الجمهورية الجزائرية الديمقراطية الشعبيةPeople's Democratic Republic of Algeria
وزارة التعليم العالي والبحث العلمي
Ministry of Higher Education and Scientific Research
اللجنة البيداغوجية الوطنية لميدان العلوموالتكنولوجيا
National Educational Committee for the field of Science and Technology

ACADEMIC MASTER HARMONIZE

National program

2022 update

Domain	Sector	Speciality
Science And Technologies	***Hydraulic***	***Hydraulic Works***

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National Educational Committee for the field of Science and Technology

مواءمة
ماستر أكاديمي

برنامج وطني

Date: 2022

الميدان	الفرع	التخصص
علوم وتكنولوجيا	ري	منشآت الري

I–Master's identity sheet

Access conditions

(Indicate the license specialties which can give access to the Master)

Sector	Harmonized Master	Access licenses to the master's degree	Ranking according to license compatibility	Coefficient assigned to the license
Hydraulic	Hydraulic works	Hydraulic	**1**	**1.00**
		Civil engineering	**2**	**0.80**
		Public works	**2**	**0.80**
		Other licenses in the ST domain	**5**	**0.60**

II – Half-yearly teaching organization sheets of the specialty

Semester 1

Teaching unit	Materials	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Evaluation mode	
	Titled			**Course**	**T.D.**	**TP**			**Continuous monitoring**	**Exam**
Fundamental EU Code: UEF 1.1.1 Credits: 10 Coefficients: 5	Applied hydraulics	6	3	3:00 a.m.	1h30		67h30	82h30	40%	60%
	Hydrological analysis and modeling	4	2	1h30	1h30		45:00	55:00	40%	60%
Fundamental EU Code: UEF 1.1.2 Credits: 8 Coefficients: 4	Free surface flows	4	2	1h30	1h30		45:00	55:00	40%	60%
	Flows under load	4	2	1h30	1h30		45:00	55:00	40%	60%
Methodological EU Code: UEM 1.1 Credits: 9 Coefficients: 5	Digital hydraulics	3	2			2h30	37:30	37:30	100%	
	Geographic Information Systems (GIS)	4	2	1h30		1h30	45:00	55:00	40%	60%
	Hydraulic TP	2	1			1h30	10:30 p.m.	27:30	100%	
EU Discovery Code: UED 1.1 Credits: 2 Coefficients: 2	Material of your choice	1	1	1h30			10:30 p.m.	02:30		100%
	Material of your choice	1	1	1h30			10:30 p.m.	02:30		100%
Transversal EU Code: UET 1.1 Credits: 1 Coefficients: 1	Technical English and terminology	1	1	1h30			10:30 p.m.	02:30		100%
Total semester 1		**30**	**17**	**1:30 p.m.**	**6:00 am**	**05:30**	**375h00**	**375h00**		

Semester 2

Teaching unit	Materials	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Evaluation mode	
	Titled			**Course**	**T.D.**	**TP**			**Continuous monitoring**	**Exam**
Fundamental EU Code: UEF 1.2.1 Credits: 10 Coefficients: 5	Dam I	6	3	3:00 a.m.	1h30		67h30	82h30	40%	60%
	Geotechnics of hydraulic works	4	2	1h30	1h30		45:00	55:00	40%	60%
Fundamental EU Code: UEF 1.2.2 Credits: 8 Coefficients: 4	Hydraulic machines and pumping stations	4	2	1h30	1h30		45:00	50:00	40%	60%
	Underground hydraulics	4	2	1h30	1h30		45:00	50:00	40%	60%
Methodological EU Code: UEM 1.2 Credits: 9 Coefficients: 5	Hydraulic modeling and simulation	3	2			2h30	37:30	37:30	100%	
	TP Geotechnics of hydraulic works	2	1			1h30	10:30 p.m.	27:30	100%	
	TP Hydraulic machines and pumping stations	2	1			1h30	10:30 p.m.	27:30	100%	
	Organization and mechanization of work	2	1	1h30			10:30 p.m.	27:30		100%
EU Discovery Code: UED 1.2 Credits: 2 Coefficients: 2	Material of your choice	1	1	1h30			10:30 p.m.	02:30		100%
	Material of your choice	1	1	1h30			10:30 p.m.	02:30		100%
Transversal EU Code: UET 1.2 Credits: 1 Coefficients: 1	Compliance with standards and rules of ethics and integrity	1	1	1h30			10:30 p.m.	02:30		100%
Total semester 2		**30**	**17**	**1:30 p.m.**	**6:00 am**	**05:30**	**375h00**	**375h00**		

Semester 3

Teaching unit	Materials	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Evaluation mode	
	Titled			**Course**	**T.D.**	**TP**			**Continuous monitoring**	**Exam**
Fundamental EU Code: UEF 2.1.1 Credits: 10 Coefficients: 5	Dam II: Concrete dam	4	2	1h30	1h30		45:00	55:00	40%	60%
	Conventional and unconventional water treatment	4	2	1h30	1h30		45:00	55:00	40%	60%
	Monitoring and monitoring of dams	2	1	1h30			10:30 p.m.	27:30		100%
Fundamental EU Code: UEF 2.1.2 Credits: 8 Coefficients: 4	Development of waterways and solid transport	4	2	1h30	1h30		45:00	55:00	40%	60%
	Agricultural Engineering	4	2	1h30	1h30		45:00	55:00	40%	60%
Methodological EU Code: UEM 2.1 Credits: 9 Coefficients: 5	Specialized software	3	2			2h30	37:30	37:30	100%	
	Water treatment TP	2	1			1h30	10:30 p.m.	27:30	100%	
	Integrated management of water resources	2	1	1h 30			10:30 p.m.	27:30		100%
	Project management	2	1	1h30			10:30 p.m.	27:30		100%
EU Discovery Code: UED 2.1 Credits: 1 Coefficients: 1	Material of your choice	1	1	1h30			10:30 p.m.	02:50		100%
	Material of your choice	1	1	1h30			10:30 p.m.	02:50		100%
Transversal EU Code: UET 2.1 Credits: 2 Coefficients: 2	Documentary research and dissertation design	1	1	1h30			10:30 p.m.	02:50		100%
Total semester 3		**30**	**17**	**3:00 p.m.**	**6:00 am**	**4:00 am**	**375h00**	**375h00**		

Discovery Unit (S1, S2, S3)

1. *ICT concept*
2. *Automation*
3. *Protection and management of irrigated areas*
4. *Sustainable agriculture and regional development*
5. *Water economics and legislation*
6. *Environmental legislation*
7. *Water saving*
8. *Environmental Concepts*
9. *Site organization*
10. *Hydro-economy*

Semester 4

Internship in a company culminating in a dissertation and a defense.

	VHS	coefficient	Credits
Personal work	550	09	18
Internship in company	100	04	06
Seminars	50	02	03
Other (Framing)	50	02	03
Total Semester 4	750	17	30

This table is given for information purposes only.

Evaluation of the End of Master Cycle Project

- Scientific value (jury assessment) /6
- Writing of the dissertation (jury assessment) /4
- Presentation and response to questions (Jury assessment) /4
- Appreciation of the supervisor /3
- Presentation of the internship report (Jury assessment) /3

III - Detailed program by subject for the S1 semester

Semester: 1
Teaching unit: UEF 1.1.1
Material: Applied hydraulics
VHS: 67 hours 30 minutes (Class: 3 hours, tutorial: 1 hour 30 minutes)
Credits: 6
Coefficient: 3

Teaching objectives:

This subject aims to deepen the notions of drinking water supply and general hydraulics acquired in the bachelor's degree, and to help students understand hydraulic phenomena, the equations which govern them and their solutions. As well as the presentation of storage and distribution works and their dimensions.

Recommended prior knowledge

- Mathematics basics
- Knowledge of MDF and hydraulics
- Hydrology concepts

Content of the material:

Chapter 1: Source catchments **(2 weeks)**

1.1 General
1.2 Project study and preliminary work
1.3 Execution of works
1.4 Catchment of bottom water
1.5 Surface water capture

Chapter 2: Drinking water consumption **(3 weeks)**

2.1 Drinking Water Supply System
2.2 Drinking water
2.3 Total consumption per person
2.4 Domestic consumption
2.5 Public consumption
2.6 Consumption in industrial zones
2.7 Losses
2.8 Fire Fighting
2.9 Factors affecting consumption
2.10 Variation in consumption

Chapter 3: Tanks **(3 weeks)**

3.1 Advantages
3.2 Distribution of distribution flow rates
3.3 Consumption
3.4 Tank location
3.5 Tank capacity
3.6 Form and implementation
3.7 Principle of construction
3.8 Water requirements for fire protection
3.9 Installation of signaling and remote control (remote control)

Chapter 4: Nature of the pipes (under pressure and gravity flow) **(2 weeks)**

4.1 Cast iron pipes
4.2 Steel pipes
4.3 Concrete pipes
4.4 Plastic pipes
4.5 Commissioning
4.6 Identification, execution plans and signage

Chapter 5: Water distribution networks **(2 weeks)**

5.1 Types of networks
5.2 Conditions on speeds and pressures
5.3 Computational throughput
5.4 Calculation of branched networks
5.5 Calculation of mesh networks
5.6 Network yields
5.7 Leak detection

Chapter 6: Accessory organs – faucets **(2 weeks)**

6.1 Gate valves
6.2 Strainers
6.3 Traps - suction cups
6.4 Pressure and flow reducers
6.5 Flow - pressure stabilizers
6.6 Control valves
6.7 Security bodies

Evaluation method:

Continuous monitoring: 40%; exam: 60%.

