PEOPLE'S DEMOCRATIC REPUBLIC OF ALGERIA

MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH

CENTER OF EXCELLENCE
"WATER TREATMENT AND REUSE (WTR)"

Training Path: **STATE ENGINEERING DEGREE**

1. Member Institutions of the Center of Excellence:

- **USTHB**
- **USDB-1**
- **U. BOUMERDES**
- **ENSH**
- **UDES**
- **ENSSMAL**

2. Host Institution: ENSSMAL

Domain	Field
SCIENCE and TECHNOLOGIE (ST)	PROCESS ENGINEERING

Academic Year : 2023/2024

REPUBLIQUEALGERIENNEDEMOCRATIQUE ETPOPULAIRE

MINISTERE DE L'ENSEIGNEMENT SUPERIEURETDELA RECHERCHE SCIENTIFIQUE

POLE D'EXCELLENCE

« TRAITEMENT ET REUTILISATION DES EAUX USEES (TREU) »

Parcours de formation : INGENIORAT D'ETAT

3. Etablissements membres du pôle d'excellence :
- **USTHB**
- **USDB-1**
- **U. BOUMERDES**
- **ENSH**
- **UDES**
- **ENSSMAL**

4. Etablissement hébergeant le pôle : ENSSMAL

Domaine	Filière
SCIENCES ET TECHNOLOGIE (ST)	GENIE DES PROCEDES

Academic Year : 2023/2024

الجمهورية الجزائرية الديمقراطية الشعبية
وزارة التعليم العالي والبحث العلمي

قطب امتياز
معالجة المياه المستعملة وإعادة استخدامها

عرض تكوين: مهندس دولة

1- مؤسسات أعضاء القطب :	جامعة هواري بومدين للعلوم و التكنولوجيا جامعة سعد دحلب 1 جامعة بومرداس المدرسة الوطنية العليا للري الوحدة التنمية الأجهزة الشمسية المدرسة الوطنية العليا لعلوم البحر وتهيئة الساحل
2- مؤسسة استضافة :	المدرسة الوطنية العليا لعلوم البحر و تهيئة الساحل

الميدان	الشعبة
علوم وتكنولوجيا	**هندسة الطرائق**

السنة الجامعية: 2023-2024

Summary

I – Identity Sheet

1 **- Location of the Program :**

1. **Host Institution:** National Higher School of Marine Sciences and Coastal Management (ENSSMAL)
2. **Excellence Hub Institutions:**
   - USTHB (University of Science and Technology Houari Boumediene)
   - University of Blida-1
   - University of Boumerdes
   - ENSH (National Higher School of Hydrology)
   - UDES, Bousmail (The Solar Equipments Development Unit)

2 – Coordinators

Project Head of the Excellence Hub "Wastewater Treatment and Reuse":

Name: AOUABED ALI

Rank: Professor

Tel/Fax: +213 555 792 400

Email: aouabed@hotmail.com

3- Program Partners *:

National Partners:

Higher Education Institutions:

1. University of Science and Technology Houari Boumediene (USTHB, Algiers): Faculty of Earth Sciences, Geography, and Land Use Planning, Faculty of Biological Sciences.
2. University of Annaba: Department of Marine Sciences
3. University of Mostaganem: Department of Marine Sciences
4. University of Bejaia
5. National Higher School of Hydrology (Blida)
6. National Polytechnic School of Algiers: Department of Civil Engineering and Department of Hydraulics.

Enterprises and Socioeconomic Partners:

Institution	Field of Activity	Nature and Terms of Collaboration
LEM Maritime Study Laboratory	Coastal Engineering	Framework Agreement
GITRAMA	Maritime Works	Framework Agreement
General Directorate of Environment	Marine Environment	Framework Agreement
National Coastal Commission	Coastal Management/Surveillance	Framework Agreement
Algerian Space Agency (ASL)	Cartography/Remote Sensing	Framework Agreement
CNRDPA (Bou-Ismaïl)	Fisheries and Aquaculture	Framework Agreement
CNRDB (Algiers)	Maritime Transport	Framework Agreement
Seawater Desalination Plant	Seawater Desalination	Framework Agreement

International Partners :

- **Istanbul University** (Turkey)
- **Ankara University** (Turkey)
- **Akdeniz University** (Antalya, Turkey)
- **International University of the Sea** (France)
- **Nouakchott Al Aasriya University** (Mauritania)

4 – Context and Objectives of the Program

A – Admission Requirements

Admission to the Wastewater Treatment and Reuse Engineering program is granted to students from preparatory classes in the fields of Science and Technology or Natural and Life Sciences..

B- Program Objectives

The Wastewater Treatment and Reuse Engineering (WTR) specialization aims to adapt and strengthen national competencies in the utilization of non-conventional water resources and water science and technology. The program seeks to equip the country with skilled professionals capable of bolstering national resilience amid water stress and climate change, while promoting the sustainable use and management of water resources.

The WTR program is interdisciplinary and integrative, encompassing multiple scientific disciplines. It directly aligns with the national strategy for sustainable natural resource management and commitments under the Sustainable Development Goals (SDGs).

This program also strives to modernize and adapt university education by incorporating innovation and artificial intelligence—indispensable tools in modern societies—to optimize resource management.

Furthermore, the WTR Engineering program endeavors to reintegrate Algerian universities into the core of societal concerns and vital needs, such as water security.

Upon completion, WTRE graduates will possess a comprehensive education that integrates theoretical knowledge with hands-on laboratory training and professional immersion, ensuring coherence between academic content and professional application.

The curriculum is structured around:

1. **Core Technical Competencies**: Foundational scientific skills central to WTRE engineering.
2. **Management and Communication**: Training in project management, leadership, and "soft skills" essential for professional success.

