Faculty of Environmental Sciences

Final State Examinations for Master Programmes – Thematic Areas

2023

Environmental Geosciences

The final state exam consists of 4 exams of different fields. There are 3 compulsory exams:

- Geology
- Environmental Soil Chemistry
- Environmental Geochemistry and Mineralogy

The 4th can be chosen from:

- Environmental Hydrogeology
- Paleoecology
- Environmental Analytical Chemistry
- Waste Geochemistry and Management

GEOLOGY

1. Structure of silicates (tetrahedrons SiO4, octahedrons AlO6, clay minerals, micas, feldspars. classification of silicates)
2. Magmatic (igneous) rocks (classification of igneous rocks, main types, genesis, structures, important minerals of igneous rocks, pyroclastic rocks)
3. Sedimentary rocks (classification of sedimentary rocks, main types, genesis, structures, important minerals of sedimentary rocks, karsts, eluvial rocks)
4. Metamorphic rocks (classification of metamorphic rocks, main types, genesis, structures, important minerals of metamorphic rocks)
5. Endogenous dynamics (creative and disturbing endogenous activity, earthquakes, volcanism, tectonics, lithosphere plates.)
6. Exogenous dynamics (creative and disturbing exogenous activity, activity of wind, gravity, seawater, freshwater, organisms, glaciers)
7. Lithosphere plate tectonics and Wilson cycle (rift valleys, oceans, subduction, island arcs, seafloor spreading, hot spots, middle oceanic mountain ridges, continental and oceanic lithosphere, orogenetic belts, deep-sea trench)
8. Historical geology (Eras and periods, fossils and evolution, settlement of continents, extinctions, ice ages, evolution of man and quaternary)

ENVIRONMENTAL GEOCHEMISTRY AND MINERALOGY

1. Geochemical principles, equilibrium and kinetic reactions in the environment
2. Global biogeochemical cycle of carbon
3. Global biogeochemical cycle of sulfur
4. Biogeochemical cycle of nitrogen
5. Geochemistry of the lithosphere, soils and hydrosphere
6. Geochemistry of the atmosphere, biosphere
7. Environmental mineralogy
8. Analytical methods in environmental geochemistry and mineralogy

ENVIRONMENTAL SOIL CHEMISTRY

1. Composition of soils, inorganic and organic phases
2. pH and redox chemistry of soils
3. Soil solution, kinetic and equilibrium processes

4. Adsorption processes in soils
5. Soil contamination; behavior of inorganic and organic contaminants in soils
6. Soil acidification and erosion
7. Soil remediation
8. Transport processes in soils
9. Analytical methods in soil sciences

ENVIRONMENTAL HYDROGEOLOGY

1. Water in the porous media (Aquifer and guitard), principles of GW flow, Darcy´s law; transmissivity and storativity (storage coefficient)
2. Groundwater movement thought the different porous media; hydrogeological structures (seepages and springs)
3. Physicochemical and chemical properties of the groundwater; processes affecting the chemical composition of the groundwater
4. Transport processes of groundwater
5. Modelling in HG (water flow and solute transport in saturated and unsaturated zone)
6. Remediation of groundwater; main contaminants and remediation techniques
7. Construction of hydrogeological boreholes; collection of groundwater and technical measuring/sampling
8. Hydrogeological aquifer tests; tracer tests

PALEOECOLOGY

1. Environmental controls on biotic distribution
   The structure of the biosphere
   Divisions of the marine environment
   Limiting factors of the distribution of organisms (light, nutrients, oxygen, temperature and salinity)
2. Taphonomy
   Preservation potential amongst biological communities
   Destruction by physical, biological and chemical processes on the sediment surface
   Preservation and destruction of shells below the sediment surface- the exceptional preservation of fossils
3. Trace fossils
   Preservation and taxonomy of trace fossils
   Trace fossils and paleoenvironments
   Marine and marginal marine ichnofacies
4. Fossils as environmental indicators
   Biofacies distribution
   Fossils as bathymetric indicators for marine shelf sediments
   Environmental indicators in deep marine sediments
   Carbonate environments (carbonate ramps, rimmed shelves and epeiric basins)
   Oxygen deficient environments
   Environments with high and low salinity
   Shell concentrations, sedimentation rate and sequence stratigraphy
5. Populations and communities
   Population structure and dynamics (types of populations, size-frequency analyses)
   Community structure (paleocommunities, numerical analysis of community data)
   Community organization (trophic structure, tiering, coevolution and community succession)

Species diversity (diversity patterns on different scales, diversity trend in marine habitats, and measuring diversity in palaeontological samples)
Environmental distribution of Phanerozoic communities

6. Paleobiogeography
   Concepts and definitions
   Controls on biogeography (dispersal and vicariance biogeography)
   Recognition of past biogeographic provinces
   Paleoclimatology
   Plate movements
7. Evolutionary paleoecology of the marine biosphere
   The early history of life
   Diversification events in Earth history (the origin of life and the earliest Procaryota, appearance of the Eucaryota, appearance of the Metazoa)
   The early Cambrian evolutionary explosion
   Diversification of the three great evolutionary faunas
   Patterns of extinction (analysing patterns of extinction, causes of extinction, recovery from mass extinctions)
   The effect of major extinctions on evolution (radiation, stasis and extinction)
8. Fossil terrestrial ecosystems
   Initial adaptations and the early terrestrial record (plants and animals)
   Terrestrial ecosystems through time (Palaeozoic and Mesozoic ecosystems)
   Mass extinctions

WASTE GEOCHEMISTRY AND MANAGEMENT

1. Characterization of waste types and principles of waste treatment
2. Municipal solid waste – definition, characterization, treatment
3. Mining waste – definition, generation, characterization
4. Metallurgical waste – definition, generation, characterization
5. Chemical and radioactive waste – definition, characterization, treatment
6. Leaching tests for waste assessment
7. Landfilling
8. Waste management – principles and legislation

ENVIRONMENTAL ANALYTICAL CHEMISTRY

1. Introduction to Environmental Analytical Chemistry; general principles and techniques
2. Analytical data, their assessment and interpretation
3. Basic chemical principles
4. Sampling, sample preparation and sample treatment
5. Titrimetry and gravimetry
6. Separation techniques
7. Atomic spectrometry
8. Mass spectrometry
9. Molecular spectrometry
10. Isotope analyses
11. Elemental analyses