UniLaSalle
Terre & Sciences

4 months of multidisciplinary sciences
and experiential learning in France

Spring Semester in Water & Environmental Management

A fully English taught program

2018 Syllabus

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References beginning with the 🕮 symbol are available in the library.

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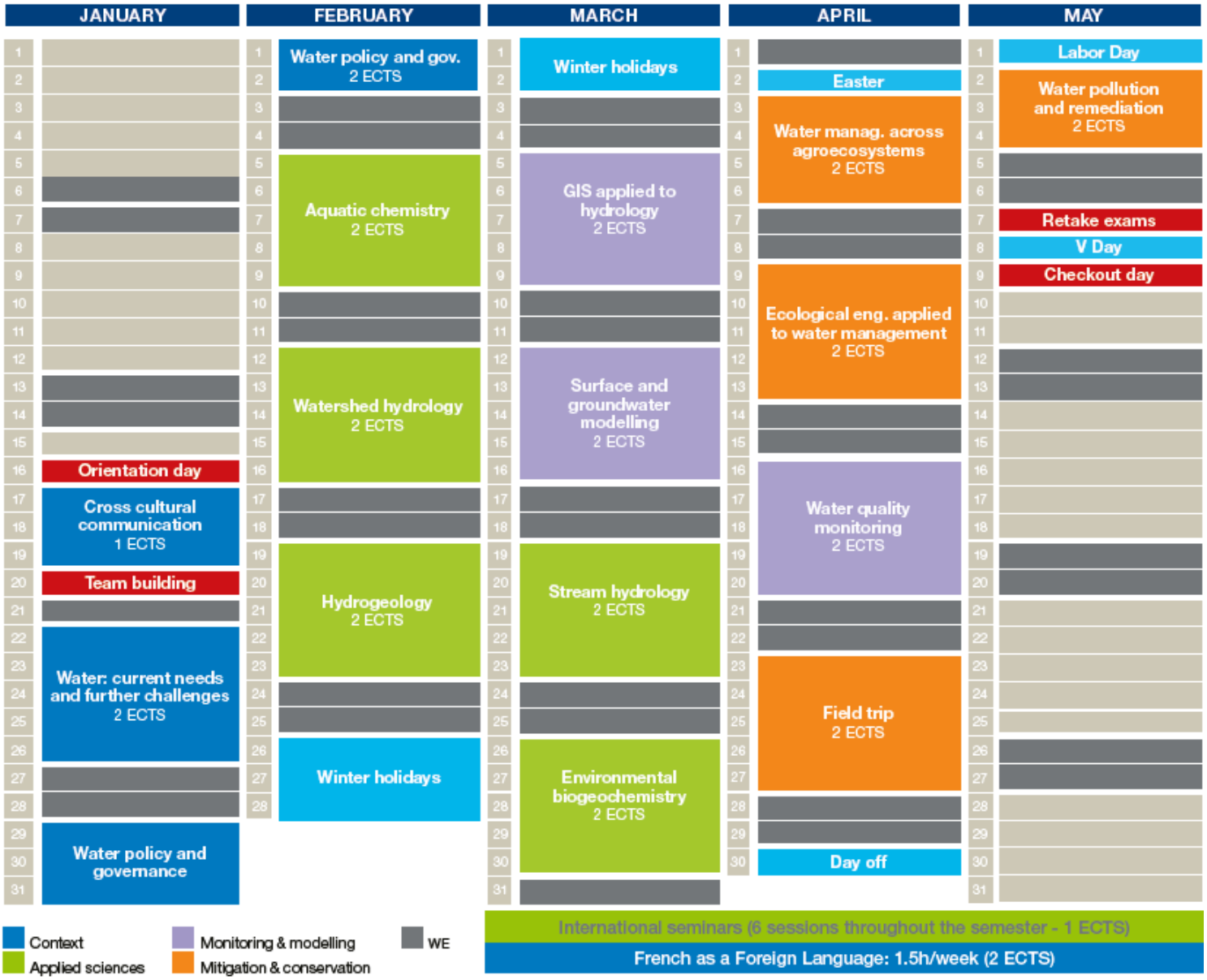
L: Lectures
PW: Practical works in classroom or computer room
FW: Field work

Please note that the number of hours is susceptible to be slightly modified.