The program employs diverse pedagogical tools, including:

- Experimental Workshops
- Technical Halls
- Field Visits
- Internships in Specialized Firms
- Virtual Collaborations
- Conference Series and Workshops
- Individual Research Projects
- Mini-Projects

C – Target Profiles and Skills

Key Attributes: Versatility | Expertise | Modernity | Responsiveness | Interactivity | Adaptability

L Upon completion of the program, the wastewater treatment and reuse engineer will be equipped to::

1) Maitriser les process et les filières de traitement des eaux, de leur réutilisation et valorisation
2) Ensure the quality of water produced by treatment plants.
3) Design comprehensive plans for the treatment and valorization of recycled wastewater.
4) Understand the legal and institutional frameworks governing wastewater treatment and reuse, including standards for treated water quality, health regulations, and environmental requirements for receiving ecosystems.
5) Develop monitoring dashboards with quantitative targets and indicators for wastewater management, treatment, and the quality of receiving environments.
6) Manage funding and operational costs of wastewater treatment facilities, including strategies for reuse and financial oversight.
7) Assess health and environmental impacts of treated wastewater utilization.
8) Implement local development plans with tailored monitoring dashboards for treated wastewater (TWW) projects.
9) Apply numerical analysis tools and water resource modeling techniques.
10) Advocate for the promotion of treated wastewater reuse through evidence-based communication.
11) Utilize mapping tools and Geographic Information Systems (GIS), including water-related databases.
12) Implement Environmental & Safety Quality Systems in compliance with industry standards.

The wastewater treatment and reuse engineer will possess a **versatile skill set**, combining technical expertise in water engineering with competencies in management and planning. This includes the ability to:

- Conduct diagnostics within their field of specialization.
- Propose **technical, technological, or governance solutions** to optimize the use of treated wastewater as a **non-conventional resource**.

D– Regional and National Employment Prospects for Graduates

REGIONAL AND NATIONAL EMPLOYMENT PROSPECTS (SOCIO-ECONOMIC PARTNERS OF THE PROGRAM)			
Enterprises	**Ministries and Local Authorities**	**Technical Entities**	**Direct Scientific Partners**
▪ Wastewater treatment plants ▪ SEAL ▪ Seawater desalination plants ▪ SONATRACH ▪ Thermal power plants ▪ Industrial enterprises ▪ Cement plants ▪ Soft drink manufacturers ▪ Naftal ▪ Sonelgaz ▪ Cevital ▪ COSIDER ▪ Agrifood enterprises ▪ Banks ▪ Insurance companies	▪ Water Resources ▪ Higher Education and Scientific Research ▪ Industry ▪ Energy ▪ Pharmaceutical industry ▪ Startups ▪ Environment ▪ Agriculture ▪ Commerce ▪ Health ▪ Tourism ▪ Finance ▪ Education ▪ Vocational Training ▪ Wilayas (administrative regions) ▪ Municipalities	▪ National Sanitation Office (ONA) ▪ Algerian Water Company (ADE) ▪ National Water Resources Agency (ANRH) ▪ National Observatory for Environment and Sustainable Development (ONEDD) ▪ National Center for Environmental Training (CNFE) ▪ National Irrigation Office ▪ National Climate Change Agency (ANCC) ▪ Directorate General of Forests (DGF) ▪ Directorate General of Civil Protection ▪ National Center for Clean Production Technologies (CNTPP) ▪ ANAD, ANDI	▪ National Higher School of Marine Sciences and Coastal Management (ENSSMAL) ▪ National Higher School of Horticulture (ENSH) ▪ University of Blida ▪ University of Boumerdès ▪ University of Science and Technology Houari Boumediene (USTHB) **Other Laboratories:** ▪ National Gendarmerie's Criminology Laboratory (MDN) ▪ Scientific Laboratory of the Directorate General of National Security (DGSN)

E – Bridges to other specialties

The WTR Engineering Program establishes academic pathways with other specializations, such as Environmental Engineering, Process Engineering, Water Technologies, and related fields.

During their academic journey, WTR engineering students may submit a request to transfer to another university program within the same specialization. This process considers their accumulated credits, outstanding coursework yet to be completed, and the supervision capacity of the host institution.

F – Program Monitoring Indicators

Pedagogy and Attractiveness of the Center of Excellence	▪ Admission rate to the program ▪ Dropout percentage ▪ Absenteeism rate ▪ Pass rate by academic distinction ▪ Annual student success rate ▪ Graduation rate (number of degrees awarded relative to enrollments)
Academic Supervision	▪ Supervision rate by faculty within the Center of Excellence ▪ Supervision rate by external faculty ▪ Supervision rate by industry professionals
Professional Immersion	▪ Internship completion rate in industry settings ▪ Number of industry partnerships ▪ Supervision rate by industry professionals ▪ Number of professional projects completed ▪ Number of professionally oriented Final Year Projects (FYP) defended ▪ Patents filed ▪ Start-ups launched
Post-Graduation Employment (Engineering Degree Holders)	▪ Number and percentage of Center of Excellence graduates employed in the professional sector of wastewater treatment ▪ Number and percentage of Center of Excellence graduates employed in the professional sector of Reuse of Treated Wastewater (RTW) ▪ Number and percentage of Center of Excellence graduates employed in the professional sector of water resources management ▪ Number and percentage of Center of Excellence graduates employed in professional sectors outside water resources

G – Supervision capacity

120 students per year.

4- Available Human Resources

A : Faculty Members involved in the Specialization

Last Name, First Name	Postgraduate Degree + Specialization	Academic Rank	Teaching Modality	Signature
Mezouar Khoudir	Ph.D., Coastal Engineering	Professor	Lectures	
HADDAD Zoubida	Ph.D., Physics	Professor	Lectures	
DAHMANI Nacera	Ph.D., Process Engineering	Professor	Lectures	
Grimes Samir	Ph.D., Marine Ecology	Professor	Lectures	
Driche Mohamed	Ph.D., Environmental Engineering	Associate Professor	Lectures, Problem Sets, Labs	
CHARIFI Salima	Ph.D., Hydraulics	Associate Professor	Lectures, Problem Sets, Labs	
Ghazi Malika	Ph.D., Environmental Geochemistry	Associate Professor	Lectures, Problem Sets, Labs	
Mokrane Zakia	Ph.D., Marine Biology	Associate Professor	Lectures, Problem Sets, Labs	
GHEZALI Katia	Ph.D., Process Engineering	Assistant Professor	Lectures, Problem Sets, Labs	
KHELASSI Amina	Ph.D., Environmental Engineering	Assistant Professor	Lectures, Problem Sets, Labs	
BOUKHAROUBA Aya	Ph.D., Microbiology	Assistant Professor	Lectures, Problem Sets, Labs	
Aït Aissa Djamila	Ph.D., English Language and Interpretation	Assistant Professor	Lectures, Problem Sets, Labs	

