Training Objectives

1. This Master's program aims to provide a multidisciplinary education on issues related to inland waters, with the goal of preparing students for careers as researchers or high-level specialists in earth sciences focused on water resource management and environmental management. The program covers topics such as the evolution of water resources (surface or groundwater), their links with climate variability, preservation of water quality, rational use of water, and the relationship between water and health. An integrated and multidisciplinary approach is required to address these themes.
2. This program offers specialization in the field of water and environment.
3. The Master's program aims to train specialists in water resource management, focusing on both quality and quantity, capable of collaborating within multidisciplinary teams.
4. It prepares students to enter the professional world as responsible actors.
5. The Khemis Miliana region is rich in hydraulic infrastructure (dams, wastewater treatment plants, irrigation systems, pumping stations, etc.). This logistical support can be a significant pedagogical asset for students, providing an open-air laboratory.

Target Profiles and Professional Competences

This Master's program, as part of the development of various specialties in the field of earth sciences at the faculty, aims to train specialized professionals in water sciences. These professionals will acquire the following competences:

• Technical skills in the field of water and environment.

• Methods to structure knowledge scientifically.

• Key skills to find information in the water domain.

• Knowledge of water-related challenges.

• Understanding of environmental issues related to water and the environment.

• Basic knowledge of water disciplines.

• Mobilization and protection of water resources.

• Water resource management.

• Environmental management.

• Increase in water resources.

• Essential natural knowledge for understanding the physical and chemical processes that determine their functioning.

Regional and National Employment Opportunities for Graduates

• Ministry of Water Resources and Environment.

• Directorate and Subdivisions of Water Resources (at the provincial level).

• National Agency for Hydraulic Resources (A.N.R.H.).

• Municipalities.

• Consulting firms.

• Urban Planning and Housing Directorate.

• Environmental Directorates.

• National Agency for Dams and Transfers (A.N.B.T.).

• National Sanitation Office (O.N.A.).

• Basin Agencies (ABH)

. • National Irrigation and Drainage Office (O.N.I.D.).

• Forest Conservations.

• Directorate of Mines and Industry.

Bridges to Other Specialties

The modular structure of this Master's program provides students with the opportunity to capitalize on course units that can be used in other academic programs. After accumulating a certain number of credits, students can pursue the following Master's programs, which are offered at Djilali Bounaama University of Khemis Miliana and other universities:

- Environmental Science.
- Geosciences.
- Earth Sciences.
- Natural and Life Sciences.

Monitoring Indicators for the Program

The final internship serves as a learning experience for students in their future profession. It represents both a valuable first professional experience and the culmination of their academic journey. In an operational context, the student will fulfill a specific mission that they understand the importance of for the company. By utilizing the resources of the company, its partners, and their own networks, the student will apply and develop their knowledge, analytical skills, reactivity, work organization, and interpersonal qualities to deliver high-quality work that meets the requirements. The qualities of the student will be evaluated based on their performance during the internship, their internship report, and its defense before a jury. The assessment aims to evaluate the scientific and technical quality of the work, as well as the student's ability to provide a contextual and well-argued analysis of the methodology, results, and conclusions. The diploma will be awarded if the following conditions are met

Semestre 1

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 1

Subject title: Fluid Mechanics **(UEF11)**

Credits: 4
Coefficient : 2

Objectives of the Course: The objective of this subject is to acquire knowledge of fluid mechanics.

Recommended Prerequisite Knowledge: Basic knowledge of physics and mathematics.

1. **Properties of Fluids**

- Definition of a fluid
- Dimensions and units
- Properties of liquids (density, viscosity, surface tension, capillarity, etc.)

2. **Hydrostatics**

- Pressure at a point
- Fundamental equation of fluid statics
- Pressure measurement devices
- Hydrostatic force on flat and curved surfaces
- Buoyancy of objects in a liquid (Archimedes' principle, stability of objects, etc.)

3. **Fluid Kinematics**

- Flow regimes of liquids
- Description of flow configurations
- Volumetric flow rate and mass flow rate
- Motion of a fluid
- Continuity equation

4. **Hydrodynamics of Fluids**

- Euler's equation for perfect fluid in motion
- Bernoulli's equation for a perfect fluid
- Fundamental equation of real fluid in motion
- Interpretation of Bernoulli's equation (in terms of energy, height, etc.)
- Correction factor for kinetic energy

5. **Flow in Charged Pipelines**

- Flow regimes of liquids (Reynolds' experiment)
- Study of head losses (linear and singular)
- Different flow systems
- Calculation and simulation of networks (branch network design, meshed network simulation)

Guided work sessions:

1. Properties of Fluids
2. Hydrostatics
3. Fluid Kinematics
4. Hydrodynamics of Fluids
5. Flow in Charged Pipelines

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 1

Subject title: General hydrogeology **(UEF12)**

Credits: 4
Coefficient : 2

Objectives of the Course: Hydrogeology aims to effectively plan the exploitation of water resources. It is therefore necessary to identify aquifers or groundwater reservoirs, but above all, it is important to protect and manage water resources.

Recommended prerequisite knowledge: Understanding of physics, mathematics, and hydrology.

Course content:

1. **Water in the reservoir**

- General introduction
- Water in the reservoir
- Porosity
    - Different types of porosity
    - Classification of porosity
        - Based on size
        - Based on origin
    - Morphological classification
    - Magnitude of porosity
- Water mobility in the soil (bound water, free water, capillary water)

2. **Movement of water in permeable rocks**

- Flow dynamics
- Hydraulic head
- Darcy's experiment (measurement of permeability, hydraulic gradient)
- Reynolds' experiment
- Flow in stratified rocks
- Horizontal permeability
- Vertical permeability

3. **Aquifers and their characteristics**

- Conditions for the existence of groundwater reservoirs
- Groundwater recharge
- Groundwater discharge
- Springs
- Classification of reservoirs based on geological and hydrodynamic criteria

4. **Study of flow in groundwater reservoirs**

- Transmissivity
- Storage coefficient
- Piezometric line and piezometric surface
- Flow lines
- Effect of transmissivity variation
- Flow equation and its solution
- Steady-state flow in unconfined aquifers (Dupuit's equation)
- Steady-state flow in confined aquifers

Guided work sessions:

1. Laboratory and in-situ measurement and estimation of permeability
2. Preparation of a piezometric map
3. Interpretation of a piezometric map
4. Creation of a hydrogeological cross-section
5. Workshops on hydrogeological maps.