2018 schedule



Cross cultural communication (LE0201)

1 ECTS

Developing communication and project management skills in a multi-cultural team

Aim

Raising awareness and developing skills around culture and its impact on behavior in international teams. Students will draw on their own experience of learning within a multi-cultural team immersed in a host culture.

Program

- Culture: definitions, metaphors; key concepts. Culture as a source of intercultural errors
- Cross cultural communication: "Talk to me"
- Managing an international team: “When in Rome ... “ (case study; video)
- Cultural perceptions of water case study: description of geographical location, identification of stakeholders, proposal of technical and legal solutions
- Student reports: results of expatriate manager interview
- Student presentations of cross cultural training packages
- Independent/group work on assignments and projects

Learning outcomes

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

- Develop a better understanding of their own culture
- Explain how stereotypes are formed
- Understand how and why miscommunication happens
- Identify cross-cultural and intercultural perceptions of water management issues

Assessment method

Group assignment and oral defense.

Prerequisites

No prerequisite.

Faculty and staff

Coordinator and lecturer: *Martine Rey (Ph.D.)*, Associate Professor, Languages & Cultural Studies.

Contact: martine.rey@unilasalle.fr

Water: current needs and further challenges (AE0201)

2 ECTS

A geography of water resources and of key issues to be addressed.

Aim

This module is designed to be an introduction of the Spring Semester. Students will be initiated to the different stakes regarding water management that have to be challenged.

Program

- Water Atlas in Africa
- Geography of water resources; water and health Geography of current water resources
- Human impacts on water ressources
- Indices of water scarcity
- Water needs by economic activities and by nation level of development
- Current and future threats to water resources (degradation of freshwater ecosystem, contamination, overexploration, climate change, *etc.*)

Learning outcomes

- Discuss the disparity between localization of water needs and of water resources
- Describe the methods to assess water scarcity
- Describe the different threats to water resources
- Use web-GIS like ArcGis Online to display table data on maps

Assessment method

Oral defense of a case study.

Prerequisites

No prerequisite.

Suggested readings

📖 Brooks, K.N., Folliott, P.F.& Magner, J.A., 2012. Hydrology and the Management of Watersheds. Wiley-Blackwell, 552 p. ISBN 978-0-470-96305-0.

Faculty and staff

Coordinator: *Romain ARMAND (Ph.D.)*, Associate Professor in surface hydrology and GIS.

Contact: romain.armand@unilasalle.fr

Lecturer: *Stanley Mubako (Ph. D.)*, Research Assistant Professor at Center for Environmental Resource Management, University of Texas at El Paso, USA.

Water policy and governance (AE0202)

2 ECTS

Which instruments allow to supervise water management and to improve water services?

Aim

Water governance is defined by the political, social, economic and administrative systems that are in place, and which directly or indirectly affect the use, development and management of water resources and the delivery of water service delivery at different levels of society (*UNDP*). This module will give to students an overview of water governance: social, economic, politic and environmental dimensions will be studied.

Program

- Stakeholders involved in water use and management
- Territorial management of water
- Pressure analysis
- Water quantity and quality standards
- Cost / benefits analysis of water conservation measures

Learning outcomes

- Describe the different stakeholders related to water supply, use and management
- Discuss the different tools to regulate water management and water conservation
- Realize a short economic study of water management

Prerequisites

No prerequisites

Assessment method

Individual report.

Faculty and staff

Coordinator: *Romain ARMAND (Ph.D.)*, Associate Professor in surface hydrology and GIS.

Contact: romain.armand@unilasalle.fr

Lecturers: *Nicolas FERMIN*, in charge of water economy, Wallonia public service department, Belgium.

Frank A. Ward (Ph. D.): Professor in water policy, New Mexico State University, USA.

Watershed hydrology (AE0203)

2 ECTS

Which processes are controlling the partition of rainfall?

Aim

The students will be familiarized with the processes explaining the partition of water in several hydrological fluxes (infiltration, runoff, recharge, evaporation). These processes will be studied at the catchment scale. The effect of soil surface state on runoff/infiltration partition will be specifically discussed because anthropogenic activities (crops, farming practices, urbanization, soil sealing, *etc*.) are permanently affecting the surface conditions and therefore the water fluxes.