BOUBCHICHE Zakia	Ph.D.,	Assistant Professor	Lectures, Problem Sets, Labs	
Boumaour Amina	Ph.D., Management	Assistant Professor	Lectures, Problem Sets, Labs	
Djahnit Nora	Ph.D., Marine Environmental Science	Assistant Professor	Lectures, Problem Sets, Labs	
Keraghel Mehdia Asma	Ph.D., Marine Sciences	Assistant Professor	Lectures, Problem Sets, Labs	
ATTIA Nourhane	Ph.D., Mathematics	Assistant Professor	Lectures, Problem Sets, Labs	
BENTEBBA Aicha	Magister, Process Engineering	Lecturer	Lectures, Problem Sets, Labs	
Amrouche Lynda	Magister, Food Technology and Nutrition	Lecturer	Lectures, Problem Sets, Labs	
Bentchikou Latifa	Magister, Chemical and Environmental Processes	Lecturer	Lectures, Problem Sets, Labs	
Boughrira Abdelhak	Magister, Marine Sciences	Lecturer	Lectures, Problem Sets, Labs	
Firad Benyahia	Magister, environement	Lecturer	Lectures, Problem Sets, Labs	
Kada Mohamed	Magister, Marine Sciences	Lecturer	Lectures, Problem Sets, Labs	
Zerrouki Mohamed	Magister, Marine Environmental Science	Lecturer	Lectures, Problem Sets, Labs	
CHAOU Nadia	Magister, Biochemistry	Lecturer	Lectures, Problem Sets, Labs	
MERRAD Anissa	Magister, Chemistry	Lecturer	Lectures, Problem Sets, Labs	

b- External supervisors:

Last Name, First Name	Degree / Specialization	Academic Rank	Teaching Modality	Etablissement de rattachement
SALEM Zineb	Ph.D. in Environmental Engineering	Pr	Teaching, Supervision	USTHB
AOUABED Ali	Ph.D. in Environmental Engineering	Pr	Teaching, Supervision	U.Blida-1
IGOUD Sadek	Ph.D. in Renewable Energy	Research Director	Teaching, Supervision	UDES
ASNAM Amira	Ph.D. in Environmental Engineering	Assoc. Prof.	Teaching, Lab, Supervision	U.Blida-1
TASSALIT Djilali	Ph.D. in Process Engineering	Research Director	Teaching, Supervision	UDES
HACHEMI Abdelkader	Ph.D. in Hydraulics	Assoc. Prof.	Teaching, Supervision	ENSH
ABDELSSSAMED Djamel	Ph.D. in Environmental Engineering	Pr	Teaching, Supervision	USTHB

5 – Specific Material Resources Available

A- Pedagogical Laboratories and Equipment

Inventory of existing pedagogical equipment for Lab sessions (one sheet per laboratory)

List of scientific equipment for measurement, analysis, and physico-chemical/biological testing required for Laboratory sessions, experiments, and trials available at the ENSSMAL technical facility.

This list includes all laboratories and equipment available at:

- **Laboratories and technical facilities of institutions** designated by the MESRS (Ministry of Higher Education and Scientific Research) under the Excellence Hub to deliver the *Wastewater Treatment and Reuse Engineering* program.
- **Technical and scientific facilities of non-academic partners** and wastewater treatment/reuse infrastructures.

Laboratory Equipment: "Analytical Methods"

Equipment Description	Quantity
Atomic Absorption Spectrometer (AAS) – Perkin Elmer PinAAcle 900H	1
High-Performance Liquid Chromatograph (HPLC) – Perkin Elmer Altus A-10	1
Ion Chromatograph – Shimadzu	1
Gas Chromatograph – Shimadzu	1
Water Circulation Chiller – LAUDA MC600	1
Freeze Dryer (4 trays, 250mm diameter) with Vacuum Pump	1
Hydrogen Generator – HyGen 600	1
Nitrogen/Air Combined Generator – NitroAir	1
Water Distillation Unit (Pure Water)	1
Drying Oven (Binder)	1
Chemical Fume Hood	1

Laboratory Equipment: Chemistry-Physics

Description	Type	Quantity	Brand
Heated Magnetic Stirrer	CB162	2	STUART
Acid/Base Storage Cabinet		1	
Precision Balance	ABS 220-4N	1	KERN
Magnetic Stir Bars		8	
Single-Port Flask Heater	655	1	NAHITA
COD Analyzer	6 POSTES -	1	FICHER
COD Analyzer	6 POSTES-(ECO6)	1	VELP SCIENTIFICA
Desiccator		1	
Distillation Unit	PURANITY TU 6	1	VWR
Drying Oven	UN55	1	MEMMERT
Fume Hood	SPL	1	ASEM
Gaz Mask		1	
Mixer	RW20.N	1	KIKA
Porcelain Mortar	EN PORCELAINE	5	
Metal Clamp		2	
Heating Plate	HB110	1	LHG
Vacuum Pump	NO26.1.2AN.18	1	KNF
Propipette 20ml, 25 ml		10	
Refrigerator	HS-208F	1	MIDEA
Spectrophotometer	2120UV	1	OPTIZEN
Mercury thermometer		4	
Ultrason	2510	1	BRANSON