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 1

Subject title: Hydrology and climatology **(UEF13)**

Credits: 4
Coefficient : 2

Objectives of the Course: This module aims to establish the foundations of general hydrology and climatology knowledge. It is divided into two parts. The first part focuses on surface waters, with the watershed as the hydrological unit. The second part deals with methods of flow measurement.

Recommended prerequisite knowledge: Understanding of physics and mathematics.

Course content:

1. **Introduction to surface hydrology**

- Water cycle
- Hydrological balance

2. **Study of the watershed**

- General characteristics of the watershed
- Shape characteristics
- Hydrographic network characteristics and Schumm's classification
- Other watershed characteristics (drainage density, torrentiality coefficient, longitudinal profile, hypsometric curve, etc.)

3. **Study of rainfall**

- Mechanism of precipitation formation
- Classification of precipitation
- Measurement of precipitation (rain gauges, pluviographs)
- Processing of rainfall data

4. **Evaporation and evapotranspiration**

- Temperature measurement
- Air temperature
- Measurement of air humidity (hygrometer)
- Wind measurement (anemometer)
- Measurement of evaporation (Colorado pan)
- Formulas for estimating evaporation and evapotranspiration

5. **Hydrometric stations - flow measurements**

- Measurement methods
- Water level measurement
    - Limnimeter scales
    - Limnographs
    - Measurement equipment
    - Current meter measurements
- Exploitation of the hydrometric network
- Analysis of current meter measurements
- Calibration curves

Guided work sessions:

1. Watershed characteristics
2. Processing of rainfall data (Thiessen polygons method and Isohyetal maps)
3. Estimation of evaporation and evapotranspiration
4. Analysis of current meter measurements
5. Flow analysis.

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 1

Subject title: Hydrology and climatology Water chemistry and analytical techniques **(UEF14)**

Credits: 6
Coefficient : 6

Objectives of the Course: The objective of this course is to acquire knowledge about water and its properties, understand the methods of acquiring hydrochemical data and their interpretation, estimate water quality, and identify possible pollution sources.

Recommended prerequisite knowledge: Basic knowledge covered in the common core curriculum is sufficient to follow this course.

Course content:

1. **Water and its general physic-chemical properties**

- Water molecule
- Different states of water and their changes
- General properties of water
- Composition of natural water

2. **Activity-concentration relationship** (Thermodynamics)

- Activities of ionic species
- Ionic activity -Variations in activity values - Saturation Index (SI)
- Carbonate-carbonic equilibrium and it's importance

3. **Acquisition of hydrochemical data**

- Field sampling
- Laboratory measurements
- Water analysis and analytical methods
- Measurement of physico-chemical parameters
- Major ion determination, hardness, TAC (Total Alkalinity as Calcium Carbonate), etc.
- Expression of results and Quality control of results

4. **Graphical representation of results**

- Different types of diagrams. Advantages and disadvantages
- Triangular diagrams: description, use, and interpretation of the Piper diagram
- Vertical diagrams: description, use, and interpretation of the Schoeller/Berkaloff diagram
- Various steps in the interpretation of analytical results of water

5. **Estimation of water quality**

- Agricultural use and determination of water suitability for irrigation
- Determination of SAR (Sodium Adsorption Ratio) and use of Richard's and/or Wilcox diagrams
- Water intended for human consumption
    - Main differences between surface water and groundwater
    - Comparison of water quality standards
    - Toxic or undesirable elements in drinking water
    - Maximum allowable concentrations according to WHO (World Health Organization)

6. **Water pollution**

- Sources of water pollution
    - Natural sources
    - Anthropogenic sources

Guided and practical exercises:

1. Measurement of physicochemical parameters of water in the laboratory
2. Measurement of pH, electrical conductivity, TDS (Total Dissolved Solids), salinity, and dissolved oxygen
3. Chemical analysis of water: major chemical elements and RS (Residual Strength)
4. Classical interpretation of water analysis results: Calculation of meq/L, percentage of error, reaction quantities in %, characteristic ratios, and graphical representations
5. Exercises on the assessment of water quality.

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 1

Subject title: Pollution **(UEM11)**

Credits: 1

Coefficient : 1

Objectives of the Course: The objective of this course is to master the field of environmental pollution. Specifically, when faced with case studies, the student should be able to appropriately use the quantities and units that characterize environmental pollution.

Recommended prerequisite knowledge: Basic education in chemistry and physics.

1. **Water Pollution**

- Measurement of water quality (sources, mechanisms, and symptoms of pollution in rivers and lakes)
- Influence of pollution on living organisms (oxygenation and deoxygenation, eutrophication)
- Wastewater treatment and purification
- Prevention of water pollution

2. **Air Pollution**

- Context: Environment-Pollution-Sustainable Development-Energy
- Primary energy consumption and CO2 emissions
- Changes in air quality and their effects on organisms
    - Chemical components of atmospheric air (dry)
    - Chemical pollutants
    - Pollution by NO2
    - Formation of pollutants
- Wind energy
- Some consequences of air pollution:
    - Greenhouse effect
    - Photochemical smog
    - Ozone hole

3. **Noise Pollution**

- Generalities and definitions, physical and psychophysiological characteristics of sound
- Auditory and non-auditory effects of noise on living organisms
- Noise reduction methods

4. **Radioactive Pollution**

- Generalities and definitions
- Transfer of pollutants in the environment

5. Soil Pollution

- Basics in soil science
- Causes and consequences of soil degradation/pollution
- Behavior of trace elements in soil
- Behavior of organic pollutants in soil
- Risk analysis and legislation
- Decontamination techniques and case studies

6. Solid Waste

- Characterization and collection of solid waste
- Selective collection
- Treatment methods: controlled landfill, composting, simple sorting, applied to urban waste
- Recycling issues

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 1

Subject title: Pollution Geographic Information System (GIS) and Spatial Analysis **(UEM12)**

Credits: 4
Coefficient : 2

Objectives of the Course: The theoretical and technical knowledge that students will possess at the end of the learning process is related to skills in geographic information processing engineering and the use of computer tools equipped with a GIS, with a practical application in hydrogeology.

Recommended Prerequisite Knowledge: Knowledge of computer science, Windows operating systems, cartography, and hydrogeology.

