessment) and their management

COURSE CONTENT:

A. Theoretical training (lectures).
- Introduction: General principles
- Seismic faults, active tectonics, deformation, historical and instrumental seismicity, seismic parameters, earthquake catalogues, focal mechanisms, seismic hazard, seismic hazard maps, seismotectonic maps
- Analysis of seismic parameters
- Methods for hypocentral location and relocation, error estima-tion and minimization, velocity models..
- Focal mechanism
- Moment tensor. Methodologies on the determination of focal mechanisms.
- Spatiotemporal analysis of seismic sequences
- Χωρική κατανομή σεισμικών ακολουθιών, συσχέτιση με ενεργές τεκτονικές δομές, προσδιορισμός γεωμετρίας σει-

σμογενών δομών, χρονικές μεταβολές, νόμος Gutenberg-Richter, χωροχρονική μεταβολή b.
- Determination of stress field
- Stress tensor. Methods of estimation of the stress field by the inversion of focal mechanisms.
- Coulomb stress transfer
- Coulomb criterion, Coulomb stress, correlation with spatio-temporal distribution of earthquakes.
- Seismic moment
- Spectral analysis, dynamics of seismic sources, stress drop
- Induced seismicity
- Man made and artificial sources earthquakes. Methods for their discrimination.
- Seismic hazard
- Global, regional, local seismic hazard models. Determination of seismic sources.
- Mapping of seismotectonic elements and their interpretation
- Characteristic examples from the literature.

B. Practical exercises: Analysis of seismic data with modern software and interpretation of results

Location and relocation of seismic sources using real data recorded by regional and local seismological networks.
Mapping hypocenters using GMT and GIS software. Cross-sections.
Constrain of focal mechanisms, mapping and projection in cross-sections.
Seismic wave analysis using SAC (Seismic Analysis Code).
Statistical analysis of seismic catalogues, diagrams, histograms, rosegrams, maps, etc.
Mapping of stress field inversion results using GMT or GIS software.
Coulomb stress transfer models using Coulomb v3.3 software.
Seismic hazard assessment through OpenQuake. Mapping of results using GIS.

TEACHING AND LEARNING METHODS

TYPE OF PRESENTATION
- Face to face lectures.
- Face to face practical exercises on the analysis and interpretation of seismic data using computer facilities.
- Use of NKUA e-class facilities (discussion areas, blogging, etc.) for dissemination of additional information, distribution of material, problem solving and questions, etc.

USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES

In Theory:
- Presentations.

In Practical exercises
- PowerPoint presentations and applications with the use of special software.

In Communication with students:
- In addition to personal contact, use of dissemination capabilities of the NKUA e-class, distribution of material, questions, etc.
-

ORGANIZATION OF TEACHING:

Activity	Labor in the Semester
Lectures	3 hours × 13 weeks
Practical exercises	1 hour × 13 weeks
Homework – includes exams preparation.	13 hours × 13 weeks
Total	**247** ώρες

STUDENT EVALUATION

Final exams are in Greek, while for foreign students (Erasmus) exams can be in English.

The final grade is formed by a series of tests which include:
- Essays/Reports, **50%** of the final grade
- Final exams at the end of the Semester, **50%** of the final grade. The topics include a mix of multiple choice questions with short answers and others with extensive formulation.

RECOMMENDED-BIBLIOGRAPHY

- Armijo, R., Lyon-Caen, H., Papanastassiou, D., 1992. East–west extension and Holocene normal-fault scarps in the Hellenic Arc. Geology 20 (6), 491–494. http://dx.doi.org/10.1130/0091-7613.
- Gutenberg, B., Richter, C.F., 1944. Frequency of earthquakes in California. Bull. Seismol. Soc. Am. 34, 185–188.
- Kapetanidis, V., Kassaras, I., 2019. Contemporary crustal stress of the Greek region deduced from earthquake focal mechanisms, Journal of Geodynamics, https://doi.org/10.1016/j.jog.2018.11.004.
- Kapetanidis, V., Papadimitriou, P., 2011. Estimation of arrival-times in intense seismic sequences using a Master-Events methodology based on waveform similarity. Geophys. J. Int. 187, 889–917. http://dx.doi.org/10.1111/j.1365-246X.2011.05178.x.

Website:

https://eclass.uoa.gr/courses/GEOL507/

ΕΠΓ-Ε04 GEOLOGY OF PUBLIC WORKS

Instructors: M. Stavropoulou (mstavrop@geol.uoa.gr).

LEVEL/ SEMESTER: 7 / 3RD

TYPE: Scientific, Specialized background, Skills development

LECTURES AND PRACTICAL EXERCISES

Lectures, Practice exercises, Laboratory exercises

4 hours of lecturing per week, 10 ECTS credits.

Prerequisites: No

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The aim of the course is the understanding by the students of the basic geological principles and methods with a view to their application in engineering projects.

Upon successful completion of the course the student:

- Will be able to record field observations accurately and clearly, and to present these observations to an audience.
- Will be familiar with analysis of basic technical-geological criteria for site selection, construction feasibility and selection of optimal alternatives,
- Understand and apply engineering geology philosophy and methodology in the design, construction and maintenance of surface and underground civil and mining structures.
- Will be familiar with design and construction requirements for principal types of engineering works, including dams, tunnels, bridges and slopes.
- Will be familiar with planning and execution of geological, geophysical, geotechnical investigations, evaluation of geo-research programs, preparation of geotechnical maps and ground models in the context of the design of construction projects.
- Will be able to conduct a literature review using international, peer-reviewed journal sources.

General Competencies

- Search, analysis and synthesis of data and information using the necessary technologies.
- Self-employment.
- Team working.
- Ability to apply knowledge in problem solving.
- Decision-making.
- Promoting free, creative and inductive thinking.
- Respect of the natural environment.

CONTENT:

This course pertains to the general design principles and construction practices in rock and soil, the role of water and its control in excavations and selected case studies. Particular emphasis is given to selecting and identifying the most "critical" geological parameters that will affect technical work construction and their safe operation.

A. Lectures

- Engineering behaviour of rock masses: rock mass classification systems RMR, Q and Geological Strength Index (GSI). Applications on the design and construction of tunnels, slopes and foundations.
- Landslides: terminology and classification, causal and triggering factors, remedial measures
- Design and construction of dams: classification of dams, design criteria, engineering geological requirements, dam and reservoir waterproofing, monitoring techniques.
- Design and construction of tunnels: geological conditions during construction, rockmass deformation and failure mechanism, construction methods (NATM and TBM) and supporting techniques. Mining cases studies.
- Geological, Engineering Geology and Geotechnical Studies: Definitions, characteristics, differences, studies to be done in the studies and preparation of Geotechnical Investigation Reports.

B. Practice exercises and laboratory exercises

AutoCad seminar, Selected case studies (literature review, final written design reports and oral presentations)

TEACHING METHODS:

- In person (in lectures and practise exercises)
- Using computers, tablets, smartphones and specialized software (in lectures and practice exercises).
- Laboratory exercises in the laboratory of soil and rock mechanics.

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

IN TEACHING:

- Presentation with multimedia content (images, animation, video).

IN COMMUNICATION WITH STUDENTS:

- Support of the learning process through the electronic platform e-Class (announcements, information, messages, documents, tasks, questionnaires, exercises, diary, user groups, multimedia, links, scorecard, e-book etc.).

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	2 hours × 13 weeks
Practical Training	2 hours × 13 weeks
Homework – includes preparation for final examinations.	16 hours × 13 weeks
Total	**260** hours

STUDENT EVALUATION/GRADING

The evaluation process are conducted in Greek (there is the possibility of examination in English for Erasmus students), either with progress in separate sections of the material or with the final examination of the whole material and includes:

I. LECTURES (**50%**)

- Written exam with short answer questions and Multiple choice test

II. PRACTICE EXERCISES (**50%**)

- Written examination with exercises and problem solving

SUGGESTED LITERATURE

I. RECOMMENDED-BIBLIOGRAPHY

- Κωστόπουλος Σπ. 2008. Γεωτεχνικές Κατασκευές, Τόμος Ι. Εκδόσεις: ΙΩΝ.
- Καββαδάς Μ. 2009. Σημειώσεις Σχεδιασμού Υπογείων Εργων. http://users.ntua.gr/kavvadas/Books/books.htm .
- Σταυροπούλου Μ. 2021. Σημειώσεις Γεωτεχνικών Εφαρμογών.
- Hoek E. 2007. Practical Rock Engineering https://www.rocscience.com/learning/hoek-s-corner/books
- Braja M. Das. 1983. Principles of Geotechnical Engineering Publisher: Cengage Learning (7th edition, 2010).
- Εξαδάκτυλος Γ & Σταυροπούλου Μ. 2006. Κατασκευή και Μηχανική των Σηράγγων και των Υπογείων Εργων.

II. JOURNALS

- 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.
- Engineering Geology, Publisher: Elsevier BV.
- Tunnels & Tunnelling International, www.tunnelsonline.info/

Website:

https://eclass.uoa.gr/courses/GEOL528/

ΕΓΓ-Ε05 ADVANCED ELEMENTS OF CONTEMPORARY SEISMOLOGY

Instructors: G. Kaviris (gkaviris@geol.uoa.gr); N. Voulgaris; V. Kouskouna; F. Vallianatos; P. Papadimitriou

TYPE: Specialization, Specialized Background, Skill Development

LECTURES AND PRACTICAL EXERCISES

4 teaching hours per week, 10 ECTS credits.

Prerequisites: No formal pre-requisites. However, students are expected to have successfully completed undergraduate courses in Geology, Physics and Mathematics. Knowledge and skills acquired by the successful completion of undergraduate courses in Seismology and Geophysics are particularly welcome.

Language: Greek

Course offered to Erasmus+ students: Yes, in English

LEARNING OUTCOMES

Learning Outcomes: The goal of the course is to familiarize students with applications of modern seismology. After successfully completing the course, the students will be able to use specialized seismological software and participate in research groups. The course emphasizes the applied nature of seismology, to provide the necessary skills in the modern work environment and has been designed with employment prospects in mind.

General Competencies

- Conducting research individually and as a member of a working group
- Understanding of specialized topics on seismological research
- Use of software related to the course's topics
- Evaluation and interpretation of results of modern seismological methods
- Comparative application of methodologies
- Evaluation and management of socially sensitive information (such as estimation of seismic risk)
- Seismological applications in operational environments

CONTENT:

Theoretical content (lectures).

- Methods for earthquake forecasting
- Forecasting methods (short-, mid- and long-term), comparative evaluation and potential for integration in operational systems
- Earthquake early warning systems
- Design and deployment of seismological networks specialized for earthquake early warning, early warning methodologies, integration in earthquake mitigation plans, social and economic impact of early warning
- Application of passive seismic tomography
- Retrieval and selection of seismological data for tomography, methods of grid design (quadtree and adaptive cells), body-wave tomography (local, regional and teleseismic), ambient noise tomography, applications of seismic tomography (volcanic and tectonic regimes, hydrocarbon exploration)

- Application of surface waves and receiver functions in exploring deep structures
- Surface waves in exploring the crust and mantle, velocity models from surface waves, receiver functions methodologies, deconvolution methods, Vp/Vs ratio and discontinuities estimation
- Applications of seismic anisotropy
- Criteria for selecting seismic anisotropy suitable data, shear-wave splitting, visual inspection method, rotation-correlation method, eigenvalue method, cluster analysis method, temporal variations as earthquake/volcanic precursors, spatial variations and different regimes of seismic anisotropy, mantle characterization from shear-wave splitting, seismic anisotropy in seismic surveys, applications in hydrocarbon exploration and production
- Applications of ambient noise in estimating dynamic features of surficial formations
- Ambient noise processing, methods for obtaining site effects, integration of estimated dynamic features in structural improvements
- Structural vulnerability
- Categories of buildings and infrastructure, methods of vulnerability estimation, vulnerability curves, vulnerability assessment of the building stock in Greece
- Seismic risk
- Seismic hazard, methods for assessing seismic hazard and seismic risk, evaluation of seismic risk models, integration in operational level
- Seismic design codes
- Development of seismic building design codes, New Greek Seismic Design Code

B. Practical exercises: Processing of seismological data with modern software and interpretation of results

Estimating shear-wave splitting from local waveform data
Evaluation of shear-wave splitting temporal variations
Synthetic accelerograms for the deterministic assessment of seismic hazard
Seismic hazard maps

TEACHING METHODS:

- Face-to-face lecturing.
- Face-to-face practical exercises in the analysis and interpretation of seismological data.
- Utilization of the e-class facility of the NKUA (blogging and discussion functions) for additional dissemination of information, distribution of educational material, answering of questions etc.

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Lecturing:

- Presentations

In Practical exercises:

- Instructional part: Presentations
- Executional part: Specialized software

In the Communication with Students:

- Personal communication and utilization of the communication features of the e-class system (24/7 availability).

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	4 hours × 13 weeks
Practical exercises	2 hours × 13 weeks
Homework – includes preparation for final examinations.	13 hours × 13 weeks
Total	**247** hours

STUDENT EVALUATION/GRADING

Examinations are conducted in Greek. Foreign students, or students from European Union countries (Erasmus Programme), can be examined in English.

The final grade is formed through a series of tests that include:

- Reports prepared and submitted as part of the practical exercise program. The mean of the grades of all reports **amounts to 50% of the final grade**.
- Written examination. This takes place at the end of the 3rd semester (main examination), or/and in the month of September (auxiliary examination). The written examination **amounts to 50% of the final grade.**

SUGGESTED LITERATURE

- Gumbel, EJ., 1958. Statistics of Extremes, Columbia University Press, New York.
- T. Lay, T. Wallace, 1995. Modern Global Seismology, Academic Press, p. 521. eBook ISBN: 9780080536712
- B.C. Papazachos, G.F. Karakaisis, P.M. Hatzidimitriou, Introduction to Seismology, [Eudoxus Code: 11254]
- A. Tselentis, General Seismology Part A, [Eudoxus Code: 59395397]
- A. Tselentis, General Seismology Part B, [Eudoxus Code: 77118155]

SCIENTIFIC JOURNALS:

- Bundled collection relevant scientific papers.
- 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

Website:

https://eclass.uoa.gr/courses/GEOL505/

ΕΠΓ-Ε06 DATA ANALYSIS AND GEOSTATISTICS

Instructors: A. Tzanis (atzanis@geol.uoa.gr).

LEVEL/ SEMESTER: 7 / 3rd

TYPE: Specific Background, Specialization, Skill Development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 10 ECTS credits.

Prerequisites: No formal pre-requisites. Students are expected to have working comprehension of the basic concepts and principles taught herein, acquired through successful completion of undergraduate courses in Statistics and Mathematics (Linear Algebra and Calculus in particular).

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

Earth Sciences investigate the internal structure and the dynamics/evolution of the Earth by studying the magnitudes, changes and interdependencies of physical parameters and phenomena generated by the activity and interaction of the host of the dynamic subsystems that comprise the crust and interior of the Planet. In addition, they are engaged in the exploration and appraisal of natural resources, in the appraisal and prediction of natural and anthropogenic hazards, in the study of geotechnical problems related to construction and the built environment and, finally, with the investigation and appraisal of anthropogenic environmental. Earth Science is required to address such complex problems and provide **answers technically robust and quantitatively accurate**. In response, the course is designed so as to maintain a fairly high technical level and focus on principal data reduction and analysis techniques applied to a broad spectrum of Earth-scientific problems.

On completion of the Course, the students should have acquired:

- Dexterity in using and programming scientific computing engines (MATLAB and OCTAVE) and their associated signal, modelling and statistical analysis toolboxes.
- Comprehension of the basic concepts and principles of Applied Mathematics and Statistics, as well as ability to advance their knowledge and keep up with new developments in the fields of quantitative data analysis.
- Dexterity with general techniques of manipulating and displaying scientific data and images.
- Dexterity in the spectral analysis and information extraction from spatio-temporal scientific data.
- Dexterity in the statistical analysis of spatio-temporal scientific data.
- 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 simple differential equations.
- 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.
- Understanding of how to compile and present scientific and technical reports.
- Dexterities necessary in addressing different practical problems related to data analysis and interpretation (economic, environmental, technical etc.)

General Competencies

- Measurement, research, analysis and synthesis of data and information, using the necessary technologies.
- Advancement of free, creative and inductive thinking.
- Critical thinking and constructive self-appraisal
- Adaptation to new conditions and situations.
- Self-contained (individual) work
- Teamwork
- Trans-disciplinary scientific work
- Decision making

CONTENT:

1. Introduction to MATLAB/OCTAVE with parallel review of the principles of Linear Algebra.
2. Advanced concepts of probability theory and parametric probability distributions in one and more dimensions. Basic distributions (normal, Poisson, γ, Student, Fisher, χ^2) and statistical testing of data (t, F, χ^2) and hypotheses. Analysis of Variance.
3. 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.
4. 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.
5. 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. Karhunen–Loeve transformations. Applications to the analysis of matrices and images; applications to geophysical and geotechnical problems – analysis of the stress and strain tensors.
6. 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.
7. Partial differential equations (Laplace, diffusion, wave): Concepts, properties 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.
8. 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).

9. Statistical analysis of multivariate data: Discriminant functions, Cluster Analysis and Factor analysis.
10. 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.).

TEACHING METHODS

- Face-to-face lecturing.
- Face-to-face practical exercises with scientific computing engines (e.g. MATLAB).
- Utilization of the e-class facility of the NKUA (blogging and discussion functions) for additional dissemination of information, distribution of educational material, answering of questions etc.

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Lecturing:

- PowerPoint presentations and demonstrations of data analysis and modeling methods; this includes educational videos available to the students via the course's website.

In Practical exercises:

- Instructional part: PowerPoint presentations and live demonstrations of data analysis procedures using MATLAB or OCTAVE.
- Executional part: Data analysis exercises using MATLAB or OCTAVE (software available through the Computing Centre of the NKUA).

In the Communication with Students:

- Personal interfacing and utilization of the communication and blogging functions of the e-class facility (24/7 availability).

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	4 hours × 13 weeks
Practical exercises	2 hours × 13 weeks
Homework – includes preparation time for final examinations.	12 hours × 13 weeks
Total	**234** hours

STUDENT EVALUATION/GRADING

- Students are evaluated by a formative assessment process in Greek. Foreign students from European Union countries (attending through the Erasmus programme) may be 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 exercises program.

SUGGESTED LITERATURE

- Βεργάδος, Ι., «Μαθηματικές Μέθοδοι Φυσικής», Τόμοι Ι & ΙΙ, Πανεπιστημιακές Εκδόσεις Κρήτης.
- Αναλυτικές Σημειώσεις Διδασκόντων (άνω των 140 σελίδων) και ύλη ασκήσεων αναρτημένες στην η-Τάξη
- Arfken, G.B and Weber, H.J., 2005. Mathematical Methods for Physicists, 6th Edition, Elsevier.
- Snieder, R., 1997, "A guided tour of Mathematical Physics", Samizdat Press .
- Hanselman, D. and Littlefield, B., «Μάθετε το MATLAB 7», [Κωδ. ΕΥΔΟΞΟΣ: 13789]
- Moller, C., 2004. «Numerical computing with MATLAB», MathWorks Inc. (https://www.mathworks.com/moler/chapters.html).
- Trauth, M.H., 2007. MATLAB Recipes for Earth Scientists, 2nd Edition, Springer Verlag.
- Scales, J.A. et al., 2001. Introductory Geophysical Inverse Theory, Samizdat Press.
- 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.

WEB PAGE:

https://eclass.uoa.gr/courses/GEOL456/

ΕΠΓ-Ε07 TECTONIC STRUCTURES AND GROUNDWATER

Instructors: E. Skourtsos (eskourt@geol.uoa.gr); Ch. Filis.

LEVEL/ SEMESTER: 7 / 3RD

TYPE: Scientific, Specialized background, Skills development

LECTURES AND PRACTICAL EXERCISES

Lectures, Practice exersices, Field work

4 hours of lecturing per week, 10 ECTS credits.

Prerequisites: No

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

In this course we explore the geological context in which groundwater flows, is stored and pumped. The focus concerns the nature of geological formations, the mechanism and tectonic conditions and their history of formation that significantly affect their hydrogeological characteristics. This information lays the foundations for a discussion about the presence of groundwater and its behavior. The hydrogeological properties of geological formations usually depend on the geological environment in which the formations were formed.

The number of geological formations and tectonic environments is huge. We will not try to comment on them all, but rather we will focus on some of the most frequent and the ones that are found in Greece. The approach we will follow is to record geological formations as incoherent deposits, coherent deposits, metamorphic rocks and igneous rocks. The genesis and relevance of the formation and tectonic environment to the flow and transmission of groundwater will be discussed.

After the successful completion of the course, laboratory exercises and field exercises, the student:

- He becomes aware of the properties of rocks and geological formations associated with the ability to store and move groundwater.
- He understands what aquifers are, their types, the basic hydraulic properties of aquifers (porous, active porous hydraulic load, hydraulic conductivity, aqueductivity, storage coefficient) and how they are related to the way geological formations form and the geological environment in which they formed.

General Competencies

The course of Applied Hydrogeology aims to:

- The search, analysis and synthesis of data and information, using the necessary technologies
- Its adaptation to new situations and scientific quests
- In decision-making
- In autonomous work
- In teamwork
- Working in an interdisciplinary environment
- The production of new research ideas
- The design and management of projects related to the exploitation of groundwater
- Respect for the natural environment
- The promotion of free, creative and inductive thinking

CONTENT:

A. Lectures (Lectures) of the course

Discontinuities and fractures in geological formations. Geological formations as aquifers. Aquifer in porous media. Aquifer in unconsolidated, porous media – alluvial plains. Aquifer in consolidated sedimentary formations. Aquifer in carbonate formations. Aquifer in ruptured formations. Aquifer in volcanic and metamorphic rocks. Faults, movement of groundwater and springs, hot springs. Hydrothermal phenomena and geothermal fluids. Aquifers in zones of folds and thrusts. Aquifers in monoclinical sequences, in postalpine basins, in areas with late orogenetic extension, in metamorphic core complexes. Tectonic maps. The aquifers in Greece – Hydrogeology of Greece.

B. Exercises

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

Field exercise in areas of Attica, Voiotia and Peloponnese

TEACHING METHODS:

- Face-to-face (in The Lectures, Practice Exercises and Field Exercises).
- With the use of computers, tablets, smartphones and specialized software (in Lectures, Practice Exercises and Field Exercises).
- By demonstrating the use of maps, specialized instruments and data-taking devices, measurements and samples (in the Field Exercises).

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

IN TEACHING:

- Presentations using multimedia (images, animation, video).
- Use of computers and specialized hydrogeology software and / or the use of Microsoft programs (mainly ECXEL).
- Completion of questionnaires.
- PowerPoints (ppt) to e-class

IN COMMUNICATION WITH STUDENTS:

- Support of the learning process through the electronic platform e-Class (announcements, information, messages, documents, tasks, questionnaires, exercises, diary, user groups, multimedia, links, scorecard, e-book etc.), and through personal contact with a reception of students in my office for discussion, analysis, and solving problems and exercises, borrowing foreign language books, indicating bibliography, etc.

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester

Lectures	26 hours
Practice Exercises	26 hours
Field work	36 hours
Unguided study	65 hours
Evaluation properation	50 hours
Familiarization of students with instruments - devices - analyzes of water samples	30 hours
Total	**168** hours

STUDENT EVALUATION/GRADING

The evaluation process is conducted in Greek, either with advances in separate parts of the course outline or with a final examination of the course outline and includes:

I. LECTURES (**45%**)
- 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 (**45%**)
- Written exam with Solving Problems

III. FIELD EXERCISES (**10%**)
- Oral examination in the field and with evaluation of deliverables of required Work or Report

SUGGESTED LITERATURE

I. RECOMMENDED-BIBLIOGRAPHY

- 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
- Βουδούρης Σ. Κ., 2015, Εκμετάλλευση και διαχείριση υπόγειου νερού, Εκδόσεις Τζιόλα, ISBN: 978-960-418-469-9
- 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
- Καλλέργης Α. Γ., 1999, Εφαρμοσμένη - Περιβαλλοντική Υδρογεωλογία. Δεύτερη έκδοση, Εκδόσεις ΤΕΕ, Αθήνα, Τόμος Α και Β., 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
- Λέκκας Σ. & Απ. Αλεξόπουλος, 2009: Εισαγωγή στην Υδρογεωλογία. Φοιτητικές σημειώσεις του Παν/μίου Αθηνών
- 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

II. JOURNALS

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

Website:

NA

4.2. SPECIALIZATION: MINERAL RESOURCES – PETROLOGY AND ENVIRONMENTAL MANAGEMENT

4.2.1. LIST OF COURSES

1st SEMESTER

Mandatory Courses		Hours per week	ECTS
ΟΠΠ-Υ01	INSTRUMENTAL ANALYTICAL METHODS	4	7
ΟΠΠ-Υ02	CRYSTAL CHEMISTRY AND MINERAL GENESIS – MINERALS AND MATERIALS SCIENCE	4	7
Μαθήματα Επιλογής – Επιλέγονται 3			
ΟΠΠ-Ε01	MAGMATISM AND GEOTECTONIC ENVIRONMENT	4	8
ΟΠΠ-Ε02	GEOCHEMICAL EXPLORATION METHODS	4	8
ΟΠΠ-Ε03	MINERAL RESOURCES, MINING AND SUSTAINABLE DEVELOPMENT	4	8
ΟΠΠ-Ε04	CONTINENTAL AND MARINE VOLCANISM – ENVIRONMENTAL VOLCANOLOGY	4	8
	Total	**16**	**30**

2nd SEMESTER

Mandatory Courses		Hours per week	ECTS
ΟΠΠ-Υ03	GEOLOGICAL FIELDWORK AND MAPPING	4	7
Elective Courses (two of 8 ECTS/ one of 7 ECTS).			
ΟΠΠ-Ε05	GENESIS – DIAGENESIS OF SEDIMENTARY DEPOSITS	4	8
ΟΠΠ-Ε06	METAMORPHIC PETROGENETIC PROCESSES	4	8
ΟΠΠ-Ε07	WASTE MANAGEMENT*	4	8
ΟΠΠ-Ε08	RESEARCH METHODOLOGY AND SCIENTIFIC WRITING	4	8
ΟΠΠ-Ε09	RISK ASSESSMENT OF POLLUTION	4	7
ΟΠΠ-Ε10	MINERAL GENESIS IN GREECE AND EUROPE – CRITICAL MINERAL RESOURCES IN THE EU	4	7
ΟΠΠ-Ε11	BUILDING STONES AND RAW MATERIALS – GEMOLOGY	4	7
ΟΠΠ-Ε12	METASOMATIC/HYDROTHERMAL ALTERATIONS AND METALLOGENY	4	7
ΟΠΠ-Ε13	LITHOLOGIES OF PETROLEUM SYSTEMS	4	7
	Total	**16**	**30**

3rd SEMESTER

Elective Courses (two of 8 ECTS/ one of 7 ECTS).		Hours per week	ECTS
ΟΠΠ-Ε14	SUSTAINABLE REMEDIATION OF CONTAMINATED LAND AND WATER	4	8
ΟΠΠ-Ε15	ADVANCED TOPICS OF SEDIMENTARY PETROLOGY	4	8
ΟΠΠ-Ε16	ARCAEOMETRIC MINERALOGY AND PETROLOGY	4	8
ΟΠΠ-Ε17	ELEMENTS OF ADVANCED GEOCHEMISTRY	4	7
ΟΠΠ-Ε18	OPHIOLITIC COMPLEXES: FROM GENESIS TO ECONOMIC SIGNIFICANCE	4	7
ΟΠΠ-Ε19	BASIC PRINCIPLES OF GEO-MICROBIOLOGY WITH APPLICATIONS IN MINERAL RESOURCE EXPLORATION AND THE ENVIRONMENT	4	7
ΟΠΠ- Ε20	ENVIRONMENTAL MINERALOGY AND PETROLOGY – MEDICAL GEOLOGY	4	7
ΟΠΠ-Ε21	INDUSTRIAL MINERALS AND CYCLIC ECONOMY	4	8
	Total	**16**	**30**

4th SEMESTER	
Postgraduate Dissertation	30
Total	**30**

4.2.2 OUTLINES

4.2.2.A. MANDATORY COURSES

ΟΠΠ-Υ01 INSTRUMENTAL ANALYSIS METHODS

Instructors: A. Argyraki (Argyraki@geol.uoa.gr); A. Godelitsas; A. Gontikas (Postdoc.).