Laboratory Equipment: Chemistry - Pollution

Description	Type	Quantity
Decanting bulb agitator	06 POSTES AGITLEC	1
Kern Balance	KERN	1
Sigma centrifuge	SIGMA	1
Heating mantle	MONO 'NAHITA'	1
Heating mantle	3 POSTES 'BI'	1
Heating mantle	BI 03 POSTES	1
Heating mantle	NAHITA MONO	1
Conductivity meter	HANNA INSTRUMENTS EC214	3
Conductivity meter	DE PALLAISSE WTW INOLAB	1
Benchtop conductivity meter	WTW INOLAB	1
Conductivity meter Hanna	HANNA	2
Crucible with lid	PORCELAINE	12
Desiccator		1
Distillation Unit with one 6-position heating mantle	WISETHERME	1
Drying oven Memmert UM600		
Flame photometer	JENWAY	1
Muffle furnace	FH05080318001	1
Wise Therm Muffle furnace	WISE THERM	1
bio-Control Micropipettes 100-1000µl	BIO CONTROL	3
bio-Control Micropipettes 5-50µl	BIO CONTROL	3
Benchtop oxygen meter	WTW INOLAB	1
pH meter Hanna	HANNA	1
Tongs		5
GM hot plate	CHAUFFANTE	1
Fisher magnetic hot plate	MAGNETIQUE	1
KIKAmagwerke magnetic hot plate	MAGNETIQUE	1
Stuart magnetic hot plate	MAGNETIQUE c	2
vacuum pump KnFNeubergerPmax	NO 22AN18	
Test tube racks	EN INOX	4
Filtration station with collection tank	NALGENE	1
Pipette fillers	POBEL DE 25ML	1
Pipette fillers	POBEL DE 10ML	6
3-position filtration rack	INOX 03 POSTES	1
Plastic filtration rack	EN PLASTIQUE	1
DCO Reactor 06 positions	VELP SCIENTIFICA	1
Refrigerator condor RDC 450		1
Spatulas	EN INOX	6
Laboratory spectrophotometer with accessories		1
UV-Vis spectrophotometer	SHIMADZU	1
Metal-based retort stand for benchtop use	EN METAL	2
Digital thermometer	HANNA	1
Benchtop turbidimeter	HANNA	1
Vortex Top Mix	FISHER	1

Laboratory Equipment Biology 1

Description	Type	Quantity
Histological needle	POINTU	9
Histological needle	FLECHE	8
Aiguille histologique	60°	6
Trays	INOX	6
Trays	PLASTIQUE	4
Arm scalpel holder	INOX	11
Scissors	10	12
Freezer	WHIRLPOOL	1
Freezer		1
Cart	INOX	1
Microscope slides		100
Eyepiece lens		31
Graduated microscope lens		18
Bleu Lens		21
bleu/white Lens		10
Magnifying glass	MOTIC	5
Magnifying glass	MOTIC(POWER)	5
Magnifying glass	OPTECH	2
Cork		11
Laboratory glasses		1
caméra mounted Microscope	ZEISS	1
Microscope	ZEISS	9
Microscope	EUROMAX	10
Power inverter		2
Manual vernier calipers	MUTITOYO	4
Black background magnifier plate	PLASTIQUE	27
White background magnifier plate	PLASTIQUE	20
Transparent magnifier plate	VERRE	7
Tweezers		14
Chisel-tip forceps		1
Wash bottles	PLASTIQUE	11
Probs		4
Spatula		2
Watch glass		12

Laboratory Equipment Biology 2

Description	Type	Quantity
Histological needle	TYPE DROITE LANCEOLE	10
Histological needle	TYPE DROITE	8
Boite à dissection		1
Scissors	CHIRURGICAL	5
Scissors	EN INOX	7
Freezer	WHIRPOOL INFINITI	1
Freezer	CONDOR	1
Microscope slides	PREPARES	134
Microscope slides	DE DIAPOSITIFS	42
Binocular Magnifying glass	MOTIC	12
Protective Glasses		1
Ocular Micrometer1	OPTIKA M-005	1
Ocular Micrometer 2	OPTIKA M-005	1

Microscopes	ZEISS	4
Microscopes	OPTIKA	5
Microscopes	BIOBLUE	4
Microscopes	OPTECH	1
Microscopes	HUND H60	1
Manual caliper	MUTITOYO	4
Tweezers	POINTUE	18
Tweezers	KOCHER	1
Plate	A LIEGE	14
Plate	EN INOX	9
Plate	EN PLASTIQUE	2
Overhead projector		
Stainless steel scalpels		9
Probes		3

Laboratory Equipment Biology 3

Description	Type	Quantity
Dissection needles	DROITES FINES	11
Dissection needles	LANCEOLEES	10
TRays	INOX	6
Scissors	DISSECTION ORDINAIRES	15
Drawer freezer		1
Binocular magnifiers		20
Scalpel handles	/	17
Microscopes		20
Microscopes	AXIO (SANS CAMERA)	1
Vernier caliper	MANUEL	4
Forceps	KOCHER	3
Dissection Forceps	COURBE	5
Dissection Forceps	PLATES	20
Dissection Forceps	POINTUES	13
Wash bottles	/	5
Microscope stages	REVERSIBLES NOIR ET BLANC	2
Microscope stages	TRANSPARENTES	5
Probes	CANNELEES	3
Dissection kit	/	1
Watch glasses	/	6

Material Potential of UDES Benefiting the Center of Excellence "Wastewater Treatment and Reuse"

1. Equipment from EVER / UDES :

N°	Equipment Description	Status
01	UV-Vis Spectrophotometer	Opertional
02	Total Organic Carbon (TOC) Analyzer	Out of order
03	Gas Chromatography-Mass Spectrometry (GC-MS)	Under operation
04	Biochemical Oxygen Demand (BOD) Analyzer	Opertional
05	DCO-meter	Lack Kits
06	Turbidimeter	Opertional
07	Multi-parameter meter	Opertional
08	Portable Multi-parameter meter	Opertional
09	Universal oven	Opertional
10	Muffle furnace	Opertional
11	Water purifier	Opertional
12	Autoclave	Opertional
13	Filtration rack	Opertional
14	Centrifuge	Opertional
15	Ultrasonic bath	Opertional
16	Circulating thermostatic bath	Opertional
17	Tube rotator shaker	Opertional
18	Vortex mixer	Opertional
19	Analytical balance	Opertional
20	Heating mantles	Opertional

2. Equipment from DDESM Team/ UDES :

N°	Equipment Description (DDESM)
01	Spectromter
02	Multi-Parameter meter
03	Turbidimeter
04	Refractometer
05	Casting knife
06	Flat organic membrane test cell
07	Analytical balance
08	Ovens
09	Shakers
10	Reverse osmosis membrane system