Course Content:

1. **Introduction to GIS**

- Geographic Information Systems
- A GIS as a model of reality
- An example of a mini-GIS

2. **Modeling**

- Cartographic modeling
- Concept of layers
- Vector-based cartographic modeling
- Raster-based cartographic modeling
- Entity-relationship modeling
- Analytical construction of the conceptual schema

3. **Structuring and computer representation of data**

- Vector-based structuring
    - Spaghetti
    - Topological
    - Representation of islands
    - Representation of complex polygons
- Raster-based structuring
    - Types of matrices
    - Normal matrices
    - Nested mesh
    - Mathematical curves
- Relational structuring
    - Definitions (field, record, key, relation, etc.)
    - Computer representation of numbers and characters
    - Third normal form

    - Three types of tables
    - Visualization
    - Referential integrity
    - Types of joins
    - SQL
- Transition from the conceptual schema to the relational structure
- Representation of surface topology
- Representation of network topology

4. Database management systems

- History and utility
- Components
- Data archiving and compression
- Macro programming
- Conventional programming

Practical Work:

1. Introduction to ArcGIS and QGIS software
2. Principles of georeferencing and spatial localization using GPS
3. Vectorization techniques and topological relationships
4. Design of a hydrogeological relational geodatabase
5. Spatial visualization and analysis (thematic queries)
6. Mastering hydrogeological symbolization in ArcGIS
7. Layout of digital hydrogeological maps in ArcGIS and QGIS.

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 1

Subject title: Groundwater extraction techniques **(UEM13)**

Credits: 4
Coefficient : 2

Objectives of the Course: Mastering the techniques of drilling and groundwater extraction in order to familiarize students with this aspect that will be useful in their professional life, particularly in the development and monitoring of groundwater extraction projects.

Recommended Prerequisite Knowledge: Knowledge of geology, hydrogeology, and civil engineering (elementary).

Course Content:

1. **Techniques for capturing springs**

- Simple development of a spring
- Development with a collection box and sizing of the tank volume, overflow, and pipes
- Development with a collection box and filter

2. **Techniques for well capturing**

- Digging in soft and hard terrain
- Casing
- Setting up the catchement
- Filtering mass
- Bottom slab
- Equipment (curbs, anti-mud devices, fencing, pump)

3. **Drilling techniques**

- Comparison of different drilling methods (advantages and disadvantages) and selection criteria
- Site setup and organization
- Description of equipment
- Pre-drilling operations (purpose and execution)
- Drilling diameters and projected drilling program based on defined objectives
- Drilling fluid: types and properties, drilling fluid circuits, and sizing of mud pits
- Compressed air for down-the-hole hammer

4. Exploration drilling

- Drilling logs (analysis of cuttings, lithological column, and grain size)
- Evaluation of well productivity (use of cuttings, behavior of drilling mud, and well logging)
- Aquifer testing

6. Tubular equipment and filter medium

- Use of lithological column and well logs
- Description of casings and types of screens
- Equipment column and material selection
- Sizing of screen slots
- Filter medium (sizing, nature, and role)

7. Well development (purpose and execution)

- Compressor development (air lift)
- Pump development

8. Pumping tests

- Step-drawdown pumping test and sizing of electromechanical equipment

9. Field report during ongoing drilling: description of in-situ cuttings, supervision of well logging operations

Guided work sessions:

1. Location of extraction facilities (methodology and application to a real case: use of geological, geophysical, hydrogeological, and environmental criteria)
2. Individual work (comparison of drilling methods, advantages, and disadvantages)
3. Field report during ongoing drilling: description of in-situ cuttings, supervision of well logging operations
4. Calculation of different constraints (crushing and buckling) on casing
5. Sizing of screen slots and gravel pack based on the grain size curve
6. Step-drawdown pumping test: calculation of head losses in the system and sizing of electromechanical equipment.

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 1

Subject title: Statistics **(UED11)**

Credits: 2
Coefficient : 2

Objectives of the Course: It is a tool that assists in the analysis, processing, interpretation of results, and their presentation in order to make data understandable.

Recommended Prerequisite Knowledge: Knowledge of mathematics and statistics.

Course Content:

1. **Variables, statistical data, tables, frequencies**

- Fundamental definitions
- Nominal qualitative variable
- Ordinal qualitative variable
- Discrete quantitative variable

2. **Univariate descriptive statistics**

- Measures of central tendency
- Measures of dispersion
- Moments
- Measures of shape
- Change of origin and unit
- Means and variances in groups
- Stem-and-leaf plot
- Box plot

3. **Bivariate descriptive statistics**

- Bivariate statistical series
- Two quantitative variables
- Two qualitative variables

4. **Probability calculation and random variables**

- Probabilities
- Combinatorial analysis
- Random variables
- Continuous random variable
- Bivariate distribution

5. **Time series, filters, moving averages, and seasonal adjustment**

- General definitions and examples
- Description of trend
- Shift and difference operators
- Linear filters and moving averages
- Seasonal adjustment

Guided work sessions

1. Characterization of a statistical series (construction of bar charts, stem-and-leaf plots, and histograms).
2. Calculation of quantiles and representation of cumulative distribution functions.
3. Calculation of measures of central tendency, dispersion, and shape, and construction of box plots.
4. Bivariate statistical analysis by determining the regression line for quantitative variables and the Cramer's coefficient for qualitative variables.
5. Application to laws governing random phenomena within the formal framework of probabilistic models.

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 1

Subject title: Technical English **(UET11)**

Credits: 1
Coefficient : 1

Objectives of the Course: Understand and learn to effectively use geological, hydro-geological and environment terms in English and become more familiar with using English language in the field of hydrogeology.

Recommended Prerequisite Knowledge Basic reading and oral communication, grammar, vocabulary building, listening and speaking. Reading of simple scientific texts, their analysis, comprehension of the main idea and a basic ability to communicate and exchange information in a simple way.

Contenu de la matière :

1. **Understanding basic hydrogeology concepts in English Speaking:** logical development of ideas, participation in a discussion presentation, dialogue, interview, discussions, interpretation, assessment and generalization on the speciality topics.

2. **Listening:** to simulate texts (presentations, academic discussions, conversations) of average complexity on speciality topics. Types of texts: practical guidelines and instructions, descriptions of a process, an interview, a conversation.

3. **Language in use:** forming and expanding professional / speciality vocabulary on the basis of the topics discussed, learning to use grammatical structures typical of scientific texts in all language skills: tenses of the verbs, active/passive voices, order of adjectives, nominal adjectives, and adverbs.

4. **Topics to be studied :** Pollution of surface and groundwater, aquifers, water resources, soil pollution, geography, water cycle, Poverty and environmental damage, Sustainable development, climate chang.