Bibliographic references:

1. *Briere F G. Water distribution and collection. Editions of the Polytechnic School of Montreal, 1994, 365 p.*
2. *Valiron F., Lyonnaise des Eaux. Handbook for the Water Supply Manager and sanitation. Volume I Water in the city Water supply. Paris, Technique and documentation Lavoisier, 1994. 435 p.*
3. *Dupont A. Urban hydraulics, Volume 2: Transport structures Elevation and water distribution. Paris, Eyrolles, 1979, 484 p. 4th ed.*
4. *Bonnin J. Urban hydraulics applied to small and medium-sized towns importance. Paris, Eyrolles, 1986, 228 p.*

Noticed :

To further strengthen the student's knowledge of applied hydraulics (common subject between the three masters), the program for this subject is enriched by the addition of a chapter 'chapter 2:consumption of drinking water.

Chapters 5 and 6 will be approached superficially, because the latter were studied in the License course: 3rd year Hydraulics (Semester 6 - Subject: Pipe technology and network equipment).

Semester: 1
Teaching unit: UEF1.1.1
Subject: Hydrological analysis and modeling
VHS: 45h (Class: 1h30, tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives

- Resolution oriented towards the precise execution and rational analysis of measurements and observations relating to the hydrometeorological factors of a phenomenon, with a view to elucidating its mechanism and its laws of probability, its objective will often be to establish methods of quantitative predetermination of the amplitude or probability of occurrence of the said phenomenon.
- Study is the forecast of flood flow, either based on exceptional flow rates observed over a long series of years, or based on the precipitation that produces them.
- Use different hydrological modeling approaches to determine the rainfall-runoff relationship, with the aim of forecasting or using such models for ungauged basins

Recommended prior knowledge

- Basics of hydrology and climatology
- Applied statistics
- Use of IT tools.

Content of the material:

Chapter 1: Concepts of probability and statistical analysis applied to hydrology.

1.1 Reminder **(5 weeks)**
1.2 Types of distribution (or density) functions in hydrology
1.1.1 Extreme values of a variable
1.3 General theory of statistical adjustment
1.2.1 Method of moments
1.2.2 Maximum likelihood method
1.2.3 Confidence intervals and confidence bands
1.4 Fit Test
1.3.1 Chi square test
1.3.2 Kolmogorov-Smirnov test
1.5 Implementation
1.4.1 Application of normal law in determining the return period
1.4.2 Example of adjusting a sample according to Goodrich's law
1.4.3 Adjustment of several types of layers for calculating the frequencies of extreme values

Chapter 2: Correlations and data analysis **(5 weeks)**

2.1 Definitions
- 2.1.1 Orthogonal correlation
- 2.1.2 Linear correlation
- 2.1.3 Other types of correlation
- 2.1.4 Primary quality analysis
- 2.1.5 Statistical complement to hydrological data

2.2 Processes, variables and series
- 2.2.1 Definitions
- 2.2.2 Characteristic values of a time series
- 2.2.3 Smoothing of time series

2.3 Homogeneity Test
- 2.3.1 General approach
- 2.3.2 Homogeneity test according to the Gumbel distribution test
- 2.3.3 Homogeneity test according to the Laplace distribution test

2.4 Implementation

Chapter 3: Hydrological modeling (4 weeks)

3.1 Hydrological modeling
3.2 Some vocabulary items
3.3 Why hydrological models
3.4 Different modeling approaches
- 3.4.1 Definitions
- 3.4.2 Presentation of some tools
- 3.4.3 Hydrological applications of global rainfall-runoff models
- 3.4.4 Hydrological applications of connectionist models

3.5Application of a hydrological model

Evaluation method:

Continuous monitoring: 40%; exam: 60%.

Bibliographic references:

1. *Réméniéras G.,Engineering Hydrology –ed. EYROLLES*
2. *Liamas José, General Hydrology –ed. Gaëtan Morin*
3. *Dubreuil, P. Introduction to hydrological analysis –ed. Masson and Co.*
4. *Hydrology – Eric Gaume, mimeograph from the National School of Bridges and Roads*
5. *Statistical Hydrology (Introduction to the Study of Hydrometeorological Processes*
6. *Miquel Jacques,. Application to the Predetermination of Flood Flows) -, mimeograph from the National School of Bridges and Roads*

Semester: 1
Teaching unit: UEF 1.1.2

Subject: Free surface flows
VHS: 45 hours (class: 1:30, tutorial: 1:30)
Credits: 4
Coefficient: 2

Teaching objectives:

This subject aims to deepen the notions of MDF and general hydraulics acquired in licenses, it aims to provide an understanding of the phenomena of free surface flows, the equations which govern them and their solutions. This subject is a theoretical basis for several areas of hydraulics (sanitation, turbo machines, irrigation, hydraulic works).

Recommended prior knowledge

- Mathematics basics
- Concepts in MDF

Content of the material:

Chapter 1:**Reminder of some general hydraulics concepts**
(2 weeks)

Chapter 2: Uniform diet **(3 weeks)**

2.1 General flow formula
2.2 Flow formulas in artificial canals and natural watercourses
2.3 Flow velocity
2.4 Cross sections and cross sections
2.5 The Aqueducts

Chapter 3: Permanent regime varies **(2 weeks)**

3.1 Use of fundamental theorems (Bernoulli and Euler)
3.2 Specific energy
3.3 Critical regime
3.4 Study of various diets

Chapter 4: Movement gradually varies **2 weeks)**

4.1 Generalities and assumptions
4.2 Differential equation of gradually varied motion
4.3 Backwater curves
4.4 Calculation of the water line in permanent movement gradually varied (eddy curves)

Chapter 5: Movement suddenly varies (the hydraulic jump). **(2 weeks)**

5.1 Definition
5.2 Lagrange formula
5.3 Wave velocity and critical speed
5.4 Stationary hydraulic spring
    5.4.1 Calculation of conjugate heights and the length of a jump
    5.4.2 Load losses in a jump
    5.4.3 Search for the position of a jump
    5.4.4 Use of a jump

Chapter 6: Application to the study of other varied diets **(2 weeks)**

6.1 Drowned and dewatered flows
6.2 Singularity of the cross section
6.3 Singularity of the long profile

Chapter 7: Gauging of free surface flows (To delete)
7.1 Classification of gauging methods
7.2 Volumetric methods
7.3 Chemical or delution methods
7.4 Anderson screen and Allen screen method
7.5 Float method
7.6 Method using the velocity field
7.7 Weir method
7.8 Contracted veins method

Evaluation method:

Continuous monitoring: 40%; exam: 60%.

Bibliographic references:

1. *Carlier. m (1972),general and applied hydraulics, Edition Eyrolles*
2. *Comolet. r(2002),experimental fluid mechanics, Edition Dunod.*
3. *Violet. pl, chabard. jp, esposito. p and laurence. d (2002),applied fluid mechanics, press edition of the national school of bridges and roads.*

Semester: 1
Teaching unit: UEF 1.1.2
Subject: Flows under load
VHS: 45 hours (Class: 1:30 a.m., tutorial: 1:30 a.m.)

Credits: 4
Semester: 2

Teaching objectives:

This course allows the deepening of knowledge relating to pressure flows at steady and non-steady regimes as well as familiarization with the measuring instruments commonly used in hydraulic and petrochemical installations under pressure..

Recommended prior knowledge:

Knowledge of the basics of fluid mechanics.

Content of the material:

Chapter 1: Reminders **(2 weeks)**

Flow regimes, Permanent flow, Uniform flow, Non-permanent flow, problems in flow under load (search for flow rate, Diameter)

Chapter 2: Flows with velocity potential **(4 weeks)**

2.1 Equation of a flow with velocity potential, solutions of the Laplace equation
2.2 Plane flows with velocity potential
2.3 Analytical functions of a complex variable
2.4 Unit flow
2.5 Simple flows, (Well or source, Uniform flow, Flow between two solid walls, flow around a vortex placed at the origin)
2.6 Compound flows
2.7 Conformal transformation method, Zhukovsky transformation
2.8 Graphical study of irrotational flows
2.9 Analogue study of irrotational flows

Chapter 3: Permanent flows in loaded pipes. (5 weeks)

2.1 Laminar flows in a cylindrical pipe

(Distribution of speeds in a laminar flow, Expression of friction coefficient, Distribution of shear tensions, Kinetic energy correction factor, Momentum factor, Initial length of laminar flows, Laminar flow between two parallel flat plates, poisuille plane flow, couette flow, laminar boundary layer development)

2.2 Turbulent Flows

Distribution of speeds in a turbulent flow, Concept of boundary layer, turbulent, sub-laminar boundary layer, Mixing length: Prandtl equation, Shear tension, Speed distribution law, Turbulent flow in a smooth cylindrical pipe. Influence of roughness, Nikuradsé experiment – Moody diagram, General formulas for steady flow in turbulent regime in cylindrical pipes of constant diameter (Ancient formulas, Modern formulas), smooth turbulent regime, rough turbulent regime, semi-rough turbulent regime .

2.3. Fluid measuring instruments:

Measurement of fluid densities (Westphal balance, constant volume densimeter and constant weight densimeter, U-tube). Measurement of fluid viscosity (MacMichael viscometer, Stormer viscometer, Saybolts viscometer, Engler viscometer, Ostwald viscometer, falling ball viscometers). Measurements of static and total pressures (manometers, micro manometers, sensors and conversion processes). Measurement of viscous stresses (Stanton tube, Preston tube). Level measurements (glass level,

resistive detector, capacitive detector). Velocity measurement (Prandtl probe, cup and propeller anemometers, hot wire and hot film anemometers). Flow measurement (diaphragm, venturi, nozzles, turbine flowmeter, rota meter, vane and elbow flowmeter, gasometer)

Chapter 4: Non-permanent flows in loaded pipes. (4 weeks)

4.1 Quasi-permanent flows (emptying from a reservoir to a river, emptying from one reservoir to another)
4.2 Oscillatory movements of liquids (in a U-tube and between two tanks, without hydraulic resistance, with laminar resistance and with turbulent resistance)
4.3 Transient flow (flow establishment time)
4.5 Water hammer (perfect fluid, real fluid, speed of the shock wave, phase study, intensity of the water hammer)
4.6 Protection against water hammer (balance chimney, slow closing, relief valve, flywheel and anti-water hammer tank)

Evaluation method:

Continuous monitoring: 40%; exam: 60%.