Program

- Water cycle
- Rainfall data acquisition (gauges)
- Rainfall losses (interception, storage, infiltration)
- Runoff / infiltration partition
- Morphometric indexes of catchment
- Flood generation
- Water balance at the catchment scale

Learning outcomes

- Explain the surface hydrological processes and how they are affected by soil surface state
- Describe these hydrological processes by means of equations
- Delineate the catchment area based on topographic maps or data
- Interpret rainfall data
- Realize water balance

Assessment method

Written examination.

Prerequisites

No prerequisite.

Suggested readings

📖 Brooks, K.N., Folliott, P.F., et Magner, J.A., 2012. Hydrology and the Management of Watersheds. Wiley-Blackwell, 552 p. ISBN 978-0-470-96305-0.

📖 Hendriks, M., 2010. Introduction to Physical Hydrology. Oxford, 352 p. ISBN 978-0-19-929684-2.

Ponce, V.M., 1989. Engineering Hydrology: Principles and Practices. Prentice Hall College Div, 640 p. ISBN 978-0-13-277831-2.

📖 Rodda, H., et Little, M., 2015. Understanding Mathematical and Statistical Techniques in Hydrology: An Examples-based Approach. Wiley-Blackwell, 112 p. ISBN 978-1-4443-3549-1.

📖 Ward, A.D., Trimble, S.W., Burckhard, S.R., et Lyon, J.G., 2015. Environmental Hydrology, Third Edition. CRC Press : 320 p. ISBN 978-1-4665-8941-4.

Faculty and staff

Coordinator and lecturer: Romain ARMAND (Ph.D.), Associate Professor in surface hydrology and GIS.

Contact: romain.armand@unilasalle.fr

Aquatic chemistry (GE0203)

2 ECTS

How chemical processes are controlling water composition?

Aim

Across the aquatic system (rivers, oceans, lakes, groundwater), natural water presents differences in its composition. Several processes are driving the chemical composition of water system and their knowledge allows defining the hydrogeochemical context, based on present species and on geological background. Studying the hydrogeochemical context is essential to detect chemical anomalies in water composition which may be an indication of severe pollution.

Program

- Natural water composition
- Chemical data and analysis
- Chemical water composition governing processes
- Natural hydrochemical processes (complexation, redox, hydrolysis, surface reaction)

Learning outcomes

- Describe the (geo)chemical processes affecting water mineral composition
- Discuss how the presence of individual species, and their interactions, will affect the overall chemistry of a complex environmental system
- Represent water mineral composition with specific charts (Piper diagram).

Assessment method

Written examination.

Prerequisites

- Chemistry

Suggested readings

📖 Langmuir, D. (1997) Aqueous Environmental Geochemistry. Prentice Hall, Upper Sadle River, New Jersey.

📖 Stumm, W. and Morgan, J.J. (1996) Aquatic Chemistry, 3rd ed. Wiley Intersciences, New York.

Faculty and staff

Coordinator: *Olivier POURRET* (Ph.D.), Associate Professor in geochemistry. Contact: olivier.pourret@unilasalle.fr

Guest lecturer: *Raul E. MARTINEZ* (Ph. D), Assistant Professor for Biogeochemistry and Aqueous Geochemistry. University of Freiburg, Germany. Contact: raul.martinez@minpet.uni-freiburg.de

Environmental biogeochemistry (AE0205)

2 ECTS

How soil processes affect biogeochemical cycles within the Earth's Critical Zone?

The Earth's Critical Zone is defined as "*heterogeneous, near surface environment in which complex interactions involving rock, soil, water, air, and living organisms regulate the natural habitat and determine the availability of life-sustaining resources*". Understanding the functioning of soil, the core of the Earth's Critical Zone, is therefore essential to well constrain biogeochemical cycling of chemical elements and pollutants. Soils are heterogeneous systems with many important reactions occurring at the interface between solid, liquid and gas phases. Soils also constitute a place of interactions with many anthropogenic inputs such as fertilizers. This course focuses on the main soil biogeochemical processes that control the transfer of chemical elements through environment and their consequences on environment and water quality. The course will cover the fundamentals of solute-solid interactions, biogeochemical cycles of elements and impacts of agricultural practices on water and environmental quality. Real issues related to the transfer of elements within the soil-water continuum as well as current research in the field of critical zone science will be explored through independent literature research and class discussion.