3. UDES Infrastructure:

- Reverse osmosis filtration prototype
- Solar pumping prototype
- Solar drying prototype
- 150-seat conference hall
- Library reading room
- Meeting rooms

B. Internship Sites and Industry Training

Internship Location	Number of Students	Duration
Algiers Central Wastewater Treatment Plants	08 à 32	1–2 weeks
National Sanitation Office (ONA)	08 à 16	1–2 weeks
SEAL	08	1–2 weeks
Seawater Desalination Plants	08	1–2 weeks
SONATRACH (Energy company)	08	1–2 weeks
Thermal Power Stations	08	1–2 weeks
Industrial Enterprises	08	1–2 weeks
Dairy Plants	04	1–2 weeks
Soft Drink Companies	04	1–2 weeks

C. Research Laboratories Supporting the Program

- Marine and Coastal Ecosystems Laboratory (ECOSYSMarL)
- Marine Resource Conservation and Valorization Laboratory (CVRM)

D- Research Projects Supporting the Program :

N°	PRFU code	Duration	Project Lead	Title
1	D00L03ES160920190001.	2019 -2022	SEMROUD R.	Posidonia oceanica Seagrass Beds: Tools for Biomonitoring of the Algiers Coastline
2	D00L03ES160920200001.	2020 -2023	HOUMA-BACHARI F.	Environmental Impact Monitoring and Valorization: Methodological and Normative Approach
3	D00L03ES160920220001	2022 -2025	REFES W.	Performance Evaluation of Cultured Artemia salina Strains Identified in Algeria
4	D00L03ES160920220002	2022-2025	BOULAHDID M.	Study of Pollution and Eutrophication in Waters of Algeria's Central Coast
5	E03L01ES160920220002	2022 -2025	FEZAA N.	Geodynamic, Morphological, and Sedimentary Evolution of Algeria's Central Coast
6	E03L03ES160920220001	2022 -2025	MEZOUAR K.	Multi-Risk Approach for Territorial Vulnerability Assessment: Case Studies in Coastal Zones

E- Personal Workspaces and TIC :

The host institution provides:

- A library with large reading rooms.
- A digitized document collection.
- Multimedia rooms (capacity: 30+ seats) for student projects.
- Four (4) computer labs for laboratory sessions.

II – Semester Course Organization Overview

1- Semester S1 :

Academic Program for the First Year of the Graduate Level (Second Cycle) Leading to the State Engineering Diploma in ***Wastewater Treatment and Reuse***

Teaching Unit (TU)	Semester Hours (15 weeks)					Weighting Coefficients	*Credits*
	Lectures	**Problem Sets**	**Labs**	**Independent work**	**Total**		
Fundamental TU							
FTU1.1.1	**37h30**	**30h**	**37h30**	**22h30**	**127h30**	**4**	**8**
Physicochemical Processes Applied to Wastewater Treatment	22h30	15h	22h30	15	75h	2	5
Water Chemistry	15h	15h	15h	7h30	52h30	2	3
FTU1.1.2	**30h**	**22h30**	**30h**	**22h30**	**105h**	**4**	**7**
Unit Operations in Water Treatment	15h	15h	15h	15h	60h	2	4
Fluid Mechanics	15h	7h30	15h	7h30	45h	2	3
Methodology TU							
MTU1.1	**60h**	**52h30**	**37h30**	**22h30**	**172h30**	**6**	**9**
Water and Sludge Analysis and Characterization Techniques	15h	15h	22h30	7h30	60h	2	3
Process Technology Applied to Wastewater Treatment	22h 30	22h 30		7h30	52h30	2	3
Study and Monitoring of Wastewater Treatment	22h30	15h	15h	7h30	60h	2	3
Transversal TU							
TTU1.1	**22h30**			**22h30**	**45h**	**1**	**1**
Expression, writing and communication techniques	22h30			22h30	45h	1	1
Discovery TU							
DTU1.1	**26h30**	**22h30**	**11h30**	**77h30**	**138h**	**3**	**5**
IT	15h	22h30		15h	52h30	1	2
Electrical Engineering	11h30		11h30	22h30	45h	1	1
Internship 1 in a Professional Setting (1 week)			40h		40h	1	2
Total Semester S1	**176h30**	**127h30**	**116h30**	**167h30**	**588h**	**17**	**30**

2- Semester S2:

Academic Program for the First Year of the Graduate Level (Second Cycle) Leading to the State Engineering Diploma in ***Wastewater Treatment and Reuse***

Teaching Unit (TU)	Semester Hours (15 weeks)					Weighting Coefficients	*Credits*
	Lectures	**Problem Sets**	**Labs**	**Independent work**	**Total**		
Fundamental TU							
FTU1.2.1	**37h30**	**30h**	**30h**	**30h**	**127h30**	**4**	**9**
Biological Processes Applied to Wastewater Treatment	22h30	15h	15h	15h	67h30	2	5
Water Biochemistry	15h	15h	15h	15h	60h	2	4
FTU1.2.2	**45h**	**37h30**	**15h**	**22h30**	**97h30**	**4**	**7**
Water Microbiology	22h30	15h	15h	15h	67h30	2	4
Irrigation Techniques	22h30	22h 30		7h30	30h	2	3
Methodology TU							
MTU2.1.	**45h**	**30h**	**15h**	**30h**	**120h**	**4**	**6**
Data Analysis and Processing	22h30	15h	7h30	15h	60h	2	3
Sludge Treatment of Sewage Treatment Plants	22h30	15h	7h30	15h	60h	2	3
Transversal TU							
TTU2.1	**22h30**			**22h30**	**45h**	**1**	**2**
Technical English 1	22h30			22h30	45h	1	2
Discovery TU							
DTU2.1	**37h30**	**18h30**	**11h30**	**110h**	**178h**	**5**	**6**
Health, Safety, and Environment (HSE)	15h	7h30		7h30	30	1	2
Membrane Separation Processes	22h30	11h30	11h30	22h30	68	1	2
Internship 2 in a Professional Setting (1 week)			80h		80h	2	2
Total Semester S2	**187h30**	**116h**	**71h30**	**192h30**	**558h**	**17**	**30**

3- Semester S3:

*Academic Program for the First Year of the Graduate Level (Second Cycle) Leading to the State Engineering Diploma in **Wastewater Treatment and Reuse***

Teaching Unit (TU)	Semester Hours (15 weeks)					Weighting Coefficients	*Credits*
	Lectures	**Problem Sets**	**Labs**	**Independent work**	**Total**		
Fundamental TU							
FTU2.1.1	**45h**	**30h**	**30h**	**30h**	**135h**	**4**	**12**
Modeling and Simulation of Processes Applied to REUSE	22h30	15h	15h	15h	67h30	3	6
Electrotechnics in the Treatment and Reuse of Treated Water	22h30	15h	15h	15h	67h30	2	6
FTU2.1.2	**45h**	**15h**	**15h**	**22h30**	**97h30**	**3**	**6**
Physical Analysis Methods	22h30	15h	15h	15h	67h30	2	4
Purification and Energy Efficiency in REUSE Infrastructure	22h30			7h30	30h	1	2
Methodology TU							
MTU2.1.	**45h**	**37h30**	**15h**	**30h**	**127h30**	**4**	**7**
Dimensioning Sewerage and Irrigation Networks	22h30	22 h30		15h	60h	2	4
Water Economics, Accounting, and Taxation	22h30	15h	15h	15h	67h30	2	3
Transversal TU							
TTU2.1	**22h30**			**22h30**	**45h**	**1**	**1**
Technical English 2	22h30			22h30	45h	1	1
Discovery TU							
DTU2.1	**22h30**		**80h**	**87h30**	**110h**	**3**	**4**
Environmental Assessment and Inspection	22h30			7h30	30	2	2
Internship 3 in a Professional Setting (2 weeks)			80h		80h	2	2
Total Semester S3	**180h**	**82h30**	**140h**	**192h30**	**515h**	**17**	**30**

4- Semester S4:

*Academic Program for the First Year of the Graduate Level (Second Cycle) Leading to the State Engineering Diploma in **Wastewater Treatment and Reuse***

Teaching Unit (TU)	Semester Hours (15 weeks)					Weighting Coefficients	*Credits*
	Lectures	Problem Sets	Labs	Independent work	Total		
Fundamental TU							
FTU2.2.1	**45h**	**30h**	**30h**	**30h**	**135h**	**4**	**9**
Hydraulics Modeling and Simulation in Water Reuse	22h30	15h	15h	15h	67h30	3	5
Aquatic Environment Quality	22h30	15h	15h	15h	67h30	2	4
FTU2.2.2	**22h30**	**15h**	**15h**	**15h**	**67h30**	**2**	**4**
Design and Sizing of Wastewater Treatment Plants	22h30	15h	15h	15h	67h30	2	4
Methodology TU							
MTU2.2.1	**45h**	**30h**		**30h**	**120h**	**3**	**6**
Mapping and GIS	22h30	22h 30		15h	60h	2	3
Wastewater and Sludge Reuse	22h30	22h30		15h	60h	1	3
MTU2.2.2	**45h**		**22h30**	**15h**	**75h**	**2**	**3**
Metrology	45h		22h30	15h	75h	2	3
Transversal TU							
TTU2.2	**45h**			**22h30**	**67h30**	**2**	**4**
Business Management	22h30			15h	37h30	1	2
Technical English 3	22h30			7h30	30h	1	2
Discovery TU							
DTU2.2	**22h30**		**80h**	**15h**	**110h**	**4**	**4**
Water Legislation and Policy	22h30			15h	30	1	2
Internship 4 in a Professional Setting (2 weeks)			80h		80h	2	2
Total Semester S4	**225h**	**75h**	**147h30**	**192h30**	**575**	**17**	**30**

5- Semester S5:

*Academic Program for the First Year of the Graduate Level (Second Cycle) Leading to the State Engineering Diploma in **Wastewater Treatment and Reuse***

Teaching Unit (TU)	Semester Hours (15 weeks)					Weighting Coefficients	*Credits*
	Lectures	**Problem Sets**	**Labs**	**Independent work**	**Total**		
Fundamental TU							
FTU3.1.1	**22h30**	**45h**	**37h30**	**22h30**	**127h30**	**6**	**10**
Operation, Control, and Monitoring of Wastewater Treatment Plants	22h30	45h	37h30	22h30	127h30	6	10
FTU3.1.2	**56h**	**22h30**	**22h30**	**30h**	**116h**	**5**	**10**
Artificial Intelligence in the Reuse of Treated Wastewater	22h30	22h30	22h30	15h	75h	4	7
Environmental and Health Risk Assessment	33h30			15h	41h	2	3
Transversal TU							
TTU3.1	**45h**	**22h30**		**30h**	**90h**	**4**	**6**
Engineering and Project Management	22h30	22h30		15h	60h	2	4
Technical English 4	22h30			15h	30h	1	2
Discovery TU							
DTU3.1	**22h30**	**22h30**		**30h**	**75h**	**2**	**4**
Renewable Energy Applied to REUSE	22h30	22h30		30h	75h	2	4
Total Semester S5	**146h**	**112h30**	**60h**	**122h30**	**441h**	**17**	**30**

6- Semester S6:

Final Year Project (including a three-month professional placement)

Teaching Unit (TU)	Semester Hours (15 weeks)		Weighting Coefficients	Credits
	Independent work	Total		
Discovery TU				
DTU 3.2	**600h**	**600h**	**17**	**30**
Final Year Project (including a three-month professional placement)	**600h**	**600h**	**17**	**30**
Total Semester S6	**600h**	**600h**	**17**	**30**

7- **Comprehensive Program Summary:** (Indicate the total instructional hours [VH], divided into lectures, Problem Sets, and labs, across the 6 semesters for different teaching unit types)

TU→ VHG↓	FTU	MTU	TTU	DTU	Internship / FYP	Total
Lectures	345h	232h30	157h30	116h15		851h15
Problem Sets	273h45	142h30	22h30	93h45		532h30
Labs	292h30	150h		22h30		465h
S/ Total Hours (In-Person)	**911h15**	**525h**	**180h**	**232h30**		**1848h45**
Individual Work	225h	112h30	112h30	120h		570h
Internships					480h	480h
Final Year Project (FYP)					360h	360h
Total	1135h15	637h30	292h30	352h30	720h	**3258h45**
Credits	82	34	9	17	38	**180**
% of Total Credits per TU	45,56	18,89	5	9,44	21,11	100