Bibliographic references

1. *Irving H. Shames, 2003, Mechanics of fluids, 4th ed., Mc. Graw Hill, International Ed. ISBN 0-07-119889-X.*
2. *Candel S., 1995, Fluid mechanics course, 2nd ed, Dunod, Paris 1995, ISBN 2-10-002585-6.*
3. *Massy BS, 1975, Mechanics of fluids, 3rd ed., VNR, London 1975, ISBN 0 442 30021 2.*
4. *Allen Jr T and RL Ditsworth, 1972, Fluid Mechanics, Int. Student ed. McGraw-Hill Kogakusha,*
5. *Merzak. Damou, Fluid Mechanics, OPU 03-1994. Code 2.05.3887.*
6. *Pump Engineering Manual, IDURCO, 1968*.

Semester: 1
Teaching unit: UEM 1.1
Subject: Digital hydraulics
VHS: 37h30 (TP: 2h30)
Credits: 3
Coefficient: 2

Teaching objectives:

The objective of this teaching is to teach the student the different numerical methods used in hydraulics of head and free surface flows.
Open to the student another horizon of digital techniques used in hydraulic simulation.

Recommended prior knowledge:
General hydraulics, programming.

Content of the material:

TP 01: Flowsgradually varies: application on codes and software such as HECRAS
(5 weeks)

TP 02: Flows suddenly vary: application on educational canals (sudden falls, hydraulic jumps, spillways, etc.).
(5 weeks)

TP 03: Load flows (branched network, mesh network, distribution and adduction) application to codes and software such as Epanet.
(4 weeks)

Evaluation method:
Continuous control: 100%.

Bibliographic references

1. *Mathematical analysis and numerical calculation for science and technology (volume 6), Robert Dautray; Lions, Jacques-Louis.*
2. *The HEC-RAS software (version 2.1) from the USArmy Corps of Engineers*
3. *The US Environmental Protection Agency's EPANET software.*
4. *Epanet 2.0 "Hydraulic simulation and quality for pressurized water networks", User manual, French version, 2003*

Semester: 1
Teaching unit: UEM 1.1
Subject: Geographic information system (GIS)
VHS: 45h00 (Class: 1h30, tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:
The course will aim to show master's students the use of new geographic positioning tools and the possibilities of crossing by layer of information.

Recommended prior knowledge:

- Topography
- Math
- Physical.

Content of the material:

Chapter 1 ;Basic GIS Design	**(2 weeks)**
Chapter 2 :Projection systems	**(1 weeks)**
Chapter 3:Presentation of Mapinfo software.	**(2 weeks)**
Chapter 4:digitalization	**(1 weeks)**
Chapter 5:formatting	**(1 weeks)**
Chapter 6:thematic cartography	**(2 weeks)**
Chapter 7:sectorization	**(1 weeks)**
Chapter 8:Digital terrain model DEM	**(2 weeks)**
Chapter 9:GIS application	**(2 weeks)**

Evaluation mode:

Continuous monitoring: 40%; exam: 60%.

Bibliographic references:

1. *Summary of Remote Sensing: Principles and methods F. Bonn and G. Rochon. Editions Presses de l'Université du Québec – AUPELF.*
2. *Image analysis: filtering and segmentation. JP Cocquerez and S. Philipp. Edition Masson.*
3. *Remote Sensing Digital Image Analysis. JA RICHARDS, X. JIA. Springer,*
4. *Processing of remote sensing data MC Girard and CM Girard.*
5. *Editions Dunod, Paris.*
6. *Remote sensing: from satellites to GIS. Edition Nathan ROBIN University.,*

Semester: 1
Teaching unit: UEM 1.1
Matter :Hydraulic TP
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives:

The objective of this teaching is to have the student practice in a laboratory what he has learned about free surface flow.

Recommended prior knowledge:

- General hydraulics
- Free surface flow.

Content of the material:

TP 01: Determination of the simple and composite roughness of a sewerage pipe: use of software (epaswimm etc.)

(2 weeks)

TP 02: Modeling storm overflows using epaswimm

(3 weeks)

TP 03: Modeling of the hydraulic jump using HSL

(3 weeks)

TP 04: Verification of Chézy's law in the laboratory in canals

(3 weeks)

TP 05: Practical determination of swirl curves in the laboratory

(3 weeks)

TP 06: Practical determination of swirl curves using software such as HSL

(3 weeks)

Evaluation method:

Continuous control: 100%.

Bibliographic references

1. *Walter Hans Graf, MS Altinakar, River hydraulics: flow and transport phenomena in river beds, 2000*
2. *Médéric Clément Lechalas, River hydraulics, 1884*
3. *L. Fargue, Fluvial hydraulics: The shape of river beds with moving bottoms, 1908*
4. *Walter Hans Graf, River hydraulics, 1996.*

Semester: 1
Teaching unit: UED 1.1
Matter :Subject 1 of your choice
VHS: 10:30 p.m. (class: 1h30)
Credits: 1
Coefficient: 1

Semester: 1
Teaching unit: UED 1.1
Matter :Subject 2 of your choice
VHS: 10:30 p.m. (class: 1h30)
Credits: 1
Coefficient: 1

Semester: 1
Teaching unit: UET 1.1
Subject 1: Technical English and terminology
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

The course aims to introduce the student to technical vocabulary. Strengthen your knowledge of the language. Help him understand and synthesize a technical document. Allow him to understand a conversation in English held in a scientific framework.

Recommended prior knowledge:

Basic vocabulary and grammar inEnglish

Content of the material:

Chapter 1: Written comprehension (3 weeks)
Reading and analysis of texts relating to the specialty.

Chapter 2: Oral comprehension (3 weeks)
Based on authentic popular science video documents, note taking, summary and presentation of the document.

Chapter 3: Oral expression (4 weeks)
Presentation of a scientific or technical subject, development and exchange of oral messages (ideas and data), Telephone communication, Gestural expression.

Chapter 4: Written expression (4 weeks)
Extraction of ideas from a scientific document, Writing a scientific message, Exchange of information in writing, writing CVs, application letters for internships or jobs.

Recommendation :

It is strongly recommended that the person responsible for the subject presents and explains at the end of each session (at most) around ten technical words of the specialty in the three languages (if possible) English, French and Arabic.

Evaluation method:

Review: 100%.

Bibliographic references:

1. *PT Danison, Practical guide to writing in English: uses and rules, practical advice, Editions d'Organization 2007*
2. *A.Chamberlain, R. Steele, Practical guide to communication: English, Didier 1992*
3. *R. Ernst, Dictionary of applied techniques and sciences: French-English, Dunod 2002.*
4. *J. Comfort, S. Hick, and A. Savage, Basic Technical English, Oxford University Press, 1980*
5. *EH Glendinning and N. Glendinning, Oxford English for Electrical and Mechanical Engineering, Oxford University Press 1995*

6. *TN Huckin, and AL Olsen, Technical writing and professional communication for nonnative speakers of English, McGraw-Hill 1991*

III - Detailed program by subject for the S2 semester

Semester: 2
Teaching unit :UEF 1.2.1
Subject: Dam I
VHS: 67.5 hours (Class: 3 hours, tutorial: 1 hour 30 minutes)
Credits: 6
Coefficient: 3

Teaching objectives:

Dam developments are often complex and require multidisciplinary teams for their study, construction and operation. The objective of this course is to have the basic tools for their design, construction and operation, while taking into account what was taught in the hydraulic works subject of semester 6 of the hydraulic license.

Recommended prior knowledge

- Hydrology
- Science of materials

Content of the material:

Chapter 1: General information on dams **(2 weeks)**

1.1 Introduction.
1.2 History.
1.3 Objectives of dam construction.
1.4 Dam safety issues.
1.5 Constructive elements of a dam.

Chapter 2: Preliminary studies of dams **(2 weeks)**

2.1 Topographic studies.
2.2 Geological and Geotechnical Studies.
2.3 Hydrological Studies.
2.4 Levels Characteristics in a dam.

Chapter 3:Upstream mask dams **(2 weeks)**

2.1 Basic materials
2.2 Mechanical properties of geomembranes
2.3 Long-term behavior of geomembranes
2.4 Technical installation provisions
2.5 Tests and checks

Chapter 4: Earth dams **(2 weeks)**

3.1 Introduction.
3.2 Advantages and Disadvantages.
3.3 Classification of earth dams.
3.4 Sizing of earthen dams.
3.5 Protective devices against the effects of infiltration water.

Chapter 5: Studies of infiltration through the dam and its foundations **(2 weeks)**

4.1 General.
4.2 Infiltration through a homogeneous earth dam.
4.3 Infiltration through a heterogeneous earth dam.
4.4 Fox phenomenon.

Chapter 6: Sliding stability of earth dams. (2 weeks)

5.1 General.
5.2 Types of land movements.
5.3 Concepts of stability coefficient.
5.4 Calculation of slope stability.

Chapter 7: Rockfill dams (2 weeks)

6.1 Introduction.
6.2 Classification of rockfill dams.
6.3 Types of riprap used.
6.4 Shapes and structures of rockfill dams.
6.5 Sealing devices.
6.6 Waterproofing of foundations.
6.7 Stability of rockfill dams.

Chapter 7: Monitoring, auscultation and maintenance of earth dams(To delete)

7.1 Dam issues
7.2 Monitoring and auscultation
7.3 Maintenance

Evaluation mode:

Continuous monitoring: 40%; exam: 60%.

