Environmental Geology (250677)

General Information

School	ETSECCPB
Departments	Departament d'Enginyeria Civil i Ambiental (DECA)
Credits	5.0 ECTS
Programs	MÀSTER UNIVERSITARI EN ENGINYERIA AMBIENTAL (pla 2014)
Course	2024/25

Main teaching language at each group

- Group 10ES2 Spanish (Q2)

Faculty

Responsible Faculty: Albert Folch Sancho
Faculty: Albert Folch Sancho

Objectives of Education

CE01 - Apply scientific concepts to environmental problems and their correlation with technological concepts.
CE08-Dimension unconventional systems and advanced treatment and raise their mass balance and energy.

Explore scientific concepts and technical principles of quality management of the receiving means, atmosphere, water and soil, and applied to problem solving.
Explore scientific concepts and technical principles of management and treatment of gaseous emissions, water supply, sewage and waste and remediation techniques for groundwater and contaminated soils.
Sized systems for the treatment of major pollutants vectors in specific sectors of activity.
Interprets rules, identifies goals, assesses technical alternatives proposed unconventional solutions and priority actions.

Organization of Natural Systems. Basic concepts. Cycles of the physical environment: tectonic cycle, erosion cycle, hydrological cycle.
The edaphic system: alteration of rocks and soil formation. Fertility. Degradation, erosion and pollution. Desertification.
The river basin: surface water system and water systems. Deltas. Water resources, vulnerability and protection.
Natural disasters. Endangerment, risk: quantitative assessment. Hydrometeorological, geological and geomorphological hazards. Prediction and prevention.
Impact on the physical environment of urban expansion and major infrastructures (road works, tunnels, dams, reservoirs, ...). Alteration of natural physical systems.
Resources use and extraction. Spills and waste dumps. Impacts and restoration.
Geological aspects of waste storage.
Management strategies and conservation of natural systems. Sustainable design. Climate and Global Change: consequences and adaptation.

Environmental geology is an applied science that deals with the practical application of the principles of geology in solving environmental problems. It is a multidisciplinary field that is closely related to geological engineering and, to a lesser extent, to environmental geography. Each of these fields involves the study of the interaction of human activities with geology, including the biosphere, the lithosphere, the hydrosphere and in some cases also the atmosphere.
In this subject, some specific topics within this broad field will be dealt with in order to expand the

knowledge acquired during the master and complement the skills necessary for the profession of environmental engineer. In this sense, topics will be discussed and examples of how geology conditions certain human activities and intervenes in different environmental processes will be explained. The focus of the different topics and problems will be from a multi and interdisciplinary point of view, necessary for the correct management of natural resources. In addition, different traditional and newly developed tools for the study and monitoring of the subsoil, water resources and natural resources will also be discussed.

Competencies

Especific

Apply scientific concepts to environmental problems and their correlation with technological concepts.
Perform, present and defend before a university tribunal an original exercise performed individually, consisting of a comprehensive study or project in the field of environmental engineering, in which the skills acquired in the lessons are synthesized by adopting the advances and developments in this field and many innovative ideas.

Transversal

SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.
FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

Total hours of student work

		Hours	Percentage
Supervised Learning	Large group	25.5 h	56.67 %
	Medium group	9.75 h	21.67 %
	Laboratory classes	9.75 h	21.67 %
	Guided Activities	0.0 h	0.00 %
Self Study		80.0 h	

Contents

Block 1: Geodynamics, water resources and derived impacts

1.1. Basic introduction to geology, mass balance and real case of application application through a numerical model
1.2. Fluvial geodynamics and impacts: importance of water and sediment transport
The case of pollution in the area of Flix will be explained and as an exercise you should stop and take into account where the sampling is done to determine the transport of the pollution taking into account the fluvial geodynamics

1.3. Environmental and socioeconomic value of subsoil resources: groundwater and geothermal energy
Using the IGCC vizier (and Google Earth) and the information from the geological map of Catalonia, identify at least 5 areas/points where you think there will be ecosystems dependent on groundwater (wetlands, rivers, etc.) with a brief justification.
1.4. Geology and coastal aquifers
Identify at least three areas of Catalonia where you would expect to find saline intrusion problems in Catalonia and justify why based on the following data Viewer Institut cartogràfic i geològic de Catalunya. Geological map of Catalonia Agència Catalana de l'Aigua Map hydrogeological areas of Catalonia Mapes hidrogelògics 1/25000

1.5. Geoenvironmental processes in coastal areas and groundwater discharge to the sea.
1.5P. Identification of potential groundwater discharge areas on the Catalan coast
1.6. Geodynamic and hydrological processes in anthropic conditions: the international case study of the Ebro Basin.