LEVEL/ SEMESTER: Postgraduate / 1st

TYPE: Specific background, skills development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing, 7 ECTS credits.

Prerequisites NO

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

This obligatory course provides specialized instruction on modern instrumental techniques for chemical and mineralogical analysis of earth materials. The lectures focus on the understanding of working principles of analytical techniques and aims to build the appropriate knowledge background of the students for solving geological problems involving chemical analysis for earth science research and innovative uses of earth materials. The course builds on case studies based on instructors' research data.

At the end of the course the students should be able to:

- Select appropriate analytical methods and techniques for studying the composition of earth materials (e.g. rocks, natural waters, sediments, soils, atmospheric particles).
- Apply methodology for quality control of geochemical analysis.
- Interpret the results of quality control of analyses.
- Take responsibility for planning the sequence of experiments and analytical methods for solving mineralogy/ petrology problems, mineral prospecting and environmental research.

General Competencies

- Search, analysis and synthesis of data and information taking advantage of the use of appropriate technologies
- Decision making
- Independent coursework
- Team coursework
- Development of new scientific ideas
- Respect to the natural environment
- Promotion of free and creative thinking

CONTENT:

A. Lectures

The course articulates in two parts. The first part examines instrumental techniques for bulk chemical analysis and the second part focuses on spot analysis techniques for earth materials. The working principles and analytical capabilities and characteristics of destructive and non-destructive techniques are examined. Sampling methodology, sample preparation for analysis and quality control of analytical results.

B. Practical exercises

Practicals are based on available analytical techniques of the Department. Case studies for selecting analytical techniques based on fitness-for-purpose. Practice on estimation of measurement uncertainty from sampling and analysis.

TEACHING METHODS

- Live lectures supported also by material in e-class
- Treatment of data by using appropriate software installed on student's computer
- Laboratory classes- demonstration of analytical techniques

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Lecturing:

- Presentations ppt of the course lectures as well as relative bibliographic material are found in the website of the course at the e-class platform.

In the Communication with Students:

- The e-class platform provides opportunities of direct communication with the students, submission of coursework and exercises, etc.

BREAKDOWN OF WORKLOAD

Activity	Φόρτος Εργασίας Εξαμήνου
Lectures and computer lab exercises	4h x 10w = 40h
Homework- literature study	100h
Student oral presentations for assessment	2h x 3w = 60h
Total	**200** hours

STUDENT EVALUATION/GRADING

Students are examined in Greek or English language. The final assessment involves a series of requirements including:

I. Oral presentations
- Relevant topic of instrumental analytical techniques (35%)

II. Term paper
- Focused on treatments and interpretation of geochemical data (35%)

III. Questions and exercises
- Questions and problems after each lecture (30%)

SUGGESTED LITERATURE

- Modern Analytical Geochemistry: An Introduction to Quantitative Chemical Analysis Techniques for Earth, Environmental and Materials Scientists 1st Edition
- Robin Gill Routledge Published May 28, 1997 Textbook - 342 Pages ISBN 9780582099449

Journals:

- Geostandards and Geoanalytical Research, Wiley
- Analyst, Royal Society of Chemistry
- Journal of Radioanalytical and Nuclear Chemistry, Springer

WEB PAGE:

http://eclass.uoa.gr/courses/GEOL451

ΟΠΠ-Υ02 CRYSTAL CHEMISTRY AND MINERAL GENESIS – MINERALS AND MATERIALS SCIENCE

Instructors: P. Voudouris (pvoudouris@geol.uoa.gr); A. Godelitsas.

LEVEL/ SEMESTER: 7 / 1st

TYPE: Specialist background, general knowledge skills and skills development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 7 ECTS credits.

Prerequisites Prerequisite knowledge refer to undergraduate courses of Chemistry, Physics, Mineralogy and Ge-ochemistry

Language: Greek - English

Course offered to Erasmus+ students: YES

LEARNING OUTCOMES

Learning Outcomes

The course is based on the description of the structure and the chemical composi-tion of minerals and the consideration of their genetic conditions. Upon successful completion of the course the student will be able to: acquire the ability to under-stand the structure and the chemical composition of minerals, to gain basic knowledge and skills for studying crystalline and amorphous geological materials, as well as mineral surfaces and interfaces, using X-ray, advanced microscopic and sur-face analysis techniques. Introduction to nano-geoscience and nano-mineralogy. Finally, to acquire the basic knowledge in distinguishing and understanding the rock-forming and secondary minerals, emphasizing on sulfides, oxides, sulfosalts and their genetic conditions.

General competences

The general competencies that students should have in mind are the following:

- Promotion of free, creative thinking and inductive reasoning
- Search, analyze and synthesize data and information, using the necessary technolo-gies.
- Autonomous work.
- Teamwork.
- Problem solving ability.
- Decision-making.
- Promote free, creative and inductive thinking.
- Respect for the natural environment.

CONTENT:

Crystal Lattices-Pauling's rules-deficiencies/impurities-solid solutions-twinning in various scales-polymorphs. Nucleation/crystal growth-intergrowth-epitaxis-dissolution of minerals. Characterization of minerals using X-rays diffraction/ fluorescence/absorption fine structure (XRD, XRF, XAFS) and advanced microscopic techniques (TEM, STEM-HAADF, EELS)- study of amorphous geological materials. Study of crystal faces & dissolution/crystallization reactions in interfaces using ex-situ & in-situ AFM and surface analyses techniques (XPS, RBS, NRA). Mi-

cro-/nano-porous minerals (zeolites, clays, Mn/Fe-oxides). Mineral nanoparticles /nano-minerals, Nanogeoscience. Formation of rock-forming and metallic minerals. Structural and chemical characteristics of silicate and non-silicate minerals. Secondary minerals, Sulfides, Sulfosalts, Tellurides. Phase stability diagrams.

TEACHING METHODS

- Face-to-face lectures
- Practical exercises using samples of minerals and rocks, optical microscopes, electron microscopy and X-ray diffractometry

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

TEACHING:

- Presentations with multimedia content (images, animation, video).

Communication with Students:

- Support for learning through the digital e-class platform (announcements, information, messages, notes, presentations, tasks).

BREAKDOWN OF WORKLOAD

Activity	Φόρτος Εργασίας Εξαμήνου
Lectures	40 h
Practical exercises	12 h
Field trip	8 h
Study and analysis of literature	30 h
Writing essays	40 h
Preparation of students for evaluation	30 h
Total	**160** hours

STUDENT EVALUATION/GRADING

The student evaluation includes written essay on a subject suggested by the teachers in co-operation with the trainees and an oral exam with a presentation of the essay at powerpoint.

The final grade is the sum of the grade of the written essay and the score of the presentation. The weight will be

- **60%** for the oral presentation and,
- **40%** for the written essay.

SUGGESTED LITERATURE

- https://pubs.geoscienceworld.org/msa/ammin/article/101/5/1036/40668/a-century-of-mineral-structures-how-well-do-we
- https://pubs.acs.org/doi/abs/10.1021/es020238i
- https://www.nature.com/articles/s41586-018-0334-5
- http://science.sciencemag.org/content/322/5909/1802
- https://www.nature.com/articles/ncomms11177
- http://advances.sciencemag.org/content/2/8/e1600621
- https://www.sciencedirect.com/journal/ore-geology-reviews/vol/42/issue/1
- http://science.sciencemag.org/content/319/5870/1631.long
- https://pubs.geoscienceworld.org/msa/elements/article-abstract/4/6/373/137787/nanogeoscience-from-origins-to-cutting-edge?redirectedFrom=fulltext
- https://www.ingentaconnect.com/content/asp/asl/2017/00000023/00000006/art00197;jsessionid=cb0fxlnvuhfr.x-ic-live-03
- http://repositorio.uchile.cl/bitstream/handle/2250/133488/The-rapid-expansion-of-environmental-mineralogy-in-unconventional-ways.pdf?sequence=1
- https://www.nature.com/articles/35009091
- https://www.sciencedirect.com/science/article/pii/S0169131718302709
- https://www.sciencedirect.com/science/article/pii/S0169136816305091
- https://www.mdpi.com/2075-163X/3/2/165/htm
- https://link.springer.com/article/10.1007/s00710-011-0160-z
- https://www.mdpi.com/2075-163X/9/1/49

WEB PAGE:

NOT AVAILABLE

ΟΠΠ-Υ03 GEOLOGICAL FIELDWORK AND MAPPING

Instructors: H. Vasilatos (vasilatos@geol.uoa.gr); S. Kilias; A. Argyraki; E. Kelepertzis; P. Voudouris; M. Kati; P. Pomonis; A. Godelitsas; D. Kostopoulos; E. Skourtsos; E. Moustaka; Z. Kypritidou.

LEVEL/ SEMESTER: 7 / 2nd

TYPE: Επιστημονικής Περιοχής, Γενικού υποβάθρου, Ανάπτυξης δεξιοτήτων

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing, 7 ECTS credits.

Prerequisites NO

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

Fieldwork is a vital part of an Earth scientist's training. Our field courses are designed to provide a wide range of practical exercises and field experience in petrology, ore geology and environmental management: observing, measuring, recording, mapping, and problem-solving. Students complete up to 15 days of field training throughout the course, in addition to their 4-6 week independent mapping project in the 2nd semester.

General abilities

- Read, interpret and locate data and information on topographic maps
- Identify rocks and minerals in the field
- Obtain pertinent geologic data from bedrock exposures in the field
- Compile and organize field data from a variety of rock and ore types
- Produce complete geologic maps from field data
- Read and interpret geologic maps from any source
- Construct standard geologic cross sections from any map
- Apply simple trigonometric functions to solve unit thickness and slope/dip issues
- Use computer drafting programs to produce diagrams.
- Write a report using field data in technical format
- Learn standard technical writing style
- Learn to separate observation from interpretation in writing and discussion

CONTENT:

A. Lectures

Introductory lectures by instructors before going to the field on geologic field methods, the collection and recording of data in the field in a variety of geologic terrains; preparation of a geologic map and technical reports based on individual fieldwork.

B. Field exercise:

Sampling and mapping exercise at appropriately selected, relatively accessible sites.

TEACHING METHODS

- Face-to-face lecturing
- Field demonstrations of map use and filed data collection
- On site demonstrations of fieldwork

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

Communication with Students:

- The e-CLASS platform provides direct communication with the students, submission of coursework and exercises.

BREAKDOWN OF WORKLOAD

Activity	Φόρτος Εργασίας Εξαμήνου
Fieldwork demonstration	8h x 2w = 16h
Preparatory lectures	4h x 2w = 8h
Student fieldwork	70h
Student preparation for the evaluation	80h
Total	**174** hours

STUDENT EVALUATION/GRADING

The language evaluation is Greek. The final grade is modulated as follows:

I. Oral presentation

- Oral presentation of field observations and measurements

II. Coursework

- Delivery of digital map and report

SUGGESTED LITERATURE

I. Recommended textbooks

- ENNISON, 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., WileyBlackwell.
- 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., WileyBlackwell.
- 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.
- ΦΤΑΟΟΥ Ξ., 2011, Γεωλογικζσ χαρτογραφιςεισ – Γεωλογικοί χάρτεσ και τομζσ, 306ςελ., University Studio Press.
- TUCKER, E. M., 2011, Sedimentary Rocks in the Field: A Practical Guide (Geological Field Guide), 275p., WileyBlackwell.

II. Relevant Journals

- Journal of Maps, Editor-in-Chief: Dr Mike Smith, Taylor & Francis Group.

WEB PAGE:

NA

4.2.2.B. ELECTIVE COURSES

ΟΠΠ-Ε01 MAGMATISM AND GEOTECTONIC ENVIRONMENT

Instructors: P. Pomonis (ppomonis@geol.uoa.gr); D. Kostopoulos; Ch. Stouraiti.

LEVEL/ SEMESTER: 7 / 1st

TYPE: Specialist background, general knowledge skills and skills development

LECTURES AND PRACTICAL EXERCISES
4 hours of lecturing, 8 ECTS credits.

Prerequisites NO

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The course deals with the magmatic processes associated with the various geotectonic environments and in particular with the provision of knowledge focused on geological, petrological and geochemical processes related with the formation of magmas and magmatic rocks on a global scale. Upon success-ful completion of the course, the student will be able to:

- Know the processes of partial melting of the mantle, the types of primary magmas and the magmatic sources.
- Understand the role of differentiation of magmas in different geotectonic environments.
- Know the evolution of magmatic activity in geological time.
- Understand the magmatic processes of the geotectonic environments related with subduction zones.
- Be aware of the processes of formation of granitoids on continental margins and collision systems.
- Understand the magmatic processes in within plates as well as in layered and alkaline complexes
- To know the methods of modeling the magmatic processes.
- To know the igneous provinces of Greece.
- Understand and apply field research methods related to the study of igneous rocks.

General Competencies

- Search, analyze and synthesize data and information, using the necessary technologies.
- Autonomous work.
- Teamwork.
- Problem solving ability.
- Decision-making.
- Promote free, creative and inductive thinking.
- Respect for the natural environment.

CONTENT:

Petrotectonic associations (e.g. Mid-Ocean ridge, Subduction, Mantle Plumes, Layered Intrusions, alkali complexes). Oceanic core complexes. Exhumation of mantle rocks and subsequent sedimentary rock deposits in ophiolitic complexes - ophicalcites. Phase Diagrams, Thermodynamics of magmas, Petrological reactions, magmatic components, exsolution of volatile magma components, unmixing of magmas, geothermobarometry of magmatic systems, heat transfer to magmas and rocks. Igneous provinces of Greece. Case studies of igneous rocks in Greece, e.g. Rhodope, Central Macedonia, Continental Greece, Aegean, Cyclades, Crete.

TEACHING METHODS:

- Face-to-face lectures
- Practical exercises using samples of minerals and rocks, optical microscopes, electron microscopy and X-ray diffractometry

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Teaching:
- Presentations with multimedia content (images, animation, video).

In Student Communication:
- Support for learning through the digital e-class platform (announcements, information, messages, notes, presenta-tions, tasks).

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	40
Practical exercises	12
Study visits	20
Study and analysis of literature	78
Writing essays	39
Preparation of students for evaluation	26
Total	**215** hours

STUDENT EVALUATION/GRADING

The student evaluation includes written essay on a subject suggested by the teachers in co-operation with the trainees and an oral exam with a presentation of the essay at PowerPoint. The final grade is the sum of the grade of the written essay and the score of the presentation.

The weight will be 60% for the oral presentation and 40% for the written essay.

SUGGESTED LITERATURE

- Best, M.G. (2002): Igneous and Metamorphic Petrology (2nd Edition), p. 752.
- Philpotts, A. & Ague, J.J. (2009): Principles of Igneous and Metamorphic Pe-trology (2nd Edition), p. 684.
- Wilson, B.M. (1989): Igneous Petrogenesis A Global Tectonic Approach., Springer Science & Business Media, p. 466.
- Winter, J.D. (2009): Principles of Igneous and Metamorphic Petrology (2nd Edition), p. 720.

WEB PAGE:

https://eclass.uoa.gr/courses/GEOL379/

ΟΠΠ-Ε02 GEOCHEMICAL EXPLORATION METHODS

Instructors: A. Argyraki (argyraki@geol.uoa.gr)

LEVEL/ SEMESTER: 7 / 1st

TYPE: Specific background, skills development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing, 8 ECTS credits.

Prerequisites: NO

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

This course focuses on cutting edge methodology for separation of geochemical anomalies linked either to the presence of underground ore deposits or environmental pollution sources.

By successfully completing the course, students will be capable of:

- Applying appropriate statistical methods for the interpretation of geochemical data aiming to describe the geochemical patterns in areas of interest.
- Identifying the factors affecting the geochemical background in study areas and distinguish significant from insignificant geochemical anomalies.
- Applying appropriate geostatistical methods for geochemical mapping in various spatial scales.
- Undertaking responsibility for the strategic planning of geochemical surveys for mineral exploration and environmental research.

General Competencies

- Search, analysis and synthesis of data and information taking advantage of the use of appropriate technologies
- Decision making
- Independent coursework
- Team coursework
- Development of new scientific ideas
- Respect to the natural environment
- Promotion of free and creative thinking

CONTENT:

Principles of applied geochemistry foe detection of anomalies linked to covered ore deposits or pollution sources. Primary and secondary dispersion patterns of chemical elements in geological media. Statistical treatment of geochemical data-estimation of geochemical background concentrations and detection of significant geochemical anomalies. Geochemical mapping from local to global scales. The course includes practical exercises based on computer software use and literature data.

TEACHING METHODS:

- Live lectures supported also by material in e-class
- Treatment of data by using appropriate software installed on student's computer

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Teaching:

- Presentations ppt of the course lectures as well as relative bibliographic material are found in the website of the course at the e-class platform.

In Student Communication:

- The e-class platform provides opportunities of direct communication with the students, submission of coursework and exercises, etc.

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures and computer lab exercises	40(4x10)
Homework- literature study	100
Student oral presentations for assessment	60(2x3)
Total	**200** hours

STUDENT EVALUATION/GRADING

Students are examined in Greek or English language. The final assessment involves a series of requirements including:

I. Oral presentations

- Relevant topic of geochemical anomalies (35%)

II. Term paper

- Focused on treatments and interpretation of geochemical data (35%)

III. Questions and exercises

- Questions and problems after each lecture (30%)

SUGGESTED LITERATURE

Textbooks:

- Handbook of Exploration and Environmental Geochemistry. Geochemical Anomaly and Mineral Prospectivity Mapping in GIS. Edited by Emmanuel John M. Carranza. Volume 11, Pages III-VIII, 3-351 (2009) ISBN: 978-0-444-51325-0 ISSN: 1874-2734

Journals:

- Journal of Geochemical Exploration, Elsevier
- Applied Geochemistry, Elsevier
- Geochemistry: Exploration Environment Analysis, Geoscience World

WEB PAGE:

https://eclass.uoa.gr/courses/GEOL452

ΟΠΠ-Ε03 MINERAL RESOURCES, MINING AND SUSTAINABLE DEVELOPMENT

Instructors: S. Killias (kilias@geol.uoa.gr); H. Vasilatos.

LEVEL/ SEMESTER: 7 / 1st

TYPE: Special background, skill development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing, 8 ECTS credits.

Prerequisites Though not typically compulsory prerequisites, adequate basic knowledge from Geology, Chemistry, Biology, Physics, Ecology, and Finance, are considered assets for successful enrollment.

Language: Greek

Course offered to Erasmus+ students: Yes in English. ERASMUS+ agreement between Stockholm University and the National and Kapodistrian University of Athens is in effect. Contact: Professor Stephanos Kilias (tel.: +30-210-7274211; kilias@geol.uoa.gr).

LEARNING OUTCOMES

Learning Outcomes

This course aims to highlight, and teach the students, recent interdisciplinary concepts, and, geoenvironmental and socioeconomic strategies, for sustainably exploiting mineral resources. Emphasis is given to: (i) the basic principles mineral deposit genesis and exploration on land and the modern seafloor; (ii) the geoenvironmental models of mineral deposits that integrate all the data from a mining project, from exploration to post-mining; (iii) the institutional, technological and socioeconomic framework, of mineral exploration, mining and environmental protection, in the European Union, and Greece, and, (iv) principles of educating the future "resource geologist", and, (v) societal issues related to exploration operations, mine opening and closure, site rehabilitation, impact mitigation and long-term monitoring. Laboratory work introduces ore study in reflected light microscopy, and applications to ore genesis, geoenviromental models and metal beneficiation and extraction.

On successful completion of this module, and in relation to the relevant study fields/subjects outlined below students will have:

- Advanced modern scientific ***knowledge*** and research methodologies, involving a critical understanding of theories and principles, as the basis for original thinking and/or research.
- Advanced ***skills***, demonstrating mastery and innovation, required to solve complex, and integrate knowledge from different fields. Also, necessary learning skills in order to continue studying to a doctoral level.
- The ***ability*** to efficiently and clearly communicate advanced and highly specialized knowledge and concepts, and review and develop performance of self and others.

Outline of fields of study:

- Future global mineral resources (ores, industrial minerals, building stones and aggregates) and sustainable development.
- Critical metals in strategic energy technologies.

- Formation and exploration for mining resources from the deep seafloor.
- Introduction to geoenvironmental models of mineral deposits and the "Life Cycle Assessment (LCA)" approach.
- The institutional, technological and socioeconomic framework, of mineral exploration, mining and environmental protection, in the European Union, and Greece.

General Competencies

- Research, analysis and synthesis of data and information using appropriate technologies.
- Autonomous work
- Team work
- Decision making
- Formulation of new research ideas
- Respect for natural environment

CONTENT:

A. Lectures

- Future global mineral resources— Metals and Minerals, now and in the future (new technologies, the energy revolution and the future availability of mineral resources).
- An interdisciplinary approach to the environmental geology and geochemistry of mineral deposits—Geoenvironmental models of mineral deposit—Mobility, bioavilability, and human toxicity of metals.
- Should we mine mineral resources from the deep seafloor? benefits, costs, and uncertainties.
- Environment friendly sourcing of Critical Metals in the EU and basic principles of exploration on land and the seafloor.
- Mineral Exploration: Geological and geographical factors affecting deposit prospectivity, Exploration techniques, process, and budget, Discovery strategy and success, Methods of economic assessment of mineral resources, Future for discovery.
- Mineral resources in the EU—Raw materials initiative, Critical metals, EuroGeoSurveys-The Geological Surveys of Europe (EGS), Sustainable Mining, Horizon 2020, Blue Mining: breakthrough solutions for sustainable deep sea mining, X-MINE Project {Real-time mineral X-Ray analysis for efficient and sustainable mining}.
- Institutional and legal framework for mineral resources in Greece—Mineral wealth of Greece, National policy for mineral resources, Greek mining code.
- Industrial minerals and environmental friendly uses:
- Raw materials used in pozzolanic cements –Benefits and drawbacks of pozzolanas
- The role of major and trace elements of cement raw materials in the quality assurance of cementitious compounds [Hg, Tl, Cr, Mg, K+Na]
- Environmentally friendly fire retardants [magnesium and aluminum compounds]
- Industrial absorbents for oil spills, olive oil mill wastes, contaminated lands
- Raw materials used in insulation and refractories
- Asbestos.

B. Laboratories:

Identify ore minerals and interpret ore textures and alteration assemblages under a microscope in reflected and transmitted light. Applications to ore genesis, geoenviromental models and metal beneficiation and extraction.

C. Field exercises and visits

Operating mines, extraction and beneficiation facilities and mine rehabilitation sites.

TEACHING METHODS:

- Oral lectures
- Laboratory work introduces ore study in reflected light microscopy.
- Educational and training visits to active mining, ore beneficiation, and environmental rehabilitation sites.

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

- Slide presentation software PowerPoint is integral to lecturing. PowerPoint lecture presentations, reading lists and relevant bibliography are uploaded in "E-class", i.e. a National and Kapodistrian University of Athens (NKUA) integrated management system for electronic courses. Electronic submission of student course work, term papers etc. via e-class.

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lecture	36 (4x9)
Laboratory work	16 (4x4)
Assessment preparation and completion (Literature review)	50
Field exercise / Educational visits	40
Assessment preparation and completion [Oral presentation (including preparation)]	20
Assessment preparation and completion [Project (Essay)]	60
Directed research and reading (Writing up of lecture notes)	10
Total	**232** hours

STUDENT EVALUATION/GRADING

I. ***Written assignments.*** Formulation of the geoenvironmental model of a Greek epithermal Cu-Au-Te deposit, and proposals for environmental friendly metal extraction methods (1500-2000 words; weight: 40% of total grade).

II. ***20' Oral presentation***. Linked to (I); weight: 25% of total.

III. ***Report(s)***, regarding the benefits from visiting active mining and ore beneficiation facilities, and environmental rehabilitation sites; Weight: 35% of final grade.

SUGGESTED LITERATURE

- Revuelta, M.B., 2017. Mineral Resources: From Exploration to Sustainability Assessment. Springer.
- Plumlee, G.S., 1999, The environmental geology of mineral deposits, in Plumlee, G.S., and Logsdon, M.J., eds., The Environmental Geochemistry of Mineral Deposits-Part A; Processes, methods, and health issues: Society of Economic Geologists-Reviews in Economic Geology, Volume 6A.

Journals:

- Economic Geology, Elsevier
- Mineralium Deposita, Springer
- Journal of Geochemical Exploration, Elsevier

WEB PAGE:

http://eclass.uoa.gr/courses/GEOL455

ΟΠΠ-Ε04 CONTINENTAL AND MARINE VOLCANISM – ENVIRONMENTAL VOLCANOLOGY

Instructors: P. Pomonis (ppomonis@geol.uoa.gr).

LEVEL/ SEMESTER: 7 / 1st

TYPE: Specific background, skills development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing, 8 ECTS credits.

Prerequisites Mineralogy, Petrology, Volcanology

Language: Greek

Course offered to Erasmus+ students: Yes in English.

LEARNING OUTCOMES

Learning Outcomes

The course provides a comprehensive overview of the processes that control when and how volcanoes erupt. Understanding these processes involves bringing together ideas from a number of disciplines, including branches of geology, such as petrology and geochemistry; and aspects of physics, such as fluid dynamics and thermodynamics. explains in accessible terms how different areas of science have been combined to reach our current level of knowledge of volcanic systems. It includes an introduction to eruption types, an outline of the development of physical volcanology, a comprehensive overview of subsurface processes, eruption mechanisms, the nature of volcanic eruptions and their products, and a review of how volcanoes affect the environment.

Upon successful completion of the course the student gains the following

- grasp of volcanological topics that refer to the dynamics of volcanic eruptions and their relationship with the geo-environment.
- knowledge of specialized concepts related to natural volcanism and intense volcanic paroxysmal phases that lead to dynamic explosions in aerial and marine environments.
- to have clear knowledge of the action mechanism for assessing the degree of volcanic hazards with the aim of taking the necessary precautionary measures.
- to acquire the ability to manage emergencies and crises with the aim of minimizing the impact on people and the environment.

General Competencies

- Search, analysis and synthesis of volcanic data and information
- Making decisions
- Independent coursework

CONTENT:

A. Lectures

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

1. Volcanic systems: classification of volcanoes based on the geotectonic characteristics of volcanoes and their petrographic features, types of volcanic eruptions.

2. Post-volcanic phenomena - description of volcanic products (steams, fumaroles, solfataras and thermometallic springs), types of volcanic products - Morphological characteristics of lavas, pyroclastic products (classification, transport and deposition).
3. Planetary volcanism: volcanism on other planets. Cryovolcanism and comparative study with terrestrial volcanism.
4. Volcanism and Ecology: reference to the relationship with human, culture and the environment.
5. Volcanic hazards: examples of volcanic areas and the degree of volcanic risk. Ways to manage and deal with any form of volcanic risk.
6. Volcanoes as a source of energy: the areas of geothermal interest, the way they are created and the degree of their exploitation.

B. Laboratory exercises:

Laboratory exercises include use of special computer simulation programs, Macroscopic and microscopic examination exercises using polarized light optical microscope, electron microscope and/or microprobe-analysis system.

C. Fieldwork:

Fieldwork in volcanic areas (e.g. Sousaki, Methana)

TEACHING METHODS:

- Face-to-face lecturing
- Practical exercises and treatment of data with the use of computing software

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

Communication with Students:

- The e-class platform provides opportunities of direct communication with the students, submission of coursework and exercises, etc.

BREAKDOWN OF WORKLOAD

BREAKDOWN OF WORKLOAD

Activity	Φόρτος Εργασίας Εξαμήνου
Lectures and exercises of data treatment	4h x 9w = 36h
Laboratory exercises	4h x 4w = 16h
Homework	90h
Field excursion	20h
Student preparation for the evaluation	50h
Total	**212** hours

STUDENT EVALUATION/GRADING

The language evaluation is Greek. The final grade is modulated as follows:

I. ***20' Oral presentation***. Students choose a topic for a Public Presentation (ppt) from a pool of topics related to one of the thematic units, developed within the Course (see (3) COURSE CONTENT) (**40% of the final grade**).