Bibliographic references:

1. *Group of Specialists from the French Planning Department (1985) – Dam technique in rural development. Edition Ministry of Agriculture, 325 p*
2. *Jean Maurice Durand, Paul Royet and Patrice Meriaux (1999) - Technique of small dams in Sahelian and equatorial Africa - Edition Cemagref, 415 p*
3. *Ledelieu P. (2003) Dams design and maintenance. University Edition, From Lyon 35p.*
4. *George P. and Pierre L. (1953) - compacted earth dams - American practices. Edition Gauthier Villars, 193 p*
5. *Bellier J. (1982) Dams. Edition Press Universitaire de France -127 p*
6. *Anton JS and Henri P. (1911) – Dams, TCG- VOL.17. Published by the French-speaking polytechnic and university press. 738 pp.*

Semester: 2
Teaching unit :UEF 1.2.1

Subject: Geotechnics of hydraulic structures
VHS: 45 hours (Class: 1h30, tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

Understanding of calculation methods and design techniques for earth dams.

Recommended prior knowledge

- Dam
- General Hydraulics
- Hydrology
- Ground Mecanic
- Geology

Content of the material:

Chapter 1: Recognition methods (2 weeks)

1.1 General
1.2 Reconnaissance by Survey (trenches and shafts; galleries; mechanical and hydraulic surveys)
1.3 Laboratory identification tests
1.4 Soil classification

Chapter 2: Water in the ground (2 weeks)

2.1 Introduction
2.2 Darcy's law on flows in porous media
2.3 Measurement of permeability in the laboratory and in-situ
2.4 Effective constraint
2.5 Hydraulic loads and one-dimensional flow
2.6 Flow and flow networks: Two-dimensional flow
2.7 Fragment method
2.8 Control of flows and filters (sizing and installation).

Chapter 3: Shear resistance of soils (3 weeks)

3.1 Introduction
3.2 Internal friction and cohesion of soils
3.3 Mohr-Coulomb rupture criterion
3.4 Intrinsic curve
3.5 Soil shear tests
3.6 Shear resistance in powdery soils, cohesive soils

Chapter 4: Lateral land pressures (2 weeks)

4.1 Lateral soil pressures in the rest state
4.2 Limit equilibrium (cohesive soils, powdery soils)
4.3 Calculation of thrusts and stops
    4.3.1 According to Rankine
    4.3.2 According to Coulomb
    4.3.3 According to Culmann
4.4 Retaining walls

4.5 Reinforced earth
4.6 Sheet pile curtains
4.7 Diaphragm walls

CHAPTER 5: Stability of slopes (Embankments, embankments, dikes and dams)

5.1 General information on slope stability
5.2Factors that control the type and rate of slip
5.3 Cause of slips
5.4Stages of landslide activity
5.5Some modes of instabilities affecting ground slopes
5.6The collapses
- 5.6.1Reversal
- 5.6.2The slips

5.7Rotational or circular slides
- 5.7.1Plane slip
- 5.7.2The flows

5.8Creep movements
5.9 Stability analysis
- 5.9.1Basic concepts for studying slope stability
- 5.9.2Concept of safety coefficient
- 5.9.3Classic methods for studying slope stability
- 5.9.4Numerical methods for studying slope stability
- 5.9.5 Presentation of some "PLAXIS" and "GEOSLOP" calculation codes

5.10 Landslide reinforcement methods (earthworks, drainage devices; geotextiles, etc.)

CHAPTER 6: Superficial and deep foundations

6.1 Surface foundations (types of surface foundation, operating mode, calculation concepts, construction techniques)
6.2 Deep foundations (mode of operation, notions of calculation; production techniques)
6.3 Foundation pathology

Evaluation method:

Continuous monitoring: 40%; exam: 60%.

Bibliographic references:

1. *Holtz, R.D., & Kovacs, W.D. (1991). "Introduction to geotechnics". Presses inter Polytechnique. 1991*
2. *Philipponat "Foundations and earthworks", Ed. Eyrolles, 1998.*
3. *CRAIG "Soil mechanics", Van No strand Reinhold (UK) co. ltd. 1984.*
4. *Bowles "Engineering properties of soils", Mc. Grawhill, New York 1988.*
5. *Terzaghi & PECK "Soil mechanics in engineering practice", Jhon Wiley, New York.*
6. *Filliat "The practice of soils and foundations", Ed. Moniteur*

Semester: 2
Teaching unit: UEF 1.2.2

Subject: Hydraulic machines and pumping stations
VHS: 45 hours (Class: 1h30, tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

- Acquire knowledge of the equipment upstream and downstream of a pumping station
- Know the different types of pumping stations
- Choose the type of pumping station
- Know how to solve the cavitation problem that affects pumps
- Control of the location of pumps in non-cavitation zones
- Type of pumping stations
- Learn to plan pumping stations
- Learn to operate the hydro-energy and hydraulic structures and equipment of the pumping station
- Acquire theoretical and practical knowledge on the construction and operating principle of Pelton, Francis and Kaplan turbines.

Recommended prior knowledge:

- Concepts of general hydraulics
- Pumps and pumping station
- Notions in electrical engineering and automation.

Content of the material:

Chapter 1: Pump reminders **(1 Weeks)**

Chapter 2: Coupling pumps in series and parallel **(3 weeks)**

2.1 Identical and non-identical pumps in series and parallel
2.2 Operating point
2.3 Setting the operating point
2.4 Study of the different variants of the operating point

Chapter 3: The laws of similarities in incompressible fluid pumps **(2 weeks)**

4.1 Introduction
4.2 Reminder of similarity
4.3 Theoretical study of similarity
4.4 Determination of specific speed
4.5 Influence of rotation speed on pump characteristics
4.6 Influence of impeller diameter on pump characteristics
4.7 Classification of vane pumps according to their specific speed

Chapter 4: Study of cavitation in pumps **(2 weeks)**

5.1 Cavitation phenomenon
5.2 Causes and consequences of cavitation

5.3 Theoretical study of cavitation
5.4 Permissible suction height
5.5 NPSH for installation under load and under vacuum

Chapter 5: Classification and maintenance of pumping stations (4 weeks)

3.1 Introduction
3.2 Sizing of pumping stations
3.3 Possible incidents
3.4 Different Troubleshooting Ways

Chapter 6: Hydraulic turbines (2 weeks)

6.1 Introduction
6.2 Role of turbines in hydraulics
6.3 Classification of turbines
6.4 Pelton turbine
6.5 Francis turbine
6.6 Kaplan turbine
6.7 Hydroelectric station

Evaluation method:

Continuous monitoring: 40%; exam: 60%.

Bibliographic references:

1. *Pumps and pumping stations. Author(s)SAVATIER- 01-1994 – Paperback*
2. *History of hydraulic energy: Mills, pumps, wheels and turbines from Antiquity to the 20th century.Author(s)VIOLLET Pierre-Louis*
3. *One-dimensional hydraulics Part 2: Water hammer and mass oscillation phenomenon. Centrifugal pumps.Author(s)PERNÈS Pierre*
4. *NF ISO 17559: hydraulic transmissions, electrically controlled hydraulic pumps .06-2004 - 28p. Pin*
5. *The pumps. Manual selection, application to variable speed. (Technical Coll., ref. MD1 POMPS). Author(s)MANON Jean- 01-2002 - 260p. 21x29.6 Paperback*
6. *NF EN 23661: end suction centrifugal pumps, dimensions relating to bases and installation. Author(s)NF EN 23661- 12-1993 – Hardcover*
7. *NF EN ISO 5198: centrifugal, elico-centrifugal and propeller pumps. Precision class hydraulic operating test code. Author(s)NF ISO 5198- 12-1987 – Hardcover*

Semester: 2
Teaching unit: UEF 1.2.2
Subject: Underground hydraulics
VHS: 45h00 (Class: 1h30, tutorial: 1h30)
Credits: 4

Coefficient: 2

Teaching objectives:

The first part of this subject lays the theoretical and experimental bases of underground hydraulics and discusses the different hypotheses leading to the fundamental equations. The second deals with particular cases of underground flows which are commonly encountered in hydraulic and civil engineering works such as flows through underground cavities, others relating to leakage or supply flow rates of trenches and canals, excavation and cofferdam drains, flows under dam foundations or through dikes, etc.

Recommended prior knowledge:

- Mathematical
- General hydraulics
- Hydrogeology

Content of the material:

Chapter 1: Introduction to underground hydraulics and aquifer systems (3 weeks)

1.1 Groundwater,
1.2 Physical properties of water,
1.3 Porous media and underground flow,
1.4 Average properties of porous media,
1.5 Groundwater and aquifers,
1.6 The hydrological cycle.

Chapter 2 :Formulation of basic groundwater flow equations (4 weeks)

2.1 Methodology of the hydraulic approach,
2.2 Laws of transport speed,
2.3 Basic equations for saturated groundwater flow,
2.4 Typical analytical solutions of fundamental equations,
2.5 Groundwater flow in rock masses,

Chapter 3: Numerical methods for analyzing groundwater flows (4 weeks)

3.1 Methods for solving groundwater flow problems,
3.2 Finite difference method,
3.3 Finite element method

Chapter 4: Groundwater Research. (4 weeks)

4.1 Definition of groundwater research.
4.2 Groundwater research techniques,
4.3 In situ measurement of the hydraulic coefficient,
4.4 Investigation of groundwater quality,
4.5 Study of soil and groundwater pollution

Evaluation method:

Continuous monitoring: 40%; exam: 60%.