Specific Objectives

In this topic, an introduction to the subject will be made as well as some basic geological concepts. In the second part, it will be explained how human activities can alter the natural cycle of water and also the concept of water budget or water balance, as a basic management tool and its application to a real case through a numerical model
Rivers are a fundamental part of the hydrological cycle where not only water transport but also sediment takes place, which affects natural systems such as Deltas and beaches, but can also become a geological irrigation during floods. This topic will explain different methods for the measurement of flows, and estimation of the risk of flooding, as well as the natural and anthropic variables that affect and / or alter the transport of water and sediments in river courses.
The case of pollution in the area of Flix will be explained and as an exercise you should stop and take into account where the sampling is done to determine the transport of the pollution taking into account the fluvial geodynamics

Although in many cases subsoil resources may go unnoticed due to their low "visibility", they are important in multiple aspects beyond mining resources, construction materials or water to supply the population. This topic will explain the services provided by the subsoil with special emphasis on the importance of groundwater for the good condition of continental aquatic ecosystems, from rivers to wetlands. The different types of geothermal energy will also be explained, with special importance of very low enthalpy, which can be applied around the globe adapted to each geological context.
Using the IGCC vizier (and Google Earth) and the information from the geological map of Catalonia, identify at least 5 areas/points where you think there will be ecosystems dependent on groundwater (wetlands, rivers, etc.) with a brief justification.
This chapter will explain how the different contexts and geological formations condition the flow of water in the subsoil. The dynamics of coastal aquifers, marine intrusion (flow in variable density), corrective measures and considerations in the field will also be explained.
The concentration of nutrients in groundwater is generally much higher than in rivers. Therefore, despite the fact that groundwater discharge flows to the sea may be quantitatively much lower than that of surface waters, its high concentration of nutrients, generally much greater than surface waters, has important implications for coastal ecosystems. This topic will explain how groundwater discharge to the sea works, its importance and quantification methods, both from a hydrogeological and oceanographic approach.
Identify at least three areas of Catalonia where you would expect to find a greater discharge of groundwater and justify why based on the following data: Viewer Institut cartogràfic i geològic de Catalunya. Geological map of Catalonia Agència Catalana de l'Aigua Map hydrogeological areas of Catalonia Mapes hidrogelògics 1/25000
The Ebro basin, with its more than 1000 km in length, is the longest in the Iberian Peninsula. Its great geological, climatic, hydrological, ecological and social diversity has made it an international case study. This topic will explain the different impacts derived from the planning and management of water resources from an environmental and social point of view, starting at the head reservoirs until ending at the mouth of the Ebro Delta.

Block 2: Basic tools of Geographic Information Systems (GIS)

Topic 2.1: Introduction to GIS and basic QGIS course (free software)
Topic 2.2: Application of QGIS to practical cases

Specific Objectives

GIS are computer systems that allow us to integrate, store, analyze, share and display widely varied information in a geo-referenced way. The appearance of GIS has marked a before and after in many fields of knowledge and is a fundamental tool for environmental management. This block will explain what GIS is and will provide the necessary bases to be able to use free QGIS software at a basic level.
Real cases will be worked with the QGIS tool

Block 3: Study, characterization and monitoring of the subsoil and natural resources

3.1. Traditional tools in geological and geophysical prospecting
3.2. New on-site application tools: multi-parameter surveys and profiles, recently developed water sensors, new geophysical prospecting methods and fiber optics.
3.3. New remote tools: drones and satellite remote sensing.
3P. Analysis and assessment of real cases

Specific Objectives

This topic will explain what are the most common tools for conducting geological prospecting, as well as the most widely used geophysical methods (non-invasive methods) for underground exploration.
Technological advances in recent years are revolutionizing existing options for characterizing and monitoring the subsoil. This topic will explain some recently developed methods for characterizing the subsoil in situ with some real examples.
These advances have not occurred only in on-site tools, but especially through new remote sensing tools. In this class, an introduction to the subject will be made, comparing the advantages and disadvantages between the different platforms (drones vs. airborne vs. satellites) as well as some examples of applications for the study of the subsoil and environmental processes.
Different examples of application and real cases of the methodologies explained in theory throughout block 3 will be explained and assessed.

Directed work. evaluation

Teaching Methodology

The course consists of 3 hours per week of classroom activity consisting in theory sessions, solving of problems and the study of real cases.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

Grading Rules

(*) The evaluation calendar and grading rules will be approved before the start of the course.

The evaluation method will be through the delivery of 3 limited-extension works focused on real cases.

Presentation 1

- Option 1 (two alternatives): a) Proposal for planning the resources of the Ebro basin for a correct management of water resources with minimal environmental and social impact, b) Analysis of management problems and impacts derived from the hydrological planning in a freely chosen hydrographic basin

- Option 2 (two alternatives): a) Analysis and proposals for improving the management of a coastal aquifer considering the problem of marine intrusion into resources and / or the discharge of groundwater to the sea in coastal ecosystems.

Presentation 2

-Study of free choice environmental problems with GIS tools.

Presentation 3

-Proposal of monitoring tools to study an environmental problem and improve the management of natural resources (it may be related and/or applied to the same area chosen for presentation 1 and/or 2).

The submitted works must be presented and defended publicly in front of the rest of the classmates. This will allow all students to ask and enrich themselves of the work done by their classmates.

Test Rules

Failure to perform continuous assessment activity in the scheduled period will result in a mark of zero in that activity.

Office Hours

By appointment

Bibliography

Basic

- Keller, E.A. Environmental geology. 9th ed. Pearson, 2010. ISBN 9780321643759.
- Montgomery, C.W. Environmental geology. 10th ed. New York: McGraw-Hill, 2014. ISBN 9781259060717.