Elimination Threshold

1. **Teaching Units: Minimum passing grade is 5/20.**
2. **Internships: Minimum passing grade is 5/20.**
3. **Mini-Projects: Minimum passing grade is 10/20.**
4. **Final Year Project (FYP): Minimum passing grade is 10/20.**

III – Detailed Program by Subject
(1 Detailed Sheet per Subject)

Semester S1
First Semester of the 1st Year of the Second Cycle

Unit Title: FTU1.1.1
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S1

Distribution of the overall time volume of the TU and its subjects	Lecture :47h30 Problem Sets :30h Lab :47h30 Individual work: 22h30
Credits and coefficients allocated to the TU and its subjects	Credits :8 Coef.4 Subject 1: Physicochemical processes applied to wastewater treatment Credits 5 Coefficient :2 Subject 2: water chemistry Credits 3 Coefficient:2
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	▪ Physicochemical processes applied to water treatment: Understand the various physicochemical processes applied to wastewater treatment. Understand the process selection criteria and calculations related to each treatment. Master treatment methods that prioritize detoxified discharges, resulting in a new biodegradable effluent that can be sent to a conventional wastewater treatment plant for final treatment. ▪ Water chemistry: Understand the equilibria in aqueous and non-aqueous solutions. Understand the precipitation, complexation, oxidation-reduction, catalysis, and radical reactions applied in water treatment and their influence, while considering the various interfering parameters, such as T, pH, etc.

Unit Title: FTU1.1.2
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S1

Distribution of the overall time volume of the TU and its subjects	Lectures: 30h Problem Sets: 22h30 Lab:30h Individual work :22h30
Credits and coefficients allocated to the TU and its subjects	Credits :7 Coef.:2 Subject 1: Unit operations in water treatment Credits :4 Coefficient :2 Subject 2: Fluid mechanics Credits :3 Coefficient:2
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	▪ Unit Operations: Understand the meaning of unit operations and understand the main laws governing unit operations used in water treatment (decantation, flotation (DAF), filtration, etc.). ▪ Fluid Mechanics ▪ Expand on the knowledge acquired in preparatory classes on circulation, flow, and fluid dynamics. Application to water.

Unit Title: MTU1.1
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse

Distribution of the overall time volume of the TU and its subjects	Lecture :52h30 T :45h Lab :52h30 Individual work: 22h30
Credits and coefficients allocated to the TU and its subjects	Credits:9 Subject 1: Water analysis and characterization techniques Credits:3 Subject 2: Process technology applied to wastewater treatment Credit 3 Coefficient:2 Subject 3: Study and monitoring of wastewater treatment Credits 3 Coefficient:1
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	▪ Water Analysis and Characterization Techniques: Understand sampling, flow measurement, and water analysis techniques. ▪ Water Treatment Process Technology: Explain the technology of wastewater treatment systems. ▪ Screening-desanding, settling, aeration tanks, disinfection. ▪ Wastewater Treatment Study and Monitoring: Understand the quality indicators for wastewater and treated water. Understand the steps of REUSE in irrigation, industry, resource improvement, and municipal use.

Unit Title: TTU1.1.1
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S1

Distribution of the overall time volume of the TU and its subjects	Lecture :22h30 T 0 Lab 0 Individual work: 22h30
Credits and coefficients allocated to the TU and its subjects	Credits:1 Coef.:1 Subject 1: Expression, writing and communication techniques Credits:1 Coefficient:1
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	Oral and Written Communication 1: Oral and interpersonal communication in English

Unit Title: DTU1.1
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S1

Distribution of the overall time volume of the TU and its subjects	Lecture :26h15 T :22h30 LAb :11h15 Individual work: 77h30
Credits and coefficients allocated to the TU and its subjects	Credits:5 Coef.:3 Subject1:IT Credits:2 Coefficient:1 Subject 2: Electrical Engineering Credits:1 Coefficient:1 Subject 3: internship 1 in a professional environment (one week) Credits:2 Coefficient:1
Assessment Method (Continuous or Examination)	IT and Electrical Engineering:Continuation and final exam Internship 1: Average of the internship supervisor's grade and the grade obtained during the internship report presentation to the jury
Description of the modules	▪ Computer Science: Use of Office (Excel, Word, PPT, etc.), study of basic algorithms, familiarization with programming and program usage ▪ Electrical Engineering: Describe the essentials of what is required to understand the various components of electrical engineering and their uses in the fields of wastewater treatment and reuse. In this capacity, the student works on automated water treatment systems consisting of a combination of mechanical, electrical, electronic, and computer components. ▪ Internship 1: The first-year internship, lasting one week, is an initial exposure to the professional environment. The objective is to familiarize the engineering student with the business world by immersing them in a professional context. This internship allows them to begin the transition from the academic environment to the professional world. Students may be asked to undertake ptofessional work on an assignment involving the study, development, and/or fine-tuning of a product or tool.

Semester S2
Second semester of the 2nd year (second cycle)

Unit Title: TUF1.2.1
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S2

Distribution of the overall time volume of the TU and its subjects	Lecture :30h T :30h Lab :37h30 Individual work: 22h30
Credits and coefficients allocated to the TU and its subjects	Credits:9 Coef.:4 Subject 1: Biological processes applied to wastewater treatment Credits:5 Coefficient:2 Subject 2: water biochemistry Credits:4 Coefficient:2
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	▪ Biological processes applied to water treatment: Expand the knowledge already acquired in S1 on the various processes applied to water treatment and REUSE. Understand the process selection criteria and the calculations related to each treatment and reuse. ▪ Water biochemistry: Acquire fundamental knowledge of environmental biochemistry. ▪ Describe the main properties of living molecules.