Bibliographic references:

1. *Anderson MP (2008).Groundwater. Wallingford: International Association of Hydrological Sciences.*
2. *Bear J. (2012).Hydraulics of Ground water. Mc. Graw Hill.*
3. *Cassan M. (1994). Underground hydraulics cheat sheet. Paris: Presses de l'Ecole Nationale des Ponts et Chaussées.*
4. *Cushman, J.H. and D. Tartakovsky. (2017).The handbook of groundwater engineering.*
5. *Delleur, JW, The handbook of groundwater engineering. 2007, Boca Raton: CRC Press.*
6. *Crim RL et al. (1972).Numerical method for groundwater hydraulics.*
7. *Cushman JH and Tartakovsky D.M. (2017).The handbook of groundwater engineering.*
8. *Franciss FO (2010). Fractured rock hydraulics. Taylor & Francis Group, London. UK.*
9. *Lohman SW and GeologicalS. (1979).Ground-water hydraulics. Washington: US Govt. Print. Off.*
10. *Rosenshein, JS, et al. (1984). Ground water hydraulics.*
11. *Schneebeli G. (1987). Underground hydraulics. Paris: Eyrolles.*
12. *Sato K., Iwasa Y. and G. (2006). Groundwater hydraulics. Tokyo: Springer.*

Semester: 2
Teaching unit: UEM 1.2
Subject: Modeling and simulation in hydraulics
VHS:37:30(TP: 2h30)
Credits: 3
Coefficient: 2

Teaching objectives:

Allow the student to digitally solve mathematical equations governing hydraulic problems and fundamental practical problems by creating simplified programs on Matlab (or other environments) and simulating real (complex) cases on appropriate software.

Recommended prior knowledge

Good knowledge of the basics of fluid mechanics, pressure flows, free surface flows and numerical methods and computer programming languages.

Content of the material:

Chapter 1: Reminder
(Methods for solving non-linear equations and the system of equations) (1 Week)

1.1 Dichotomy Method (Bisection), Secant Method, Regula Falsi Method (False Position),
1.2 Newton Raphson method, Fixed point method
1.3 Methods used to solve systems of equations (Direct and indirect methods)

Chapter 2: Modeling by mfinite difference method (MDF)flows
(2 weeks)

2.1 Discretization of differential operators
2.2 Introduction of boundary and initial conditions
2.3 Finite differences of the first order
2.4 Second-order finite differences
2.5 Temporal discretization schemes (explicit, implicit and mixed)
2.6 Convergence, stability and precision of numerical schemes.
2.7 Example of application of mmodeling of a uniform steady flow by MDF

Chapter 3: modeling by the finite element method of flows (MEF)
(2 weeks)

3.1 Mesh and elements
3.2 Error minimization methods (weighted residuals, Galerkin, etc.)
3.3 Nodal approximations
3.4 Reference elements
3.5 Weak integral methods
3.6 Calculation on the elements
3.7 Digital integration
3.8 Example of application of mmodeling a uniform steady flowby the MEF

Chapter 4: Introduction to the finite volume method **(1 week)**

4.1 (Introduction, Discretization methods, Equation of heat conduction, convection, diffusion,
4.2 Application example

Chapter 5: Modeling and simulation of flows **(9 Weeks)**

5.1 Modeling of a non-steady free surface flow in a 1D prismatic channel
5.2 Modeling of a flow under transient load in a 1D pipe
5.3 Calculation of eddy curves (use of software)
5.4 Draining a reservoir (dam) to the atmosphere
5.5 Flow between two reservoirs (dams)
5.6 Simulation of flows in AEP, sanitation, irrigation and drainage networks

5.7 Other simulations…etc.

Evaluation mode:

Continuous control: 100%.

Bibliographic references:

1. *HervouetJean-Michel (2003), Hydrodynamics of free surface flows, Press Edition of the National School of Bridges and Roads (ENPC)*
2. *GRAF WH - river hydraulics Civil Engineering Treatise of the Ecole Polytechnique de Lausanne: Vol.16*
3. *Carlier. M (1972), General and applied hydraulics, EYROLLES edition*
4. *Comolet. R(2002), Experimental fluid mechanics, DUNOD edition.*
5. *Violet. PL, CHABARD. JP, ESPOSITO. P and LAURENCE. D (2002), applied fluid mechanics, Press Edition of the National School of Bridges and Roads.*
6. *Lencastre. A, general hydraulics manual, Eyrolles (EDF).*
7. *Massey BS (1975) Fluid mechanics, 3rd Edition, Edition VNRC, London.*
8. *Curtis F. Gerald Patrick o. Wheatley (1997). Applied Numerical Analysis 4th ed.*
9. *Nougier JP (1991) Methods of numerical calculation Masson, 3rd ed. Paris.*
10. *Euvrard (1994). Numerical solution of partial differential equations. Masson, 3rd ed. Paris.*
11. *Sibony .M and MARDON J.CL Approximation and Differential equations. Edition Hermann (1982)*
12. *Bathe K.-J. (1996). Finite element procedures. Prentice Hall.*
13. *Dhatt G., TOUZOT G. (1984). A presentation of the finite element method. Maloine SA Paris.*
14. *Prat M. (1995). Modeling of works, Hermès, Paris.*
15. *Zienkiewicz OC (1979). The finite element method. 3rd ed., McGraw Hill.*
16. *Graf WH - River Hydraulics Civil Engineering Treatise of the Ecole Polytechnique de Lausanne: Vol.16*
17. *M. Boumahrat and A. Gourdin Applied numerical methods, OPU Edition, 440p*
18. *Patankar, SV, Finite volume method applied to conduction problems... Numerical Heat Transfer and Fluid Flow, Ed. McGraw-Hill, 1980. [2].*
19. *Hervouet Jean-Michel (2003), Hydrodynamics of free surface flows, Press Edition of the National School of Bridges and Roads (ENPC)*

Semester: 2
Teaching unit: UEM 1.2
Subject: Practical work on geotechnics of hydraulic structures
VHS:10:30 p.m.(TP: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:
The student will be able to characterize the physical parameters of soils, classify them based on in-situ and laboratory identification tests and master compaction procedures.

Recommended prior knowledge:
Soil mechanics course.

Content of the material:

TP 1:Simple compression test **(2 weeks)**

TP 2:Compressibility test using the odometer **(2 weeks)**

TP 3:Box shear test **(2 weeks)**

TP 4: Triaxial test **(2 weeks)**

TP 5: Laboratory scissometer test **(2 weeks)**

Evaluation mode:
Continuous control: 100%.

Bibliographic references:

1. *Costet and Sanglerat, "Practical courses in soil mechanics", Dunod – Paris.*
2. *Caquot and Kerisel, "Treatise on soil mechanics", Gauthier, Villars – Paris.*

Semester: 2
Teaching unit: UEM 1.2
Subject: TP Hydraulic machines and pumping stations
VHS:10:30 p.m.(TP: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives

The objectives assigned by this subject concern the initiation of students to put into practice the theoretical knowledge acquired in the courses on hydraulic machines and pumping stations.

Recommended prior knowledge

- General hydraulics
- Hydraulic machines and pumps and pumping stations.

Content of the subject

TP 1: Characteristics of a centrifugal pump (height, power and efficiency) (3 weeks)

TP 2: Assembly of pumps in series (height, power and efficiency) (3 weeks)

TP 3: Mounting pumps in parallel (height, power and efficiency) (3 weeks)

TP 4: Francis / Pelton turbine (2 weeks)

TP 5: Cavitation (2 weeks)

Evaluation mode:

Continuous control: 100%.

Bibliographic references:

1. *Pumps and pumping stations. Author(s)SAVATIER- 01-1994 – Paperback*
2. *History of hydraulic energy: Mills, pumps, wheels and turbines from Antiquity to the 20th century.Author(s)VIOLLET Pierre-Louis*
3. *One-dimensional hydraulics Part 2: Water hammer and mass oscillation phenomenon. Centrifugal pumps.Author(s)PERNÈS Pierre*
4. *The pumps. Manual selection, application to variable speed. (Technical Coll., ref. MD1 POMPS). Author(s)MANON Jean- 01-2002 - 260p. 21x29.6 Paperback*
5. *NF EN ISO 5198: centrifugal, elico-centrifugal and propeller pumps. Precision class hydraulic operating test code. Author(s)NF ISO 5198- 12-1987 – Hardcover*

Semester: 2
Teaching unit: UEM 1.2
Subject: Organization and mechanization of work
VHS:10:30 p.m.(Class: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives

The objectives assigned by this subject relate to the initiation of students to the various actions necessary for the organization and mechanization of work on hydraulic sites..

Recommended prior knowledge

- Applied hydraulics,
- Sanitation
- Hydraulic works.

Content of the material:

Chapter 1 :Common vocabulary (2 weeks)

1.1 Construction site
1.2 Project manager and project owner, definitions and differences
1.3 Contracts and legal aspect

Chapter 2: Site installation (4 weeks)

2.1 Preparatory work
2.2 Clearance of rights-of-way
2.3 Sanitation, hydraulic protection and networks
2.4Signs – Supports
2.5 Pickets and settlements
2.6 Estimated work schedule
2.7 Execution phasing
2.8 Site Facilities

Chapter 3: Earthworks (3 weeks)

3.1 General earthworks
3.2 Mass earthworks
3.3 Earthworks in excavations
3.4 Channel earthworks
3.5 Earthworks in trenches
3.6 Protections and shielding
3.7 Reduction of water tables and drainage

Chapter 4: Laying pipes **(3 weeks)**

4.1 Criteria for choosing pipelines based on the nature of the terrain
4.2 Earthworks for pipelines
4.3 Backfills for pipes
4.4 Pipe handling
4.5 Installation and assembly techniques
4.6 Leak testing and acceptance of the work
4.7 Quality control

Chapter 5: Hydraulic concretes **(3 weeks)**

5.1 General information
5.2 Consistency of concrete
5.3 Dosages and compositions
5.4 Strength of concrete
5.5 Choice of composition materials
5.6 Concrete manufacturing
5.7 Transport, handling and workability
5.8 Additives
5.9 Tests and checks

Evaluation mode:

Review: 100%.