II. ***Written Written examination of the laboratory with:*** a) Short development questions to evaluate the students' critical thinking in the methodologies and practices practiced, b) Problems to evaluate their skills in the analysis and synthesis of data and information and c) Exercises to evaluate their abilities in inductive thinking and the application of the knowledge acquired to solve research problems (**40% of the final grade**).

III. ***Reports:*** report regarding the exercises done in the fieldwork (**20% of the final grade**).

SUGGESTED LITERATURE

Recommended textbook

- Fundamentals of Physical Volcanology by Liz Parfitt, Lionel Wilson (ISBN-13: 9781444307566
- ISBN-10: 0632054549).

WEB PAGE:

http://eclass.uoa.gr/courses/GEOL555

ΟΠΠ-Ε05 GENESIS-DIAGENESIS OF SEDIMENTARY DEPOSITS

Instructors: M. Kati (kati@geol.uoa.gr); I. Megremi.

LEVEL/ SEMESTER: 7 / 2nd

TYPE: General background, General knowledge specialization, Skill development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, practical and Laboratory exercises, field exercise, 8 ECTS credits.

Prerequisites: ΟΠΠ-Ε01 και ΟΠΠ-Ε04

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The course focuses on advanced topics of petrogenesis of sedimentary deposits with emphasis on their origin, genetic mechanisms, depositional systems and diagenetic modifications in space and time. On successful completion of the course the student will be able to:

- Interpret the depositional processes and environments through the study of their composition, textures and structures.
- Comprehend the tectonic setting of the sedimentary basins in which sedimentary deposits have formed.
- Interpret sedimentary successions through facies analysis, facies associations and facies models.
- Comprehend the role of climate, eustasy and tectonics in the development of sedimentary facies.
- Interpret the diagenetic environments in which the various post-depositional changes have ta-ken place through the study of the products of the related diagenetic processes.
- Construct paragenetic sequences and draw conclusions on the evolution of porosity.
- Combine and evaluate the depositional and diagenetic characteristics of the sedimentary rocks in the exploration and exploitation of mineral resources and ores, in industrial applications and also in paleogeographic, paleoclimatic and archaeometric studies.
- Apply mineralogical, petrographic and geochemical methods and techniques that are widely used in the research and uses of the sedimentary rocks.

General Competencies

- Research, analysis and synthesis of data and information, using the necessary technologies.
- Design and project management.
- Independent work.
- Teamwork.
- Work in inter-disciplinary environment.
- Decision-making.
- Promotion of free, creative and inductive thinking.
- Respect for the natural environment.

CONTENT:

A. Lectures

The lectures of the course include the follow topics:

- Origin and genetic factors and processes of the sedimentary deposits.
- Sedimentary basins and their main rock types.
- Siliciclastic and carbonate depositional systems.
- Interpretation of sedimentary successions – Facies analysis, Facies models.
- Clastic, biological and chemical facies models.
- Diagenetic stages and realms.
- Diagenetic sequences and patterns.
- Evolution of porosity.
- Geochemical research and diagenesis.
- Distribution of the main sedimentary deposits and formations in the Hellenides and their uses.

B. Practical and Laboratory Exercises

Part A: Methodology and application of the petrographic analysis in the interpretation of the depositional and diagenetic features of the sedimentary rocks.

Part B: Methodology and application of laboratory techniques that are widely used in the research of sedimentary rocks.

C. Field Exercise

Practice in facies analysis and construction of graphic logs and columns of sedimentary successions. Methodology of the sedimentary facies mapping.

TEACHING METHODS:

- Face-to-face lectures.
- Face-to-face practical and laboratory exercises using samples of sediments and sedimentary rocks, optical microscopes, X-ray diffractometer and other specialized instruments and materials
- Face-to-face practical exercises in the field exercise.

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

• In Teaching:
- PowerPoint presentations, videos with relevant content.

• In Student Communication:
- Support for learning through the digital e-class platform of the NKUA (announcements, information, messages, notes, tasks)

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	52 (4h x 13 w)
Practical and Laboratory Exercises	30 (3h x 10 w)
Individual training tasks	40
Field Exercise	12
Preparation of students for evaluation	60
Total	**194** hours

STUDENT EVALUATION/GRADING

The evaluation process is conducted in Greek or English (for foreign students or students of Erasmus Programme). The final grade of the course is based on exams that include an oral presentation and a written essay on a subject suggested by the

instructors in cooperation with the trainees, and with the following severity:

- Oral presentation (**60% of the final grade**)
- Written essay (**40% of the final grade**)

SUGGESTED LITERATURE

- 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 University Press, Cambridge, 600 p.
- Burley, S. & Worden, R. (2003). Sandstone Diagenesis: Recent and Ancient. Reprint Series of the IAS, Vol. 4, Blackwell Publishing, 649 p.
- Catuneanu, O. (2006). Principles of Sequence stratigraphy. Elsevier, 375 p.
- Coe, A. (2003). The sedimentary Record of Sea-Level Change. Cambridge University Press, 279 p.
- Einsele, G. (2000). Sedimentary Basins (2nd edition). Springer, 792 p.
- James, N.P. & Dalrymple, R.W. (2010). Facies Models 4. GEOtext 6, Geological Association of Canada, 586 p.
- James, N.P. & Jones, B. (2016). The origin of carbonate sedimentary rocks. John Wiley and Sons Ltd, UK, 446 p.
- Mackenzie, F.T. (2005). Sediments, Diagenesis, and Sedimentary Rocks. Treatise on Geochemistry, Vol. 7, Elsevier, 425 p.
- MacIlreath, I.A. & Morrow D.W. (1990). Diagenesis. Geoscience Canada Reprint series vol. 4, 338 p.
- Morad, S., Ketzer, J.M. & De Ros, L.F. (2012). Linking Diagenesis to Sequence Stratigraphy. Special Publication of the IAS, no 45, Wiley-Blackwell, 522 p.
- Scholle, P.A. & Umber-Scholle, D.S. (2003). A color guide to the Petrography of Carbonate Rocks. Memoir 77, American Association of Petroleum Geologists, Tulsa, OK., 474 p.
- Tucker, M.E. (2001). Sedimentary Petrology (3rd edition). Blackwell Science, 262 p.
- Tucker, M.E. (2011). Sedimentary Rocks in the field (4th edition). Wiley & Sons Ltd, 275 p.
- Umber-Scholle, D.S., Scholle, P.A., Schieber J. & Raine R. (2014). A color guide to the Petrography of Sandstones, Siltstones, Shales and Associated Rocks. Memoir 109, American Association of Petroleum Geologists, Tulsa, OK., 526 p.

WEB PAGE:

http://eclass.uoa.gr/courses/GEOL460

ΟΠΠ-Ε06 METAMORPHIC PETROGENETIC PROCESSES

Instructors: D. Kostopoulos (dkostop@geol.uoa.gr); E. Moustaka

LEVEL/ SEMESTER: 7 / 2nd

TYPE: Specific background, specialisation of general knowledge and skill development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, practical and laboratory work, 8 ECTS credits.

Prerequisites Typically none. However, to be able to attend the course, the students should have a decent background on undergraduate-level mineralogy, petrology, mathematics, physics and chemistry. Good knowledge of Microsoft Excel is considered a must.

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The course offers advanced knowledge in the field of metamorphic rocks which, mantle included, make up 99.5% of the Earth. It requires a solid background in mineralogy, petrology, mathematics, physics and chemistry, since it deals particularly with problems whose solution requires the use of thermodynamics. During the course, the physicochemical processes that cause mineralogical transformations within the Earth are studied as a function of temperature, pressure, time and deformation. This provides fundamental insight on the composition of the lithospheric mantle beneath continents and oceans, the state of mantle oxidation beneath mid-ocean ridges and island arcs, the mineralogical transformations that take place in oceanic crust at subduction zones and on how these transformations can affect magma generation, seismicity and the velocity of seismic waves. It also sheds ample light on phase changes in continental crust at collision zones in time and space, on the transport of water and carbon dioxide in the deep interior of the Earth and their back-release to the atmosphere influencing climate, and on diamond formation (where and how). It additionally stresses the contribution of metamorphic processes to the generation of abiotic hydrocarbons and proteins at great depths in the oceans and the origin of life on Earth.

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

- Describe clearly the mechanisms of mineral transformations within the Earth when physicochemical conditions change.
- Evaluate the effects of the reactions occurring in rocks on the rheology of crust and mantle, magmatism, climate and seismicity.
- Accurately calculate the temperature and pressure conditions recorded by the rocks during their journey inside or at the surface of the Earth, as well as the times required for thermo-tectonic events to occur on both the macro- (e.g., sub-

duction and collision zones) and micro-scale (e.g., chemical zoning in minerals).
- Combine physicochemical information from minerals and suggest the spatio-temporal evolution of the rocks that contain them, support the possibility of recycling light elements and volatiles via oceanic subduction zones, reconcile the concepts of metamorphism, seismicity and magmatism, provide clear documentation of their arguments, revise holding opinions and produce new knowledge.
- Assess the contribution of physicochemical processes occurring in oceanic mantle rocks to the creation of life on the planet.

General Competencies

- Search, analyse and synthesise data and information, using the necessary technologies
- Decision making
- Autonomous work
- Teamwork
- Ability to apply knowledge to problem solving
- Promote free, creative and inductive thinking
- Respect for the natural environment

CONTENT:

A. Lectures

The content of the lectures is separated into four thematic modules:

1. HEAT FLOW ON EARTH (Heat and heat sources, heat generation and heat transfer mechanisms, heat flow, heat state of crust, mantle and core, continental and oceanic geotherms, mantle adiabat, mineral stratification of the upper mantle, thermal regime of continental collision and thermal evolution of thickened crust. Lithostatic pressure, thermodynamic pressure and tectonic overpressure, spatial distribution of pressure and temperature in crustal-scale shear zones, geotectonic environments and geothermal gradients.
2. INTRACRYSTALLINE ION DIFFUSION, CLOSURE TEMPERATURE AND OROGEN COOLING (Fick's laws, diffusivity, concentration gradients, diffusivity hierarchy in metamorphic minerals, the effect of mineral chemical composition and oxygen fugacity on diffusivity. Chemical zonation and elemental mineral maps, evaluation of the potential use of minerals as chronometers and trace-element thermometers. Closure temperature, mineral geometry effect on diffusion and cooling rate of orogens).
3. OCEANIC SUBDUCTION ZONES Young/old lithosphere, fast/slow subduction, dry/dump/wet rheology, spatial distribution of isotherms, global water flux at subduction zones, metamorphic facies and assemblages in dry/hydrated/ enriched/depleted mantle peridotite, in hydrothermally-altered volcanic rocks, in clay-rich/silica-rich/carbonate-rich sediments. Dehydration reactions and melting, metamorphism and electrical conductivity in the wedge wedge, spatial distribution of metamorphic facies, mineral density and seismic wave velocities).
4. THERMODYNAMIC APPLICATIONS IN PETROLOGY (Laws of thermodynamics, enthalpy, entropy, heat capacity, compressibility, expansivity, chemical potential, Gibbs and Helmholtz free energy, equations of state. Clausius-Clapeyron equation, excess free energy of mixing, thermodynamic mineral models, equilibrium constant, water phase diagram, density and relative dielectric constant of water at geological conditions, metamorphic reactions as geological thermometers and barometers).

B. Practicals

The content of the practicals is separated into three thematic modules:

PART A': Exercises on heat flow in the crust and mantle. Calculation of radiogenic heat production and content of radioactive isotopes in the crust and mantle. Calculation of the mantle adiabat. Calculation of oceanic geotherm. Calculation of steady-state continental geotherm as a function of surface heat flow.

PART B': Exercises on intracrystalline ion diffusion and closure temperature. Effect of mineral geometry, chemical composition, oxygen fugacity and cooling rate. Calculation of chemical zoning in minerals and investigation of the suitability of minerals as chronometers and thermometers.

PART C': Exercises on thermodynamics. Calculation of boundaries of metamorphic reactions (ideal end members and solid solutions, reactions with and without water, investigation of the importance of compressibility and heat capacity in the calculations), aluminosilicate boundaries and triple point, upper-mantle facies boundaries, boundary of ultrahigh-pressure metamorphism, boundary of high-pressure metamorphic facies, applications of geothermobarometers in the crust and mantle.

C. Laboratory training

Use of optical (polarised-light) microscopy for the identification of metamorphic minerals and metamorphic rocks from Greece (Rhodope, Cyclades) and the Scottish Highlands originating from different igneous and sedimentary protoliths.

TEACHING METHODS:

- Face to Face (in Lectures, Practicals, and Laboratory Training)
- Using PC/laptop (Lectures and Practicals).
- By demonstrating the methodology of identification of minerals, rock types and metamorphic textures using a transmitting light polarising microscope (in Laboratory Training).
- By demonstrating the methodology of mineral analysis using a scanning electron microscope equipped with an energy dispersive system (in Laboratory Training).

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Teaching:

- Delivering lectures of multimedia content (images, animation, video) in PowerPoint Presentation format.
- Solving exercises and creating charts in the practicals with the help of appropriate software (Microsoft Excel).
- Support of learning through the e-class platform (lecture material, essays and exercises are uploaded on the course page in the e-class in Portable Document Format).

In Student Communication:

- E-class enables students to communicate in multiple ways (announcements, information, messages, documents, tasks,

questionnaires, exercises, diaries, user groups, multimedia, links, e-books, etc.).

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	26 (2×13)
Practicals	18 (2×9)
Laboratory training	8 (2×4)
Homework, studying and literature review	75 (5×13)
Preparation for the final exam	40 (8×5)
Total	**167** hours

STUDENT EVALUATION/GRADING

Students are evaluated in Greek (Erasmus students can be assessed in English). The evaluation method, through which the final grade is shaped, includes a series of tests as follows:

I. LECTURES (40%)
- Oral Examination including a PowerPoint presentation of an essay by the students and/or
- Written Examination with Short Response Questions and Multiple Choice Test and/or
- Written Examination with Extended Response Questions

II. PRACTICALS AND LABORATORY TRAINING (60%)
- Practicals: Written Examination (50%)
- Laboratory Training: Oral Examination (10%)

SUGGESTED LITERATURE

Textbooks

- 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
- Irina M. Artemieva, 2011. The Lithosphere: an interdisciplinary approach. Cambridge University Press
- John D. Winter, 2014. Principles of Igneous and Metamorphic Petrology (2nd Edition) Pearson Education Limited
- Bruce Fegley, 2013. Practical Chemical Thermodynamics for Geoscientists. Academic Press
- Jibamitra Ganguly, 2008. Thermodynamics in Earth and Planetary Sciences. Springer-Verlag
- Roger Powell, 1978. Equilibrium thermodynamics in Petrology. An introduction. Harper & Row Ltd.
- Richard A. Robie & Bruce S. Hemingway, 1995. Thermodynamic Properties of Minerals and Related Substances at 298.15 K and 1 Bar (105 Pascals) Pressure and at Higher Temperatures. US Geological Survey Bulletin 2131
- Shun-ichiro Karato, 2008. Deformation of Earth Materials. Cambridge University Press
- Kurt Stüwe, 2007. Geodynamics of the Lithosphere (2nd Edition) Springer
- Donald L. Turcotte & Gerald Schubert, 2014. Geodynamics (3rd Edition). Cambridge University Press

Journals

- Journal of Petrology (Oxford University Press)
- Journal of Metamorphic Geology (Wiley)
- Lithos (Elsevier)
- Earth and Planetary Science Letters (Elsevier)
- Geochimica et Cosmochimica Acta (Elsevier)
- Nature Geoscience (Nature Publishing Group)
- Scientific Reports (Nature Research)
- Contributions to Mineralogy and Petrology (Springer Link)

WEB PAGE:

http://eclass.uoa.gr/courses/GEOL399

ΟΠΠ-Ε07 WASTE MANAGEMENT

Instructors: Ch. Stouraiti (chstouraiti@geol.uoa.gr); I. Megremi

LEVEL/ SEMESTER: 7 / 2nd

TYPE: NA

LECTURES AND PRACTICAL EXERCISES

A) Lectures, B) Practical exercises, C) Field exercise

4 hours of lecturing per week, practical exercises, field-work; 8 ECTS credits.

Prerequisites: Geochemical Exploration Methods
Mineral Resources, Mining And Sustainable Development

Language: Greek

Course offered to Erasmus+ students: Yes, in English

LEARNING OUTCOMES

Learning Outcomes

The course provides applied and specific knowledge in the field of solid waste management and focuses on the waste of the extractive industry and the protection of the soil / water from the disposal of the waste.

The aim of the course is to familiarize students with the subject of solid waste management based on case studies from Greece and the basic laboratory characterization tests. The course also consists of lectures that will introduce the requirements of the laboratory exercise that will follow, while then there will be a presentation of the basic analytical instruments that will be used in the exercise.

Upon successful completion of the course the student gains the following:

- Gains experience in the sampling of extractive waste in the field and in the processing and analysis of samples in the laboratory.
- Identifies, describes and classifies the various categories of solid waste based on the macroscopic, geochemical and mineralogical characteristics.
- Apply appropriate leaching tests and gains familiarity with the waste classification methodology based on the European Waste Catalog.
- Analyzes and implements European and national waste legislation through exercises and case studies.

General Competencies

- Search, analysis and synthesis of geochemical data and information taking advantage of the use of appropriate methodologies
- Making decisions
- Independent coursework

CONTENT:

A. Lectures:

The course deals with the environmental characterization and classification of solid wastes into waste categories, with an emphasis on extractive waste, according to the European Waste Catalog. Extensive reference is made to European and national legislation governing waste management and in particular to extractive industry waste.

Legislative framework; Solid waste management activities are analyzed in detail (Disposal - D, Recyclying - R). Landfills of municipal - industrial waste - inert waste. Management of special waste streams (mining, metallurgical waste, ash, radioactive waste) and management technologies. Environmental monitoring. Application of Geographic Information Systems (GIS) in site selection of waste management facilities (landfills).

B. Laboratory exercises:

Application of standard leaching test (static and kinetic) for the characterization of mining wastes as well as the characterization of contaminated soils (Regulatory test EN 12457-1, -2, -3, -4). TCLP Toxicity Characteristic Leaching Procedure (US / EPA). Standard Acid-Base Accounting Potential Prediction (ABA) Test of Mines - EN 15875. Presentation of geochemical data, data analysis and decision making.

C. Field exercise:

Sampling and mapping exercise at historic wastes disposal sites and closed mines (North Attica, Lavrion).

TEACHING METHODS:

- Face-to-face lecturing
- Treatment of data with the use of statistical program (XLstat)
- Laboratory exercises
- Field measurements

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

COMMUNICATION WITH STUDENTS: The e-CLASS platform provides direct communication with the students, submission of coursework and exercises.

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures and exercises of data treatment	4h x 8w = 32
Laboratory exercises	4h x 4w = 16
Homework	70
Field excursion	8
Student preparation for the evaluation	80
Total	**206** hours

STUDENT EVALUATION/GRADING

The language evaluation is Greek. The final grade is modulated as follows:

I. ***Oral presentation***. The topic of the oral presentation is relative to the waste plan of mining facilities (characterization of mining wastes, facility classification, risk evaluation, monitoring and closure) (**50% of the final grade**)

II. ***Coursework.*** Treatment of geochemical data (**30% of the final grade**)

III. ***Questionnaires and short exercises.*** 'Next-day' assignments (**20% of the final grade**)

SUGGESTED LITERATURE

I. Recommended textbook

- Lottermoser, B. 2007. Mine Wastes. Characterization, Treatment and Environmental Impacts. Second Edition, Springer, pp. 297.
- Misra, K. (2017). Introduction to Geochemistry: principles and applications. Wiley- Blackwell

II. Relative scientific journals

- Waste Management, Elsevier
- Journal of Hazardous Materials, Elsevier
- Chemosphere, Elsevier

WEB PAGE:

https://eclass.uoa.gr/courses/GEOL299

ΟΠΠ-Ε08 RESEARCH METHODOLOGY AND SCIENTIFIC WRITING

Instructors: S. Kilias (kilias@geol.uoa.gr); A. Gontikas (Post-doc)

LEVEL/ SEMESTER: 7 / 2nd

TYPE: Specific background, skills development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 8 ECTS credits.

Prerequisites NO

Language: Greek

Course offered to Erasmus+ students: YES in English. ERASMUS+ agreement between Stockholm University and the National and Kapodistrian University of Athens is in effect. Contact: Professor Stephanos Kilias, tel.: +30-210-7274211; / +30-6944884561 (mobile); e-mail: kilias@geol.uoa.gr

LEARNING OUTCOMES

Learning Outcomes

This module will provide the students with the necessary ***knowledge*** and information, and teach them the required ***skills*** to positively perform their own academic research leading to a M.Sc. degree. The module will focus on teaching the students to prepare and express their own research ideas, develop those ideas into scientific study projects, undertake scientific research and produce analysis data, analyze the results of their study, organize and write a thesis and distribute the results of that research. On successful completion of this module, students will have the capability to :

- Analyze and interpret data using appropriate numerical techniques supported by relevant software
- Design, plan and carry out research projects
- Write scientific or consultancy reports
- Use scientific databases and efficiently find key findings in research literature.

Skills

- Planning and organization of research
- Scientific problem solving
- Basic statistics
- Computer knowledge
- Data analysis, presentation and interpretation
- Resource database usage; and,
- Written and oral scientific communication skills.

General Competencies

- Researching, and, data and information analysis and synthesis, using appropriate technology.
- Independent work
- Decision making
- Research hypothesis formation
- Writing scientific reports

CONTENT:

- Hypothesis driven and exploratory research.
- h-index, i10-index

- Scientific sins (plagiarism, fraud etc.)
- Literature research for proposals, reviews and discussions, Scientific hypothesis, researching the hypothesis, reputable (and disreputable) sources of data, databases and search engines), writing a literature review
- Scientific experiments, experimental approaches, fundamentals of experimental design.
- Carrying our research-project planning, project inception report structure, work programme/timetable/plans, risk to human health, project risk, efficient execution of project plan, effective management of experiment and analyses.
- Presenting your findings, Dissertation and papers, introduction to (good!) academic writing, writing a publication, publish or perish?
- Dissertation: Dissertation structure, Dissertation tips, Methods, Results, Discussion, Referencing, citations in the text and citation list, use of figures.
- Conferences, Posters, Oral presentations
- Data presentation and analysis
- Effective use of scientific data in papers and dissertations
- Critical thinking (Inference, Interpretation, Deduction, Recognition of assumptions, Evaluation of arguments).

Practicals

Basic statistics and data presentation

TEACHING METHODS:

- Lecture
- Computer practicals

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

- Slide presentation software PowerPoint is integral to lecturing. PowerPoint lecture presentations, reading lists and relevant bibliography are uploaded in "E-class", i.e. a National and Kapodistrian University of Athens (NKUA) integrated management system for electronic courses. Electronic submission of student course work, term papers etc. via e-class.

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	40 (4x10)
Assessment preparation and completion (Literature review)	40
Assessment preparation and completion [Project (Essay, Project inception re-port(PIR)]	50
Assessment preparation and completion [Oral PIR presentation (including prepa-ration)]	10
Independent study	50
Directed research and reading (Writing up of lecture notes)	25
Practical	12(4×3)
Total	**227** hours

STUDENT EVALUATION/GRADING

I. ***Written exercise/Essay***. Peer Assessment Exercise (1500-2000 words, percentage 25%).

II. ***Research proposal/Dissertation*** Project Inception Report(PIR) (approx. 5 pages, percentage 50%).

III. ***15' Oral presentation*** Linked to PIR (percentage 25%).

SUGGESTED LITERATURE

Textbooks:

- MASSACHUSETTS INSTITUTE OF TECHNOLOGY, ACADEMIC INTEGRITY, A HANDBOOK FOR STUDENTS. 2013 Why and what to cite. http://integrity.mit.edu/citing-your-sources/avoiding-plagiarism-cite-your-source.
- NATURE, NATURE GEOSCIENCE, GUIDE TO AUTHORS. 2013. Editorial policies, including the guide for referees. http://www.nature.com/authors/gta.pdf.
- NIELSEN, K. H. 2012. Scientific Communication and the Nature of Science. Science & Education, 1-20.
- GRAUE, B. 2006. The transformative power of reviewing. Educational Researcher, 36-41.
- ARMSTRONG, J. S. 1997. Peer review for journals: Evidence on quality control, fairness, and innova-tion. Science and engineering ethics, 3(1), 63-84.
- COMITTEE ON PUBLICATION ETHICS, RESOURCES, CODE OF CONDUCT, 2011.
- A Guide to Writing Scientific Essays
- Robert A. Day, How to Write and Publish a Scientific Paper, Cambridge University Press 1989.

Journals:

- Educational Research-Taylor and Francis
- Science & Education - Springer

WEB PAGE:

http://eclass.uoa.gr/courses/GEOL454

ΟΠΠ-Ε09 RISK ASSESSMENT OF POLLUTION

Instructors: E. Kelepertzis (kelepert@geol.uoa.g); I. Megremi.

LEVEL/ SEMESTER: 7 / 2nd

TYPE: Specific background, skills development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 7 ECTS credits.

Prerequisites a) Methods of geochemical exploration, b) Mineral resources - mining activity and sustainable development

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The course focuses on the understanding of interactions between anthropogenic activities and the natural environment and the risk assessment of geoenvironment pollution. Emphasis is given to soil and water systems and the importance of pollution evaluation for the well-being of plants and humans. Case studies with environmental data from various areas of Greece are presented targeting to the development of critical thinking of students and the scientifically-based approach of modern environmental problems. At the end of the course, the student should be able to:

- Apply appropriate methods with the aim to determine the natural and anthropogenic sources of chemical elements enrichment in environmental samples.
- Treat and evaluate environmental data for risk assessment of pollution.
- Combine mineralogy and geochemistry knowledge for the integrated understanding and assessment of mobility and environmental availability of chemical elements in the surficial environment.
- Apply proper methodology for the quantification of risk that arises from the occurrence of potentially toxic elements in environmental samples.
- To process geochemical samples in the laboratory aiming to their environmental characterization and the assessment of environmental availability of potentially toxic elements.

General Competencies

- Search, analysis and synthesis of data and information taking advantage of the use of appropriate technologies
- Making decisions
- Independent coursework
- Team coursework
- Development of new scientific ideas
- Respect to the natural environment
- Promotion of free and creative thinking

CONTENT:

A. Lectures:

The course lectures include the presentation of the following thematic topics:

- Introduction to fundamental concepts related to environmental pollution
- Occurrence of chemical elements in soil and water systems
- Natural and anthropogenic sources of enrichment
- Geochemical forms of trace elements
- Mobility and environmental availability of trace elements in the surficial environment
- Analytical methods of determination of elemental environmental availability
- Urban geochemistry
- Pollution of water systems with N,P
- Methodology of risk assessment according to the U.S.EPA model
- Critical loads and environmental quality limits in soil and waters
- Interaction of chemical elements in the rock-soil-plant system

Furthermore, case studies of pollution evaluation related to urban soils from Athens, as well as agricultural soils from Thiva, Argos and Nemea regions are presented. Emphasis is also given to the environmental occurrence of hexavalent chromium in diverse water systems of Greece.

B. Problem sets and laboratory exercises

Part A: Treatment of soil and water geochemical data for pollution evaluation with the use of appropriate statistical programme.

Part B: Laboratory exercises: processing of geochemical samples (soil, plants), dissolution with weak chemical reagents and chemical measurements of trace elements by atomic absorption spectroscopy.

C. Field excursion: Practice in sampling soils and surface waters.

TEACHING METHODS:

- Face-to-face lecturing
- Treatment of data with the use of statistical programme installed on student's computer
- Laboratory exercises
- Field excursion

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Teaching:

- Presentations ppt of the course lectures as well as relative bibliographic material are found in the website of the course at the e-school platform.

In Student Communication:

- The e-school platform gives opportunity of direct communication with the students, submission of coursework and exercises, etc

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures and exercises of data treatment	32 (4h × 8w)
Laboratory exercises	16 (4h × 4 w)
Homework	70
Field excursion	8
Student preparation for the evaluation	70
Total	**196** hours

STUDENT EVALUATION/GRADING

The language evaluation is Greek. The final grade is modulated as follows:

I. Oral presentation

The topic of the oral presentation is relative to the environmental occurrence and behavior of potentially toxic elements (**35% of final grade**)

II. Coursework

Treatment of geochemical data (soils, plants) and pollution evaluation (**35% of final grade**)

III. Questionnaires and short exercises

'Next-day' assignments including multiple choice test questions, short questions and/or exercises (**30% of final grade**)

SUGGESTED LITERATURE

Textbook:

- Brian J. Alloway (2013). Heavy metals in soils: Trace metals and metalloids in soil and their bioavailability. Third Edition, Springer.