Semestre 2

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 2

Subject title: General hydrolic **(UEF11)**

Credits: 4
Coefficient : 2

Objectives of the Course: The objective of this course is to acquire knowledge of fluid mechanics.

Recommended Prerequisite Knowledge: Basic knowledge of physics, mathematics, and fluid mechanics.

Course Content:

1. **Generalities on free-surface flows**

- Classification of free-surface flows
- Velocity of a section, flow regimes
- Pressure and average head in a section

2. **Uniform steady flow**

- Definitions and properties
- Equations and formulas
- Calculation of uniform flow in the case of a covered channel
- Calculation of uniform flow in the case of an open channel

3. **Gradually varied non-uniform flow**

- Definition
- Variation of specific energy
- Critical regime
- Hydraulic jump curves

4. **Rapidly varied non-uniform flow**

- Generalities and study methods
- Hydraulic jump
- Control section
- Different weirs
- Parshall flumes
- Applications of hydraulic jumps

5. **Study of singularities**

- Change in slope
- Change in bottom level
- Change in cross-section, bends, screens...

6. **Flow through orifices, nozzles, and weirs**

- Submerged and unsubmerged orifices
- Drainage of a reservoir with an orifice
- Cylindrical and conical nozzles
- Application of nozzles
- Flow through thin-plate weirs
- Flow through thick-crested weirs
- Flow through contracted weirs
- Drainage of a reservoir through a weir
- Use of weirs as water level regulators

Guided work sessions

- Calculation of hydraulic parameters for channels
- Calculation of circular conduits with free-surface flow
- Depths and critical heads
- Calculation of water profiles using different methods
- Calculation of conjugate depths of a hydraulic jump
- Design of energy dissipation basins
- Calculation of thick-crested weirs and thin-plate weirs

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 2

Subject title: Hydrology and modeling **(UEF12)**

Credits: 4
Coefficient : 2

Objectives of the Course: This module covers hydrological statistics, frequency analysis, rainfall-runoff relationship, and hydrological modeling.

Prerequisite knowledge recommended: Basic knowledge of general principles of topography and drawing is required to follow this course.

Content of the course:

1. **Hydrological Statistics**

- Frequency analysis
- Selection of frequency model
    - Gaussian distribution (normal distribution)
    - Galton distribution (log-normal distribution)
    - Gumbel distribution
- Fitting frequency models
    - Presentation of a distribution
    - Fitting techniques
    - Goodness-of-fit tests
    - Uncertainty analysis

2. **Hydrological Models**

- Terminology used in models (input and output variables, state variables, etc.)
- Different modeling approaches
    - Deterministic models
    - Physical-based models
    - Parametric models
    - Conceptual models
    - Analytical models
    - Empirical models
- Model calibration
- Model validation

3. **Flood Hydrographs**

- Empirical formulas
- Event analysis (floods and rainfall events)
- Flood studies
- Unit hydrograph method
- Gradex method

4. Flood Routing and Propagation

- Hydrologic routing
- Hydraulic routing
- Muskingum method

Guided work sessions

1. Frequency analysis
2. Distribution fitting
3. Applications of hydrological models
4. Flood hydrographs
5. Unit hydrograph
6. Application of Gradex method
7. Muskingum method

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 2

Subject title: Hydrology and flow modeling **(UEF13)**

Credits: 4
Coefficient : 2

Objectives of the Course: By the end of the course, students will have acquired training in pumping tests and the determination of hydrogeological parameters, as well as aquifer modeling. They will be capable of:

- Making appropriate conceptual choices based on the problem to be simulated.
- Collecting and organizing the necessary data for hydrogeological modeling.

Recommended Prerequisite Knowledge: A thorough understanding of the following subjects: General Hydraulics, General Hydrogeology, and Groundwater Dynamics.

Course Content:

1. **Determination of Hydrogeological Parameters through Pumping Tests**

- Basic concepts and definitions.
- In-situ permeability test.
- Step-drawdown test.
- Pumping test or aquifer test.
- Interpretation of steady-state tests.

2. **Introduction to Hydrogeological Modeling**

- Principles of modeling.
- Steps in modeling.
- Conceptual model.
- Mathematical model.
- Numerical model.
- Code and its verification.
- Model validation.
- Calibration.
- Parameter estimation.

3. **Basic Mathematics and Computer Code**

- Introduction.
- Governing equations for groundwater flow.
- Boundary conditions.
- Analytical models.
- Numerical models.
- Code selection.
- Code execution.
- Modeling errors.
- Uncertainties.

4. **Model Dimensionality and Boundary Establishment**

- Spatial dimensions.
- Selection of boundary conditions.
- Implementation of boundaries in a numerical model.
- Extraction of local boundary conditions from a regional model.
- Simulation of unconfined aquifers.
- Common modeling errors.

5. **Modeling Reports, Archiving, and Review**

- Introduction.
- Modeling reports.
- Model archiving.
- Reviewing modeling reports.
- Common errors in report and archive preparation.

Practical Exercises:

1. Familiarization with Aquifer Test Pro software.
2. Use of charts and determination of parameters.
3. Hands-on experience with Modflow, GMS, and Visual Modflow software.
4. Data acquisition and preparation (case studies).
5. Exercises on groundwater dynamics equations.
6. Criteria for code-model selection.
7. Integration of model input parameters.
8. Calibration techniques and uncertainties.
9. Simulation techniques (case studies).
10. Presentation of results and exporting.

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 2

Subject title: Hydrogeochemical and Isotopic Methods. **(UEF14)**

Credits: 6
Coefficient : 3

Objectives of the Course: The objective of this course is to provide knowledge and interpretation methods of physico-chemical and isotopic analysis results in understanding the hydrogeological conditions of groundwater aquifers. The course will focus on the following aspects:

Recommended Prerequisites: Basic knowledge of geology and geochemistry, chemistry, and water analysis.