Bibliographic references:

Semester: 2
Teaching unit: UED 1.2
Material: Material 1 of your choice
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Semester: 2
Teaching unit: UED 1.2
Material: Material 2 of your choice
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Semester: 2
Teaching unit: UET 1.2
Subject: Respect forstandards and rules of ethics and integrity.
VHS: 10:30 p.m. (Class: 1h30)
Credit: 1
Coefficient: 1

Teaching objectives:

Develop students' awareness of respect for ethical principles and the rules that govern life at university and in the world of work. Raise awareness about respecting and valuing intellectual property. Explain to them the risks of moral evils such as corruption and how to combat them, alert them to the ethical issues raised by new technologies and sustainable development.

Recommended prior knowledge:

Ethics and professional conduct (the foundations)

Content of the material:

A.Respect for the rules of ethics and integrity,

1. **Reminder on the MESRS Charter of Ethics and Professional Conduct:**Integrity and honesty. Academic freedom. Mutual respect. Requirement for scientific truth, objectivity and critical thinking. Equity. Rights and obligations of the student, the teacher, the administrative and technical staff,

2. Integrity and responsible research

- Respect for ethical principles in teaching and research
- Responsibilities in teamwork: Professional equality of treatment. Conduct against discrimination. The search for the general interest. Inappropriate conduct in the context of collective work
- Adopt responsible conduct and combat abuses: Adopt responsible conduct in research. Scientific fraud. Conduct against fraud. Plagiarism (definition of plagiarism, different forms of plagiarism, procedures to avoid unintentional plagiarism, detection of plagiarism, sanctions against plagiarists, etc.). Falsification and fabrication of data.

3. Ethics and professional conduct in the world of work:

Legal confidentiality in business. Loyalty to the company. Responsibility within the company, Conflicts of interest. Integrity (corruption in the workplace, its forms, its consequences, methods of combating and sanctions against corruption)

B- Intellectual property

I- Fundamentals of intellectual property

1- Industrial property. Literary and artistic property.
2- Rules for citing references (books, scientific articles, communications in a congress, theses, dissertations, etc.).

II- Copyright

1. Copyright in the digital environment

Introduction. Database copyright, software copyright. Specific case of free software.

2. Copyright in the Internet and e-commerce

Domain name law. Intellectual property on the internet. E-commerce site law. Intellectual property and social networks.

3. Patent

Definition. Rights in a patent. Usefulness of a patent. Patentability. Patent application in Algeria and around the world.

III- Protection and valorization of intellectual property

How to protect intellectual property. Violation of rights and legal tool. Valorization of intellectual property. Protection of intellectual property in Algeria.

C. Ethics, sustainable development and new technologies

Link between ethics and sustainable development, energy saving, bioethics and new technologies (artificial intelligence, scientific progress,Humanoids, Robots, drones,

.

Evaluation method:

Review: 100%

Bibliographic references:

1. *Charter of university ethics and professional conduct. https://www.mesrs.dz/documents/12221/26200/Charte+fran__ais+d__f.pdf/50d6de61-aabd-4829-84b3-8302b790bdce*
2. *Orders No. 933 of July 28, 2016 setting the rules relating to the prevention and fight against plagiarism*
3. *The ABCs of Copyright, United Nations Educational, Scientific and Cultural Organization (UNESCO)*
4. *E. Prairat, On teaching ethics. Paris, PUF, 2009.*
5. *Racine L., Legault GA, Bégin, L., Ethics and engineering, Montreal, McGraw Hill, 1991.*
6. *Siroux, D., Deontology: Dictionary of Ethics and Moral Philosophy, Paris, Quadrige, 2004, p. 474-477.*
7. *Medina Y., Ethics, what will change in the company, Editions d'Organisation, 2003.*
8. *Didier Ch., Thinking about the ethics of engineers, Presses Universitaires de France, 2008.*
9. *Gavarini L. and Ottavi D., Editorial. of professional ethics in training and research, Research and training, 52 | 2006, 5-11.*
10. *Caré C., Morality, ethics, deontology. Administration and education, 2nd quarter 2002, n°94.*
11. *Jacquet-Francillon, François. Concept: professional ethics. Letélémaque, May 2000, n° 17*
12. *Carr, D. Professionalism and Ethics in Teaching. New York, NY Routledge. 2000.*
13. *Galloux, JC, Industrial property law. Dalloz 2003.*
14. *Wagret F. and JM., Patent of invention, trademarks and industrial property. PUF 2001*
15. *Dekermadec, Y., Innovating through patents: a revolution with the internet. INSEP 1999*
16. *AEUTBM. The engineer at the heart of innovation. Belfort-Montbéliard University of Technology*
17. *Fanny Rinck etléda Mansour, literacy in the digital age: copying and pasting among students, University of Grenoble 3 and University of Paris-Ouest Nanterre la Défense Nanterre, France*
18. *Didier Duguest iemn, Cite your sources, IAE Nantes 2008*

19. *Similarity detection software: a solution to electronic plagiarism? Report of the Working Group on Electronic Plagiarism presented to the CREPUQ Subcommittee on Pedagogy and ICT*
20. *Emanuela Chiriac, Monique Filiatrault and André Régimbald, Student guide: intellectual integrity plagiarism, cheating and fraud… avoiding them and, above all, how to properly cite your sources, 2014.*
21. *Publication of the University of Montreal, Plagiarism prevention strategies, Integrity, fraud and plagiarism, 2010.*
22. *Pierrick Malissard, Intellectual property: origin and evolution, 2010.*
23. *The website of the World Intellectual Property Organizationwww.wipo.int*
24. *http://www.app.asso.fr/*

III - Detailed program by subject for the S3 semester

Semester: 3
Teaching unit: UET 2.1.1
Subject: Dam II

VHS: 45 hours (Class: 1h30, tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives

Dam developments are often complex and require multidisciplinary teams for their study, construction and operation. The objective is to have the basic tools for their design, production and operation.

Prior knowledge:

- Hydraulic works
- Hydrology
- Materials

Content of the material:

Chapter 1: Introduction to Concrete Dam (2 weeks)

1.1 Choice of site and type of concrete dam
1.2 Reminder of the main Preliminary Studies devoted to the concrete dam
1.3 Properties of concrete used in dams
1.4 Morphology of the different types of concrete dam
1.5 Statistics and evolution of concrete dams

Chapter 2: Weight dam (2 weeks)

2.1 Actions to which a gravity barrier is subject.
2.2 Study of overall stability
2.3 Study of internal stability
2.4 Study of a gravity dam on a loose foundation
2.5 Finite element and computer calculation
2.6 Gravity dam in RCC

Chapter 3: Vault Dam (2 weeks)

3.1 Design and type of arch dam
3.2 Stability calculation
3.3 Horizontal Arcs (Tube formula, Bresse formula, etc.)
3.4 Plunging arches and console arches (Trial Load Method)
3.5 Calculation with finite elements and finite differences

Chapter 4: Hollow gravity dams and buttress dams (2 weeks)

4.1 Hollow gravity dams
4.2 Buttress dams
4.3 Calculation of overall stability
4.4 Internal resistance
4.5 Constructive provisions

Chapter 5:Flood spillways and sizing criteria (2 weeks)

3.1 Role of spillways and flood lamination (Blackmore method, Kotcherine method, etc.)
3.2 Type of spillway

3.3 Hydraulic calculation of weirs
3.4 Input channel
3.5 Courier
.6 Damping basin
3.7 Energy dissipator
.8 Civil engineering of flood spillways.

Chapter 6:Intake and drainage works **(2 weeks)**

4.1 Type of water intake
4.2 Drain line
4.3 Resistance of intake and drain pipes to mechanical stress
4.4 Installation technique

Evaluation mode:

Continuous monitoring + examination

Bibliographic references:

1. *Jean Maurice Durand. Paul Royet and Patrice Meriaux (1999) - Technique of small dams in Sahelian and equatorial Africa - Edition Cemagref, 415 p*
2. *Ledelieu P. (2003) Dams design and maintenance. University Edition. From Lyon 35p.*
3. *George P. and Pierre L. (1953) - compacted earth dams - American practices. Edition Gauthier Villars, 193 p*
4. *Bellier J. (1982) Dams. Edition Press Universitaire de France -127 p*
5. *Anton JS and Henri P. (1911) – Dams, TCG- VOL.17. Published by the French-speaking polytechnic and university press. 738 pp.*
6. *Le Delliou, P. (2003). Dams: design and maintenance. Lyon University Press.*
7. *Rolley, R., H. Kreitmann, J. Dunglas, A. Pierrejean and L. Rolland (1977). Technique of dams in rural development. Ministry of Agriculture, Paris, France.*

Semester: 3
Teaching unit: UEF 2.1.1
Subject: Conventional and unconventional water treatment

VHS: 45 hours (Class: 1h30, tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

In this subject, the student will learn water treatment and liquid effluent purification techniques, the operating modes of biological reactors and the basics of sizing treatment and purification works to be able to simulate;

Recommended prior knowledge

- The basics of chemistry
- the fundamental notions of general hydraulics.

Content of the material:

PART 1: WATER TREATMENT.

Chapter 1: Properties of drinking water and potability standards (2 weeks)

1.1 Characteristics of natural waters
1.2 Drinking water quality standards.
1.3 Water uses and their requirements
1.4 Typical diagram of a water treatment plant

Chapter 2: Clarifying treatments (2 weeks

2.1 Coagulation – flocculation-decantation
2.2 Decantation
2.3 Filtration

Chapter 3: Finishing treatments (2 weeks)

3.1 Adsorption and ion exchange
    3.1.1 Adsorption
    3.1.2 Ion exchange
3.2 Water disinfection
3.3 Water softening by chemical precipitation
3.4 Removal of iron and manganese.