Journals:

- Applied Geochemistry, Elsevier
- Journal of Exploration Geochemistry, Elsevier
- Science of the Total Environment, Elsevier
- Environmental Pollution, Elsevier

WEB PAGE:

https://eclass.uoa.gr/courses/GEOL449

ΟΠΠ-Ε10 MINERAL GENESIS IN GREECE AND EUROPE – CRITICAL MINERAL RESOURCES IN THE EU

Instructors: S. Klilias (kilias@geol.uoa.gr); P. Voudouris.

LEVEL/ SEMESTER: 7 / 2nd

TYPE: Specific background, skills development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 7 ECTS credits.

Prerequisites Although there are no prerequisite course(s), students are advised to have successfully attended the following undergraduate courses, or have acquired equivalent knowledge, before enrolling into ΟΠΠ-Ε11: "Geology of Ore Deposits", "Ore Forming Processes", "Mineralo-gy", "Geochemistry", and "Petrology"

Language: Greek/English

Course offered to Erasmus+ students: YES

LEARNING OUTCOMES

Learning Outcomes

The Course is based on the description of the major mineral resource types that are found in the Greece and the EU, as well as at the physicochemical conditions they were formed.

At the end of the course the student should be able to:

- acquire the ability to understand the structure and the distribution of different types of deposits in relation with the geologic evolution, regional tectonics and magmatism in the EU countries and Greece.
- acquire fundamental knowledge and skills for the research of ore and gangue minerals.
- choose basic methods of mineralogical and geochemical research for the detection of minerals bearing "critical metals" and evaluate their quantity.
- use the mineral databases ProMine (ProMine Mineral Databases: New Tools to Assess Primary and Secondary Mineral Resources in Europe

General Competencies

- Search, analysis and synthesis of data and information taking advantage of the use of appropriate technologies
- Independent coursework
- Team coursework
- Decision making
- Development of new scientific ideas
- Respect to the natural environment

CONTENT:

A. Course Lectures:

The lectures contain the development of the following subject fields:

- The Greek and European mineral resources.

- Geodynamic overview, and pre-Cenozoic and Cenozoic evolution of the European and Greek terrains.
- Metallogeny of Europe—Metallogenetic provinces, Metallogenetic epochs and world-class deposits in Europe.
- Cenozoic Metallogeny of Greece — Cenozoic geological evolution, and types of primary and secondary magmatic-hydrothermal ore deposits, and their relationship with regional tectonics and magmatism in Greece.
- Deposit Types and minerals of "critical" and of "energy critical" importance and "rare" metals and "high technology" metals in deposits of the European and Greek terrains.
- Depositional geologic environments, Detection and mapping of ore deposits in the field.
- The importance of sulfides, sulfosalts and tellurides as bearers of critical and precious metals, on land and in the submarine environment. The use of sulfides, sulfosalts and tellurides in the investigation of magmatic-hydrothermal processes, in the applied research and in the high technology industry.
- The mineral databases ProMine {ProMine Mineral Databases: New Tools to Assess Primary and Secondary Mineral Resources in Europe}

B. Lab work

Optical properties of opaque minerals. Technics of optical microscopy in the reflected light—Determination of ore minerals in the metallographic microscope.
Mineralogical and histological determination of ore minerals with examples from Greece

C. Field trips:

Field trip in the facilities of "Ελληνικός Χρυσός ΑΕ" at the Chalkidiki mines (N. Greece) or at the facilities of the French Company at Lavrion and at abandoned mines of Lavrion, Attica.

TEACHING METHODS:

- In person lectures
- Metallographic (Reflected light) microsco-py lab exercises
- Field trips in active and inactive mines

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Teaching:

- PowerPoint Presentations of the course lectures as well as relative bibliographic material are found in the website of the course at the e-class platform.

In Student Communication:

- The e-class platform provides opportunities of direct communication with the students, submission of coursework and exercises, etc.

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures and seminars	4h x 9w = 36h
Metallographic microscopy lab exercises	4h x 4w = 36h
Literature study/homework	90
Field trip	20
Preparation of students for finals assessment	50
Total	**212** hours

STUDENT EVALUATION/GRADING

The students are examined in Greek and English language. The final grade results from a series of tests that include:

a. The students choose a topic for ***Public Oral Presentation (ppt)*** from a bank of topics relevant with one of the following subjects: (1) Major Greek and EU ore deposits (**40% of the final grade**)

b*. Lab examination,* examination of polished thin sections in both reflected and transmitted light with samples from Greek ore deposits (**40% of the final grade**).

c. Essays/Reviews, relevant with the field trips in the active or inactive mines (**20% of the final grade**).

SUGGESTED LITERATURE

- Economic Geology, Society of economic Geologists
- Mineralium Deposita, Springer
- Ore Geology Reviews, Elsevier
- Frontiers in Earth Science,

WEB PAGE:

https://eclass.uoa.gr/courses/GEOL561

ΟΠΠ-Ε11 BUILDING STONES AND AGGREGATES - GEMOLOGY

Instructors: P. Pomonis (ppomonis@geol.uoa.gr); M. Kati; P. Voudouris.

LEVEL/ SEMESTER: 7 / 2nd

TYPE: Specialist background, general knowledge skills and skills development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 7 ECTS credits.

Prerequisites

ΟΠΠ-Ε01 Magmatism and Geotectonic Environment

ΟΠΠ-Ε04 Continental and Marine Volcanism – Environmental Volcanology

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The course deals with applications and uses of minerals and rocks and in particular with the knowledge of research on clay and artificial aggregates, building stones and precious and semi-precious stones. Upon successful completion of the course the student will be able to:

- Recognize natural and artificial aggregates.
- Understand the role of petrography in the mechanical behaviour of building stones and aggregates.
- Be familiar with the laboratory methods for the evaluation of structural raw materials.
- Have the relevant knowledge of the mining sites and the environmental problems that arise.
- Have information on specifications and exploitation laws.
- Recognize the most important natural precious and semi-precious stones and how they are made.
- Be aware of the methods of diagnosis and identification of gems.
- Be aware of methods of producing synthetic gemstones.
- Be aware of the techniques of processing and optimizing gems.

General Competencies

The general competencies that students should have in mind are the following:

- Search, analyze and synthesize data and information, using the necessary technologies.
- Autonomous work.
- Teamwork.
- Problem solving ability.
- Decision-making.
- Promote free, creative and inductive thinking.
- Respect for the natural environment.

CONTENT:

Limestones, marbles, ophicalcites, granites, peridotites, volcanic rocks, detrital sedimentary rocks, gypsum, ceramics, etc. rocks as building and decorative materials. Physical properties, typical uses. Historical value. Technical - mechanical characteristics and behavior of materials in use and in time. Harmful elements on building stones, control and protection measures. Specification and legality of mining, marketing and use. Technical Mineralogy - Petrography and Rock Mechanics. Greek Quar-ries and Environmental Problems. Geological framework for the origin of building and decorative stones. Historical and modern use of stones. Evaluation methodology - recycling of sterile materials. Mineralogy of the most important semi-precious stones, geological framework of genesis, research-estimation methodology. Synthetic gems. Determination of stones by: refractive index, absorption spectrum, specific gravity, relative density, radioscopy. Inclusions as an indication of the origin of stones. Artificial processing and optimization. Diamond, emerald, ruby, sapphire, pearls and tourmalines: identification, varieties and qualities. The gems of Greece. Prospects for future exploitation. Aesthetic minerals, collections, trade and museum design. Stones and stamps. Uses-meaning from Antiquity to the present day.

TEACHING METHODS:

- Face-to-face lectures
- Practical exercises using samples of minerals and rocks, optical microscopes, electron microscopy and X-ray diffractometry

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Teaching:

- Presentations with multimedia content (images, animation, video).

In Student Communication:

- Support for learning through the digital e-class platform (announcements, information, messages, notes, presentations, tasks).

BREAKDOWN OF WORKLOAD

Activity	Workload/semester
Lectures	40
Practical exercises	12
Study visits	8
Study and analysis of literature	39
Writing essays	39
Preparation of students for evaluation	39
Total	**177** hours

STUDENT EVALUATION/GRADING

The student evaluation includes written essay on a subject suggested by the teachers in co-operation with the trainees and an oral exam with a presentation of the essay at Powerpoint. The final grade is the sum of the grade of the written essay and the score of the presentation.
The weight will be 60% for the oral presentation and 40% for the written essay.

SUGGESTED LITERATURE

- Τα ελληνικά μάρμαρα & άλλα διακοσμητικά πετρώματα (Τσιραμπίδης Α. , University Studio Press, 1996).
- Οδοποιία (Νικολαΐδης, Α., University Studio Press, 2011).
- Stone Conservation: Principles and Practice (Henry, A., Routledge, 2006).
- Aggregates (Smith, M.R. & Collis, L., Geological Society of London, Special Publication No. 17, 2001).
- Petrographic Atlas: Characterisation of Aggregates Regarding Potential Reactivity to Alkalis (Fernandes, I., Ribeiro, M., Maarten A T M Broekmans & Ian Sims, Springer, 2016).
- Gemstones of the World (Schumann, W., Sterling Publishing Co., Inc, 1997).
- Geology of Gems (E. Ia Kievlenko, Ocean Pictures Ltd., 2003).

WEB PAGE:

http://eclass.uoa.gr/courses/GEOL446

ΟΠΠ-Ε12 METASOMATIC/HYDROTHERMAL ALTERATIONS AND METALLOGENY

Instructors: D. Kostopoulos (dkostop@geol.uoa.gr); P. Voudouris

LEVEL/ SEMESTER: 7 / 2nd

TYPE: Specialist background, general knowledge skills and skills development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 7 ECTS credits.

Prerequisites

ΟΠΠ-Ε01 Magmatism and Geotectonic Environment
ΟΠΠ-Ε04 Continental and Marine Volcanism – Environmental Volcanology

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The course offers advanced knowledge in the field of interaction between fluids and rocks, thus leading to an understanding of how mineralisation is created in different geotectonic environments. It is divided into two sections:

- The first section includes the description of the types of hydrothermal alteration and metasomatic processes associated with basic types of ore deposits and active geo-thermal fields, as well as their conditions of genesis.
- The second section includes the study of the stability fields of sulphide minerals and the solubilities of ore minerals (transport in solution and deposition) upon changes of physico-chemical conditions.

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

- Understand the spatio-temporal distribution of the various types of hydrothermal al-teration in relation to tectonics and magmatism.
- Use the skills they acquired for the study and distinction of minerals and types of hydrothermal alteration.
- Apply basic methods of mineral-chemical and geochemical research for the detection of mineral hydrothermal alterations.
- Combine physico-chemical information from ore and gangue minerals and recon-struct the composition of ore-forming hydrothermal fluids.
- Evaluate the thermodynamic conditions of genesis of ore minerals and the potential of mining districts.

General Competencies

- Search, analyse and synthesise data and information, using the necessary technologies
- Decision making
- Autonomous work
- Teamwork

- Production of new research ideas / Ability to apply knowledge to problem solving
- Promote free, creative and inductive thinking
- Respect for the natural environment

CONTENT:

A. Lectures

The content of the lectures is divided into the following thematic areas:

- Styles of hydrothermal alteration in various types of ore deposits (porphyry, epither-mal, reduced intrusion-related gold systems, carbonate replacement, volcanogenic massive sulphides, etc.), and their relationship to tectonics and magmatism in Greece.
- Hydrothermal alteration mineral assemblages and their use in vectoring mineralisa-tion.
- Identification of different hydrothermal alteration styles and their mapping in the field.
- Physico-chemical conditions of ore genesis – depositional environments.
- Basic methods of mineral-chemical and geochemical exploration in zones of hydro-thermal alteration.
- The use of hydrothermal alteration mineral assemblages in applied research and the industry.
- Identification and interpretation of textures of different hydrothermal altera-tion/metasomatism styles and ores.
- Chemical transfer in hydrothermal/metasomatic processes.

B. Practical and Laboratory Training

Optical properties of hydrothermal alteration minerals. Optical microscopy tech-niques in transmitted light — Identification of ore minerals under the metallographic microscope.
Mineral-chemical and textural characterisation of secondary minerals with examples from Greece.
Use of thermodynamics in the construction and interpretation of activity of chemical species-temperature-pressure-fluid composition diagrams, with emphasis on ore genesis.

C. Field Exercise

Visit mine facilities and mineralisation sites in the Lavrio mining district and mapping of hydrothermal alteration zones.

TEACHING METHODS:

- Face to Face (in Lectures, Practicals, Laboratory Training and Field Training).
- Using a PC/laptop (Lectures and Practicals).
- By demonstrating the methodology of identification of minerals, rock types, hydrothermal alteration styles and textures using a transmitted light polarising microscope (in Laboratory Training).
- By demonstrating the methodology of mapping different hydrothermal alteration and mineralisa-tion styles (in Field Training).

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Teaching:

- Delivering lectures of multimedia content (images, animation, video) in PowerPoint Presentation for-mat.
- Solving exercises and creating charts in the practicals with the help of appropriate software (Microsoft Excel).
- Support of learning through the e-class platform (lecture material, essays and exercises are uploaded on the course page in the e-class in Portable Document Format).

In Student Communication:

- E-class enables students to communicate in multiple ways (announcements, information, messages, documents, tasks, questionnaires, exercises, diaries, user groups, multimedia, links, e-books, etc.).

BREAKDOWN OF WORKLOAD

Activity	Workload/semester
Lectures / Seminars	26h (2 h x 13 w)
Practicals & Laboratory training (optical microscopy)	26h (2 h x 13 w)
Homework, studying and literature review	65h (5 h x 13 w)
Field Training	16h (8 h x 2 d)
Preparation for the final examination/evaluation	40h (8 h x 5 d)
Total	**173** hours

STUDENT EVALUATION/GRADING

Students are evaluated in Greek (Erasmus students can be assessed in English).

The evaluation method, through which the final grade is shaped, includes a series of tests as follows:

I. LECTURES (**40%**)

- Oral Examination that includes a class presentation of a topic by the students (PowerPoint Presentation). Students choose a topic from a pool of topics related to one of the following thematic areas:
  - Occurrences of hydrothermal alteration styles across the globe.
  - Hydrothermal alteration textures and ore textures.
  - Conditions of thermodynamic stability of sulphide ore minerals

and/or

- Written Examination with Short Response Questions and Multiple Choice Test

II. PRACTICALS AND LABORATORY TRAINING (**40%**)

- Evaluation, using a transmitted light polarising microscope, of thin sections of samples from Greek ore deposits in Laboratory Training (**20%**)
- Written examination with exercises on solubility and deposition of sulphide ores from hydrothermal fluids in the Practicals (**20%**)

III. FIELD TRAINING - MAPPING (**20%**)

- Written report on field mapping project (**20%**)

SUGGESTED LITERATURE

Textbooks:

- D.F. Sangster, 1996. Carbonate-Hosted Lead-Zinc Deposits. Special Publication, No. 4. Society of Economic Geologists
- G.J. Corbett, & T.M. Leach, 1998. Southwest Pacific Rim Gold-Copper Systems: Structure, Alteration, and Mineralization. Special Publication, No. 6. Society of Economic Geologists

- Walter L. Pohl, 2011. Economic Geology: Principles and Practice. Wiley-Blackwell
- R.W. Henley, A.H. Truesdell, & P.B. Barton, Jr., 1984. Fluid-Mineral Equilibria in Hydrothermal Systems. Reviews, in Economic Geology, Vol. 1. Society of Economic Geologists
- Robert M. Garrels & Charles L. Christ, 1965. Solutions, Minerals and Equilibria. Freeman, Cooper & Company
- Hubert L. Barnes, 1979. Geochemistry of hydrothermal ore deposits. 2nd Edition. John Wiley & Sons
- Bruce Fegley, 2013. Practical Chemical Thermodynamics for Geoscientists. Academic Press
- Jibamitra Ganguly, 2008. Thermodynamics in Earth and Planetary Sciences. Springer-Verlag
- Roger Powell, 1978. Equilibrium thermodynamics in Petrology. An introduction. Harper & Row Ltd.
- Richard A. Robie & Bruce S. Hemingway, 1995. Thermodynamic Properties of Minerals and Related Substances at 298.15 K and 1 Bar (105 Pascals) Pressure and at Higher Temperatures. US Geological Survey Bulletin 2131

Journals:

- Ore Geology Reviews (Elsevier)
- Economic Geology (GeoScienceWorld)
- Lithos (Elsevier)
- Earth and Planetary Science Letters (Elsevier)
- Geochimica et Cosmochimica Acta (Elsevier)
- Nature Geoscience (Nature Publishing Group)
- Chemical Geology (Elsevier)
- Scientific Reports (Nature Research)
- Mineralium Deposita (Springer Link)
- Minerals (MDPI)

WEB PAGE:

http://eclass.uoa.gr/courses/GEOL470

ΟΠΠ-Ε13 THE LITHOLOGIES OF PETROLEUM SYSTEMS

Instructors: M. Kati (kati@geol.uoa.gr).

LEVEL/ SEMESTER: 7 / 2nd

TYPE: Specialization, Specific background, Skill development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, practical and laboratory exercises, field exercise, 7 ECTS credits.

Prerequisites: ΟΠΠ-Ε01 and ΟΠΠ-Ε04

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The course is designed to provide specialized knowledge on characteristics and properties of the sedimentary lithologies which are major elements of the petroleum systems regarding the generation, accumulation and storage of hydrocarbons. On successful completion of the course the student will be able to:

- Demonstrate an understanding of specific features of various rock types as source rocks, reservoirs and seals (cap rocks).
- Describe and classify the individual components of a petroleum system.
- Interpret the effect of the depositional and diagenetic features of siliciclastic and carbonate rocks on their porosity modification and evaluate their reservoir quality.
- Interpret mineralogical, petrographic, geochemical, and petrophysical characteristics of source rocks and evaluate their potential through the quantity and quality of their organic matter content.
- Apply the appropriate methods and techniques for determining the properties of rocks during their assessment in the petroleum exploration and exploitation.

General Competencies

- Research, analysis and synthesis of data and information, using the necessary technologies.
- Design and project management.
- Independent work.
- Teamwork.
- Work in inter-disciplinary environment.
- Decision-making.
- Promotion of free, creative and inductive thinking.
- Respect for the natural environment.

CONTENT:

A. Lectures

The lectures of the course include the follow topics:

- The petroleum system (major element and processes)
- Diagenesis of organic matter and the petroleum formation
- Kerogen types and hydrocarbon potential
- Oil shales, organic-rich mudstones and other lithologies as source rocks

- Siliciclastic and carbonate reservoir rocks (composition, lithofacies, petrophysical properties, diagenetic modifications, evolution of porosity)
- The effect of diagenesis on reservoir quality
- Depositional and diagenetic reservoirs
- Evaporites and mudstones as sealing rocks (types and characteristics)
- Characteristics of major oil fields in the word.

B. Practical and Laboratory Exercises

Part A': Methodology and application of mineralogical and petrographic analysis in hydrocarbon exploration and exploitation.

Part B': Methodology and application of laboratory techniques and interpretation of geochemical and petropghysical data for characterization and assessment of the rocks as main parts of the petroleum systems.

C. Field Exercise

Sites of Western Greece for identification and study of sedimentary rocks and formations that are considered to have played an important role in the formation of hydrocarbons in the wider area.

TEACHING METHODS:

- Face-to-face lectures.
- Face-to-face practical and laboratory exercises using samples of sediments and sedimentary rocks, optical microscopes, X-ray diffractometer and other specialized instruments and materials
- Face-to-face practical exercises in the field exercise.

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Teaching:

- PowerPoint presentations, videos with relevant content.

In Student Communication:

- Support for learning through the digital e-class platform of the NKUA (announcements, information, messages, notes, tasks)

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	52 (4h x 13 w)
Practical and Laboratory Exercises	36 (3h x 12 w)
Individual training tasks	30
Field Exercise	12
Preparation of students for evaluation	40
Total	**170** hours

STUDENT EVALUATION/GRADING

The evaluation process is conducted in Greek or English (for foreign students or students of Erasmus Programme). The final grade of the course is based on exams that include an oral presentation and a written essay on a subject suggested by the instructors in cooperation with the trainees, and with the following severity:

- Oral presentation (**60% of the final grade**)
- Written essay (**40% of the final grade**)

SUGGESTED LITERATURE

- Berg R.R. (1985). Reservoir Sandstones. Prentice-Hall, Inc., NJ, 481 p.
- Bjørlykke K. (2015). Petroleum Geoscience - From Sedimentary Environments to Rock Physics (2nd edition), Springer, 662 p.
- Emery D. & Robinson A. (1993). Inorganic Geochemistry – Applications to Petroleum Geology. Black well Scientific Publications, 254 p.
- Magoon L.B. & Dow W.G. 91994). The Petroleum System – From Source to Trap. AAPG Memoir vol. 60, Tulsa, OK., 639 p.
- Moore C.H. & Wade W.J. (2013). Carbonate Reservoirs - Porosity and Diagenesis in a Sequence Stratigraphic Framework. Developments in Sedimentology, v. 67, Elsevier, 374 p.
- Russell P.L. (1990). Oil shales of the word: their origin, occurrence, and exploration. Oxford, England, 753p.
- Scholle P.A. & Umber-Scholle D.S. (2003). A color guide to the Petrography of Carbonate Rocks. Memoir 77, American Association of Petroleum Geologists, Tulsa, OK., 474 p.
- Scott R. A., Smyth H. R., Morton A.C. & Richardson N. (2014). Sediment Provenance Studies in Hydrocarbon Exploration and Production. Geological Society, London, Sp. Publ., v. 386, 476 pp.
- Selley R.C. & Sonnenberg S.A. (2014). Elements of Petroleum Geology (3rd edition). Elsevier, 515 p.
- Shanmugam G. (2006). Deep-Water Processes and Facies Models - Implications for Sandstone Petroleum Reservoirs. Elsevier, 476 p.
- Tucker M.E. (2001). Sedimentary Petrology (3rd edition). Blackwell Science, 262 p.
- Tucker M.E. (2011). Sedimentary Rocks in the field (4th edition). Wiley & Sons Ltd, 275 p.
- Umber-Scholle D.S., Scholle P.A., Schieber J. & Raine R. (2014). A color guide to the Petrography of Sandstones, Siltstones, Shales and Associated Rocks. Memoir 109, American Association of Petroleum Geologists, Tulsa, OK., 526 p.
- Warren J.K. (2016). Evaporites: A Geological Compendium (2nd edition). Springer, 1813 p.

WEB PAGE:

http://eclass.uoa.gr/courses/GEOL461

ΟΠΠ-Ε14 SUSTAINABLE REMEDIATION OF CONTAMINATED LAND AND WATER

Instructors: A. Argyraki (argyraki@geol.uoa.gr); Z. Kypritidou

LEVEL/ SEMESTER: 7 / 3rd

TYPE: Specific background, skills development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 8 ECTS credits.

Prerequisites NO

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The course builds on knowledge relevant to cutting edge environmental technology for contaminated land and water, with emphasis in non-degradable pollutants such as potentially toxic trace elements. At the end of the course the students should be able to:

- Critically assess remediation methods and techniques based on sustainability criteria and their potential applicability in various cases of pollution.
- Take responsibility and plan innovative applications of geo-materials for the sustainable remediation of contamination.
- Treat, interpret and assess the results of remediation tests.

General Competencies

- Search, analysis and synthesis of data and information taking advantage of the use of appropriate technologies
- Decision making
- Independent coursework
- Team coursework
- Development of new scientific ideas
- Respect to the natural environment
- Promotion of free and creative thinking

CONTENT:

Comparison of traditional remediation practices for contaminated land (e.g.dig and removal) and water (e.g. pump and treat) with sustainable strategies based on circular economy and the protection of air, water and land. Stabilization methods for inorganic, non-degradable pollutants in soil. Case studies on applications of geo-materials as binders of pollutants in soil and water and the challenge of long term effectivenes of treatments.

TEACHING METHODS:

- Live lectures supported also by material in e-class
- Treatment of data by using appropriate software installed on student's computer

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Teaching:

- Presentations ppt of the course lectures as well as relative bibliographic material are found in the website of the course at the e-class platform.

In Student Communication:

- The e-class platform provides opportunities of direct communication with the students, submission of coursework and exercises, etc.

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures and computer lab exercises	40(4x10)
Homework- literature study	100
Student oral presentations for assessment	60(2x3)
Total	**200** hours

STUDENT EVALUATION/GRADING

Students are examined in Greek or English language. The final assessment involves a series of requirements including:

I. Oral presentations
- Relevant topic of in-situ remediation treatment (35%)

II. Term paper
- Focused on treatments and interpretation of geochemical data (35%)

III. Questions and exercises
- Questions and problems after each lecture (30%)

SUGGESTED LITERATURE

Textbook:

- Soil Remediation and Rehabilitation Treatment of Contaminated and Disturbed Land. Authors: Meuser, Helmut. eBook ISBN: 978-94-007-5751-6. DOI:10.1007/978-94-007-5751-6. 2013 , Springer.

Journals:

- Remediation, Wiley
- Journal of Geochemical Exploration, Elsevier
- Applied Geochemistry, Elsevier
- Geochemistry: Exploration Environment Analysis, Geoscience World

WEB PAGE:

https://eclass.uoa.gr/courses/GEOL453

ΟΠΠ-Ε15 ADVANCED TOPICS IN SEDIMENTARY PETROLOGY

Instructors: M. Kati (kati@geol.uoa.gr)

LEVEL/ SEMESTER: 7 / 3rd

TYPE: Specialist background, general knowledge skills and skills development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 8 ECTS credits.

Prerequisites NO

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The course deals with the profound study of sedimentary rocks. Upon successful completion of the course the student will obtain knowledge in:

- processes of studying the origin of clastic formations and relate it to the tectonic evolution of the area.
- processes of study of marine and non-marine carbonate sedimentation in all environments and their economic significance.
- processes of study of chemical/biochemical (siliceous) and their economic significance.

General Competencies

The general competencies that the students should have acquired and in which the course aims:

- Search, analyse and synthesize data and information, using the necessary technologies.
- Autonomous work and teamwork.
- Ability to apply knowledge in problem solving and decision making.
- Promote free, creative and inductive thinking.
- Respect for the natural environment.

CONTENT:

Study of the origin of classical formations. Clay sedimentation: structure, groups, formation in different environments and diagenesis. Soil formation processes, residual deposits. Continental carbonate rocks (inorganic carbonate precipitation, geochemistry diagenesis, palaeoclimatic interpretations). Microbial carbon production system (organically contaminated with microbial deposits). Mudstone rich in organic material (paleogeography and economic importance). Biochemical (bioelemental) systems. Petroleum / petrography of coal - main coal formations of the Greek area.

TEACHING METHODS:

- Face-to-face lectures
- Practical exercises of rock samples, using optical microscope, electron microscopy and XRD

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Teaching:

- Presentations with multimedia content (images, animation, video).

In Student Communication:

- Support for learning through the digital e-class platform (announcements, information, messages, notes, presentations, tasks).

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	52
Practical exercises	15
Literature	8
Field Exercises, literature research	40
Written essay	40
Preparation of students for evaluation	40
Total	**195** hours

STUDENT EVALUATION/GRADING

The student evaluation includes written essay on a subject suggested by the teachers in co-operation with the trainees and an oral exam with a presentation of the essay at PowerPoint. The final grade is the sum of the grade of the written essay and the score of the presentation. The weight will be **60%** for the oral presentation and **40%** for the written essay.