Course Content:

1. **Introduction and Importance of Hydro-geochemistry:**

- Physico-chemical parameters:
  - Definition
  - Measurements
  - Interpretation
- Different methods of water classification:
  - Chemical facies and origin
  - Evolution of water mineralization
  - Water saturation and aggressiveness (Equilibrium pH, CO2 content, saturation indices, calcite-carbonate equilibrium, and their relevance in the evolution of water mineralization in the subsurface)
- Establishment and interpretation of hydrochemical maps

2. **Isotopes:**

- Isotopes: Concepts and expressions
- Properties: Stability, instability, abundance
- Average distribution of isotopes (stable isotopes - natural abundance in %)
- Isotopic ratios and abundance
- Isotopic fractionation (Origin, Consequences)
- Groundwater dating using tritium (Overview of tritium, Natural and artificial tritium, Tritium as a tracer and dating tool in hydrogeology)
- Groundwater dating using radiocarbon (Overview of carbon-14, Groundwater dating: Case of crystalline aquifer and limestone aquifer)
- Dating of hydrothermal waters (Definitions of thermal waters, Origin of mineral waters, Physico-chemical characterization: water thermality, causes of thermality, geothermometry)
- Thermal classification of waters and water mineralization (associated gases, organic matter, radioactivity of waters, classification of mineral waters, Laboratory analysis of samples collected from thermal sources)

Guided work sessions:

1. Classification of waters using vertical diagram methods
2. Classification of waters using diamond and triangular diagram methods
3. Determination of equilibrium pH and saturation indices
4. Comparison of water mineralization maps and aquifer permeability (case study)
5. Drawing maps of chemical element concentrations and hydrogeological interpretations based on geological and hydrodynamic factors (flow direction, mixing zone, and boundary conditions)

Practical Work:

1. Measurement of physico-chemical parameters (pH, electrical conductivity, total dissolved solids)
2. Titrimetric analysis of major cations and anions
3. Drawing maps of chemical element concentrations and hydrogeological interpretations based on geological and hydrodynamic factors (flow direction, mixing zone, and boundary conditions)"

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 2

Subject title: Ecopedology. **(UEM11)**

Credits: 4
Coefficient : 2

Objectives of the course: This module aims to understand soil as an important component of the ecosystem. The soil's constituent elements, its physical, chemical, and biological properties are analyzed. Different soil classifications and soil-vegetation relationships are also studied.

Recommended prerequisite knowledge: Generally, it is advisable to have taken courses in ecology or have a general understanding of the environment.

Course content:

1. **Introduction to soil**

- Definition of soil and the purpose of pedology

2. **Constituent elements of soil**

- Mineral constituents
- Organic constituents
- Colloidal complexes

3. **Morphological organization of soils**

- Elementary organizations
- Pedological horizons
- Pedological profiles
- Soil cover
- Soil and water
- Soil atmosphere
- Soil temperature
- Soil color

4. **Chemical properties of soil**

- Ion exchange phenomena
- Electronic properties of soil

5. **Biological properties of soil**

- Soil organisms
- Microbial transformations

6. **Soil classification**

- Soil classification
- Different classifications (Russian, American, French)
- Soils of Algeria and their relation to climate and geomorphology

7. **Soil-vegetation relationships**

Practical work:

1. Sampling and collection of soil - description of the pedological profile
2. pH and electrical conductivity (EC) measurement - Carbonate (CO^{2-} .HCO^{3-}) titration
3. Sulfate (SO^{2-}) measurement
4. Total limestone/active limestone measurement
5. Bulk density/real density
6. Particle size analysis
7. Calcium (Ca^{2+})/magnesium (Mg^{2+}) titration
8. Nitrate (NO^{-}) and chloride (Cl^{-}) measurement
9. Potassium (K^{+})/sodium (Na^{+}) measurement

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 2

Subject title: Applied remote sensing **(UEM12)**

Credits: 4
Coefficient : 2

Objectives of the Course: The objectives of this course are to provide knowledge of the physical and technical foundations of remote sensing, to learn about remote sensing and digital processing techniques in earth sciences, to acquire a comprehensive understanding of the applications of remote sensing in hydrogeological studies through examples, and to use remote sensing tools in practical situations for hydrological and geological applications.

Recommended Prerequisites: Knowledge of GIS and mapping techniques, basic understanding of electromagnetism and wave physics, knowledge of statistics, proficiency in operating a personal computer's operating system.

Course Content:

1. **Spatial Information**

- Structure of spatial information
- Cartographic representation systems
- Analysis of spatial structure

2. **Remote Sensing**

- Introduction to remote sensing
- Physical foundations of remote sensing
- Sources of energy and principles of radiation
- Energy interactions in the atmosphere
- Energy interactions with objects on Earth
- Data acquisition and interpretation
- Visual interpretation of imagery

3. **Digital Image Processing**

- Image rectification and restoration
- Image enhancement and contrast manipulation
- Image transformation
- Image classification
- Cartographic representation of imagery

4. **Active Remote Sensing**

- Principles
- Synthetic Aperture Radar (SAR)
- Wave interaction with the surface
- Backscattering phenomenon
- Practical applications

Guided work sessions:

1. Introduction to the practical session and use of Google Earth
2. Introduction to ENVI and ERDAS software
3. Data acquisition and image downloading
4. Image visualization techniques and file management
5. Image rectification (geometric, spectral, and radiometric corrections)
6. Image preprocessing and processing (filtering and enhancement)
7. Use of spectral indices
8. Cartographic representation of an image.

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 2

Subject title: Environnemental geophysics **(UEM13)**

Credits: 1
Coefficient : 1

Objectives of the Course: Introduction to techniques for subsurface reconnaissance and exploration, with a focus on groundwater resources.

Recommended Prerequisites Knowledge : geology, hydrogeology, and physics.

Course Content:

1. Geophysical Prospecting Using Electrical Methods

- Basic concepts
- Direct current resistivity methods
- Instrumentation and implementation
- Vertical electrical sounding (VES)
- Electrical profiling
- Electrical tomography

2. **Geophysical Prospecting Using Seismic Methods**

- Elastic properties of rocks
- Seismic theory
- Seismic refraction
- Seismic reflection
- Seismic tomography

3. **Magnetic Method**

- Origin of the Earth's magnetic field
- Measured magnetic parameters
- Measurement of the Earth's magnetic field, data processing techniques
- Examples of applications in archaeometry

4. **Electromagnetic Method**

- Introduction
- Rocks and their mineral properties
- Homogeneous Maxwell's equations
- Constitutive relations
- Electromagnetic waves
- Boundary conditions
- Galvanic effect in electromagnetism

- Reflection and refraction of plane EM waves
- Plane wave incident on a layered medium

5. Ground Penetrating Radar (GPR) Method

- Principle of the method
- Data acquisition mode
- Interpretation of GPR profiles
- Applications in hydrogeology and environmental studies.

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 2

Subject title: Topogrphy **(UED11)**

Credits: 2
Coefficient : 1

Objectives of the course : Acquire knowledge of the measurement tools for distances and elevations necessary for various piezometric surveys and site surveys, etc.