Chapter 4:Desalination of seawater and brackish water (2 weeks)

4.1 Reverse osmosis
4.2 Electrodialysis
4.3 Distillation and Evaporation
4.4 Solar distillation

PART 2: PURIFICATION

Chapter 5: Reminders of the basics of microbiology (1 weeks)

Chapter 6: Wastewater pollution parameters and discharge standards **(1 weeks)**

6.1 General information on wastewater pollution parameters
6.2 Assessment of flow rates and pollutant load of wastewater
6.3 Discharge standards

Chapter 7: Biological treatment of wastewater (2 weeks)

7.1 Fundamentals of biological purification
7.2 Biological purification with fixed biomass
7.3 Biological purification with free biomass (activated sludge processes)
7.4 Biological purification by lagooning

Chapter 8: Complementary biological treatments (2 weeks)

8.1 Nitrification-denitrification reactors of wastewater.
8.2 Biological elimination of phosphorus in wastewater treatment plants.

Evaluation mode:

Written exam + continuous assessment

Bibliographic references:

1. *Edeline F., Biological water purification: Theory and technology of reactors, Ed. Cebedoc, Liège, 1993, 298 p.*
2. *Gaid A., Biological purification of urban wastewater, Volume 1, Ed. OPU, Algiers, 1984, 261 p.*
3. *Gaid A., Biological purification of urban wastewater, Volume 2, Ed. OPU, Algiers, 1984, 234 p.*
4. *Gomella C. and Guerree H., Wastewater in urban or rural areas, Volume 2: Treatment, Ed. Eyrolles, 1982, Paris, 260 p.*
5. *Anonymous, Technical handbook on water (Volume 1 and 2), Ed. Degremont-Suez, 10th Edition, 2005, 1904 p.*

Semester: 3
Teaching unit: UEF 2.1.1
Subject: Auscultation and monitoring of dams

VHS: 10:30 p.m. (Class: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

This course allows students to acquire necessary knowledge in the field of dam monitoring, which presents important issues in terms of public safety. In this subject, students will become familiar with the procedures for monitoring and controlling mobilization works.

Prior knowledge:

- Hydraulic works
- Hydrology
- Geotech

Content of the material:

Chapter 1: Dam aging mechanisms. (2 weeks)

1.1 Aging mechanisms of the dam body
1.2 Aging mechanisms of dam foundations

Chapter 2 :General principles of dam monitoring. (2 weeks)

2.1 Identification of failure modes
2.2 Objectives of dam monitoring
2.3 Principles of dam monitoring

Chapter 3:Monitoring of dams (3 weeks)

3.1 Principles and frequencies of visual inspection
3.2 Choice of auscultation profiles
3.3 Choice of auscultation devices
3.4 Instruments and means of measurement
3.5 Significant and evolving parameters of dams
    3.5.1 Settlements and deformations
    3.5.2 Pore pressures and piezometric levels
    3.5.3 Under pressure
    3.5.4 Leakage and drainage flow

Chapter 4:Behavioral parameter measurements 3 weeks)

4.1 Mechanical parameters
4.2 Hydraulic parameters
4.3 Stress measurements
4.4 Program and frequency of measurements
4.5 Interpretation of measurements

Chapter 5: Monitoring the surroundings near and far from dams (4 weeks)

5.1 Scour at the downstream foot of the dam
5.2 Resurgences downstream
5.3 Survey of the water table
5.4 Sediments in the reservoir

5.5 Rockfalls
5.6 Areas of unstable terrain
5.7 Avalanches
5.8 Glaciers

Evaluation mode:

100% review

Bibliographic references:

Semester: 3
Teaching unit: UEF 2.1.2
Subject: Development of waterways and solid transport
VHS: 45h00 (Class: 1h30, tutorial: 1h30)

Credits: 4
Coefficient: 2

Teaching objectives:

The Objective of teaching this subject is to enable students to acquire knowledge on the phenomena of erosion and solid transport, an important problem affecting watersheds and causing siltation of dams.

Recommended prior knowledge:

- Basis on geology
- Basics of watershed hydrology

Content of the material:

Chapter 1: Modes of transportation (1 Weeks)

Chapter 2: Solid load measurement technique (2 weeks)

Chapter 3: Transport formulas and quantification of solid inputs (gauged and ungauged rivers). (3 weeks)

Chapter 4: Physical and ecological role of the watercourse (2 weeks)

Chapter 5: Different types/techniques of bank reinforcement torrential correction (3 weeks)

Chapter 6: Land development and fight against water erosion (2 weeks)

Chapter 7: Overview of the impact of developments on the environment (2 weeks)

Evaluation mode:

Continue + review

Bibliographic references:

1. *Jean-Paul Duroudie, Solid transport ed: Process engineering 2017.*
2. *Cemagref Collective; Erosion and solid transport in rivers. 1, ed: Cemagraf 2000*

Semester: 3
Teaching unit: UEF 2.1.2
Subject: Rural engineering
VHS: 45h30 (Class: 1h30, tutorial: 1h30)

Credits: 4
Coefficient: 2

Teaching objectives

The objective of this subject is to show the tasks and role of a specialist in rural engineering, relating to all these interventions in rural areas, this subject is introduced in this master's degree following the department's perspective of offering a master's degree in this direction.

Recommended prior knowledge

- The basics of water resources.
- The basics on water mobilization and production works.

Content of the material:

Chapter 1: Introduction. (1 week)

Chapter 2: Construction in rural areas. (2Week)

Chapter 3: Drinking water supply in rural areas. (2Weeks)

Chapter 4: Sanitation in rural areas. (2 SECweeks)

Chapter 5: Watershed development. (2 Sweeks)

Chapter 6: Concept on irrigation. (1 Semaine)

Chapter 7: Rural electrification. (2 Sweeks)

Chapter 8: Agricultural machinery. (2 Sweeks)

Evaluation mode:

Exams + Continuous monitoring

Bibliographic references:

1. *Baume, J.-P., Belaud, G., & Vion, P.-Y. (2013). Hydraulics for rural engineering (UMR Ges; LUG de L'Eau, Ed.). Retrieved from https://hydraulique.g-eau.fr/-Hydraulique-pour-le-genie-rural-*
2. *Cherif, R. (2014). Traditional techniques for capturing and sharing irrigation water in the Béni Ounif Oasis (Bechar Region, South-West, Algeria). Five Continents, 8(9), 16–25.*
3. *Rivas, Y., Rivera, D., Gallardo, R., Lagos, E., Yevenes, M., Zambrano, F., & Mendoza, J. (2020). Water availability, quality, and use in rural communities of the Chilean Coastal Range. Journal of Soil and Water Conservation, 75(1), 75–90. https://doi.org/10.2489/jswc.75.1.75*

Semester: 3
Teaching unit: UEM 2.1
Subject: Specialized software
VHS: 37h30 (TP: 2h30)
Credits: 3

Coefficient: 2

Teaching objectives:

This subject will aim to enable the student to master hydrological modeling software as well as the realization of a measurement campaign for the calibration and validation of the modeling results.

Recommended prior knowledge:

The student must have knowledge in fundamental subjects, namely mathematics, flows, hydrology and computer science.

Content of the material:

Chapter 1: Modeling: Concepts, Approaches (2 weeks)

Chapter 2: Objectives of modeling hydrological phenomena. (2 weeks)

Chapter 3: Definition of a hydrological model (2 weeks)

Chapter 4: The different types of models (2 weeks)

Chapter 5: The main stages of modeling (2 weeks)

Chapter 6: Presentation of modeling software used (2 weeks)

Chapter 7: Construction of the physical model of the network (2 weeks)

Chapter 8: The measurement campaign and model calibration (2 weeks)

Chapter 9: Coupling between GIS and different hydrological models (2 weeks)

Evaluation mode:

Continuous control: 100%.

Bibliographic references:

1. *Blain, W. R. (2000). Hydraulic Engineering Software VIII (Wessex Ins). Retrieved from https://www.witpress.com/books/978-1-85312-814-1*
2. *Hager, WH, Schleiss, A., Boes, RM, & Pfister, M. (Michael U. . (2021). Hydraulic engineering of dams (Taylor & F).*
3. *Tanguy, J.-M. (2010). Treatise on environmental hydraulics. Water cycle engineering software (Hermes Sci; HS Publications, ed.). Retrieved from Walski, TM, & Meadows, ME (1999). Computer Applications in Hydraulic Engineering (Haestad Me). Haestad Press.*

Semester: 2
Teaching unit: UEM 2.1
Material: TP Water treatment
VHS:10:30 p.m.(TP: 1h30)
Credits: 2

Coefficient: 1

Teaching objectives

The objectives assigned by this subject concern the initiation of students to put into practice the theoretical knowledge acquired in the water treatment and purification courses.The student will be able to use benchtop measuring devices as well as pilots intended to carry out studies on water treatment and purification.

Recommended prior knowledge

Water chemistry, water biology, water treatment, water purification.

Content of the material:

TP01: Sampling and characterization of water. (3 weeks)

Determination of: Temperature, pH, TA, TAC, THCa, THMg, TH., Turbidity, MES, MM, MO, Dissolved oxygen, BOD5, COD. And Dosage of Iron, NO3, of PO4, and Chlorides,

TP 02: Coagulation – flocculation test. (2 weeks)

2.1 Determination of the optimal dose
2.2 Determination of optimal rapid agitation (degree and time)
2.3 Determination of optimal slow agitation (degree and time)
2.4 Determination of the optimal settling time
2.5 Determination of the best coagulant, flocculant, adjuvant
2.6 Elimination by flocculation of pollution: metallic, organic, mineral

TP 03: Decantation test. (2 weeks)

3.1 Decantation test for discrete particles (grained decantation)
3.2 Flaky decantation test
3.3 Piston settling test (Tracing of the Kynch curve)

TP 04: Filtration and adsorption test. (2 weeks)

4.1 Sand filtration (single-layer, two-layer): Filter performance, Tracing of
The variation of the pressure loss, depending on the thickness of the filter, puncture of the filter
4.2 Filtration and adsorption on carbon, biolite, bentonite, kaolinite, etc.