SUGGESTED LITERATURE

- Carbonate Sedimentology, Maurice E. Tucker, Blackwell, 2008
- Carbonates in Continental Settings, A.M. Alonso-Zarza & L.H. Tanner, Elsevier, 2010
- Evaporites, John K. Warren, Springer, 2006.
- Facies Models 4, Ed. Noel P. James& Robert W. Dalrymple, Canadian Sedimentology, 2010
- Petrology of Sedimentary Rocks, Sam Boggs, 2nd Edition Cambridge University Press, 2009
- Provenance of Arenites, G. G. Zuffa, Springer, 1985
- Sand and sandstone, Francis J. Pettijohn, Springer, 1972
- Sandstone diagenesis : Recent and ancient, Stuart D. Burley& R.H. Worden, IAS, 2003
- Sedimentary Petrology: An Introduction to the Origin of Sedimentary Rocks 3rd Edition, Maurice E. Tucker, Kindle Edition, 2001

WEB PAGE:

http://eclass.uoa.gr/courses/GEOL463

ΟΠΠ-Ε16 ARCHAEOMETRIC MINERALOGY AND PETROLOGY

Instructors: M. Kati (kati@geol.uoa.gr); P. Pomonis; P Voudouris; A. Godelitsas.

LEVEL/ SEMESTER: 7 / 3rd

TYPE: Specialist background, general knowledge skills and skills development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 8 ECTS credits.

Prerequisites NO

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The course deals with the decay of building stone of Ancient and Modern Monuments. Upon successful completion of the course the student will obtain knowledge in:

- The identification of the building stone of our cultural heritage.
- The degree and the causes of monument decay.
- The identification of the origin of ancient and historical building stone.
- The analytical techniques for controlling materials and interventions.
- The preservation and restoration of monuments, sculptures, decorative works, papyri, textiles, seals.
- Mineral and petrographic geotopes of origin.

General Competencies

The general competencies that the students should have acquired and in which the course aims:

- Search, analyse and synthesize data and information, using the necessary technologies.
- Autonomous work. And also teamwork.
- Problem solving ability and decision-making
- Promote free, creative and inductive thinking.
- Respect for the natural environment.

CONTENT:

Introduction to the conservation and restoration of monumental building stones. Description, causes and mechanisms of decay. Techniques for controlling the extent and severity of the alteration. Preventive and healing maintenance techniques. Ancient building materials. Non-destructive surface analysis techniques and spectroscopic techniques. Methods of identification, identification of limestone. Applications of thermal analysis methods. Design of maintenance interventions and control of their effectiveness in paintings, papyrus, fabrics and mortar-structural stones. Ancient mortars. Ancient quarry-mining. Study of cases of ancient monuments. Mineralogy and cultural heritage. Mineralogical and petrological geotopes, mineral paths - geoparks and environmental problems. Application with GIS methods. Greek land exploitation proposals.

TEACHING METHODS:

- Face-to-face lectures
- Practical exercises of rock samples, using optical microscope, electron microscopy and XRD

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Lecturing:

- Presentations with multimedia content (images, animation, video).

In the Communication with Students:

- Support for learning through the digital e-class platform (announcements, information, messages, notes, presentations, tasks).

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	39
Practical exercises	15
literature	40
Exercises in field	20
Written essay	40
Preparation of students for evaluation	40
Total	**194** hours

STUDENT EVALUATION/GRADING

Student evaluation includes written essay on a subject suggested by the teachers in co-operation with the trainees and an oral exam with a presentation of the essay at power point. The final grade is the sum of the grade of the written essay and the score of the presentation. The weight will be **60%** for the oral presentation and **40%** for the written essay.

SUGGESTED LITERATURE

- Building Stone Decay From Diagnosis to Conservation EDITED BYR. PI~IKRYL & B. J. SMITH, GSSP 271, 2007.
- Decay and Conservation of Building Stones on Cultural Heritage Monuments Vicen-te Rives,1,3,a and Jacinta García-Talegón, Materials Science Forum Vols. 514-516,2006.
- Decay and preservation of stone in modern environments, K. Lal Gauri, Springer, 1990 Building Stone Decay"
- Introduction to stone in historic buildings: characterization and performance J. Cas-sar, M. G. Winter, B. R. Marker, N. R. G. Walton, D. C. Entwisle, E. N. Bromhead and J. W. N. Smith Geological Society, London, Special Publications, 2014.
- Processes of Urban Stone Decay by B.J. Smith (Editor), P.A. Warke (Editor) Routledge, 1996.
- Stucture and failure of natural bulding stone-Application in the Restoration of An-cient Monuments, Editor Stavros K. Koutkoulis, 2018.

WEB PAGE: http://eclass.uoa.gr/courses/GEOL446

ΟΠΠ-Ε17 ELEMENTS OF ADVANCED GEOCHEMISTRY

Instructors: Ch. Stouraiti (chstouraiti@geol.uoa.gr); E. Kelepertzis.

LEVEL/ SEMESTER: 7 / 3RD

TYPE: Specific background, skills development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, practical exercises; 7 ECTS credits.

Prerequisites Geochemistry, Petrology

Language: Greek

Course offered to Erasmus+ students: Yes in English.

LEARNING OUTCOMES

Learning Outcomes

The course provides applied knowledge for studying petrogenetic and metallogenetic processes associated with ore formation. The theoritical part covers various geochemical systems: use of trace elements, stable isotopes C, H, O, S and radiogenic isotopes (U-Pb, Sm-Nd, Rb-Sr, Zr-Hf) at whole rock and mineral scale for the study of hydrothermal systems, origin of fluids and petrogenesis of igneous rocks associated with mineral bodies. Application of the isotopes U-Pb, Sm-Nd, Rb-Sr and Re-Os in the dating of hydrothermal minerals associated with deposits. Use of non-conventional isotopic systems

The aim of the course is to develop practical skills and includes the processing of geochemical and isotopic data from worked examples.

Upon successful completion of the course the student gains the following

- Identify and describe geochemical processes related to the distribution of trace elements and metals in a magmatic series.
- Apply geochemical classifications and standard diagrams to determine the tectonic environment of igneous rocks.
- Use appropriate computational methods to model petrogenetic processes
- Use specific software to calculate isochrons.
- To combine knowledge of geology, mineralogy, and geochemistry for decision making regarding the exploration of mineral raw materials associated with magmatic/hydrothermal systems

General Competencies

- Search, analysis and synthesis of volcanic data and information
- Making decisions
- Independent coursework

CONTENT:

A. Lectures

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

1. Magma geochemistry: geochemical criteria for classification of basaltic and granitic magmatic rocks. Combination of stable and radiogenic isotope systems Study of the origin of hydrothermal fluids using isotopes H, O and S.
2. Geochemistry of radioactive isotopes. Applications of Sm-Nd, Rb-Sr, U-Th-Pb, Re-Os systems in mineral and total rock, for the study of the origin of magmas and hydrothermal fluids. Dating magmatic and metallogenetic processes.

B. Laboratory exercises:

Laboratory exercises include processing of geochemical data from the literature using computer software, calculation of typical geochemical parameters as well as graphical representation of data in various types of geochemical diagrams.
Computer software includes: GCDkit 4.0 (Data presentation); MINPET (Mineral classification); RCrust (models of thermodynamic equilibrium in silicate systems); ISOPLOT; PETROMODELER

TEACHING METHODS:

- Face-to-face lecturing
- Practical exercises and treatment of data with the use of computing software

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

Communication with Students:

- The e-class platform provides opportunities of direct communication with the students, submission of coursework and exercises, etc.

BREAKDOWN OF WORKLOAD

Activity	Φόρτος Εργασίας Εξαμήνου
Lectures and exercises of data treatment	3h x 8w = 24h
Laboratory exercises	3h x 4w = 12h
Homework	70h
Field excursion	-
Student preparation for the evaluation	80h
Total	**186** hours

STUDENT EVALUATION/GRADING

The language evaluation is Greek. The final grade is modulated as follows:

I. ***Oral presentation***. The topic of the oral presentation is relative to applications of isotope and trace element geochemistry as tracers in petrogenesis of magmatic rocks, in ore exploration, in provenance studies (**50% of the final grade**).

II. ***Coursework:*** Treatment of geochemical data (**30% of the final grade**).

III. ***Questionnaires and short exercises:*** 'Next-day' assignments (**20% of the final grade**).

SUGGESTED LITERATURE

Recommended textbook

- Faure, G. 1986. Principles of Isotope Geology. 2nd Edition, United States

- Allegre, C. 2008. Isotope Geology. 1st Edition, Cambridge University Press, New York.
- Hoefs, J. 2015. Stable Isotope Geochemistry. 7th Edition. Springer,
- Misra, K. (2017) Εισαγωγή στην Γεωχημεία: Αρχές και Εφαρμογές (Επιμέλεια μετάφρασης Α. Αργυράκη, Χ. Στουραΐτη). Εκδόσεις Πεδίο. (πρωτότυπη έκδοση στην Αγγλική: Misra K. (2012) Introduction to Geochemistry: principles and applications. Wiley- Blackwell)

Relative scientific journals

- Chemical Geology, Elsevier
- Applied Geochemistry, Elsevier
- Geochimica et Cosmochimica Acta, Elsevier

WEB PAGE:

http://eclass.uoa.gr/courses/GEOL503

ΟΠΠ-Ε18 OPHIOLITIC COMPLEXES: FROM GENESIS TO ECONOMIC SIGNIFICANCE

Instructors: P. Pomonis (ppomonis@geol.uoa.gr); D. Kostopoulos.

LEVEL/ SEMESTER: 7 / 3rd

TYPE: Specialist background, general knowledge skills and skills development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 7 ECTS credits.

Prerequisites NO

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The course focuses on ophiolitic complexes and more specifically on providing knowledge related to their origin and evolution in the various geotectonic environments. It also deals with the methods of their exploitation. Upon successful completion of the course, the student will be able to:

- To recognize the types of ophiolitic complexes.
- Understand the processes of magma differentiation in the magma chambers.
- To know the different models of ophiolitic emplacement.
- To know the petrological and geochemical characteristics of MOR- and SSZ-type ophiolites.
- To have studied modern analogues and classical cases of ophiolitic complexes.
- To explain the occurrences of boninites and komatiites in ophiolitic sequences
- Be aware of the metasomatic and metamorphic processes occurring in the ophiolitic rocks.
- To know the Tethys ophiolites and the major ophiolitic complexes of the Greek territory and their significance.

General Competencies

The general competencies that students should have in mind are the following:

- Search, analyse and synthesize data and information, using the necessary technologies.
- Autonomous work.
- Teamwork.
- Problem solving ability.
- Decision-making.
- Promote free, creative and inductive thinking.
- Respect for the natural environment.

CONTENT:

Opholites (types, origin, evolution, emplacement). Theory of lithospheric plates and ophiolites. Description of petrogenic processes for the formation of a complete ophiolitic complex. Ore deposits in the ophiolithic rocks. Geochemical modeling for

the formation of ophiolites and definition of their geotectonic setting. Boninites, Komatiites and Ophiolite sequences. Meta-somatic processes in ophiolitic rocks. Description of major oph-iolitic occurrences. Low degree metamorphic processes in oph-iolitic complexes. Tethys ophiolites. Ophiolitic complexes of Greek territory and their significance.

TEACHING METHODS:

- Face-to-face lectures
- Practical exercises using samples of minerals and rocks, opti-cal microscopes, electron microscopy and X-ray diffractome-try

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Lecturing:

- Presentations with multimedia content (images, animation, video).

In the Communication with Students:

- Support for learning through the digital e-class platform (announcements, information, messages, notes, presenta-tions, tasks).

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	40
Practical exercises	12
Study visits	8
Study and analysis of literature	39
Writing essays	39
Preparation of students for evaluation	39
Total	**177** hours

STUDENT EVALUATION/GRADING

The student evaluation includes written weekly essays, which cover the modules of the course and oral examination with presentation of the work at PowerPoint in front of the teachers. The final grade is the sum of the grade of the writ-ten essays and the grade of the presentations. The weight will be 60% for the oral presentation and 40% for the written essay.

SUGGESTED LITERATURE

- Ophiolites in Earth History (Dilek, Y. & Robinson, P.T., Geolog-ical Society of Lon-don, 2004)
- Ophiolite Genesis and Evolution of the Oceanic Lithosphere (Peters, Tj., Nicolas, A. & Coleman, R., Springer; 1991).
- Structures of Ophiolites and Dynamics of Oceanic Lithosphere (Nicolas, A, Kluwer Academic Publishers, 1990).
- Mantle and Lower Crust Exposed in Oceanic Ridges and in Ophiolites (Vissers, RLM & Nicolas, A., Kluwer Academic Pub-lishers, 1993).
- A Petrographic Atlas of Ophiolite: An example from the east-ern India-Asia collision zone (Naresh Chandra Ghose, Nilanjan Chatterjee & Fareeduddin, Springer, 2016).
- The igneous rocks of Greece (Piper, D.J.W. & Pe-Piper, G., Borntraeger, 2002).

WEB PAGE:

http://eclass.uoa.gr/courses/GEOL462

ΟΠΠ-Ε19 BASIC PRINCIPLES OF GEO-MICROBIOLOGY WITH APPLICATIONS IN MINERAL RESOURCE EXPLORATION AND THE ENVIRONMENT

Instructors: S. Kilias (kilias@geol.uoa.gr);
E. Chatzitheodoridis(NTUA)
(e.chatzitheodoridis@metal.ntua.gr).

LEVEL/ SEMESTER: 7 / 3RD

TYPE: Specific background, skills development

LECTURES AND PRACTICAL EXERCISES
4 hours of lecturing, 7 ECTS credits.

Prerequisites Although there are no prerequisite course(s), students are advised to have successfully attended the following undergraduate courses, or have acquired equivalent knowledge, before enrolling into ΟΠΠ-Ε19: "Geology of Ore Deposits and Ore Forming Processes", "Mineralogy", "Geochemistry", "Introduction to Microbiology".

Language: Greek / English

Course offered to Erasmus+ students: Yes in English.

LEARNING OUTCOMES

Learning Outcomes

The course focuses on the modern interdisciplinary field of Geobiology/Geomicrobiology, that investigates the interaction and the parallel trajectory of evolution of the geosphere and the biosphere, and especially the intersection of Geology and Microbiology, namely the impact of microbes in geological and geochemical processes and vice versa.

Special focus is given to: The definition of geobiology and geomicrobiology. Overview of the role of microbial and bacterial processes in geological and geochemical processes. Microbial processes with geochemical/geoenvironmental importance. Bacteria and Metallogeny: A) Bacteria and liberation of metals from minerals and rocks, B) Ore minerals as source of energy for bacterial processes, C) The role of bacteria in the direct deposition and concentration of metals in minerals. Examples from different types of deposits in terrestrial and submarine environments. Environmental applications in bioremediation methods.

At the end of the course the student should have acquired:

- The ability to understand the subjects of biological processes (e.g., bacterial metabolism) that are connected with redox reactions with carbon, sulfur, nitrogen and different metals (e.g., iron, manganese, gold etc.), from the appearance of life on Earth until today, and the impact of bacteria in the concentration of metals in economic deposits.
- Fundamental knowledge and skills for the research of biogenic ore and gangue minerals.
- Knowledge of combined basic interdisciplinary mineralogical/mineral chemical, geochemical and microbiological methods of research for the determination of biogenic mineral-bearing precious and critical metals

General Competencies

- Research, analysis and synthesis of geobiological/geomicrobiological data and information taking advantage of the use of appropriate technologies
- Independent coursework
- Team coursework
- Decision making
- Development of new scientific ideas
- Respect to the natural environment

CONTENT:

A. Course Lectures

The presentations of the Course contain the development of the following subject fields:

- Microbial diversity, the structure of microbe cells (prokaryotic and eukaryotic) and of their metabolism, microbial processes with environmental importance, elements of microbial genetics and ecology and introduction in the variety of microbiological technics.
- Microbial processes with geochemical/geoenvironmental importance: primary production, production and consumption of atmosphere gasses (CO2, CH4, N2O), acidic mine drainage, and dissolution/leaching of minerals, bioremediation of metals (Au, U, Zn, Cu), biomineralization (sedimentary carbonate minerals, sedimentary siliceous minerals, elemental sulfur, sulfides, magnetite, hematite, manganese oxides etc.,).
- Microorganisms and environment - Biogeochemical cycles: Cycles of carbon, hydrogen, oxygen, nitrogen, sulfur, phosphorous, iron, manganese, etc.
- Geomicrobiology of ore deposits. Bioprocesses and Banded Iron Formations (BIF's).
- Microbial systems for the management of organic pollutants. Bioavailability. Bioremediation.
- Basic methods of examination and laboratory analysis of microorganisms and biogenic minerals.

B. Laboratory exercises:

Microbiological nutritious substrates - Aseptic work methods - Sterilization.

Determination of the metabolic activity of the microbial population in the soil.

Optical and electronic properties of biogenic minerals. Optical microscopy technics in transmitted and reflected light microscopy, and scanning electron microscopy for the mineralogical, morphological and textural characterization of biogenic metallic minerals with examples from Greece.

C. Field Trips:

Sampling methods for Geomicrobiological examination in areas of mining metallurgical activity, e.g. Lavrion, Milos etc.

TEACHING METHODS:

- In person lectures
- Lab exercises.
- Educational field trips in mining and metallurgical areas.

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

Teaching:

- Presentations ppt of the course lectures as well as relative bibliographic material are found on the website of the course at the e-class platform.

Communication with Students:

- The e-class platform provides opportunities of direct communication with the students, submission of coursework and exercises, etc.

BREAKDOWN OF WORKLOAD

Activity	Φόρτος Εργασίας Εξαμήνου
Lectures and seminars	4h x 9w = 36h
Metallographic microscopy lab exercises	4h x 4w = 16h
Literature study-Homework	90h
Field trip	20h
Preparation of students for finals assessment	50h
Total	**212** hours

STUDENT EVALUATION/GRADING

Students are examined in Greek/English language. The final assessment involves a series of requirements including:

a. The students choose a topic for ***Public Oral Presentation (ppt)*** from a bank of topics relevant with one of the subject sessions, that are developed in the context of the Course (see Course content) (**40% of the final grade**).

b. Lab examination with a) Short answer questions that evaluate the critical thinking of the students on the methods and practices that they were taught, b) Problems that evaluate their skills in analysis and synthesis of data and information and c) Exercises for the evaluation of their ability in inductive thinking and their ability to apply this newfound knowledge for the resolve of research problems (**40% of the final grade**).

c. Essays/Reviews, relevant with sampling and analysis assign

SUGGESTED LITERATURE

- ***"Introduction to Geomicrobiology"*** by Kurt O. Konhauser (ISBN-13: 978-0632054541
- ISBN-10: 0632054549). Introduction to Geomicrobiology is a timely and comprehensive overview of how microbial life has affected Earth's environment through time. It shows how the ubiquity of microorganisms, their high chemical reactivity, and their metabolic diversity make them a significant factor controlling the chemical composition of our planet.

WEB PAGE:

http://eclass.uoa.gr/courses/GEOL560

ΟΠΠ-Ε20 ENVIRONMENTAL MINERALOGY AND PETROLOGY – MEDICAL GEOLOGY

Instructors: A. Godelitsas (agodel@geol.uoa.gr); S. Kilias; H. Vasilatos; I. Megremi.

LEVEL/ SEMESTER: 7 / 3RD

TYPE: Special knowledge, skills development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 8 ECTS credits.

Prerequisites: NO

Language: Greek and English

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

On completion of the Course the postgraduate student should have the following learning outcomes defined in terms of knowledge and skills:

Understands the importance of specific minerals & rocks (carbonates, Fe and Mn ox-ides/oxyhydroxides, zeolites, clay minerals) in environmental issues; can explain how potentially hazardous chemical elements (As, Hg, Pb, Cr, Th, U) behave in the environment; demonstrate how a key dissolved element, such as Pb, interacts with carbonate and aluminosilicate mineral surfaces; evaluate which methodology and techniques (including the use of Large-Scale Facilities) are appropriate for solving an Environmental Mineralogy & Petrology problem; knowing the basics of bio-mineralogy and the fundamentals of Medical Geology; getting well-informed about recent advances in fibrous minerals reactivity and for modern techniques being used in asbestos characterization.

General Competencies

The postgraduate student can formulate an opinion on a scientific problem in a short essay; present a scientific topic in a clear and ordered way; collaborate with others during laboratory work in a constructive manner.

CONTENT:

The nature and scope of environmental mineralogy & petrology; potentially hazardous elements (e.g. As, Hg, Pb, Cr, U) and molecules -contaminants/pollutants- and their minerals; (bio)geochemical cycles and (bio)geoavailability; minerals & rocks related to environmental issues and technology (carbonates, Fe and Mn oxides/oxyhydroxides, zeolites, clay minerals); microporous and nanoporous minerals; specific surface area, ion exchange capacity and ζ-potential; geochemical stability of minerals, solubility product (Ksp), dissolution rate (R), weathering; mineral surfaces - interactions at mineral-water interface; ion-exchange, adsorption, surface complexation, surface precipitation, crystal nucleation and growth; nanogeosci-

ence and the role of nanominerals and mineral nanoparticles in environmental mineralogy & petrology and ore/economic geology; analytical, microscopic, and spectroscopic laboratory techniques with emphasis in micro- and nano-scale; use of Large-Scale Facilities (Synchrotrons and particle accelerators); recent examples of environmental mineralogy & petrology of As, Hg, Pb, Cr, Th, U; example of Pb2+aq interaction with calcite and zeolite surfaces; environmental mineralogy of Acid Mine Drainage (AMD); actinide mineralogy and geochemistry, radioactivity and related Earth materials & wastes; basics of Medical Geology, biominerals, kidney stones and gallstones; atmospheric micro- and nano-particles, Saharan dust; asbestos, serpentine and amphibole group fibrous minerals, the role of surface Fe (Fenton's reaction); microscopic and spectroscopic techniques for asbestos characterization.

TEACHING METHODS:

- Lectures/seminars
- Laboratory work and exercises
- Homework essays

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

- Presentations with multimedia content (images, animation, video)
- Free access in personal websites of the coordinator/instructors (http://users.uoa.gr/~agodel/Arxeia/Courses/POSTGRAD%20COURSE_ENV%20MINERAL_NOV06.pdf); all electronic platforms open for communication, announcements, evaluation, etc.

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	4h x 13w
Practical Training	2h x 13w
Homework – includes preparation time for final examinations.	12h x 13w
Total	**234** hours

STUDENT EVALUATION/GRADING

The postgraduate student examination includes written essay on a subject suggested by the teachers in co-operation with the trainees and an oral exam with a presentation of the essay in the form of .ppt. The final grade is the sum of the grade of the written essay and the score of the presentation. The weight will be 60% for the oral presentation and 40% for the written essay. **To pass the Course, a minimum grade 5 (out of 10) is necessary.**

SUGGESTED LITERATURE

- https://www.amazon.co.uk/Environmental-Mineralogy-Interactions-Anthropogenic-Mineralogical/dp/0903056208
- http://www.minsocam.org/msa/EMU_Notes/EMU002.html
- http://www.minsocam.org/msa/EMU_Notes/EMU013.html
- http://www.minsocam.org/msa/rim/rim49.html
- https://www.wiley.com/en-us/Chemistry+of+the+Solid+Water+Interface%3A+Processes+at+the+Mineral+Water+and+Particle+Water+Interface+in+Natural+Systems-p-9780471576723
- https://www.sciencedirect.com/science/article/pii/S1631071311000046
- http://science.sciencemag.org/content/319/5870/1631.long
- http://repositorio.uchile.cl/bitstream/handle/2250/133488/The-rapid-expansion-of-environmental-mineralogy-in-unconventional-ways.pdf?sequence=1
- https://www.ingentaconnect.com/content/asp/asl/2017/00000023/00000006/art00197;jsessionid=bhb9cmabo7o9s.x-ic-live-02
- https://pubs.acs.org/doi/10.1021/es020238i#
- https://www.sciencedirect.com/science/article/abs/pii/S1387181103003524?via%3Dihub
- https://www.sciencedirect.com/science/article/pii/S0169131718302709?via%3Dihub
- https://www.sciencedirect.com/science/article/pii/S0304420315300426?via%3Dihub
- https://www.sciencedirect.com/science/article/pii/S0168583X11004149?via%3Dihub
- http://www.minsocam.org/msa/rim/rim64.html
- https://www.researchgate.net/publication/298572446_Medical_geology_new_relevance_in_the_earth_sciences
- https://hardylab.chem.umass.edu/wp-content/uploads/2017/08/HardyChemReviews1995.pdf
- https://www.researchgate.net/publication/301359108_Microscop-ic_and_Spectroscopic_RAMAN_LIBS_Characterization_of_Asbestos_minerals_in_building_materials_of_Athens_Greece
- https://pubs.geoscienceworld.org/msa/ammin/article-abstract/96/8-9/1414/45448/differences-in-fe-redox-for-asbestiform-and?redirectedFrom=fulltext
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3041679/

WEB PAGE:

NOT AVAILABLE

ΟΠΠ-Ε21 INDUSTRIAL MINERALS AND CYCLIC ECONOMY

Instructors: Charalambos Vasilatos (vasilatos@geol.uoa.gr).

LEVEL/ SEMESTER: 7 / 3RD

TYPE: Specific background, skills development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 8 ECTS credits.

Prerequisites: NO

Language: Greek / English

Course offered to Erasmus+ students: Yes in English.

LEARNING OUTCOMES

On completion of the course the student should be able to:

- Describe the modern applications of industrial minerals and their contribution to sustainable development.
- Describe the techniques and the environmental parameters for terrestrial and underwater mining.
- Assess the quality of industrial minerals and rocks according to their applications in the context of sustainable development.
- Decide on and use the most appropriate methodologies for the identification and evaluation of industrial minerals and rocks.
- Identify and describe industrial minerals and rocks, their properties and uses as well as their exploration and evaluation methods.
- Use field and laboratory techniques and to contribute in projects for the exploration and evaluation of industrial minerals resources.
- Combine his knowledge for the synthesis of technical reports and decision-making regarding the research and exploitation of mineral raw materials and the protection of the environment.
- Participate in the research and development of applications for the utilization of mineral by-products, as well as in the development of secondary uses after the end of the life cycle of those materials.
- Report his findings in technical papers and presentations.
- Will have realized the importance in the 21st century of the utilization of Industrial Minerals in the context of the circular economy for a sustainable development.

General Competencies

- Independent work
- Team work
- Decision making
- Development of new scientific ideas
- Respect to the natural environment

CONTENT:

A. Course Lectures

- Advanced usage of industrial minerals.
- Industrial minerals and sustainable development.
- Carbon balance during the production and applications of industrial minerals.
- Contribution and role of industrial minerals in addressing the climate crisis.
- Methodologies for exploration and evaluation of industrial minerals and rocks.
- Technical and environmental studies for the exploration, characterization, and extraction of industrial minerals.
- Technical and environmental factors of terrestrial and underwater mining.
- Legal framework and licensing procedures for exploration and mining activities.
- Techniques for evaluating the quality of industrial minerals and rocks according on the application: Cement, aggregates, mortars, pigments, coatings, soil improvers, fillers, ceramics, glass, plastics, paper, elastomers, adhesives, etc.
- Environmental applications.
- Research and development for utilization of mining by-products.
- Research and development of secondary uses after the end of the life cycle of the above products.

B. Laboratory and Practical Exercises:

Laboratory testing and determination of selected properties of industrial minerals.

Experimental application of industrial minerals to deal with environmental problems (environmental restoration).

Manufacturing of lightweight aggregates for use in geotechnical and agricultural applications.

Experimental applications by the utilization of mineral by-products.

Laboratory tests of secondary uses after the end of the life cycle of materials.

C. Fieldwork:

on site the identification, sampling, assessment, and mapping of Industrial Minerals, mining by-products and end-of-life materials that can be exploited in a cyclic economy context.

TEACHING METHODS:

- Face to face
- Laboratory exercises.
- Educational field trips.
- Homework and essays.

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In teaching:

- Powerpoint presentations and relevant bibliographic material.

In communication with Students:

- The web page of the course in the asynchronous education platform of the N.K.U.A provides opportunities of direct communication with the students, submission of coursework and exercises, etc.