Program

- Concept of Earth's Critical Zone
- Biogeochemical cycles (N, P, Ca, Mg, Si …) within the Earth's Critical Zone
- Isotope geochemistry and it significance to study biogeochemical cycles
- Factors affecting element transfer across environment
- Impacts of agricultural N and P inputs on water and environmental quality

Learning outcomes

- Characterize biogeochemical cycles and fluxes of elements across different reservoirs using innovative analytical tools (*e.g.* stable isotopes)
- Discuss how human activities may affect biogeochemical cycles
- Discuss how agriculture practices impact water and environmental quality

Assessment method

Individual written examination.

Prerequisites

- Introduction to soil science
- Analytical chemistry

Suggested readings

📖 Botkin, D.B., et Keller, E.A., 2014. Environmental Science: Earth as a Living Planet. John Wiley & Sons, 688 p. ISBN 978-1-118-42732-3.

🕮 Brady, N.C. & Weil, R.R., 2002. The nature and properties of soils. Prentice Hall, 960 p. ISBN 978-0-13-016763-7.

Faculty and staff

Coordinator and lecturer: *David HOUBEN* (Ph.D.), Associate Professor in soil science and biogeochemistry.

Contact: david.houben@unilasalle.fr

Guest lecturer: *Sophie OPFERGELT* (Ph.D.), Associate Professor in soil science and isotope geochemistry, Université Catholique de Louvain, Belgium. Contact: sophie.opfergelt@uclouvain.be

Stream hydrology (AE02XX)

2 ECTS

How to assess the stream response to natural and anthropic factors?

Aim

Rivers are providing essential services to human people: irrigation, drinking water, power, industries, shipping, wildlife habitats, *etc*. Rivers are also feeding wetlands with water and thus strongly control the status of these hotspots of biodiversity. The upstream areas and the river networks have been considerably disturbed by anthropogenic activities (landuse changes, dams, channelization, excess water abstraction, *etc*). This results in changes of stream morphology and affects the natural flow regime which alters the previously mentioned services.

In this module, students will be trained to the processes occurring at the river scale. They will be able to identify which environmental parameters are controlling the natural flow regime. They will then be introduced to the different effects of human infrastructures on the hydrological regime and the resulting morphologies. A focus will be done on the different computational methods which allow to assess the environmental flow which refers to “a flow regime designed to maintain a river in some agreed ecological condition” (*Smakhtin 2007, Hydrological Processes, 21, 2007*).

Program

- Hydrological regimes
- Fluvial systems
- Alluvial transport and processes
- Effect of human infrastructures on river flow
- On site discharge measurement Check out our blog.
- Computing environmental flow

Learning outcomes

- Describe the different morphologies of river systems and the contributing factors
- Understand the factors which are controlling spatial and temporal variability of flow
- Measure the flow velocity on a small stream section and assess the global discharge
- Decide on an admissible management strategy for allocating environmental flow
- Assess the environmental flow potentials/requirements by several techniques

Assessment method

Group field report / individual examination.

Prerequisites

- Microsoft Excel handling skills

Suggested readings

📖 Hauer, F.R., Lamberti, G.A., 2017. Methods in Stream Ecology: Volume 1: Ecosystem Structure, 3rd ed. Academic Press.

📖 Hendriks, M., 2010. Introduction to Physical Hydrology. Oxford, 352 p. ISBN 978-0-19-929684-2.

📖 Ward, A.D., Trimble, S.W., Burckhard, S.R., et Lyon, J.G., 2015. Environmental Hydrology, Third Edition. CRC Press : 320 p. ISBN 978-1-4665-8941-4.

Faculty and staff

Coordinator and lecturer: *Romain ARMAND* (Ph.D.), Associate Professor in surface hydrology and GIS.

Contact: romain.armand@unilasalle.fr

Guest Lecturer: *Ali GÜL* (Ph. D.), Associate Professor, Hydraulics Division, Dokuz Eylül University, Turkey.

