UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Environmental Hydrogeology (blended)

2425-1-F7501Q092

Aims

The course aims to convey to the student of Sciences and Technologies for the Environment and the Territory

- knowledge of the basic principles of hydrogeological discipline and of the connection between groundwater and surface water as the only environmental system;
- the ability to study and quantitatively analyze the main natural hydrogeological aspects and the anthropic impact on them;
- the ability to express complex scientific concepts in an elaborate form, both orally and in written form, with properties of language and conceptual relevance;
- the ability to develop an autonomy of analysis and elaboration of complex hydrogeological situations, for the purpose of an integrated management.

At the end of the course the student is able to

- Describe quantitatively the geometric and hydrogeological structure of a complex environmental context
- Calculate the main hydrogeological parameters and understand their influence on the environmental context
- Calculate the flow velocity of a water table

At the end of the course the student has acquired a judgment autonomy that allows him to

- Analyze an environmental hydrogeological problem
- Identify the most suitable tools for this analysis

The student acquires in the course a learning ability that can be expressed in:

- Apply the acquired knowledge to contexts that are also different from those studied during the course
- Understanding scientific articles related to the hydrogeological characterization of an environmental system

Contents

The target of the course is the study of groundwater resources, also in relation with the surface water, with a view to their sustainable management. In particular, the course aims to teach to students how to develop a quantitative assessment of the hydrogeological aspects.

The course deals:

- physical structure and hydraulic properties of porous media,
- hydrogeological balance elements; water flow in confined and unconfined aquifers,
- water wells and groundwater flow to wells,
- the impact on groundwater of human structures such as hydraulic barriers, quarry, pumping stations, irrigation systems, etc..

Detailed program

The course is divided into weekly modules, according to a blended learning course, using lessons in classroom and e-learning activities, implemented on the Moodle platform of the University. In particular, the course will be structured in modules, weekly, divided by
subject:

- Confined and unconfined aquifer: structural and hydraulic elements to characterize them
- Hydrogeological balance elements: balance elements in and out in plain ot mountain areas
- The hydrogeological sections to reconstruct the underground structure: reconstruction of manual hydrogeological sections,
- Groundwater laws: Darcy, Dupuit and Bernulli laws,
- Hydrogeological parameters,: hydraulic conductivity, transmissivity, real and apparent velocity, storage coefficient,
- Aquifer network flow: isopiezometric lines and flow lines, 3D view
- Hydrogeological instruments: drilling and hydrogeological instrumentation: wells and piezometers, development and completion
- The catchment of the groundwater: wells pumping cones, interference between wells, protection and respect area.

The course also includes the presence for 30 hours of a **DISCIPLINARY TUTOR** who follows the students, in particular in the blended elearning mode to answer their questions on the platform, prepare training quizzes, encourage active participation in the forum and, in general, to help them following the development of the course on an ongoing and regular basis and to reach the exam, more prepared.

Prerequisites

Knowledge of fluid dynamics and of hydrological balance.

Teaching form

The teaching is done in blended-e-learning mode and is divided into the following teaching methods:

- 16 lessons of 2 hours of dispensing and interactive teaching, alternating during the lesson (4 CFU)
- 8 exercises of 2 hours of interactive teaching carried out independently by the student (2 CFU)

Each module has a specific structure:

1. a lecture, to clarify the theoretical aspects more complex, to be carried out in the classroom with meetings of four hours weekly fixed (for a total of 32 hours);
2. slide screened and discussed by the teacher in the classroom;
3. guided exercises carried out by the teacher and students can follow them at their own pace and ways;
4. development of specific quiz for each topic to help students in self-assessment, to prepare themselves for the exam;
5. a specific forum on the subject that encourages constant dialogue between students, teachers and tutors. The teacher will moderate all asynchronous forums designed to explore the themes of the course, with the help of material provided.

Textbook and teaching resource

Book - Fetter C.W., 2014. Applied hydrogeology, Prentice Hall
Teacher resources, at link (https://elearning.unimib.it/course/view.php?id=57758)

- video material
- extra material for self-study in blended elearning hours
- exercises carried out and to be performed independently
- training quizzes independently

Semester

First semester

Assessment method

The competences provided during the frontal lessons are evaluated with

- **ongoing activities in blended-learning during the course,**
- **a written exam at the end of the course**
- **an optional oral exam at the request of the student.**

The activity in blended-e-learning includes exercises which must be carried out by the student during the teaching and delivered at the end of the course. This activity contributes to the final evaluation for a maximum of 10/30.

The writing exam consists of

- four open questions (for a maximum total of 10/30) to verify the knowledge of the principles of the discipline, the ability to deal with the main hydrogeological situations and the ability to express complex scientific

concepts (these questions account for 50% of the writing)
- an exercise that brings together the skills acquired during the course (for a maximum total of 10/30), to verify the ability to connect the various parts of the program to face real hydrogeological problems (weighs 50% of the text). The writing is valid at most 20/30.

At the request of the student it is possible to take an oral exam if the minimum mark of 11/30 is reached in the written exam and 7/10 in the blended elearning part.

Office hours

By appointment via email

tullia.bonomi@unimib.it

Sustainable Development Goals

CLEAN WATER AND SANITATION