BREAKDOWN OF WORKLOAD

Activity	Φόρτος Εργασίας Εξαμήνου
Lectures and seminars	4h x 9w = 36h
Laboratory Work	4h x 6w = 24h

Bibliography study & analysis	68h
Fieldwork	12h
Evaluation of results and report writing of laboratory exercises	50h
Essay compilation and writing	70
Total	**230** hours

STUDENT EVALUATION/GRADING

Student assessment is in Greek (English for Erasmus+ students). The final grade is derived from a combination of examimations, tests and essays that include:

- Presentation of assigned work (in the form of review on topics associated with Industrial Minerals in relation to Cyclic Economy).
- Laboratory exercises, Problem solving and reporting during laboratory work.
- Participation in fieldwork and composing relevant reports

SUGGESTED LITERATURE

Προτεινόμενη Βιβλιογραφία:

- Ciullo A.P. Industrial minerals and their uses. A Handbook & Formulary. Elsevier, 647 pages (1996)
- Ι.Γ.Μ.Ε. Ελληνικός Ορυκτός Πλούτος – Νέες αναπτυξιακές δυνατότητες για βιώσιμες και παραγωγικές επενδύσεις (2011)
- Tsirabidis, A., The mineral wealth of Greece, Jachoudi Publications (2015)

Συναφή επιστημονικά περιοδικά:

- Industrial Minerals
- Sustainability (MDPI)
- Waste and biomass valorization (Springer)
- Cement and concrete composites (Elsevier)
- International Journal of Mineral Processing (Elsevier)
- Resources, Conservation & Recycling, Elsevier
- Recycling, (MDPI)

WEB PAGE:

https://eclass.uoa.gr/courses/GEOL625/

4.3. SPECIALIZATION: CLIMATIC VARIATIONS AND IMPACT ON THE ENVIRONMENT

4.3.1 LIST OF COURSES

1st SEMESTER

Mandatory Courses		Hours per week	ECTS
ΚΜΠ-Υ01	GEOSYSTEMS	4	8
ΚΜΠ-Υ02	ENVIRONMENTAL STRATIGRAPHY AND APPLICATIONS	4	8
ΚΜΠ-Υ03	METHODS OF APPLIED RESEARCH IN GEOSCIENCES – METHODS OF ENVIRONMENTAL DATA ANALYSIS	4	7
ΚΜΠ-Υ04	ENVIRONMENTAL GEOMORPHOLOGICAL PROCESSES – BIOGEOCHEMICAL CYCLES	4	7
	Total	**16**	**30**

2nd SEMESTER

Mandatory Courses		Hours per week	ECTS
ΚΜΠ-Υ05	GEOGRAPHIC INFORMATION SYSTEMS IN ENVIRONMENTAL APPLICATIONS	4	8
ΚΜΠ-Υ06	ENVIRONMENTAL SEDIMENTOLOGY	4	8
ΚΜΠ-Υ07	CLIMATE VARIABILITY (PALEOCLIMATE) AND CLIMATE CHANGE (ANTHROPOCENE)	4	7
ΚΜΠ-Υ08	QUATERNARY GEOENVIRONMENT-GEOARCHAEOLOGY	4	7
	Total	**16**	**30**

3rd SEMESTER

Elective Cources (two of 8 ECTS/ one of 7 ECTS)		Hours per week	ECTS
ΚΜΠ-Ε01	MARINE PALAEOECOLOGY	4	8
ΚΜΠ-Ε02	PALAEOCEANOGRAPHIC AND PALAEOCLIMATIC INDICES	4	8
ΚΜΠ-Ε03	PALAEONTOLOGY AND BIODIVERSITY	4	7
ΚΜΠ-Ε04	BIOSPHERE AND GEOENVIRONMENTAL APPLICATIONS	4	7
ΚΜΠ-Ε05	GEOHAZARDS AND SEDIMENTOLOGY	4	7
ΚΜΠ-Ε06	APPLIED HYDROLOGY	4	8
ΚΜΠ-Ε07	SUBMARINE GEOMORPHOLOGY – COASTAL ZONE MANAGEMENT	4	7
ΚΜΠ-Ε08	REMOTE SENSING AND SATELLITE DATA APPLICATIONS	4	7
ΚΜΠ-Ε09	APPLIED AND KARSTIC GEOMORPHOLOGY	4	8
ΚΜΠ-Ε10	NATURAL HAZARDS AND HUMAN IMPACT ON THE ENVIRONMENT	4	8
	Total	**16**	**30**

4th SEMESTER

Postgraduate Dissertation		30
	Total	**30**

4.3.2 OUTLINES

4.3.2.A. MANDATORY COURSES

ΚΜΠ-Υ01 GEOSYSTEMS

Instructors: P. Nastos (nastos@geol.uoa.gr); S. Poulos; K. Eleftheratos.

LEVEL/ SEMESTER: 7 / 1st

TYPE: Background Knowledge, Skills Development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 7 ECTS credits.

Prerequisites: There are no prerequisite courses, though the knowledge acquired from the successful attendance of the first semester courses is considered necessary:
ΚΜΠ-Υ03. Methods of applied research in geosciences - Methods of environmental data analysis
ΚΜΠ-Υ04. Environmental geomorphological processes - Biogeochemical cycles

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The aim of the course is to describe the main features of the four main systems (or spheres) that make up planet earth (the hydrosphere, the atmosphere, the lithosphere and the biosphere) and how they interact continuously and adapt to internal and external factors. Upon successful completion of the course, students will be able to understand and explain:

- the basic processes that determine the Hydrosphere, i.e. the oceans and fresh water (rivers, lakes and underground waters) and the cryosphere (where water is a solid, i.e. ice or snow, ice caps, glaciers and permanently frozen ground.
- The characteristics and composition of the Atmosphere and its individual units (troposphere, stratosphere, mesosphere and thermo-sphere). Conditioning of climatic conditions, as well as the wind regime
- The lithosphere is the term given to the rock and minerals which form Earth's outer crust and its tectonic plates. This is an important part of the Earth's system as these rocks become eroded and weathered to provide important minerals to the other Earth systems. At the outermost layer of the lithosphere, the 'pedosphere' (meaning soil sphere) exists at the interface between lithospheric, atmospheric, biospheric and hydrospheric processes.
- The biosphere, which refers to all types of life on Earth, including plants, animals and bacteria. Over the history of the Earth the biosphere has changed considerably with a great number of species evolving, adapting, and becoming extinct. It examines its diversity and its relation to the climate.

Skills

Students will be able to

- Recognize and discuss the factors of the four main and individual spheres of the earth system. Understanding lithosphere-ocean-atmosphere- biosphere interactions
- Communicate the history of the evolution of the earth in relation to the presence of man.

General Competencies: The general competencies that students should have upon completion are the following:

- Production of free, creative and inductive thinking
- Ability to apply knowledge to problem solving
- Search, analysis and synthesis of data and information, by the use of the necessary technology
- Decision making
- Working independently
- Team work
- Working in an interdisciplinary environment
- Respect of natural environment
- Promoting free, creative and inductive thinking

CONTENT:

Lectures

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

- Atmosphere (troposphere, stratosphere, mesosphere, thermosphere)
- Components of the global climate system, distribution of basic climatic elements, natural climatic variability in different space and time scales, atmosphere - ocean interaction, atmospheric oscillations (ENSO, MJO, NAO, etc.), coercive and feedback mechanisms
- Observed signals of climate change in the human-knot, climate change factors (natural and man-made)
- Basic principles of operation of climate models, climate change scenarios and climate simulations, uncertainties related to future projections of global climate change
- Hydrosphere (hydrological cycle) involving oceans? fresh water (rivers, lakes and groundwater) and the cryosphere (ice, ice caps, permanently frozen ground)
- Sea currents - Sea Waves, Tiller - Sea level
- Lithosphere (rocks, minerals)
- Lithosphere and tectonic plates (description, evolution)
- Basic geomorphological processes (lithosphere - atmosphere - hydrosphere)
- Soil, as a result of lithospheric, atmospheric, biospheric and hydrospheric processes
- Biosphere (animals and plants), species evolution and biosphere-climate relationship.

TEACHING METHODS:

- Face to face (lectures and seminars)
- Use of PC, tablets, smartphones and specialized software
- Access to databases and scientific libraries
- Demonstration of method and techniques used in Climatology and Palaeoclimatology
- Possibility of distance learning (e-exercises) and communication (discussion areas, blogging, messages, etc.) via the electronic platform e-class of NKUA.

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Lecturing:

- Presentations with multimedia content (images, animation, and video) and demonstration of methods of analysis, simulation and interpretation of data.

In the Communication with Students:

- Support of learning process through e-Class (communication, information, messages, documents, tasks, questionnaires, exercises, diaries, user groups, multimedia, links, rating, e-book, etc.) with 24/7 availability for communication, material distribution, queries.

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	52 (13x4)
Fieldwork	20
Non-Guided Study (Required Repetition, Material Study, Preparation of intermediate essays)	50
Final essay writing	50
Total	**172** hours

STUDENT EVALUATION/GRADING

The evaluation process is in Greek (possibility of evaluation in English for Erasmus students), and includes:

- Examination through short essays / exercises during semester
- Final essay on a topic chosen by the students with teacher guidance

SUGGESTED LITERATURE

Bibliography

- Raymond S. Bradley, Paleoclimatology-Reconstructing Climates of the Quaternary, 3rd ed, Wiley (2015)
- Roger G. Barry, Eileen A. Hall-McKim, Essentials of the Earth's Climate System, 1st ed, Cambridge University Press (2014)

Scientific journals:

- Kasting, J. F., & Crane, R. G. (2004). The Earth system. Prentice-Hall.
- Butz Stephen, 2007. Science of Earth Systems(2nd edition), Cengage Learning US, 720p.
- Jacobson Michael, Charlson Robert, Rodhe Henning Orians Gordon, 2000. Earth System Science. Biogeochemical Cycles to Global Changes Volume 72 1st edition).
- Ernst, W. G. (editor) 2000. Earth Systems, Processes and Issues Stanford University, California
- Climatic Change, Springer
- Nature Climate Change, Springer
- Global Environmental Change, Elsevier

Additional Material: Lectures notes, lectures presentations, essay material on the e-class platform

WEB PAGE:

NOT AVAILABLE

ΚΜΠ-Υ02 ENVIRONMENTAL STRATIGRAPHY AND APPLICATIONS

Instructors: M. Triantafyllou (mtriant@geol.uoa.gr); I. Panagiotopoulos ; Th. Tsourou; N. Tsaparas.

LEVEL/ SEMESTER: 7 / 1st

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 8 ECTS credits.

Prerequisites: None

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

Upon successful completion of the course students will be able to understand the concepts and methods used to study the stratigraphy of natural environments, including field observation and sampling, laboratory analysis, and interpretation of data.

- To identify and classify different types of sediment, and rock, and understand the processes that formed them.
- To understand how environmental factors such as climate, vegetation, and human activities affect the formation and preservation of stratigraphic layers.
- To learn to use stratigraphy to reconstruct past environmental conditions and to predict future changes in the environment.
- To understand the role of stratigraphy in environmental assessment and management, such as identifying and mitigating contamination and erosion, and preserving archaeological and paleontological sites.
- To develop critical thinking skills through the analysis and interpretation of data to understand the earth's past, present and future.
- To understand the importance of stratigraphy in the context of broader earth-science and environmental studies.

General Competencies:

- Research, analysis and synthesis of data and information with the use of necessary technologies
- Autonomous work
- Working in an interdisciplinary environment Promoting free, creative and inductive thinking

CONTENT:

Lectures

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

- Description and analysis of numerous microfossil-, macrofossil-, tracefossil-indices combined with sedimentary and geochemical data in high resolution sedimentary records in order to detect and determine (paleo)environmental variability due to natural and/or anthropogenic stressors (e.g., pollution, eutrophication, climate change, tectonic deformation).
- Biostratigraphy, Chronostratigraphy, Geochronology
- LIthostratigraphy, Cyclostratigraphy
- Magnetostratigraphic applications
- Chemostratigraphic applications
- Ecostratigraphic applications
- Tectonostratigraphic applications

TEACHING METHODS:

- Presentations-teaching with specified software (ppt etc.)
- Communication via e-mail

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures of the instructor, practical work and oral presentations of the students	52h (13 weeks x4h)
Independent study	90h
Writing of the research paper	30h
Final written examination	30h
Total	**175** hours

STUDENT EVALUATION/GRADING

NOT AVAILABE

SUGGESTED LITERATURE

Bibliography

Electronic sources and peer reviewed papers provided throughout the course.

WEB PAGE:

NOT AVAILABLE

ΚΜΠ-Υ03 METHODS OF APPLIED RESEARCH IN GEOSCIENCES – METHODS OF ENVIRONMENTAL DATA ANALYSIS

Instructors: K. Eleftheratos (kefef@geol.uoa.gr); E. Vassilakis; E. Stathopoulou.

LEVEL/ SEMESTER: 7 / 1st

TYPE: Specialized background, general knowledge, skills development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 7 ECTS credits.

Prerequisites: There are no prerequisites, but basic knowledge on geo-environmental issues is required

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

Knowledge

- Statistical analysis, remote sensing, geographic information systems and sampling of geo-environmental data. Knowledge of how laboratory instruments function.

Skills

- Application of specialized software for the analysis of geo-environmental data (geographic information systems, software packages for photogrammetry, R-project programming language, statistical software, 2D and 3D graphs). Skills in the use of appropriate laboratory techniques for treatment and preparation of samples.
- Processing, analysis and display of geo-environmental data from international databases. Improved abilities of laboratory processes and safety procedures.

General Competencies

- Search, analysis and synthesis of data and information, using the necessary technolo-gies
- Decision making
- Autonomous work
- Teamwork
- Working in an interdisciplinary environment
- Respect for the natural environment
- Promotion of free, creative and inductive thinking

CONTENT:

Simple linear model, general linear model, multivariate analysis, time series analysis (homogeneity test, time series gaps filling, trends, normalization, periodicity), spatial and temporal analysis of atmospheric data.

The contribution of state of the art remote sensing techniques in environmental research, global position systems, high resolution relief representation techniques, applications of geographic information systems in physical and environmental geography.

Functions and applications of laboratory instruments. Laboratory techniques for treatment and preparation of samples, optical and Scanning Electron Microscope techniques.

TEACHING METHODS:

- Face-to-face lectures
- Practical exercises using PC
- Field exercises

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

- PowerPoint presentations, slide presentations
- Exercises using specialized software
- Field exercises
- Oral communication with students, Communication through the e-Class electronic platform

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	24 (4 h x 6 w.)
Laboratory exercises	16 (4 h x 4 w.)
Field exercises	8 (4 h x 2 w.)
Project and paper writing	127 h
Preparation for exams	7 h
Total	**175** hours

STUDENT EVALUATION/GRADING

- Evaluation in the Greek language
- Written work
- Multiple choice tests
- Short answer questions
- Oral examinations

SUGGESTED LITERATURE

- Printed notes
- Electronic sources from teachers

WEB PAGE:

https://eclass.uoa.gr/courses/GEOL458

ΚΜΠ-Υ04 ENVIRONMENTAL GEOMORPHOLOGICAL PROCESSES – BIOGEOCHEMICAL CYCLES

Instructors: P. Nomikou (evinom@geol.uoa.gr); M. Chatzaki; M. Triantafyllou; I. Panagiotopoulos.

LEVEL/ SEMESTER: 7 / 1st

TYPE: Specialized background

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 7 ECTS credits.

Prerequisites: NO

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The current course focuses on the understanding of the fundamental atmospheric and physical processes of the geoenvironment as well as of the repetitive bidirectional 'cyclic' processes of vital elements such as C, N, P, O and S among the abiotic environments (i.e., atmosphere, hydrosphere and lithosphere) and biosphere. Upon successful completion of the course, the students will be able:

- To understand the processes associated with extreme weather and climate phenomena (such as floods, droughts, sea level rise) as well as their devastating effects on the natural and social environment
- To study the recent geomorphological evolution of the terrestrial and submarine relief and understand its alteration due to the anthropogenic interventions and physical processes
- To understand the need for the preservation of the balance in the Biogeochemical Cycles in order the proper functioning and sustainability of the ecosystems on Earth to be accomplished and realize the magnitude of the human impact on the disruption of these Cycles
- To identify the scientific gaps and choose the appropriate methodology for the interpretation and management of complex environmental problems

General Competencies

The skills that students can acquire during the present course are:

- Research potential and ability to process, analyze and integrate scientific data using the available technology tools
- Decision-making ability
- Ability to complete a scientific task in an autonomous way
- Ability to promote effective teamwork
- Ability to emerge new scientific challenges
- Ability to promote free, creative and inductive thought

CONTENT:

A. Theoretical Knowledge

The course presentations include the following scientific topics:

- Energy distribution in the earth-atmosphere system and interactions of radiation with matter, with emphasis on the role of the atmosphere through its variability.
- Atmospheric processes in different space and time scales. Atmospheric oscillations of large-scale (e.g. NAO, ENSO, etc.) and their interaction with land and sea.
- Physical Processes (Terrestrial - Atmospheric - Marine) in different environments
- Analysis of the origin and evolution of major landforms and coastal features created by the physical, chemical or biological processes operating at or near the Earth's surface (synthesis, conclusions)
- Assessment of Geological Hazards induced by natural processes and/or human interventions and ways of facing their consequences
- Mechanisms of the Carbon, Nitrogen, Phosphorus, Oxygen and Sulfur cycles. Introduction to the concepts of Reservoir and Biological Pump
- Marine Biochemistry: Analysis of the structure of the main organic compounds in the marine environment - Description of the origin of the marine organic matter and analysis of the physical and chemical processes that govern its transport, deposition and maintenance/degradation on the seabed
- Analysis of the basic anthropogenic effects on the smooth operation of the Biogeochemical Cycles. Predictions for the future evolution of the Biogeochemical Cycles and description of the adverse impacts on humans as well as on the rest of the living beings due to the continuous disruption of their balance

B. Practical Exercises – Laboratory work

Part A: Factors of the earth-atmosphere energy balance. Atmospheric processes and their interactions with land and sea

Part B: Identification of landforms and coastal landscapes, classification and processing of topographic data. Environmental risk assessment

Part C: Understanding of the quantitative and qualitative information derived from the bio-chemical reactions - Stoichiometry, chemical equilibrium, calculation of the theoretically or biochemically required oxygen during the oxidation processes concerning a variety of compounds

TEACHING METHODS:

- Face-to-face teaching
- Multiple-choice comprehension test
- Laboratory exercises through training with specialized software

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

- Application of information technology during teaching
- Support of the learning process with the electronic platform e-class
- Electronic communication with students

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures and exercises of data processing with PC's	32 (4 h x 6 w.)
Laboratory practice	16 (4 h x 4 w.)
Homework / Literature review	68 h

Project / Practical exercises	80 h
Total	**196** hours

STUDENT EVALUATION/GRADING

Language of evaluation: Greek (English for the Erasmus students)

- Written essay on a subject selected from a list of avail-able topics / Oral presentation of the topic (**65%**)
- Short individual practical exercises including the appli-cation of various methodologies for the solution of relevant prob-lems (**35%**)

SUGGESTED LITERATURE

- Embleton C., Embleton-Hamann C. (1997). Developments in Earth Science Processes 5: Geomorhological Hazards of Eu-rope. Elsevier, Amsterdam.
- Huggett R.J. (2007). Fundamentals of Geomorphology, Se-cond Edition. Routledge, Taylor & Francis Group, New York.
- United States Department of Energy (2008). Carbon Cycling and Biosequestration: Integrating Biology and Climate through Systems Science. Report DOE/SC 108, Office of Sci-ence.
- Libes S. (2009). Introduction to Marine Biochemistry, Second Edition. Elsevier, Amsterdam. https://booksite.elsevier.com/9780120885305/
- Davidson-Amott R. (2010). An Introduction to Coastal Pro-cesses and Geomorphology. Cambridge University Press, New York.
- R. G. Barry, E. A. Hall-McKim (2014). Essentials of the Earth's Climate System, 1st ed., Cambridge University Press.

Journals:

- Journal of Earth System Science, Springer
- Climate Dynamics, Springer
- Climate and Atmospheric Science, npj
- Geomorphology
- Progress in Physical Geography: Earth and Environment
- Geosciences
- Global Biogeochemical Cycles
- Biogeochemistry
- Organic Geochemistry

Additional Material: Additional bibliographical sources are avail-able via this course webpage (e-class)

WEB PAGE:

https://eclass.uoa.gr/courses/GEOL465

ΚΜΠ-Υ05 GEOGRAPHIC INFORMATION SYSTEMS IN ENVIRONMENTAL APPLICATIONS

Instructors: N. Evelpidou (evelpidou@geol.uoa.gr); E. Vass-ilakis; A. Karkani.

LEVEL/ SEMESTER: 7 / 2nd

TYPE: Specialized background, specialization of general knowledge, skill development

LECTURES AND PRACTICAL EXERCISES

Lectures, Practical exercises

4 hours of lecturing per week, 8 ECTS credits.

Prerequisites NO

Language: Greek (Ε.Φ.[1] English)
Course offered to Erasmus+ students: YES

LEARNING OUTCOMES

Learning Outcomes

This course aims to a better understanding of Geographic Infor-mation Systems and its basic principles, remote sensing data and geographical data processing as these are necessary tools for geosciences. The students will become familiar with Geographic Information Systems in a theoretical and practical level, through the use of suitable software

General Competencies

- Search, analysis and composition of data and information by using the necessary technologies
- Theoretical thinking and ability to turn theory into practice
- Problem solving ability through application of knowledge
- Independent work
- Team work
- Work in interdisciplinary environment
- Respect of the natural environment
- Promotion of free, creative and inductive thinking

CONTENT:

Introduction to digital cartography, G.I.S. Theory, Introduction to ArcGIS, GIS operation method, Geo-reference, Digitization, Management of Geographical and Descriptive Information, Im-port Data: Vector and Raster, Data Analysis, Thematic Cartog-raphy, Map Composition, Digital Elevation Models, GIS applica-tions in Geosciences, Modelling erosion, flood risk and coastal erosion.

TEACHING METHODS:

- Lectures in person
- Practical exercises using computers.

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Lecturing:

- Presentations with multimedia content (images, animation, videos). Specialized GIS software

[1] Ε.Φ.: Επισκέπτες Φοιτητές (π.χ. ERASMUS)

In the Communication with Students:

- Support of learning process through e-class (an-announcements, information, messages, essays, questionnaires, exercises, calendar, user groups, links, marks, e-book, etc.).

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	13
Laboratory exercises	39
Unsupervised study	60
Preparation semester assignment	88
Total	**200** hours

STUDENT EVALUATION/GRADING

Evaluation Language: Greek (English for Erasmus students).

- Performance during lectures **50%** (laboratory exercises and teaching)
- Project in the end of semester **50%** (oral presentation)

SUGGESTED LITERATURE

Textbooks:

- Evelpidou, N., Antoniou, V., 2015. Geographic Information Systems [ebook]. Hellenic Academic Li-braries Link, Athens. Available Online at: http://hdl.handle.net/11419/1044
- Vaiopoulos D., Vasilopoulos A. Evelpidou N., 2008. GIS from theory to practice. Symmetria, Athens.
- Koutsopoulos K., Evelpidou N., Vasilopoulos A., 2006. Geographical Information Systems by using MapInfo professional. Papasotiriou, Athens

Journals:

- GIS and Remote Sensing Journal
- Journal of Geographic Information System
- Transactions in GIS
- International Journal of Advanced Remote Sensing and GIS

Additional bibliographic sources and lecture contents are available to students who are participating in this lesson through the respective e-class website.

WEB PAGE:

https://eclass.uoa.gr/courses/GEOL304

ΚΜΠ-Υ06 ENVIRONMENTAL SEDIMENTOLOGY

Instructors: H. Drinia (cntrinia@geol.uoa.gr) ; I. Panagiotopoulos ; G. Kontakiotis; P. Makri.

LEVEL/ SEMESTER: 7 / 2nd

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 8 ECTS credits.

Prerequisites: None

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The content of this course provides graduate students with a working knowledge of environmental sedimentology: main concepts, issues and methods of the sedimentary systems and environmental changes due to anthropogenic activities. Upon successful completion of the course, students should be able to:

- Fully explain the fundamental concepts of environmental sedimentology
- Carry out studies in the sedimentary environments and to identify the present day environmental changes due to anthropogenic activities.
- Develop critical and creative thinking and communication skills
- Solve problems related to sedimentological research in all environments
- Produce, analyse and compare data with the use of reliable and applied technologies
- Wonder, arise questions and make decisions on the right management of problems deriving in urban sedimentary environments

General Competencies

- Theoretical thinking and ability to convert theory into practice
- Ability to solve problems
- Search, analysis and synthesis of data and information, using the necessary technologies
- Decision making
- Autonomous work
- Teamwork
- Working in an interdisciplinary environment
- Respect for the natural environment
- Promote free, creative and inductive thinking

CONTENT:

- Introduction on the impact of present day environmental change due to anthropogenic activities including modification of sedimentary systems. Response of ever evolving sedimentary systems to sediment budgets and pollution. Change and vulnerability of sedimentary environments due to climatic and direct anthropogenic impact to:

- Continental settings
- Coastal settings
- Open sea settings
- Synthetic exercise (3 weeks)
- Synthetic exercise presentation

TEACHING METHODS:

- NA

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

- NA

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	50 h
Practical Exercises	50 h
Assignments	50 h
Preparations for Examinations	50 h
Total	**200** hours

STUDENT EVALUATION/GRADING

- NA

SUGGESTED LITERATURE

- 1. C. Perry and K. Taylor (eds), 2007. Environmental Sedimentology. Blackwell, 428pp; ISBN-13, 978-1-4051-1515-5.
- 2. Reading, H.G. (1996). Sedimentary Environments Processes, Facies and Stratigraphy, 3rd Edition, Blackwell-Oxford, 704pp; ISBN 978-0-632-03627-1.

WEB PAGE:

NOT AVAILABLE

ΚΜΠ-Υ07 CLIMATE VARIABILITY (PALEOCLIMATE) AND CLIMATE CHANGE (ANTHROPOCENE)

Instructors: M. Hatzaki (marhat@geol.uoa.gr); P. Nastos; M.Triantafyllou; A. Kouli.

LEVEL/ SEMESTER: 7 / 2nd

TYPE: Special Background, Specialised General Knowledge, Skills Development

LECTURES AND PRACTICAL EXERCISES

3 hours of lecturing per week, 7 ECTS credits.

Prerequisites: There are no prerequisite courses, although knowledge acquired from successful attendance of the 1st semester courses is considered necessary: (ΚΜΠ-Υ01, ΚΜΠ-Υ02, ΚΜΠ-Υ03 and ΚΜΠ-Υ04)

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The aim of the course is to give an understanding of the processes that determine and change the Earth's climate system at different spatial and temporal scales by studying climate variability at different geological times and climate changes during the anthropocene. Upon successful completion of the course, students will be able to understand and explain:

- the key processes that determine the climate system of the earth and the main natural mechanisms of climatic variability
- how and why the earth's climate has changed in geological time
- the methods that identify the paleoclimate, to project their use and to describe their limitations
- the natural and anthropogenic mechanisms of global climate change
- the uncertainties associated with the future projections of global climate change
- the current scientific knowledge related to adaptation and mitigation strategies for climate change impacts

Skills

Students will be able to

- Identify and discuss global and regional climate factors, including the carbon cycle, tectonic changes, solar radiation, ocean-atmosphere interactions, anthropogenic influences
- analyse paleoclimatic data, climatic data and climate simulation data to draw conclusions about the past, present and future climate

And generally:

- Communicate the climate history and the human role in the climate system and critically evaluate scientific information.

General Competencies

- Production of free, creative and inductive thinking

- Ability to apply knowledge to problem solving
- Search, analysis and synthesis of data and information, by the use of the necessary technology
- Decision making
- Working independently
- Team work
- Working in an interdisciplinary environment
- Respect of natural environment
- Promoting free, creative and inductive thinking

CONTENT:

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

- Components of the global climate system, distribution of basic climate data, natural climate variability in different space and time scales, atmospheric-ocean interaction, atmospheric oscillations (ENSO, MJO, NAO etc.), forcing and feedback mechanisms
- Greenhouse phenomena in paleo-ocean, the Paleocene–Eocene Thermal Maximum (PETM), the Mid- Miocene Climatic Optimum (MMCO) and the mid-Pliocene Warm Period (mPWP)
- Glacial periods of the Upper Cenozoic, sea level changes
- Isotopic archive and Milankovich circles, Dansgaard circles, Heinrich events
- Paleoclimate reconstruction methods with the use of palaeobiological data
- Observed signals of climate change in the anthropocene, factors of climate change (natural and anthropogenic)
- Basic principles of climate models, climate change scenarios and climate simulations, uncertainties related to future projections of global climate change
- Impact of climate change on the environment, human activities and health, adaptation strategies and mitigation of climate change impacts, sustainable development.