Contact: ali.gul@deu.edu.tr

Hydrogeology (GE0202)

2 ECTS

How to determine the physical properties of an aquifer?

Aim

Groundwater constitutes a major water resource, especially for countries located in arid and semi-arid contexts. Student will be familiarized with theoretical knowledge of aquifers properties (which determine the water flows) and with field methods, thanks to our well field close to the campus and of our newly developed hydrogeology facilities. This module is designed to give a very practical introduction to “Flow and transports in groundwater”.

Program

- Aquifers typology (porous, fractured, karst, coastal) and geography
- Hydrodynamic parameters of aquifers: permeability, transmissivity, diffusivity.
- Groundwater hydraulics
- Assessment of aquifer recharge
- Issues regarding aquifers (subsidence, seawater intrusion, pollution, *etc*.)
- Piezometric and sampling campaign around the on-site hydrogeology platform

Learning outcomes

- Describes the different types of aquifer and the impact on hydrodynamic parameters
- Discuss the susceptibility to issues, according to physical and geographical information
- Realize basic monitoring operations: depth measurement, water sampling.
- Solving exercises: compute water flow between two wells, draw piezometric map and assess the direction of water flow

Assessment method

Written examination.

Prerequisites

No prerequisite.

Suggested readings

📖 Hendriks, M., 2010. Introduction to Physical Hydrology. Oxford, 352 p. ISBN 978-0-19-929684-2.

📖 Karamouz, M., Ahmadi, A., et Akhbari, M., 2011. Groundwater hydrology: engineering, planning, and management. CRC Press, 649 p. ISBN 978-1-4398-3756-6.

Faculty and staff

Coordinator: Lahcen Zouhri (Ph.D.), Associate Professor in hydrogeology.

Contact: lahcen.zouhri@unilasalle.fr

Surface water and groundwater modelling (AEXXXX)

2 ECTS

How to model the fate of water and associated contaminants in the hydrosystem?

Aim

Despite the monitoring activities carried out on water bodies regarding their quality and quantity properties, water management needs analysis which take spatial and temporal variability of hydrological factors into account. These data can be processed in Geographical Information Software (GIS) which are relevant tools to store, analyze and visualize large datasets.

In this module, students will be trained to the FREEWAT platform for sustainable water resource management. This platform runs in the open-source GIS "QGIS," and is based on the hydrological cycle, hydrochemical or economic-social processes. They will be able to produce maps and documents which will be essential in decisions related to water management.

Program

- Basic handling of QGIS
- Training to FREEWAT (*Free and Open Source Software Tools for Water Resource Management*)
  NB: FREEWAT is an HORIZON 2020 project financed by the EU Commission
- Sensitivity analysis and calibration
- Several case studies devoted to the application of the European Water Framework or to rural water management

Learning outcomes

- Understand how theoretical knowledge are transopose in GIS-based models
- Use a spatially distributed and physically based model
- Realize a sensitivity analysis
- Interprate and discuss results processed by simulation

Prerequisites

- Aquatic chemistry
- Hydrogeology
- Watershed hydrology

Assessment method

Exam in computer classroom.

Faculty and staff

Coordinator: *Romain ARMAND* (Ph.D.), Associate Professor in surface hydrology and GIS. Contact: romain.armand@unilasalle.fr

Guest lecturer: *Rudy ROSSETTO* (Ph. D), Institute of Life Sciences, Scuola Superiore Sant'Anna, Pisa, Italy. Contact: rudy.rossetto@santannapisa.it

GIS applied to hydrology (AE0204)

2 ECTS

How to create synthetic maps to obtain an accurate overview of watershed management?

Aim

Geographical Information Systems (GIS) are software commonly used to study water issues on a wide range of topics (watershed management, groundwater, floods, *etc*.). GIS constitute a focal tool which aggregates data from different sources and scales. In this module, students will be initiated to the ArcGIS software and to general GIS files (vectors, rasters and tables). Basic skills will be taught (data handling, mapping) and a focus will be done on the use of hydrological dataset.

The module will be designed to facilitate future use of other GIS than ArcGIS software.