Recommended prerequisites Knowledge: trigonometry, geometry, and geodesy.

Course content:

1. **General Topography**

- Objectives of topography
- Units of measurement
- Geographic coordinates, azimuth
- Rectangular coordinates

2. **Distance Measurement**

- Overview of distance measurement instruments
- Staking
- Flat measurement
- Measurement accuracy
- Indirect length measurement
- Trigonometry review

3. Angle Measurement

- Units of angle measurement
- Theodolite
- Tachymeter

4. **Direct and Indirect Leveling**

- Direct leveling
- Indirect leveling
- Slope and distance
- Longitudinal profile

5. **Topographic Surveying**

- Closed traverse
- Open traverse
- Determination of areas

Guided work sessions:

1. Review of trigonometric methods
2. Distance measurement
3. Angle measurement
4. Setup and field measurement of distances and angles
5. Field implementation of closed and open traverses

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 2

Subject title: Topogrphy Basics of Environmental science **(UET11)**

Credits: 1

Coefficient : 1

Objectives of the course: The objectives of the course are to provide an introduction to the various topics encompassed by the field of environmental science.

Recommended prerequisites Prior knowledge: the English language.

Course content:

1. **Introduction**

- What is environmental science?
- Environmental interactions, cycles, and systems
- Ecology and environmentalism

2. **Earth Sciences**

- Formation and structure of the Earth
- Formation of rocks, minerals, and geologic structures
- Weathering
- Evolution of landforms
- General circulation of the atmosphere
- Weather and climate
- Climate change

3. **Physical Resources**

- Freshwater and the hydrologic cycle
- Saltwater, brackish water, and desalination
- Irrigation, waterlogging, and salinization
- Soil formation
- Transport by water and wind
- Soil erosion and its control

4. **Biosphere**

- Biosphere, biomes, biogeography
- Major biomes
- Respiration and photosynthesis
- Ecosystems
- Succession and climax

5. Biological Resources

- Evolution
- Evolutionary strategies and game theory
- Adaptation
- Dispersal mechanisms
- Wildlife species and habitats
- Biodiversity
- Forests
- Human population and demographic change

6. Environmental Management

- Wildlife conservation
- Restoration ecology
- World conservation ecology
- Pollution control
- Hazardous waste"

Semestre 3

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 3

Subject title: Topogrphy Basics of Environmental science Water management methods **(UEF11)**

Credits: 4
Coefficient : 2

Objectives of the Course: Knowledge acquisition, mobilization of water potential, integrated water resource management, development of water resource plans, design and management of water facilities, decision-making.

Recommended Prerequisites: Good knowledge of hydrogeology and hydrology.

Course Content:

1. **General Overview of Water Resources:**

- Surface water resources
- Groundwater resources
- Non-conventional resources
- Artificial groundwater recharge
- Perspectives

2. **Quantification of Water Resources:**

- Methods for quantifying water resources.

3. **Modeling:**

- Importance of modeling in preserving and quantifying water resources
- Hydrological models
- Spatial models and geographic information systems
- Resource mapping (regionalization)
- Knowledge of water resources
- Mobilization of water resources
- Conservation of water resources.

4. **Approach to Water Resource Systems Development:**

- Multiple uses (supply, demand)
- User sectors of water resources (human consumption, agriculture, industry, etc.)
- Spatial distribution
- Temporal distribution
- Conflicting interests
- Dynamic nature
- Economics of water resource systems
- Social aspects
- Development-environment relationship.

5. **Integrated Water Resources Management:**

- Management context
- Decision-making context
- Methodological context
- Modeling
- Water resource management plan (master plan)
- Database design
- Integrated development
- Decision-making."

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 3

Subject title: Topogrphy Basics of Environmental science Water management methods Pollution and Protection of Aquifers **(UEM112)**

Credits: 4
Coefficient : 2

Objectives of the Course : Protection of groundwater and abstraction systems against degradation of their physicochemical and microbiological quality.

Recommended Prerequisite Knowledge : Good knowledge of hydrogeology, hydrodynamics, biology, and chemistry.

Course Content:

1. **Groundwater Pollution: Natural and anthropogenic pollution, etc.**
2. **Characteristics of Pollutants:**

- Aqueous solubility,
- Vapor pressure;
- Adsorption, -Biodegradability
- Physicochemical properties of pollutants

3. **Mechanisms of Pollutant Transport and Attenuation in Aquifers**

- Physical processes
- Chemical processes
- Biological processes

4. **Transfer and Evolution of Pollutants**

- Transfer in the soil
- Transfer in the unsaturated zone
- Evolution in the saturated zone

5. **Protection of Groundwater Abstraction Systems**

- Purification capacity of the soil, -Drawdown criterion,
- Transfer time
- Distance from the pollution source to the emergence point,
- Flow limits and recharge areas.

6. **Protection of Groundwater Resources against Pollution:**

- Piezometric mapping,
- Fixed-radius method,
- Evaluation of aquifer vulnerability to pollution
- Protection of water points and abstraction points
    - Sizing of immediate protection perimeter
    - Sizing of close protection perimeter
        - Rhese method
        - Radius of influence method and capture zone
        - Self-purification power method
        - Transfer time method
        - Other graphical methods
- Sizing of distant protection perimeter: Definition and criteria

- Aquifer-scale protection: Evaluation and mapping of groundwater vulnerability to pollution

7. **Techniques and Actions for the Remediation of Polluted Aquifers**

- Hydraulic methods (active barriers, confinement, fixation)
- Air lift methods (sparging, stripping)
- Biochemical methods (biological filter, in situ treatment by bioventilation of the unsaturated zone, biolixiviation treatment)

Practical Work:

1. Presentations on pollution
2. Presentations on point source pollution, contamination plume (transport, advective, dispersive, and diffusive movement of contaminants) with examples of modeling using CTRAN/W software by Geoslope.
3. Calculation of transfer times analytically
4. Numerical examples of calculating contaminant transfer times.
5. Analytical sizing of the close protection perimeter using analytical methods
6. Numerical determination of contaminant transfer times
7. Presentation on groundwater remediation techniques

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 3

Subject title: Environmental Impact Studies of Polluting Installations **(UEF13)**

Credits: 4
Coefficient : 2

Objectives of the Course: Protection of the environment and water against pollution that may be generated by industrial or other installations through the implementation of impact assessment studies and techniques for their mitigation.

Recommended Prerequisite Knowledge: Solid understanding of water sciences, chemistry, and biology.