TEACHING METHODS:

- Face to face (lectures and seminars)
- Use of PC, tablets, smartphones and specialized software
- Access to databases and scientific libraries
- Demonstration of method and techniques used in Climatology and Palaeoclimatology
- Possibility of distance learning (e-exercises) and communication (discussion areas, blogging, messages, etc.) via the e-class platform of NKUA

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Lecturing:

- Presentations with multimedia content (images, animation, and video) and demonstration of methods of analysis, simulation and interpretation of data.

In the Communication with Students:

- Support of learning process through e-Class (communication, information, messages, documents, tasks, questionnaires, exercises, diaries, user groups, multimedia, links, rating, e-book, etc.) with 24/7 availability for communication, material distribution, queries.

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	52 (13w x 4h)
Homework	39 (13w x 3h)
Non-Guided Study (Required Repetition, Material Study, Preparation of intermediate essays)	42h
Final examination	42h
Total	**175** hours

STUDENT EVALUATION/GRADING

The evaluation process is in Greek (possibility of evaluation in English for Erasmus students), and includes:

- Examination through short essays / exercises during semester
- Final essay on a topic chosen by the students with teacher guidance

The course evaluation criteria are described in the Student Handbook and auxiliary material (questions, exercises, etc.) for the essays are posted on the e-class platform.

SUGGESTED LITERATURE

Textbooks:

- Raymond S. Bradley, Paleoclimatology-Reconstructing Climates of the Quaternary, 3rd ed., Wiley (2015)
- Roger G. Barry, Eileen A. Hall-McKim, Essentials of the Earth's Climate System, 1st ed, Cambridge University Press (2014)

Journals:

- Climate of the Past, EGU
- Climatic Change, Springer
- Natural Hazards and Earth System Science, EGU
- Nature Climate Change, Springer
- Global Environmental Change, Elsevier

Additional Teaching Material: Lectures notes, lectures presentations, essay material on the e-class platform

WEB PAGE:

https://eclass.uoa.gr/courses/GEOL459

ΚΜΠ-Υ08 QUATERNARY GEOENVIRONMENT-GEOARCHAEOLOGY

Instructors: A. Kouli (akouli@geol.uoa.gr); E. Stathopoulou; N. Evelpidou; P. Nomikou.

LEVEL/ SEMESTER: 7 / 2nd

TYPE: Specialized background

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 7 ECTS credits.

Prerequisites: NO

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

This course focuses on the understanding of the dynamics of Quaternary Geoenvironments and their intertemporal interaction with human societies. Special emphasis is given to the study and comprehension of the physical and human processes that have formed and altered the image of our planet, the Historical Landscape. Various methodologies and case studies are presented, based on data from areas in Greece and the Eastern Mediterranean, in order to develop the student's critical ability and the scientifically documented approach to Geoarchaeological problems.

Upon successful completion of this course, the students will be capable of:

- Recognizing the scientific question and selecting the appropriate methodology
- Applying the appropriate sampling techniques or field data collection methods, in order to address specific interdisciplinary questions
- Applying the appropriate methodology by combining knowledge from the whole spectrum of the Geosciences in order to fully approach the specific question
- Processing, evaluating and synthesizing geoenvironmental data, by assessing and combining their results, in order to answer geoarchaeological questions.

General Competencies

- Research, analysis and synthesis of data and information, through the necessary technology
- Decision making
- Autonomous work
- Team work
- Production of new scientific ideas
- Respect towards the natural environment
- Promotion of free, creative and inductive thought

CONTENT:

A. Lectures

The course presentations include the following thematic topics:

- Man and the geoenvironment, Geoarchaeology, basic principles of Archaeology
- Dating methods in environments of archaeological interest: archaeological time, absolute dating, and age models.
- Methodologies of sampling and analysis, the palaeoenvironment of sites of Archaeological interest
- Contribution of the study of fossils (microfossils, osteological material, plant remains, pollen, palynomorphs) in archaeological research and the interpretation of Quaternary palaeoenvironments
- Historical Landscape, interaction of human societies/environment, effects of climatic variations on human societies, study of the selection of land use by human societies of the past.
- Quaternary sea level changes, Holocene transgression, sea level indicators, notches, beachrocks
- Palaeogeography and Palaeoenvironment: methods, reconstruction, evolution. Case studies.
- Mapping of the coastal zone using high resolution multibeam systems
- 3D morphology of the coastal zone using ROV: case studies.

B. Exercises and laboratory work

Part A: Processing of palaeobiological data through appropriate methodologies in order to address geoarchaeological questions.

Part B: Processing and interpretation of sea level proxy data, processing of bathymetric data and creation of photomosaic

TEACHING METHODS:

- teaching face to face
- practical exercises in the lab
- laboratory practice with the use of microscopes, Pc's and specialized software

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

- Use of informatics technologies in teaching
- Support of learning process through the electronic platform e-class
- Electronic communication with students

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures and data pro-cessing exercises with PC's.	32(4h×8w)
Laboratorial practice	16(4h×4w)
Homework/bibliographic re-search	68
Project/Practical exercise	80
Total	**196** hours

STUDENT EVALUATION/GRADING

Language of evaluation: Greek (English for Erasmus students)

- Written essay on subject chosen from list of topics/oral examination of subject (**65%**)
- Short individual practice exercises that include the application of methodologies for the solution of relevant problems (**35%**)

SUGGESTED LITERATURE

Textbooks:

- Καρκάνας Π., 2010. Εισαγωγή στη γεωαρχαιολογία. Εκδ. Νεφέλη
- Karkanas P., Goldberg P., 2018. Reconstructing Archaeological Sites: Understanding the Geoarchaeological Matrix, Wiley-Blackwell
- Renfrew C. & Bahn P., 2001. Αρχαιολογία: Θεωρίες, μεθοδολογία και πρακτικές εφαρμογές. (μτφρ. Ι. Καραλή-Γιαννακοπούλου) Εκδ. Καρδαμίτσα
- Shennan, I., Long, A. J., Horton, B. P. (Eds.), 2015. Handbook of sea-level research, John Wiley & Sons

Journals:

- Quaternary International, Elsevier
- Journal of Quaternary Science, Wiley
- Quaternary Research, Elsevier
- Quaternary Science Reviews, Elsevier
- Geaoarchaeology, Wiley Science of the Total Environment, Elsevier
- Journal of Archaeological Science, Elsevier

Additional bibliographical sources are available to students attending the specific course through the course webpage in E-class.

WEB PAGE:

http://eclass.uoa.gr/courses/GEOL450

4.3.2.B. ELECTIVE COURSES

ΚΜΠ-Ε01 MARINE PALAEOECOLOGY

Instructors: H. Drinia (cntrinia@geol.uoa.gr); E. Koskeridou; Th. Tsourou; G. Kontakiotis..

LEVEL/ SEMESTER: 7 / 3rd

TYPE: NA

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 8 ECTS credits.

Prerequisites: None

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The content of this course provides graduate students with a working knowledge of marine paleoecology: main concepts and issues and Methods of paleoecological analysis of the marine ecosystem. Upon successful completion of the course, students should be able to:

- Fully understand the fundamental concepts of paleoecology
- To acquire a practical knowledge of how to carry out paleo-logical studies in the marine ecosystem and to identify the strengths and weaknesses of the paleoecological data
- Develop critical thinking and communication skills
- Solve problems related to palaeoecological research in ma-rine environments
- Understand the relationship between micro- and macro-fossils and paleo--environmental parameters
- Understand the use of other proxies (Milankovitch variables, trace element analysis, sediment analysis, etc.) in relation to the faunal pattern and the reconstruction of the history of past marine environments
- Understand the relationships between climate variations and the development of paleo- ecosystems

General Competencies

- Theoretical thinking and ability to convert theory into prac-tice
- Ability to apply knowledge to solve problems
- Search, analysis and synthesis of data and information, using the necessary technologies
- Decision making
- Autonomous work
- Teamwork
- Working in an interdisciplinary environment
- Respect for the natural environment
- Promote free, creative and inductive thinking

CONTENT:

- Introduction - Basic concepts and principles of paleoecology – the marine eco-system - use of micro-fossils in the inter-pretation of paleoenvironments
- Qualitative and quantitative analysis of fossil assemblages: diversity indices, individual ecology, etc
- Microfossils as indicators of physico-chemical parameters and paleodepth of paleo environments: Quantitative and qualitative methods
- Invertebrate paleoecology: quantitative and qualitative methods
- Deep Sea Environments
- Shelf environments
- Marginal environments
- Synthetic exercise (3 weeks)
- Synthetic exercise presentation

TEACHING METHODS:

- NA

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

- NA

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	40 h
Practical Exercises	40 h
Assignments	40 h
Preparations for Examinations	80 h
Total	**200** hours

STUDENT EVALUATION/GRADING

- NA

SUGGESTED LITERATURE

- Ζαμπετάκη Λέκκα, Α., Αντωναράκου, Α., Ντρίνια, Χ., Τσουρού, Θ., Di Stefano, A., Baldassini, N., 2015. Η μικροπα-λαιοντολογία και οι εφαρμογές της. [ηλεκτρ. βιβλ.] Αθή-να:Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών. Avail-able in http://hdl.handle.net/11419/3435
- Δερμιτζάκης, Μ.Δ., Γεωργιάδου- Δικοπούλια, Ε., 1985, Εισα-γωγή στη θαλάσσια Μικροπαλαιοντολογία. σελ. 720, Εκδό-σεις Επτάλοφος, Αθήνα.
- Murray, J., 2006. Ecology and Applications of Benthic Forami-nifera. Cambridge University Press, p. 426.
- Boudagher-Fadel, M.K., 2008. Evolution and geological signif-icance of larger benthic foraminifera. Elsevier B.V., p. 540.

WEB PAGE:

NOT AVAILABLE

ΚΜΠ-Ε02 PALEO-OCEANOGRAPHIC AND PALEO-CLIMATIC INDICES

Instructors: A. Antonarakou (aantonar@geol.uoa.gr); M. Triantafyllou; G. Kontakiotis.

LEVEL/ SEMESTER: 7 / 3RD

TYPE: Specialization, Specialized Background, Skill Development

LECTURES AND PRACTICAL EXERCISES

Lectures and Practical Training

4 hours of lecturing per week, 8 ECTS credits.

Prerequisites: There are no formal pre-requisites. Knowledge and skills acquired by successful completion of under-graduate courses in Oceanography, Micropaleontology and Marine Geology are particularly welcome and will be appreciated.

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

On completion of the course the students are expected to:

- understand the reasons for climate change and the consequences of these changes on both the environment and humans
- understand the interaction of the atmosphere-biosphere-hydrosphere system using paleoclimatic and paleoceanographic proxies
- connect climate changes with the evolution of the planet and civilization during the past
- learn qualitative data collection practices related to the modern and past envi-ronment
- practice analyzing and interpreting paleoenvironmental data
- practice synthesizing multi-subject data

General Competencies

- Measurement, research, analysis and synthesis of data and information, using the necessary technologies
- Advancement of free, creative, and inductive thinking
- Critical thinking and constructive self-appraisal
- Adaptation to new conditions and situations
- Self-contained (individual) work
- Teamwork
- Trans-disciplinary scientific work
- Respect for the natural environment
- Project design and management
- Decision making

CONTENT:

- Basic concepts of Paleoceanography - Paleoceanographic indices
- (Paleo)Climatic changes/cyclicity
- Paleotemperature proxies based on faunal data - Paleoclimate curve based on the relative abundance of foraminifera in the sedimentary record
- Sea Surface Temperature proxies based on the geochemical imprint of fossils: Stable oxygen isotopes, Mg/Ca ratio on foraminifera, Alkenones
- Integrated proxies for calculating Sea Surface Salinity
- Water column stratification and primary productivity indices
- Introduction to the study of foraminifera as bioindicators of variable paleoceanographic conditions
- Greenhouse effects within the Paleocean's evolution
- Paleoceanography and Paleoclimatology of the Mediterranean basin
- Examples of extreme geological phenomena in the past – Paleoclimatic reconstruc-tion
- Climatic variability and driving factors
- Greenhouse effect
- Comparison of paleoclimatic data between the marine and terrestrial records
- Techniques for measuring carbon dioxide concentrations from proxy data
- Effects of global climate change
- Ocean acidification

TEACHING METHODS:

- Face-to-face lecturing.
- Face-to-face practical training in the analysis and interpretation of paleoclimatic and paleoceanographic data.
- Utilization of the e-class facility of the NKUA for additional dissemination of information, distribu-tion of educational material, answering of ques-tions etc.

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Lecturing:

- PowerPoint presentations available through the course's web site in the e-class facility of the NKUA.

In Practical Training:

- Instructional part: PowerPoint presentations avail-able through the course's web site in the e-class facility of the NKUA; they incorporate edu-cational videos with relevant content.
- Executional part: Specialized educational or/and professional software for the interpretation of paleoclimatic and paleoceanographic records.

In the Communication with Students:

- Personal interfacing and utilization of the communication and blogging functions of the e-class facility (24/7 availability).

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures+ Practical Training	4 hours × 13 weeks
Total	**52** hours

STUDENT EVALUATION/GRADING

Examinations are conducted in Greek. Foreign students, or students from European Union countries (Erasmus Programme), can be examined in English.

The final grade is formed through a series of tests that include:

- Reports prepared and submitted as part of the practical exercise program. The scientific topic of these exercises will be related to the rele-vant theory and will follow each lecture. The

mean of the grades of all reports **amounts to 50% of the final grade**.

- Oral presentation through a power point presenta-tion and subsequent discussion with the examiners on selected subjects related to paleoceanographic and paleoclimatic data. The written examination **amounts to 50% of the final grade**.

SUGGESTED LITERATURE

Suggested Literature:

- Bradley, R.S., 2014. Paleoclimatology: Reconstructing Climates of the Quaternary 3rd Edition, Academic Press
- Hyman, A., 2017. Principles of Paleoclimatology, Callisto Reference
- Fischer, G., Wefer, G., 1999. Use of Proxies in Paleoceanography, Springer
- Hillaire-Marcel, C., de Vernal, A., 2007. Proxies in Late Cenozoic Paleoceanography, Elsevier
- Harff, J., Meschede, M., Petersen, S., Thiede, J., 2016. Encyclopedia of Marine Geosci-ences, Springer.

Related scientific journals:

- Paleoclimatology Palaeoecology Palaeogeography
- Paleoceanography and Paleoclimatology
- Quaternary Research
- Holocene
- Quaternary International
- Global and Planetary Change
- Frontiers in Marine Science
- Journal of Marine Science and Engineering
- Journal of Marine Systems
- Geo-Marine Letters

WEB PAGE

https://eclass.uoa.gr/courses/GEOL566/

ΚΜΠ-Ε03 PALEONTOLOGY AND BIODIVERSITY

Instructors: E. Koskeridou (ekosker@geol.uoa.gr); G. Lyras; S. Rousiakis.

LEVEL/ SEMESTER: 7 / 3RD

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 7 ECTS credits.

LEARNING OUTCOMES:

Learning Outcomes

The content of this course provides graduate students with a working knowledge of paleontology and biodiversity: main concepts, issues and Methods of paleontological analysis of biocommunities and the dependence of biodiversity on environmental factors. Upon successful completion of the course, students should be able to:

- Fully understand the fundamental concepts of palaeontology and biodiversity
- Develop critical thinking and communication skills
- Understand the relation between the global ecosystem, bio and lithospheres and the effect of terrestrial and extraterrestrial phenomena on macroevolution.
- Extinctions and adaptations due to paleoenvironmental changes.
- Understand the basic identification and description principles of important macrofossil group assemblages and the relationship between taxonomy and ecological variation.
- Interpret the constitution of macrofossil assemblages and their significance in geology.
- Fully understand their use as geological facies markers and as proxies for palaeoenvironmental and palaeoclimatic changes.
- Collect, combine and evaluate the relevant literature, especially on Mediterranean and greek area studies.

General Competencies

- Theoretical thinking and ability to convert theory into practice
- Ability to apply knowledge to solve problems
- Search, analysis and synthesis of data and information, using the necessary technologies
- Decision making
- Autonomous work
- Teamwork
- Working in an interdisciplinary environment
- Respect for the natural environment
- Promote free, creative and inductive thinking

CONTENT:

- Introduction to biotic diversity.
- Phylogenetic and non-phylogenetic methods in the study of macro-evolutionary patterns.
- Micro and macro-evolutionay processes during climatic change. Geography and climate as determinants of biotic diversity and abundance.
- Geographic patterns in lineages and faunas.
- Island biogeography and environment.
- Ecomorphology and extinct organisms.

- Changes in biodiversity during environmental changes.
- Speciation and extinction during the Holocene and Anthropocene.

TEACHING METHODS:

- NA

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

- NA

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	40 h
Practical Exercises	30 h
Assignments	25 h
Preparations for Examinations	80 h
Total	**175** hours

STUDENT EVALUATION/GRADING

NA

SUGGESTED LITERATURE

NOT AVAILABE

WEB PAGE

NOT AVAILABLE

ΚΜΠ-Ε04 BIOSPHERE AND GEOENVIRONMENTAL APPLICATIONS

Instructors: A. Kouli (akouli@geol.uoa.gr); M. Triantafyllou; Th. Tsourou

LEVEL/ SEMESTER: 7 / 3rd

TYPE: Skills Development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, practical exercises, 7 ECTS credits.

Prerequisites NO

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Knowledge

- Acquisition of basic Knowledge and understanding the role of biosphere in the relationship between the geosphere, atmosphere, and hydrosphere
- analysing the biological content of past and modern geoenvironments, and its environmental applications

Skills

- skills to analyse data on biological content and apply them as a tool for solving environmental issues
- skills to use biosphere information to address questions of global climate change

Competencies

- Improved abilities of scientific research, analytical and critical thinking and oral communication and writing
- Research, analysis and synthesis of data and information with the use of necessary technologies
- Autonomous work
- Working in an interdisciplinary environment

CONTENT:

- Biogeochemical indicators and microfossils
- Primary productivity and the global carbon cycle, stable isotopes and paleoceanographic applications
- Marine microfauna as bioindicators for environmental monitoring
- Floral archives and global environmental changes, mass extinctions
- Vegetation response to Quaternary climatic changes, permanent populations and refuges in the Mediterranean

TEACHING METHODS:

- Face-to-face Lectures

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Lecturing:

- PowerPoint presentations.

In the Communication with Students:

- Communication via e-mail

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures of the instructor, practical work and oral presentations of the students	52 h
Independent study	90 h
Writing of the research paper	30 h
Final written examination	3 h
Total	**175** hours

STUDENT EVALUATION/GRADING

Language of evaluation: Greek (English for Erasmus students)

- Class participation (10%)
- Oral presentation in class (20%)
- Written assignment with a deadline for handing –in report 4 weeks after completion of the course (30%)
- Final written examination (40%)

SUGGESTED LITERATURE

- Electronic sources and peer reviewed papers are provided throughout the course.

WEB PAGE:

NA

ΚΜΠ-Ε05 GEOHAZARDS AND SEDIMENTATION

Instructors: H. Drinia (cntrinia@geol.uoa.gr); I. Panagiotopoulos.

LEVEL/ SEMESTER: 7 / 3RD

TYPE: Specialization, Specific Background, Skill Development

LECTURES AND PRACTICAL EXERCISES

Lectures and Practical Training

4 hours of lecturing per week, 7 ECTS credits.

Prerequisites: There are no formal pre-requisites. However, students are expected to have successfully completed undergraduate courses in Physics, Geomorphology, Stratigraphy, Sedimentology, Geological Heritage in their respective school of origin.

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

Upon completion of the course the student should have the following learning outcomes defined in terms of knowledge, skills and general competence:

- overview of the physical and geological processes that cause geohazards such as landslides, floods, tsunamis, earthquakes and volcanic eruptions
- knowledge to describe methods of quantifying the risk of individual geohazards and the factors controlling their uncertainty
- an understanding of the potential consequences of geohazards and of risk and dis-aster management
- knowledge of the possible interactions between geohazards and their consequences
- perform simple quantitative analyses (e.g. calculate landslide run-off, calculate ex-pected seismic ground shaking)
- identification of deposits and geomorphs associated with geohazards
- Identify, assess and communicate the human role, impacts and consequences of geohazards.

General Competencies

- Measurement, research, analysis and synthesis of data and information, using the necessary technologies.
- Advancement of free, creative and inductive thinking.
- Critical thinking and constructive self-appraisal
- Adaptation to new conditions and situations.
- Self-contained (individual) work
- Teamwork
- Trans-disciplinary scientific work
- Respect for the natural environment
- Project design and management
- Decision making

CONTENT:

- Introduction to geohazards - conceptual framework

- Slope failures - landslides (maximum 3 presentations)
- Land subsidence - collapse - heave (maximum 4 presentations)
- Geological heritage - threats to geodiversity
- Climate change - UNESCO World Geoparks as learning sites for climate change adaptation
- the role of geoparks in reducing geohazards
- All presentations are linked by comprehension exercises

TEACHING METHODS:

- Face-to-face lecturing.
- Face-to-face practical exercises in the analysis and interpretation of geophysical data.
- Utilization of the e-class facility of the NKUA (blogging and discussion functions) for additional dissemination of information, distribution of educational material, answering of questions etc.

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Lecturing:

- PowerPoint presentations available through the course's web site in the e-class facility of the NKUA; they incorporate educational videos relevant to the lectures.

In Practical exercises:

- Instructional part: PowerPoint presentations available through the course's web site in the e-class facility of the NKUA; they incorporate educational videos with relevant content.

In the Communication with Students:

- Personal interfacing and utilization of the communication and blogging functions of the e-class facility (24/7 availability).

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	4 hours × 13 weeks
Practical exercises	2 hours × 13 weeks
Homework – includes preparation for final examinations.	12 hours × 13 weeks
Total	**234** hours

STUDENT EVALUATION/GRADING

Examinations are conducted in Greek. Foreign students, or students from European Union countries (Erasmus Programme), can be examined in English.

The final grade is formed through a series of tests that include:

- Reports prepared and submitted as part of the practical exercise program. The mean of the grades of all reports **amounts to 50% of the final grade**.
- Project presentation.

SUGGESTED LITERATURE

- Fassoulas, Ch., Mouriki, D., Dimitriou, P. & Iliopoulos, G.. (2012). Quantitative Assessment of Geotopes as an Effective Tool for Geoheritage Management. Geoheritage. 4. 177-193. 10.1007/s12371-011-0046-9.
- Gray, M. Geodiversity: Valuing and Conserving Abiotic Nature, 2nd ed.; Wiley-Blackwell: Hoboken, NJ, USA, 2013; pp. 3–14.
- Hunt, R. E,(2007) Characteristics of Geologic Materials and Formations, A Field Guide for Geotechnical Engineers, ISBN 1-4200-4276-9 (CRC Press, Taylor and Francis Group LLC, Boca Raton, 2007) p54.
- Lima, F.F. Proposta metodológica para inventariação do patrimônio geológico brasileiro. Dissertação (Mestrado em Patrimônio Geológico e Conservação); Universidade do Minho: Braga, Portugal, 2008.
- Nakada, S. (2013). Characteristics of recent geohazards and roles of Geoparks.Rendiconti Online Societa Geologica Italiana
- Selmi, L.; Canesin, T.S.; Gauci, R.; Pereira, P.; Coratza, P. Degradation Risk Assessment: Understanding the Impacts of Climate Change on Geoheritage. Sustainability 2022, 14, 4262. https://doi.org/10.3390/su14074262
- Wignall, R.M.L., Gordon, J.E., Brazier, V., MacFadyen, C.C.J. & Everett, N.S. 2018. A climate change risk-based assessment for nationally and internationally important geoheritage sites in Scotland including all Earth science features in Sites of Special Scientific Interest (SSSI). Scottish Natural Heritage Research Report No. 1014.
- Zafeiropoulos, G.; Drinia, H. Comparative Analysis of Two Assessment Methods for the Geoeducational Values of Geosites: A Case Study from the Volcanic Island of Nisyros, SE Aegean Sea, Greece. Geosciences 2022, 12, 82. https://doi.org/10.3390/geosciences12020082
- • Zafeiropoulos, G.; Drinia, H.; Antonarakou, A.; Zouros, N. From Geoheritage to Geoeducation, Geoethics and Geotourism: A Critical Evaluation of the Greek Region. Geosciences 2021, 11, 381. https://doi.org/10.3390/geosciences11090381

WEB PAGE

https://eclass.uoa.gr/courses/GEOL565/

ΚΜΠ-Ε06 APPLIED HYDROLOGY

Instructors: S. Poulos (poulos@geol.uoa.gr); E. Vassilakis; P. Nastos.

LEVEL/ SEMESTER: 7 / 3RD

TYPE: Specialization, Specific Background, Skill Development

LECTURES AND PRACTICAL EXERCISES

Lectures and Practical Training

4 hours of lecturing per week, 7 ECTS credits.

Prerequisites: There are no prerequisite courses. Essential knowledge is acquired during the first semester courses: ΚΜΠ-Υ01 and ΚΜΠ-Υ03

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

NOT AVAILABLE

General Competencies

- Theoretical thinking and the ability to turn theory into practice
- Ability to apply knowledge in problem solving
- Search for, analysis and synthesis of data and information by the use of appropriate technologies
- Decision-making
- Individual/Independent work
- Group/Team work
- Working in an interdisciplinary environment
- Environmental awareness
- Development of free, creative and inductive thinking

CONTENT:

Lectures (Theory and Practice)

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

- Introduction to Hydrology: hydrologic cycle, river basin, watershed-based water balance.
- Climate change. Impact of climate change on the hydrological cycle.
- Methods of Measurement of Precipitation (Rainfall), rainfall data processing methods, statistical analysis of rainfall characteristics (duration, intensity), IDF curves.
- Analysis of the spatio-temporal characteristics of precipitation and estimation of the average rainfall depth (arithmetic average method, isohyet curves, Thiessen polygons, rainfall gradient, etc.). [1st H/W].
- Frequency analysis of hydrological data (normal distribution, logarithmic distribution, extreme value distributions, Pearson distributions. [2nd H/W].
- Potential and actual evapotranspiration (ET). Methods for estimation of the ET (Turc method, Thornthwaite, Blaney – Criddle, Penman, etc.) and Methods of Measurement of ET.
- Surface runoff. Factors controlling runoff, discharge, stage-discharge curves, hydrographs: SCS Dimensionless Unit Hydrograph, time-area diagram method, etc.), methods for hydrological losses estimation, peak discharge estimation, Rational method, Manning Equation. [3rd H/W][4th H/W].
- Flood hydrology. Integrated approach for flood risk assessment – Directive 2007/60/EC.
- The relationship between rate of sediment discharge and rate of water discharge. Runoff and sediment load of the rivers over Greece and the Mediterranean.

TEACHING METHODS:

- Face to face lectures
- Laboratory exercises involving PC, Tablet, smartphones and specialized software
- Demonstration of various scientific equipment (flow meter, weather station)
- Possibility of distance learning (e-exercises) and communication (forum, blogging, messages, etc.) through the electronic platform e-class of NKUA: NOT AVAILABLE

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Lecturing:

- Presentations that incorporate multimedia (images, animation, video) and demonstration of methods of analysis, simulation and interpretation of data through statistical analysis software.

In Communication with students:

- Support of the learning process through the electronic platform NOT AVAILABLE (announcements, information, messages, documents, assignments, questionnaires, exercises, calendar, user groups, multimedia, links, gradebook, e-book, etc.).

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	36 h
Laboratory exercises	16 h
Self-study (study and analysis of bibliography, prepare exercise deliverables)	100 h
Final Project Preparation	48 h
Total	**200** hours

STUDENT EVALUATION/GRADING

The evaluation of the students takes place in Greek language (there is the possibility of an examination in English for Erasmus students), and includes:

- Examination through short assignments/exercises during lectures
- Final exam or individual semester assignment.

The evaluation criteria of the course and the participation criteria are described in the Guide of the course and auxiliary material (questions, exercises, etc.) for the assignments are posted on the electronic platform e-class (NOT AVAILABLE)

SUGGESTED LITERATURE

Bibliography

- Κωτσόπουλος Σ., Υδρολογία, Εκδόσεις Ίων, 2006.