Program

- Introduction to the different types of data
- Software basic handling
- Realization of a map: which information should be provided?
- Extraction of dataset from web libraries (USGS)
- Use of elevation dataset (SRTM)
- Creation of topographical and hydrological raster files: slope, indexes (Beven-Kirkby, TPI), catchment delineation, direction and accumulation flow, stream network generation
- Export (other GIS, web-based solutions)
- Use of GPS device and import into the software
- Application to watershed management and water resources management

Learning outcomes

- Describe the different GIS data
- Realize maps
- Create hydrological data from elevation dataset
- Search and download on-line free dataset

Assessment method

Exam on computer.

Prerequisites

No prerequisites

Suggested readings

📖 Dixon, B., et Uddameri, V., 2015. GIS and Geocomputation for Water Resource Science and Engineering. Wiley-Blackwell: 504 p. ISBN 978-1-118-35413-1.

Faculty and staff

Coordinator and lecturer: Romain ARMAND (Ph.D.), Associate Professor in surface hydrology and GIS. Contact: romain.armand@unilasalle.fr

Water management across agroecosystems (AE0207)

2 ECTS

How to adapt farming practices to reduce agricultural impacts on water quality?

Aim

Agricultural practices, especially the use of nutrients and plant-health products, can degrade chemical quality of surface water and of groundwater. This module is designed to provide an agronomy background to students to understand how farmers may conciliate their yield goals, crop needs and water quality. A focus on major nutrients (nitrates and phosphorus) will be done.

This theoretical knowledge will be applied to the Pisa floodplain (Italy) where different crop systems or land use managements are tested to identify the impacts of farming practices on water quality. This area is illustrative of Mediterranean coastal areas periurban dynamics (urban sprawl, land abandonment).

Program

- Introduction to agronomy
- Nutrient balance
- Regulatory context of farming practices regarding water quality
- Overview of agro-environmental measures in the EU
- Hydrology applied to agroecosystems
- Fate of phosphorus: anthropogenic and natural sources; transfer and impact on water quality
- Use of spatialized modelling tools

Learning outcomes

- Describe the interaction between farming practices and water quality
- Describe the agro-environmental measures that may be used to conserve water quality
- Realize a nutrient balance

Assessment method

Written examination.

Prerequisites

- Aquatic chemistry
- Soil hydrology
- Environmental biogeochemistry

Suggested readings

📖 Botkin, D.B., et Keller, E.A., 2014. Environmental Science: Earth as a Living Planet. John Wiley & Sons, 688 p. ISBN 978-1-118-42732-3.

📖 Brady, N.C. & Weil, R.R., 2002. The nature and properties of soils. Prentice Hall, 960 p. ISBN 978-0-13-016763-7.

Faculty and staff

Coordinator and lecturer: *Elisa MARRACCINI* (Ph.D.), Associate Professor in agronomy and geo-agronomy.

Contact: elisa.marraccini@unilasalle.fr

Guest lecturer: Nicola *SILVESTRI* (Ph. D), Associate Professor in agronomy. University of Pisa, Italy. Contact: nicola.silvestri@unipi.it

Ecological engineering applied to water management (AE0206)

2 ECTS

What are applications of wetland ecosystems and functional plant traits in ecological engineering?

Aim

In this module, students will be familiarized with ecological engineering, in particular influence of plant species diversity and plant traits on the physical and biogeochemical processes of water and nutrient flows. Natural areas such as wetlands will be particularly studied as they are high biodiversity ecosystems and present functions in water protection. Therefore, wetlands are particularly focused by stakeholders and are concerned by conservation measures.

Land planning is now enhanced by the possibilities of plant-based engineering. Artificial wetland may be used for wastewater phyto-treatment technologies. Runoff and erosion in agricultural catchments can be reduced by herbaceous hedges inspired by plant morphology and other properties.

Program

1- Wetland ecology and applications in ecological engineering for water protection and treatment

- Ecosystem services of wetlands
- Impact of wetlands on water quality (nitrate and phosphate removal)
- Wetland reconstruction or restoration to improve water protection
- Visit: waste water treatment plant based on plant-based engineering

2. Plant functional ecology and applications in ecological engineering to reduce runoff and erosion

- Effect of plant traits on efficiency of herbaceous hedge to concentrated runoff
- Effect of cover crops (e.g. multispecies cover crops) on runoff generation and erosion
- 1 day field trip: Pays de Caux (agricultural area strongly affected by runoff issues)

Learning outcomes

- Describe the functional role of different types of plants in wetlands
- Describe the key processes of importance for nutrient removal in wetlands
- Discuss the choice of techniques to reduce the impacts of runoff through a case study

Assessment method

Individual assignment.