Course Content:

1. **General Presentation of Potentially Polluting Facilities**

- Location, History, Organization.
- Importance of climatological data (wind direction, site flood risks).
- Geology and hydrogeology of the region (general configuration of the site's geology, landslide risks, subsidence risks, seismic risks).
- Hydrogeology of the region (identification of groundwater aquifers near the site, particularly downstream, and their vulnerability to pollution).
- Surrounding populated areas with descriptive maps.
- Legal requirements.

2. **Diagnostic of the Facility's Installations and Description of the Manufacturing Process**

- Organization plan of the facility's workshops.
- Manufacturing scheme with input and output of raw materials, energy, etc.
- Subdivision of manufacturing processes into elementary operations.
- Diagnostic of each elementary operation.
- Quantitative and qualitative assessment of input:
    - Raw materials.
    - Chemicals.
    - Energy.
    - Water.
        - Source of supply.
        - Destination.
- Quantitative and qualitative assessment of output:
    - Finished products.
    - By-products.
    - Solid and liquid waste (residues, sludge, etc.).
        - Description of waste management conditions.

- Liquid Effluents:
    - Identification of discharge points.
    - Identification of the receiving environment.
    - Quality of discharged water and comparison with wastewater standards:
        - Flow rate; pH; Temperature; Suspended solids; Biochemical Oxygen Demand (BOD);
        - Other parameters (depending on the products used by the activity).

- Gaseous Emissions:
    - Identification of point source or continuous emissions.
    - Identification of major gaseous pollutants through analysis.
    - Assessment of neighborhood inconvenience.

- Noise Emission outside the facility:
    - Noise measurements in the vicinity.
    - Assessment of neighborhood inconvenience.

- Contaminated Site:
    - Identification of contaminated sites.
    - Drilling and analysis of contaminated sites.

3. **Comparison of input/output balances with national and international standards**.
4. **Proposal of measures aimed at reducing generated nuisances and saving raw materials, energy, and water resources, with an option to promote cleaner technologies**.
    - Modification of the manufacturing process.
    - Modification of equipment and installations.
    - Reduction or substitution of raw materials used in production.
    - Study of possibilities for valorization and recycling of by-products and waste.
5. **Development of an action plan for reducing generated nuisances and consumption of water, energy, and raw materials.**
6. **Financial evaluation of the action plan.**

Guided work sessions:

- Case studies

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 3

Subject title: Geostatistics and Data Analysis **(UEF14)**

Credits: 6
Coefficient : 4

Objectives of the Course: The objectives of this course are to teach students how to analyze the spatial structure of natural phenomena, perform accurate spatial estimations, and evaluate the quality and precision of maps.

Recommended Prerequisite Knowledge : Knowledge of cartography, statistics, and computer science.

Course Content:

1. **Introduction**

- Historical background
- Concepts of random function and regionalized variable

2. **Basic assumptions in geostatistics**

- Stationarity
- Intrinsic hypothesis

3. **Variography**

- Definition and objectives
- Calculation of experimental variogram
- Variogram modeling
- Directional variograms and anisotropy
- Variance estimation

4. **Kriging**

- Definition and properties
- Types of kriging
    - Simple kriging
    - Ordinary kriging
    - Indicator kriging
- Validation of kriging results

Guiding work sessions:

1. Review of Geostatistics - Exercises
2. Probability Distributions - Exercises
3. Introduction to Variowin, Geostatistical Analyst, and Surfer software
4. Variogram Analysis - Practice
5. Experimental Variogram - Practice
6. Variogram Modeling and Adjustment - Exercises and Practice
7. Anisotropy
8. Spatial Estimation using Kriging - Exercises and Practice

Practical Work:

1. Variowin Practical
2. Surfer Practical
3. ArcGIS Practical

Title of Master's Degree: Water Resources and Geo-Environment

Semester: 3

Subject title: Conservation of Water and Soil **(UEM11)**

Credits: 4
Coefficient : 2

Course Objectives: Acquire knowledge related to land degradation, loss of soil, and principles of conserving water and soil resources.

Recommended Prerequisite Knowledge: Knowledge of geology and hydrology.

Course Content:

1. **Soil Degradation: Processes and Factors**

- Definition
- Visible effects of erosion
- Processes and factors of soil degradation

2. **Water Erosion**

- Origin and mechanisms
- Forms of erosion
- Types of damage
- Effects on agricultural production
- Factors contributing to water erosion
- Estimation of land loss
- Prevention and control methods

3. **Runoff Control**

- Common structures and measures
- Designing runoff control devices
- Empirical approach
- Calculation of spacing between control devices in a Conservation and Erosion Site (CES) network
- Designing structures based on the water balance

4. **Ravine Erosion Control**

- Runoff rates
- Types of waterways or drainage systems

5. **Wind Erosion**

- Origins and mechanisms of wind erosion
- Effects and significance of wind erosion
- Estimation of wind erosion and prevention methods

6. **Soil Conservation**

- Principles
- Biological soil conservation methods
- Methods applicable to cultivated lands
- Application of mechanical water-conserving measures
- Major land management techniques

7. **Water Conservation**

- Principles
- Surface drainage
- Methods of water collection and storage
- Losses in stored water
- Utilization of groundwater resources

8. **Sustainable Land and Water Management**

- Practices for managing and conserving water and soil
- Practices for combating sand encroachment and stabilizing mobile dunes
- Management and improvement practices for grazing lands
- Agronomic techniques and practices
- Other techniques and methods

Guinding work sessions

1. Erosion prediction methods
2. Quantification methods (empirical methods, etc.)
3. Corrective measures

Title of Master's Degree

Subject title: Thematic**: Water Resources and Geo-Environment**

Semester: 3

Subject title: Thematic Cartography **(UEM12)**

Credits: 4
Coefficient : 2

Course Objectives: The objectives of this course are to teach students how to create maps on multiple themes, master the principles of graphic semiotics, and construct simple and high-quality communicative maps. Students will be guided step-by-step in drawing a map background, constructing statistical maps with proportional symbols, and using color schemes.

Recommended Prerequisite Knowledge: General cartography, descriptive statistics.