- Μιμίκου Μ., Μπαλτάς Ε., Τεχνική υδρολογία 6η έκδοση, Εκδόσεις Παπασωτηρίου, 2018.
- Musy A. & Higy C., Hydrology: A science of Nature, CRS Press, 2011.
- Chow Te Ven, Maidment David and Mays Larry, "Applied Hydrology," 2nd edition, McGraw- Hill, 2013.

Related scientific Journals

- Journal of Hydrology, Elsevier
- Hydrology, MDPI
- Hydrology and Earth System Science, EGU
- Water, MDPI
- Hydrology Journal, Springer

Additional Sources

- Notes and presentations posted on the e-Class platform of the course.

WEB PAGE:

NOT AVAILABLE

ΚΜΠ-Ε07 SUBMARINE GEOMORPHOLOGY – COASTAL ZONE MANAGEMENT

Instructors: P. Nomikou (evinom@geol.uoa.gr); S. Poulos; H. Angelopoulos.

LEVEL/ SEMESTER: 7 / 3RD

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 7 ECTS credits.

LEARNING OUTCOMES

NOT AVAILABLE

CONTENT:

NOT AVAILABLE

TEACHING METHODS:

NOT AVAILABLE

STUDENT EVALUATION/GRADING

NOT AVAILABLE

SUGGESTED LITERATURE

NOT AVAILABLE

WEB PAGE:

NOT AVAILABLE

ΚΜΠ-Ε08 REMOTE SENSING AND SATELLITE DATA APPLICATIONS

Instructors: E. Vassilakis (evasilak@geol.uoa.gr)

LEVEL/ SEMESTER: 7 / 3RD

TYPE: Specialization, Specific Background, Skill Development

LECTURES AND PRACTICAL EXERCISES

Lectures and Practical Training

4 hours of lecturing per week, 7 ECTS credits.

Prerequisites: Geographic Information Systems and Principles of Remote Sensing (Undergraduate - Optional)
Photogeology - Remote Sensing - Mathematical Geog-raphy (Undergraduate - Optional)
Geographical Information Systems in Environmental Applications (Master's)

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes The research areas of the course "Remote Sensing and Satellite Data Applications" meet the modern space application techniques related to the disciplines of Geodesy (Satellite Geodesy), Topography, Photogrammetry, Digital Cartography and Satellite Observations. It applies terrestrial, aerial and satellite remote sensing methods using modern digital techniques including Digital Image Processing (Aerial photographs, IKONOS, QUICKBIRD) and Orthorectification. Additionally, it applies the most modern mapping and digital imaging techniques finding many applications in excavations, demarcation of flooded areas, constructions, landslides, and geomorphological changes. Within the modern socio-economic background, the course offers (as far as possible) interdisciplinary knowledge and skills suitable for dealing with theoretical and practical geoscientific problems. The program of lectures and practical exercises is structured so as not to overlook the need to maintain a high scientific and educational level, but also to emphasize the applied part of Science in a way that equips students with skills necessary for modern labor markets and strengthens the possibility of professional rehabilitation.

Based on the above principles and needs, by completing the Course the students are expected to have acquired:

- Understanding of the concept of Remote Sensing and its application for the study of the Earth's surface.
- Understanding the operation and use of satellites in geological applications
- Understanding and Application of alternative ways of monitoring and studying phenomena on the Earth's surface through Remote Sensing (Aerial photographs, Laser Scanners, Unmanned Aircraft Systems)
- Knowledge of digital image processing and spatial data analysis.
- Skills in specialized software for Remote Sensing data analysis.
- Skills in how to process, analyze and display Remote Sensing data.

General Competencies

- Measurement, research, analysis and synthesis of data and information, using the necessary technologies.
- Advancement of free, creative and inductive thinking.
- Critical thinking and constructive self-appraisal.
- Adaptation to new conditions and situations.
- Self-contained (individual) work.
- Teamwork.
- Trans-disciplinary scientific work.
- Respect for the natural environment.
- Project design and management
- Decision making.

CONTENT:

Theoretical background of (lectures).

- The concept of Remote Sensing and applications for the study of the Earth's surface.
- Physical background of Remote Sensing (electromagnetic spectrum and its interaction with matter, atmospheric scattering and absorption of electromagnetic radiation)
- Types of Satellites and their use for the study of the earth's relief
- The use of Unmanned Aircraft Systems (UAS)
- The use of Laser Scanners for the study of smaller scale geological structures and relief

B. Practical exercises: Familiarization with the equipment; field measurements; data analysis and interpretation with specialized/dedicated software; compilation of technical reports.

- Aerial photographs - Photogrammetry – Orthorectification techniques with control point finding – Triangulation algorithms – Error correction – Orthophotomosaics
- High spatial and spectral resolution satellite imagery – Histogram, statistics – Channel combinations – Channel ratios – Classification techniques – Process modeling – Atmospheric correction

TEACHING METHODS:

- Face-to-face lecturing.
- Face-to-face practical exercises in the analysis and interpretation of Remote Sensing data.
- Utilization of the e-class facility of the NKUA (blogging and discussion functions) for additional dissemination of information, distribution of educational material, answering of questions etc.

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Lecturing:

- PowerPoint presentations available through the course's web site in the e-class facility of the NKUA; they incorporate educational videos relevant to the lectures.

In Practical exercises:

- PowerPoint presentations available through the course's web site in the e-class facility of the NKUA.
- Specialized educational or/and professional software.

In the Communication with Students:

- Personal interfacing and utilization of the communication and blogging functions of the e-class facility (24/7 availability).

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	26 (2 hours x 13 weeks)
Practical exercises	26 (2 hours x 13 weeks)
Homework	52 (4 hours x 13 weeks)
Total	**104** hours

STUDENT EVALUATION/GRADING

Examinations are conducted in Greek. Foreign students, or students from European Union countries (Erasmus Programme), can be examined in English.

The final grade is formed through a series of tests that include:

- Evaluation during the practical training with a percentage of **50% of the final grade**.
- Practical Laboratory Assignments and a written report with a percentage of **50% of the final grade.**

SUGGESTED LITERATURE

- Teacher's notes
- Electronic resources from the teacher
- Principles of Remote Sensing, 2004, ITC

WEB PAGE

https://eclass.uoa.gr/courses/GEOL447/

ΚΜΠ-Ε09 APPLIED & KARSTIC GEOMORPHOLOGY

Instructors: N. Evelpidou (evelpidou@geol.uoa.gr); E E. Vassilakis, A. Karkani.

LEVEL/ SEMESTER: 7 / 3rd

TYPE: Specialized background, skill development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 8 ECTS credits.

Prerequisites NO

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

This course is focused in the applications of Geomorphology and particularly in topics related to the changes of the geomorphological environment due to human interventions. It aims to a better understanding of the changes in the geomorphology due to natural and human activities. The course deals with the estimation and management of natural disasters such as floods, landslides, coastal and runoff erosion, as well as changes in sea level. Additionally it deals with subjects of karstic geomorphology, with particular focus to the methods of basic and applied karst research. When students finish this course, they will be able to:

- Understand the methods of analysing and managing natural hazards such as floods, landslides, erosion.
- Understand sea level changes.
- Understand, distinguish and interpret the impacts of urbanisation and human intervention to the changes of the geomorphological environment, changes in relief and their impacts on triggering natural disasters such as floods, landslides, subsidence, erosion etc.
- Calculate physical parameters for the design of geotechnical projects as torrent management, dams, roads, dwellings.
- Apply methods of applied geomorphology for the design of geotechnical projects and the estimation of geomorphological hazards.
- Collect and analyse relevant bibliography as well as applying and composing studies in Greece and in international level.
- Explain, collect, compare and evaluate data in order to solve problems, such as geological setting of urban areas, management of surface waters, estimation of natural hazards (floods, landslides, subsidence, erosion), the development and management of urban areas.
- Understanding karstic processes through the karstic landforms
- Apply methods of basic and applied karstic research

General Competencies

- Theoretical thinking and ability to turn theory into practice
- Problem solving ability through application of knowledge
- Search, analysis and composition of data and information by using the necessary technologies
- Decision making

- Independent work
- Team work
- Work in interdisciplinary environment
- Respect of the natural environment
- Promote free, creative and inductive thinking

CONTENT:

Changes in the geomorphological environment – human intervention. Estimation and management of natural hazards (floods, landslides, subsidence, coastal and soil erosion). Sea level changes. Urbanization and human intervention- impacts on geomorphological environment, relief changes and the impacts on natural hazards such as floods, landslides, erosion, etc. Physical parameters for the design of technical projects such as torrent management, dams, roads, dwellings. Methods of applied geomorphology for the development of technical projects and the estimation of natural hazards. Management of surface waters. Technical and environmental topics of urban areas, such as the geo-logical setting of urban areas, management of surface water, development, design and management of urban areas. Karstic processes, Karstic landforms, Methods of basic and applied Karstic research.

TEACHING METHODS:

- Lectures in person (Class and practice exercises)
- Practical exercises using maps, bibliography and questionnaires)

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In Lecturing:

- Presentations through multimedia content(images, animation, videos). Recorded classes and field exercises in the e-class.

In the Communication with Students:

- Support of learning procedure through e-class and e-platform open courses (announcements, information, messages, essays, questionnaires, exercises, calendar, group users, links, marks, e-book, etc.).

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	26 h
Laboratory exercises	26 h
Non-surveyed study	64 h
Project preparation	84 h
Total	**200** hours

STUDENT EVALUATION/GRADING

Language of student performance evaluation: Greek (English for the Erasmus students).

I. CLASSES-LECTURES (50%)

- Presenting subject that has been chosen from a respective subjects list

II. LABORATORY EXERCISES (50%)

- E-class, individual essays that will have the solutions of the laboratory exercise.

SUGGESTED LITERATURE

- Lecture notes available through the e-class

Related scientific journals:

- Geomorphology
- Applied Geomorphology

WEB PAGE:

NOT AVAILABLE

ΚΜΠ-Ε10 NATURAL HAZARDS AND HUMAN IMPACT ON THE ENVIRONMENT

Instructors: P. Nastos (nastos@geol.uoa.gr); N. Evelpidou; P. Nomikou.

LEVEL/ SEMESTER: 7 / 3rd

TYPE: Special Background, Specialised General Knowledge, Skills Development

LECTURES AND PRACTICAL EXERCISES

4 hours of lecturing per week, 8 ECTS credits.

Prerequisites: There are no formal prerequisite courses, although the knowledge acquired from successful attendance of the 1st and 2nd semester courses ΚΜΠ-Υ01, ΚΜΠ-Υ03, ΚΜΠ-Υ04 and ΚΜΠ-Υ07 is considered useful.

Language: Greek

Course offered to Erasmus+ students: YES in English

LEARNING OUTCOMES

Learning Outcomes

The aim of the course is to understand the spatio-temporal variability of natural disasters and the anthropogenic interventions on the environment that contribute to the development and intensification of natural hazards and maximize the risk of phenomena.

Knowledge:

Upon successful completion of the course the students will be able to understand and explain:

- Extreme weather and climatic phenomena (tornadoes, storms, heat waves, cold waves, frost and snow, droughts), river floods, sudden urban floods
- Landslide Risk Assessment / Sedimentation Risk Assessment / Scree Flows / Scree Flow Risk and Soil Vulnerability / Land Movements
- Erosion risk, flood risk assessment, fires, coastal erosion (vulnerability indicators)
- Land use planning in relation to natural hazards and
- Current scientific knowledge related to the natural hazards by natural and man-made causes.

Skills: Students will be able to

- Identify and discuss the natural and man-made causes that affect natural hazards
- Assess the risk of floods, erosion, fires and other hydrometeorological phenomena; and
- Understand the new techniques and methodologies for mitigating natural hazards and adaptation measures on climate change that enhance natural hazards

General Competencies

- Production of free, creative and inductive thinking
- Ability to apply knowledge to problem solving
- Search, analysis and synthesis of data and information, by the use of the necessary technology
- Decision making
- Working independently
- Team work
- Working in an interdisciplinary environment
- Respect of natural environment
- Promoting free, creative and inductive thinking

CONTENT:

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

- Extreme meteorological and climatic phenomena (tornadoes, storms, heat waves, cold waves, frost and snow, drought). Spatiotemporal variation, causes and impacts
- Flash urban floods and river floods (causes and effects)
- Climate change and extreme hydrometeorological phenomena
- Landslides, sedimentation, earth movements, soil vulnerability, fires, coastal erosion. Causes, physical processes and vulnerability indicators
- Risk of erosion, flood and use planning in relation to natural hazards, and
- Impact of natural hazards on the built environment and ecosystems
- Adaptation and methods for mitigating the effects of natural hazards

TEACHING METHODS:

- Face to face (lectures and seminars)
- Use of PC, tablets, smartphones and specialized software
- Access to databases and scientific libraries
- Demonstration of method and techniques used in Meteorology, Climatology and Hydrology
- Possibility of distance learning (e-exercises) and communication (discussion areas, blogging, messages, etc.) via the electronic platform e-class o NKUA:
  https://eclass.uoa.gr/courses/GEOL467

MULTI-MEDIA AND COMMUNICATION TECHNOLOGIES

In lecturing:

- Presentations with multimedia content (images, animation, and video) and demonstration of methods of analysis, simulation and interpretation of data.

For communication with the students:

- Support of learning process through e-Class (communication, information, messages, documents, tasks, questionnaires, exercises, diaries, user groups, multimedia, links, rating, e-book, etc.) with 24/7 availability for communication, material distribution, queries.

BREAKDOWN OF WORKLOAD

Activity	Workload/Semester
Lectures	52 (13w x4h)
Laboratory practice	30 h
Fieldwork	20 h
Non-Guided Study, Preparation of essays etc.	35 h
Final essay writing	40 h
Total	**177** hours

STUDENT EVALUATION/GRADING

The evaluation process is in Greek (possibility of evaluation in English for Erasmus students), and includes:

- Examination through short essays / exercises during semester
- Final essay on a topic chosen by the students with teacher guidance

The course evaluation criteria are described in the Student Handbook and auxiliary material (questions, exercises, etc.) for the essays are posted on the course's website.

SUGGESTED LITERATURE

Textbook

- Roger G. Barry, Eileen A. Hall-McKim, Essentials of the Earth's Climate System, 1st ed., Cambridge University Press (2014)

Relate scientific journals

- Natural Hazards and Earth System Science, EGU
- Natural Hazards
- Theoretical and Applied Climatology
- Regional Environmental Change
- Climatic Change, Springer
- Nature Climate Change, Springer

Additional Teaching Material: Lectures notes, lectures presentations, essay material on the e-class platform

WEB PAGE:

https://eclass.uoa.gr/courses/GEOL467

4.4. ACADEMIC CALENDAR AND PUBLIC HOLIDAYS 2022-2023

1) Winter Semester:

a) Duration: 3 October 2023 to 20 January 2024
   Field Exercises: *See* Paragraph 3 (Field Exercises)
b) Examinations: 23 January 2024 to 17February 2024
c) Public Holidays:
   - National Holiday 28 October 2023
   - Polytechneio Uprising Commemoration: 17 November 2023
   - Christmass/New Year Break: 24 December 2023 to 8 January 2024
   - University Holiday: 30 January 2024

2) Spring Semester:

a) Duration: 20 February 2024 to Friday 9 June 2024
   Fied Exercises: *See* Paragraph 3 (Field exercises)
b) Examinations: 12 June 2024 to 5 July 2024
c) Public Holidays:
   - Law School Uprising Commemoration: 21 February 2024
   - Ash Monday: 18 March 2024
   - National Holiday: 25 March 2024
   - Easter/Spring Break: 29 April 2024 to 10 May 2024
   - 1st May Day: 1 May 2024
   - Holy Spirit Day: 24 June 2024
d) Classes are off during student elections.

3) Field Exercises:

Field Exercises **WINTER SEMESTER Academic Year 2023-2024:**
Monday 23 October 2023 to Monday 30 October 2023

Field Exercises **SPRING SEMESTER Academic Year 2023-2024**:
Monday 27 May 2024 to Friday 7 June 2024

Mapping **SPRING SEMESTER Academic Year 2023-2024**:
Monday 27 May 2024 to Friday 7 June 2024

4) Repeat Examination Period (September):

From Monday 2 September 2024
To Friday 27 September 2024

Chapter 5

STUDENT CARE AND OTHER BENEFITS

5.1. SUSTENANCE

All students are entitled to sustenance at the Campus Refectory (tel. 210-72774443 και 210-7277734), which operates in the premises of the School of Philosophy, at approximately 10 minutes walking distance from The Department. Sustenance is subsidised and provided at particularly low prices. The Refectory is open daily, between 12:00 – 16:00 and 18:-21:00, except for a 15-day break during the Christmas and Easter holidays. Students are also entitled to special low-price sustenance at all other refectories of the NKUA, as well as and at the University Club.

European Union students who meet the requirements of the Law with respect to (low) family income are entitled to free sustenance up to the day of their graduation. If students entitled to free sustenance decide to suspend their studies, the benefit is accordingly suspended but can be reinstated once they resume their studies.

Information can be sought in phone (landline) numbers 2103688216, 2103688252 and 2103688230, as well as at the Student Club, (Hippocrates 15 St., 5th floor, daily between 09:00 and 12:00.

5.2. HEALTH CARE

Subject to the limitations specified in Section 3.6 of the present Guide, students are entitled to free and comprehensive health and medical care for the duration of their studies and up to the 31st of December of the year of their graduation. Health care is provided at the numerous facilities of the University and at the clinics and hospitals of the School of Medicine. In special cases, or under special circumstances, care can be provided in facilities outside of the University. It includes in or out of hospital care, all types of medical tests, medication, child birth services, dental care, physical therapy, orthopaedic care and social services.

For students who decide to suspend their studies, medical and health care benefits are accordingly suspended. The benefits are reinstated once they resume their studies and up to their completion (also see Section 3.6 of the Guide).

If a student is entitled to the benefits of a third party health care provider, he/she has the right of choice between the services provided by the University or the services of the third party. If a student decides on third party care, all expenses will be reclaimed from his/her provider. However, if the student's health care provider may cover only part of these expenses, (e.g. only a percentage of hospital costs), the University will supplement the costs to their full extent.

The Health Services of the University are located in the 1st floor of the University Club; the landline of the secretariat is 210 3688218. Services include:

- Medical examinations (tel. 2103688208)
- Hospital care (tel. 2103688208, 2103688218)
- Pharmaceutical care (tel. 2103688208, 2103688241, 2103688243, 2103688210)
- Paraclinical examinations (tel. 2103688208, 2103688241, 2103688243, 2103688210)
- Examinations at home (tel. 2103688208, 2103688243)
- Physical therapy (tel. 2103688208, 2103688241, 2103688243)
- Dental care (tel. 2103688210)
- Orthopedic articles (tel. 2103688208, 2103688241, 2103688243)

Clinics operate at the University Club and the University Campus (Panepistimiopoli) as follows:

UNIVERSITY CLUB 1st FLOOR

- **Internal Medicine** (tel. 2103688241 and 2103688243): daily Monday to Friday between 8:00 and 14:00.
- **Gynecology** (tel. 2103688242) Tuesday and Thursday 10:30 - 12:45 and Friday 10:30 - 15:00.
- **Dermatology** (tel. 2103688209) Tuesday and Thursday 12:00 - 14:30.
- **Radiology laboratory** (tel. 2103688212), daily 8:00 - 13:30.
- **Dentist** (tel. 2103688210), daily 8:30 - 13:00.
- **Social and Psychological Support** (tel. 2103688226, 2103688282, 2103688209), daily 08:00 – 14:00.

UNIVERSITY CAMPUS (PANEPISTIMIOPOLI) – BUILDING A'

- **Internal Medicine** (tel. 2107275567): daily, Monday to Friday, 9:00 - 13:30.
- **Dermatology** (tel. 210 7275582) Monday and Wednesday 12:00 - 14:30.
- **Social and Psychological Support** (tel. 2107275580, 2103688282, 2103688209), daily 08:00 – 14:00.

UNIVERSITY CAMPUS – SCHOOL OF PHILOSOPHY (GROUND FLOOR)

- **Internal medicine** (tel. 2107277873): daily, 8:30 - 14:00.

UNIVERSITY CAMPUS – SCHOOL OF SCIENCES

- **First aid services** (tel 2107274391): daily, Monday to Friday, 8:00 – 20:30.

5.3. DISCOUNT IN TRANSPORTATION FARES

Students are entitled to 50% discount in Public Transportation fares (bus/trolley-bus, subway, tram and suburban railway) operating in the Metropolitan area of Athens and 25% discount in the fares of Public Transportation in other Greek cities. Students permanently residing in cities other than Athens are also entitled to a 50% discount in bus and railway fares to and from their city of residence.

The right to reduced student fares is effective immediately upon matriculation and holds until the day of graduation. Students are supplied with a special ID card which they must produce when

they buy a reduced fare ticket; the card is strictly personal and non-transferable. If lost, it can be replaced but only following a tedious process which may take a minimum of two months to complete.

For students who decide to suspend their studies (Section 3.6), the right to reduced fares is accordingly suspended and the ID cards are returned to the Secretariat. The benefit is reinstated once studies are resumed.

Further information can be sought in the Secretariat as well as at http://paso.minedu.gov.gr or in telephone numbers 801-11-31400 and 210-7724375.

5.4 Other Facilities and Contact Information

5.4.1. Foreign Languages

See Section 1.3.1

5.4.2. Accessibility Unit for Students with Disabilities

The mission of the Accessibility Unit for Students with Disabilities is ***to actively realize coequal access to academic studies for students with different abilities and needs, through built environmental modifications, Assistive Technologies and access services.***

The Unit provides students with disabilities with:

- Access to interpersonal communication with members of the academic community.
- Access to the built environment of the University including transportation services.
- Access to printed or electronic educational material.
- Access to classroom material and presentations.
- Assistance in note keeping, course and laboratory work and access to written examinations.
- Access to information, Internet content and applications of Information Technology.

Tel: 210 7275687

FAX: 210 275193

E-mail: access@uoa.gr

Website: https://access.uoa.gr/en/

5.4.3. Student Relief Fund

Provides material and moral support in extraordinary cases or extenuating circumstances. The service is located at the University Club, 3rd floor; Tel: 2103688221; Website: . http://tafpa.uoa.gr/.

5.5.4. Student Counceling Centre

Open Monday to Friday, 10:00 - 16:00. Tel.: 2107277554; Website http://www.cc.uoa.gr/skf/

5.4.5. Student Ombudsman

The Student Ombudsman endeavours to:

- review complaints pertaining to problems with the academic and administrative services and seek their solution;
- facilitate the interaction of the students with the Institution and administrative services;
- review complaints related to violations of laws and regulations, as well as academic and professional ethics;
- inform the students about their rights and obligations as members of the University Community

Address: University Club Building (15, Ippokratous st., 1st floor) – open every Wednesday, hours: 14:00 - 15:30 p.m.

Telephone: 210 368 8274

e-mail: sinigorosfititi@uoa.gr

5.4.6. Sports Facilities

Tel: 2107275554, 2107275551, 2107275556, 2107275549.

Web: http://www.lesxi.uoa.gr/foithtiki-merimna/panepisthmiako-gymnastirio.html.

APPENDIX I –
GRADING SYSTEM FOR EVALUATION AND RANKING OF CANDIDATE POSTGRADUATE STUDENTS

		Weight Factor	Min/Max Points	Min/Max. Grade
a.	**Degree**	30	6.5/ 10	195/ 300
b.	**Command of English** Points awarded: C2 (Proficiency)……10 C1 (Advanced)……8 B2 (Lower)……5 Certificate/Degree by English–speaking secondary or tertiary educational institute ……10	8	0/ 10	0/ 80
c.	**Command of other major Languages** (French, German, Italian, Spanish, Russian, Japanese, Chinese Mandarin) Point awarded: Proficiency level ……10 Functional knowledge ……5	4	0/10	0/ 40
d.	**Additional Studies** Points awarded: Postgraduate……3.5 Undergraduate……3 Relevant practical exercises …….0.25 Continued education, seminars etc. ……..0.75	20	0/ 4.5	0/ 90
e.	**Experience in Research** Points awarded for publications in Scientific Journals, Conference Proceedings etc.: ≥ 3 publications ……3 2 publications ……2 1 publication ……1 Participation in scientific projects ……1	20	0/ 4	0/ 80
f.	**Professional Experience in Earth Sciences:** ≥ 10 years……3.5 5-10 years……3 2-5 years……2 Up to 2 years……1 **Other Professional Experience:**…0.5	20	0/ 4	0/ 80
g.	**Interview**	29	0/ 10	0/ 290
h.	**Motivation Letter**	4	0/ 10	0/ 40
				1000

BASIC ELIGIBILITY CRITERIA:

1. Eligible candidates must demonstrate **undergraduate *or* previous postgraduate degree ranking at the top 35% of the scale by which their institution of origin ranks its graduates**. This is approximately equivalent to Level C of the European Credit Transfer and Accumulation System (ECTS). For example, Greek institutions rank their graduates on a scale from 5 to 10; therefore, Greek candidates must have a grade of at least 6.5/10 in order to be eligible. Failure to meet this requirement constitutes ***irrefutable presumption*** for the rejection of an application.

2. **Functional knowledge of the English Language (level B2 and higher)**. Applicants without official titles/ certificates of their command of English are entitled to request certification of their working knowledge by written and oral tests in front of an ad hoc Board appointed by The Department.

3. The personality and composure of the candidates is appraised by a personal interview in front of a student selection board. In order to be eligible, **an applicant should be able to *secure* at least one third 1/3 of the maximum points allocated for the interview, namely 96 points or 10% of the maximum possible number of credit points**. Failure to do so constitutes *irrebuttable presumption* for the rejection of an application.

APPENDIX II –
NON-INFRINGEMENT OF INTELLECTUAL PROPERTY

To be attached to all Postgraduate Dissertations

Infringement of Intellectual Property is defined to be the total or partial reproduction of the intellectual work of other person/persons, or the appropriation of the intellectual work of other person/persons and its presentation as intellectual work of the Student signing and submitting a Dissertation. The Department of Geology and Geoenvironment is ardently opposed to such practices and vehemently condemns such conduct by its Postgraduate Students. In cases of apparent or voluntary infringement of intellectual property, the competent organs of The Department are authorized to investigate and impose sanctions that may result in the expulsion of students from the PSP. In compiling their Postgraduate Dissertation, students are obliged to fully and unreservedly observe the following guidelines:

1. The Postgraduate Dissertation must be the exclusive intellectual product of the student who signs and submits it.
2. To copy or paraphrase the work of a third party constitutes infringement of intellectual property and is a serious of-fense. The offense includes appropriation of the intellectual property of fellow students as well as the verbatim re-production or appropriation of material from published sources (books, textbooks, dissertations, scientific articles). The appropriation and usage of material copied from websites and digital documents of any kind is equally serious to the appropriation and usage of material copied prom printed sources or data bases.
3. Utilization of excerpts from the work of third parties is acceptable if and only if the source of the excerpt is clearly ref-erenced. If verbatim quotation of excerpts from the work of a third party is necessary, then the use of quotes or ap-propriate footnotes/ endnotes is mandatory in order for the source to be acknowledged.
4. The paraphrase of text from the work of third parties constitutes infringement of intellectual property.
5. The sources of information used and/or quoted in the Dissertation must be listed in the “References Section” attached to the Dissertation.
6. The infringement of intellectual property, once demonstrated, is subject to severe sanctions that may result in expul-sion from the PSP and are completely specified in Art. 7, Par. 7 of the “Regulation of Studies”.

I hereby declare that the Postgraduate Dissertation that I herewith submit does not contain elements of Infringement of In-tellectual Property, as these are defined in the above Declaration whose terms I have read, understood and unreservedly accept.

I unreservedly provide assent for a digital copy of my Postgraduate Dissertation to be inspected either manually or by com-petent software in order to confirm that elements of Infringement of Intellectual Property are totally absent from my Dis-sertation.

Date **Signature**

APPENDIX III –
ALPHABETIC LIST OF COURSES (ALL SPECIALIZATIONS)

List of Courses .....(Outline in Page))

APPENDIX IV – MAPS AND PLAN DIAGRAMS OF THE DEPARTMENT

TOPOGRAPHIC MAP / INFORMATION ON HOW TO ACCESS THE DEPARTMENT

Refer to : http://maps.uoa.gr