Prerequisites

No prerequisite.

Suggested readings

📖 Botkin, D.B., et Keller, E.A., 2014. Environmental Science: Earth as a Living Planet. John Wiley & Sons, 688 p. ISBN 978-1-118-42732-3.

📖 Morgan, R.P.C., 2005. Soil Erosion and Conservation. Wiley-Blackwell, 316 p. ISBN 978-1-4051-1781-4.

Faculty and staff

Coordinator and lecturer: *Michel-Pierre FAUCON* (Ph.D.), Associate Professor in plant ecology and restoration ecology.

Contact: michel-pierre.faucon@unilasalle.fr

Guest lecturer: *Freddy REY* (Ph. D.), Research Director in ecological engineering. IRSTEA, Grenoble, France.

Contact:

Field trip (AE0209)

2 ECTS

Study and visit of sites presenting specific water management facilities or issues.

Program

Program of field trip is still under construction. In 2016, the field trip took place in Alsace, at the eastern border of France. Several case study were visited with invited speakers:

- The impacts of the Rhine channelization on the sediment supply and the dynamic of riparian ecosystems.
- The land planning of Strasbourg city related to the Rhine dynamics (bike tour).
- Soil conservation and mitigation of erosion of agricultural lands in hilly areas.

Insights of the field trip can be checked out on this link.

Prerequisites

No prerequisites.

Assessment method

Group assignment and oral defense.

Faculty and staff

Coordinator and lecturer: *Romain ARMAND* (Ph.D.), Associate Professor in surface hydrology and GIS.

Contact: romain.armand@unilasalle.fr

Water quality monitoring (AE0208)

2 ECTS

How to assess the ecological and physico-chemical quality of water systems?

Aim

Determining water quality is a key question in the EU where Water Framework Directive (WFD) aims at achieving an ecological and chemical "good status" of all water bodies. In this module, we will focus on superficial water bodies (*e.g.*: rivers and lakes) and the way to assess the status of their biological and physico-chemical status by means of sampling, indicators and laboratory analysis. Anthropogenic perturbations (sewage effluents, agricultural practices) and their effects on water quality will be particularly studied.
Stream station(s) near Beauvais will be used to perform water and biological samples.

Program

- Animal and vegetal bio-indicators
- Review of water biological quality indexes
- In-site physico-chemical measurement (multiparametric probe)
- Macro-invertebrates sampling in stream stations near Beauvais
- Recognition of the taxonomic rank of sampled macro-invertebrates
- Determination of biological index of the selected stream station(s)
- Lab measurements of physico-chemical parameters (pH, Nitrate, Chlorine, etc.)
- Introduction to sensors involved in monitoring of water properties

Learning outcomes

- Explain the location of the sampling site depending on expected anthropogenic perturbation
- Assessing first ecological level of a water system
- Measuring basic physico-chemical parameters of water samples
- Discuss the effects of environmental and anthropogenic factors on biological index or physico-chemical parameters

Assessment method

Group assignment.

Prerequisites

- Aquatic chemistry

Suggested readings

📖 Martin, J.L., 2014. Hydro-Environmental Analysis: Freshwater Environments. CRC Press, Boca Raton : 567 p. ISBN 978-1-4822-0607-4.

Faculty and staff

Coordinator and lecturer: *Anne-Maïmiti MERCADAL* (Ph.D.), Associate Professor in animal ecology.

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Water pollution and remediation (GE0205)

2 ECTS

How to characterize a water pollution and propose specific remediation techniques?

Aim

Preventing and controlling pollution of the environment is a major challenge facing both developed and developing countries. In this module, students will be initiated to the major environmental pollutants and to the current methods used to control soil and water pollutions.