Course Content:

1. **Introduction to thematic cartography**

- Definitions
- Types of maps
- General use of maps
- Map scale
- Modern view and communicative map
- Spatial visualization and geo-visualization
- Thematic maps

2. **Generalization and cartographic abstraction**

- Selection
- Classification
- Simplification
- Symbolization
- Thematic map design

3. **Nature of geographic data and selection of thematic map symbols**

- Nature of data
    - Data characteristics: Location, shape, size, time, transformation
    - Data measurement: Nominal, ordinal, interval, ratio
- Map and thematic relationships
    - Symbols, saturation, and value
    - Visual variables: Size, shape, orientation, texture
- Cartographic errors
- Data sources

- Descriptive statistics and data classification

4. Techniques of quantitative thematic cartography

- Data classification
- Mapping geographic surfaces
- Dot density map
- Proportional symbol map (point to point)
- Cartogram (value-by-area)
- Dynamic representation (3D and GeoWeb)
- Use of colors

Title of Master's Degree

Subject title: Thematic**: Water Resources and Geo-Environment**

Semester: 3

Subject title: Management of Rivers and Dams **(UEM13)**

Credits: 1
Coefficient : 1

Course Objectives: The objectives of this course are to understand the hydrological behavior of rivers, the potential for artificial groundwater recharge through river management, the impact of unconventional water sources (such as wastewater) on the environment, integrated river management, design and management of river infrastructure, decision-making in flood situations, feasibility studies of dams considering water quality issues (e.g., presence of wastewater and seawater), and regulation of river structures.

Recommended Prerequisite Knowledge: A basic understanding of the following concepts is recommended to successfully follow this course.

Course Content:

1. **General Overview of Rivers:**

- Classification of rivers
- Hydrographic network
- Floods
- River-aquifer relationship
- Unconventional water resources
- Artificial groundwater recharge

2. **River Management:**

- Methods of river management
- Construction of river infrastructure within urban areas
- Advanced technologies for flood control

3. **River Modeling:**

- Importance of modeling in flood control
- Hydrological models
- Stochastic models
- Spatial models and geographic information systems
- River mapping (regionalization)

4. Dam Regulation:

- Introduction
- Classification of dams based on:
    - Volume
    - Construction materials
    - Lifespan
    - Sedimentation rate
    - Construction cost
    - Rehabilitation cost
    - Connection to distribution network
    - Water transfer
- Understanding water volumes
- Mobilizing water resources
- Water resource conservation
- Techniques for dam cleaning and monitoring

5. Integrated River Management:

- Context of management
    - Decision-making context
    - Methodological context
- Modeling
- River management plan (master plan)
- Database design
- Integrated development
- Decision-making processes

Title of Master's Degree

Subject title: Thematic**: Water Resources and Geo-Environment**

Semester: 3

Subject title: Geomorphology **(UED11)**

Credits: 1
Coefficient : 1

Objectives of the Course: After reviewing the concepts of tectonics and lithology, the course focuses on studying the morphological systems of Algeria and the processes that have shaped them.

Recommended Prerequisite Knowledge: Prior knowledge in general ecology, hydrology, and surface geology is recommended. A general understanding of the environment is also welcomed.

Course Content:

1. **General Overview**

- Introduction
- Geomorphology-Ecology Relationships
- Valleys and Interfluves
- Erosion, Lithology, Structure

2. **Structural Geomorphology**

- Landforms and Rocks (Landforms in sedimentary rocks, massive limestone formations (karst landforms), and plutonic and crystalline rocks)
- Structural Relief (from foothills to mountain ranges and massifs)
- Other Landforms (Volcanic landforms and coastal forms)

3. **Tectonic Deformations**

- Isostatic Equilibrium
- Continental Drift and Plate Tectonics
- Formation of Landforms
- Tectonic Faults
- Tectonic Data: Syncline, Anticline
- Relief of Simple Structures: Cuestas
- Evolution of Jurassic Landforms
- Relief of Complex Structures

4. **External Factors in Morphology**

- Modes of Erosion
- Processes of Erosion
- Areolar Erosion
- Slope Profiles

- Linear Erosion: Terraces
- Periglacial Erosion
- Karstic Model
- Wind Erosion: Aeolian Landforms
- Hydroaeolian Basins: Daia
- Human Impact and Morphogenesis

5. Azonal Climatic Geomorphology

- Climate Variations: The Quaternary Period
- Morphological System of Algeria
    - Humid Domain
    - Arid Domain
    - Desert or Saharan Domain
    - Forms Common to Arid Zones
- Evolution of Forms in the Three Domains

Title of Master's Degree

Subject title: Thematic**: Water Resources and Geo-Environment**

Semester: 3

Subject title: Geomorphology **(UED12)**

Credits: 1
Coefficient : 1

Objectives of the Course: This study unit aims to develop knowledge about different types of geological hazards that generate risks. It teaches students the techniques for identifying and assessing these hazards and how to delineate the areas that may be affected, in other words, the risk zones.

Recommended Prerequisite Knowledge: Completion of the courses in the first and second year of Geology Bachelor's degree.

Course Content:

1. Risk Assessment

- Remote Sensing, Aerial Photography, and Hazards
- Hazard Maps
- Hazards and Land Use

2. Seismic Hazard and Risk

- Intensity and Magnitude of Earthquakes
- Effects of Earthquakes
- Site Effects
- Assessment of Hazard and Associated Risk
- Seismic Zoning

3. Mass Movements

- General Overview of Mass Movements
- Classification of Landslides
- Causes of Landslides
- Monitoring of Unstable Slopes
- Evaluation and Mapping of Landslide Hazard
- Stabilization Methods

4. Rivers

- Fluvial Processes
- Floods
- Factors Affecting Runoff
- Runoff Evaluation
- Hazard Zoning and Forecasting
- Flood Control and Regulation

5. Problematic Soils

- Quicksands
- Expansive Clays
- Collapsible Soils
- Quick Clays
- Soils in Arid Regions
- Tropical Soils
- Peat Soil

Title of Master's Degree

Subject title: Thematic**: Water Resources and Geo-Environment**

Semester: 3

Subject title: Water and Environmental **(UET11)**

Credits: 1
Coefficient : 1

Objectives of the Course: The main objective of this matter is to know very well the national and international law of water and environment

Knowledge of English

Course Content:

1. **Legal Framework relating to the Environment in Algeria**

- Industrial Pollution
- Waste
- Marine environment
- Water
- Overall environment

2. **Problematic of environment protection in Algerian**

The instruments of environment protectionActions for environment protection

3. **International conventions**

- Convention UNFCC
- Convention Kyoto protocol
- Convention UNCCD
- Convention RAMSAR
- Etc,

4. Water and Environmental Laws of Algerian

- Algerian law of water
- Algerian law of Environment