TP 05: Disinfection test. (2 weeks)

5.1 Disinfection by chlorine: Break point test (chlorine demand)
5.2 Water discoloration test
5.3 Disinfection test with chlorine dioxide, ozone, UV

TP 06: Testing on pilots and simulation with software. (3 weeks)

Coagulation flocculation pilot, Decantation pilot, Filtration pilot…etc.

Evaluation mode:

Continuous control: 100%.

Bibliographic references:

1. *Masschelein WJ, Unitary processes of water treatment, Ed CEBEDOC 1996, 493p*
2. *Anonymous, Technical guide to water (Volume 1 and 2), Ed. Degremont-Suez, 10th edition, 2005, 1904 p.*
3. *Raymond Desjardins, Water Treatment, Ed. Ecole Polytechnique de Montréal, 1997, 303 p.*
4. *Alain Maurel, Desalination of sea water and brackish water, And other unconventional processes for supplying fresh water EDTec et Doc - Lavoisier, 2001, 226p*
5. *Mohand Said OUALI, Biological unit processes and water treatment, ED OPU, 156p*
6. *Marcel Doré, Chemistry of Oxidants and water treatment, Ed TEC et Doc, 1998, 505p*
7. *Claud, Cardot, Water treatments, physico-chemical and biological processes, courses and solved problems, Ed. Ellipses, 2002, 252p*

Semester: 3
Teaching unit: UEM 2.1
Subject: Integrated management of water resources
VHS: 45 hours (Class: 1h30, tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives

Teach the student the strategies of the concept of sustainable development, the principles of integrated management of water resources according to demand and other technical, socio-economic and environmental constraints. In addition, he will be able to describe and know how to use the principles and methods of choice and optimization for sustainable management of water resources.

Recommended prior knowledge

The student must first know:

- The basics of water resources.
- The basics on water mobilization and production works.

Content of the subject:

Chapter 1: Sustainable development (3 weeks)

Chapter 2: Sustainable development strategies (2 weeks)

Chapter 3: Integrated water resources management (3 weeks)

Chapter 4: Implementation of integrated water resources management (4 weeks)

Evaluation method:

Exams + Continuous monitoring

Bibliographic references:

Semester: 3
Teaching unit: UEM 2.1
Subject: Project management
VHS: 10:30 p.m. (Class: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

The objective of this course is to initiatethe student in the fundamental and modern bases of project management

Recommended prior knowledge

The course does not require any specific prior knowledge.

Content of the subject:

Chapter 1: Introduction to project management. **(1 week)**

Chapter 2: History of project management. **(1 week)**

Chapter 3: Modern project management. Systematic approach **(1 week)**

Chapter 4: Managerial functions. **(1 week)**

Chapter 5: Define the project. The wbs **(1 week)**

Chapter 6: Estimated duration and costs of the project. **(1 week)**

Chapter 7: Planning and programming in projects. **(2 weeks)**

Chapter 8: Human resources. **(2 weeks)**

Chapter 9: Motivation. **(1 week)**

Chapter 10: The decision. **(1 week)**

Chapter 11: Leadership and leaders **(1 week)**

.

Evaluation method:

100% review

Bibliographic references:

1. *Jack R. Meredith and Sanuel J. Mantel, Project Management: A Managerial Approach, 5th Edition, ,Jr.,Wiley, 2006.*
2. *James A. F. Stoner, "Management," 3rd Edition. Prentice Hall*
3. *Chase, Aquilano and Jacobs, "Production and Operations Management" Irwin-McGraw Hill. 8th edition*
4. *Ray H. Garrison and Eric W. Noreen, "Managerial Accounting" 7th, Edition ERWIN*
5. *Project Management: A systems Approach to planning, Scheduling, and Controlling, 2003*
6. *E. Wendy Trachte-Huber & S. K Huber. "Alternative Dispute Resolution: Strategies for Law and Business." Edition Anderson*
7. *C. Hendrickson "Project Management for Construction", book to download free from the site: http//www.ce.cmu.edu/~cth/pmbook/*
8. *Lasary "Business management", Self-printed work, ISBN: 9947-0-1395-2, 2006*

9. *Clifford F. Gray and Erik W. Larson "Project management: the management process", McGraw hill, second edition, 2003*

Semester: 3
Teaching unit: UED 2.1
Matter :Material of your choice
VHS: 10:30 p.m. (class: 1h30)
Credits: 1
Coefficient: 1

Semester: 3
Teaching unit: UED 2.1
Subject 2: ICT concepts or other subject of your choice
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Recommended prior knowledge:

- Computer basics
- General information on information and communication technologies

Content of the subject:

Chapter 1: Internet and the Web: Definitions and historyChapter 2: Principles of the InternetChapter 3: Main Internet services Chapter 4: Introduction to HTML

Evaluation method: Review: 100%

Bibliographic references:

1. *Council, N.R. (2012). Water reuse: Potential for expanding the nation's water supply through reuse of municipal wastewater. In The National Academies Press. https://doi.org/10.17226/13303*
2. *De Marsily, G. (2008). Water, climate change, food and demographic change. Revue Des Sciences de l'Eau, 21(2), 111–128. https://doi.org/10.7202/018460AR*
3. *Hunter, PR, MacDonald, AM, & Carter, RC (2010). Water Supply and Health. PLoS Medicine, 7(11), e1000361. https://doi.org/10.1371/journal.pmed.1000361*
4. *Saleth, R. M. (2002). Water resources and economic development. Retrieved from https://cgspace.cgiar.org/handle/10568/36608*
5. *Voulvoulis, N. (2018, April 1). Water reuse from a circular economy perspective and potential risks from an unregulated approach. Current Opinion in Environmental Science and Health, Vol. 2, pp. 32–45. https://doi.org/10.1016/j.coesh.2018.01.005*

Semester: 3
Teaching unit: UET 2.1
Subject 1: Documentary research and memory design
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:
Give the student the necessary tools to search for useful information to better use it in their end-of-study project.Help them go through the different stages leading to the writing of a

scientific document. Tell himthe importance of communication and itlearn to present the work carried out in a rigorous and educational manner.

Recommended prior knowledge:

- Writing methodology
- Presentation methodology.

Content of the subject:

Part I-: DOCUMENTARY RESEARCH:

Chapter 1: Definition of the subject (02 Weeks)

1.1 Title of the subject
1.2 List of key words relating to the subject
1.3 Gather basic information (acquisition of specialized vocabulary, meaning of terms, linguistic definition)
1.4 The information sought
1.5 Take stock of your knowledge in the field

Chapter 2: Selecting information sources (02 Weeks)

2.1 Type of documents (Books, Theses, Memoirs, Periodical articles, Conference proceedings, Audiovisual documents, etc.)
2.2 Type of resources (Libraries, Internet, etc.)
2.3Evaluate the quality and relevance of information sources

Chapter 3: Locate documents (01 Week)

3.1 Research techniques
3.2 Search operators

Chapter 4: Processing information (02 Weeks)

4.1 Work organization
4.2 Initial questions
4.3 Summary of documents retained
4.4 Links between different parties
4.5 Final plan for the documentary research

Chapter 5: Presentation of the bibliography (01 Week)

5.1 Systems for presenting a bibliography (The Harvard system, The 5.2 Vancouver system, The mixed system, etc.)
5.3 Presentation of documents.
5.4 Citation of sources

Part II: MEMORY DESIGN

Chapter 6: Plan and stages of the dissertation (02 Weeks)

6.1 Identify and delimit the subject (Summary)
6.2 Problem and objectives of the dissertation

6.3 Other useful sections (Acknowledgments, Table of abbreviations, etc.)
6.4 The introduction (Writing the introduction last)
6.5 State of the specialized literature
6.6 Formulation of hypotheses
6.7 Methodology
6.8 Results
6.9 Discussion
9.10 Recommendations
6.11 Conclusion and outlook
6.12 Table of contents
6.13 The bibliography
6.14 Appendices

Chapter 7: Writing Techniques and Standards **(02 Weeks)**

7.1 Formatting. Numbering of chapters, figures and tables.
7.2 The cover page
7.3 Typography and punctuation
7.4 Writing. Scientific language: style, grammar, syntax.
7.5 Spelling. Improved general language skills in terms of comprehension and expression.
7.8 Back up, secure, archive your data.

Chapter 8: Workshop: critical study of a manuscript **(01 Week)**

Chapter 9: Oral presentations and defenses **(01 Week)**

9.1 How to present a Poster
9.2 How to present an oral communication.
9.3 Defense of a dissertation

Chapter 10: How to Avoid Plagiarism? **(01 Week)**

(Formulas, sentences, illustrations, graphs, data, statistics,...)
10.1 The quote
10.2 Paraphrasing
10.3 Indicate the complete bibliographic reference

Evaluation method:

Review: 100%

Bibliographic references:

1. *M. Griselin et al., Guide to written communication, 2nd edition, Dunod, 1999.*
2. *JL Lebrun, Practical guide to scientific writing: how to write for the international scientific reader, Les Ulis, EDP Sciences, 2007.*
3. *HAS.Mallender Tanner, ABC of technical writing: instructions for use, user manuals, online help, Dunod, 2002.*
4. *M. Greuter, Write your dissertation or internship report well, L'Etudiant, 2007.*