Program

- Different types of organic and inorganic contaminants in surface water and groundwater
- Document review of a contaminated site
- Diagnostis of a contaminated site
- Management process of contaminated site
- Remediation techniques of contaminated water and soils

Learning outcomes

- Describe the different types of contaminants and their behavior in surface water and in groundwater
- Based on document review, summarise the key factors and processes that are controling pollution
- According to site context,disccuss the choice of the most accurate remediaition technqiue

Prerequisites

- Aquatic chemistry
- Water flow and transport

Suggested readings

📖 Appelo, C.A.J. and Postma, D. (1999) Geochemistry, groundwater and pollution. A.A. Balkema, Rotterdam.

Assessment method

Oral defense.

Faculty and staff

Coordinator: *Olivier POURRET* (Ph.D.), Associate Professor in geochemistry.

Contact: olivier.pourret@unilasalle.fr

Lecturer: *Raul E. MARTINEZ* (Ph. D), Assistant Professor for Biogeochemistry and Aqueous Geochemistry. University of Freiburg, Germany. Contact: raul.martinez@minpet.uni-freiburg.de

International seminars (AE0210)

1 ECTS

International point of view about water and environmental management

Aim

As spring program is limited to 4 months, the seminars provide opportunity to raise new topics and give prime examples of water management. The seminars will be given by professors from partner universities or specialists from public and private institutions.

Program

Program is still under construction, it may include:

- Mapping the agricultural use of soils based on remote sensing analysis.
- How increase agriculture tolerance to drought and soil salinization?
- New technics of water depollution
- Integrating climate change in management plans of water basin area
- How to monitor and reduce water consumption thanks to digital techs?
- How to feed growing cities with fresh water in semi-arid context?

Prerequisites

No prerequisites.

Assessment method

Attendance to the seminar.

Faculty and staff

Coordinator: *Romain ARMAND* (Ph.D.), Associate Professor in surface hydrology and GIS.
Contact: romain.armand@unilasalle.fr

French as a Foreign Language (LE0202)

2 ECTS

Discovering French language

Aim

This module is designed for students who have had little or no previous French instruction. Students will discover French and acquire some basic tools for real-life language use while they study and travel in France.
Class will be conducted entirely in French, and students will be expected to participate actively, using the language skills they are learning inside and outside the classroom. In the end, students are encouraged to pursue the study of French once they return to their home institutions.

Program

- Describe, narrate, and ask/answer questions in the foreign language in the present time about a variety of topics related to family, daily activities, eating, and traveling.
- Comprehend the foreign language with sufficient ability to grasp the main idea in short conversations pertaining to the topics mentioned above.
- Read and understand the main idea and some details of materials related to daily life and travel (maps, classified ads,)
- Write sentences and short paragraphs on familiar topics relating to personal interests and practical needs. (e.g. postcards)

Prerequisites

No prerequisite.

Assessment method

Written examination.

Faculty and staff

Coordinator and lecturer: *Martine REY* (Ph. D.), Associate Professor, Languages & Cultural Studies.
Contact: martine.rey@unilasalle.fr

Example of a transcript of academic record

TRANSCRIPT OF ACADEMIC RECORD

ACADEMIC YEAR

To whom it may concern

Student:
Home University:
Host University:
Period of study:

Water Spring Semester

Course	ECTS* credits per course	Result / 20	ECTS* credits obtained	Grade
WATER : CURRENT NEEDS AND FURTHER CHALLENGES				
WATER POLICY AND GOVERNANCE				
SURFACE HYDROLOGY				
HYDROGEOLOGY				
AQUATIC CHEMISTRY				
SOIL HYDROGEOCHEMISTRY				
GIS APPLIED TO HYDROLOGY				
ECOLOGICAL ENGINEERING APPLIED TO WATER MANAGEMENT				
FLUID MECHANICS APPLIED TO HYDROGEOLOGY				
FLOW AND TRANSPORT IN GROUNDWATER				
WATER QUALITY MONITORING				
WATER QUALITY MANAGEMENT ACROSS AGROECOSYSTEMS				
WATER POLLUTION AND REMEDIATION				
FIELD TRIP				
INTERNATIONAL SEMINARS				
FRENCH AS A FOREIGN LANGUAGE				
TOTAL ECTS* CREDITS OBTAINED				

* 2 ECTS = 1 US CREDIT

Romain ARMAND
Coordinator

Valerie LEROUX
Dean