Unit Title: FTU1.2.2

Field: Process Engineering

Specialty: Wastewater Treatment and Reuse

Semester : S2

Distribution of the overall time volume of the TU and its subjects	Lecture :22h30 T :22h30 LAb :26h15 Individual work: 22h30
Credits and coefficients allocated to the TU and its subjects	Credits:7 Coef.:2 Subject 1: Water microbiology Crédits:4 Coefficient:1 Subject 2: Irrigation techniques Credits:3 Coefficient:1
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	▪ Water Microbiology: Understand the different pathways of bacterial metabolism. Understand biotechnological applications in the biological treatment of buckets. ▪ Irrigation Techniques: Understand the different irrigation systems for treated wastewater. Clogging of drip systems, etc.

Unit Title: TUM1.2

Field: Process Engineering

Specialty: Wastewater Treatment and Reuse

Semester : S2

Distribution of the overall time volume of the TU and its subjects	Lecture :45h T :37h30 Lab :45h Individual work: 22h30
Credits and coefficients allocated to the TU and its subjects	Credits:6 Coef.:5 **Subject 2: Data Analysis and Processing** Credits:3 Coefficient:2 **Subject : Sludge Treatment of Sewage Treatment Plants** Credits:3 Coefficient:2
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	▪ Data Analysis and Processing: Understand the methods and tools of statistical analysis and their use in fields related to water resources. Understand the processes used to extract and transform information from raw data. ▪ WWTP Sludge Treatment: Characterization of sludge produced by WWTPs. Description of the various aerobic and anaerobic processes for treating the sludge produced. Conditioning and mechanical filtration of sludge and study of the different recovery pathways for WWTP sludge.

Unit Title: TUT1.2

Field: Process Engineering

Specialty: Wastewater Treatment and Reuse

Semester : S2

Distribution of the overall time volume of the TU and its subjects	Lecture :37h30 T :33h45 Lab :11h15 Individual work: 77h30
Credits and coefficients allocated to the TU and its subjects	Credits:2 Coef.:1 Subject 1: Scientific and Technical English 1 Credits:2 Coefficient:1
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	This course must prepare the student to master the use of the English language and to acquire a sufficiently significant level of language, capable of enabling him to use a scientific document, in particular the scientific and technical language used in the fields of water and similar or associated fields.

Unit Title: DTU1.2
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S2

Distribution of the overall time volume of the TU and its subjects	Lecture :37h30 T :33h45 Lab :11h15 Individual work: 77h30
Credits and coefficients allocated to the TU and its subjects	Credits:6 Coef.:3 Subject 1: Hygiene, safety and environment Credits:2 Coefficient:1 Subject 2::Membrane separation processes Credits:2 Coefficient:1 Subject 3: internship 2 in a professional environment (one week) Credits:2 Coefficient:1
Assessment Method (Continuous or Examination)	Membrane separation processes: Continued final exam Internship 2: Average of the internship supervisor's grade and the grade obtained during the internship in front of the jury
Description of the modules	▪ Hygiene, Safety, and Environment: Develop the various concepts and methods used in business and professional environments regarding hygiene, safety, and the environment, with a focus on the professional environment related to water resources, particularly wastewater remediation, treatment, and reuse. ▪ Membrane Separation Processes: The objective is to provide in-depth theoretical and experimental knowledge in the field of membrane techniques and familiarize students with the latest advances in membrane technology. ▪ Internship 2: The second internship of the first year, lasting one week, provides a second exposure to the professional environment. The objective is to strengthen the engineering student's understanding of the professional environment. This second internship must focus on a axperimental case discussed in advance with the teaching staff of the department and the host company. The internship is validated by an activity report that must highlight the student engineer's professional skills.

Semester S3
First semester of 2nd year (second cycle)

Unit Title: FTU2.1.1
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S3

Distribution of the overall time volume of the TU and its subjects	Lecture :45h T :30h T :30h Individual work: 30h
Credits and coefficients allocated to the TU and its subjects	Credits:12 Coef.:4 Subject 1: Modeling of processes applied to water treatment Credits:6 Coefficient:2 Subject 2: : Électrotechnique in the treatment and reuse of treated wastewater Credits:6 Coefficient:2
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	▪ Modeling of processes applied to water treatment: Use of mathematical equations in the modeling of treatment processes. Biological processes used in wastewater treatment (activated sludge, bioreactor, etc.) ▪ Electrical engineering in the treatment and reuse of treated wastewater: Introduction to automation. Learn how to define the conditions necessary for the development of an automated system. Use of measurement and data acquisition tools in WWTPs.

Unit Title: FTU2.1.2
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S3

Distribution of the overall time volume of the TU and its subjects	Lecture :45h T :15h Lab :15h Individual work: 22h30
Credits and coefficients allocated to the TU and its subjects	Credits:6 Coef.:3 Subject 1: Design and sizing of wastewater treatment plants Credits:4 Coefficient:2 Subject 2: Effectiveness and energy efficiency in treated wastewater reuse infrastructures Credits:2 Coefficient:1
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	▪ Design and sizing of wastewater treatment plants: Study of the selection criteria for biological processes. Adaptation of the process choice to the study conditions. Sizing of the different stages. ▪ Energy efficiency and effectiveness in wastewater treatment infrastructure: Definition of energy efficiency, with a focus on the design, operation, and occupancy of a wastewater treatment plant using a life cycle analysis of the energy component. Implementation of integrated solutions to improve the energy efficiency of wastewater treatment plants and infrastructure.

Unit Title: MTU2.1

Field: Process Engineering

Specialty: Wastewater Treatment and Reuse

Semester : S3

Distribution of the overall time volume of the TU and its subjects	Lecture :45h T :30h Lab :15h Individual work: 30h
Credits and coefficients allocated to the TU and its subjects	Credits:7 Coef.:4 **Subject 1: Sizing of sanitation and irrigation networks** Crédits:4 Coefficient:2 **Subject 2: Water economics, accounting and taxation** Credits:3 Coefficient:2
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	▪ Sizing of sanitation and irrigation networks: Define the methods, modes, tools, and infrastructure for wastewater treatment from consumer discharge to the WWTP. Teach students the design and sizing of sanitation and irrigation networks. ▪ ▪ Water economics, accounting, and taxation: Describe the methods for analyzing water-related accounting and taxation. Describe and explain the various environmental taxes related to water resources and water pollution. Teach students analytical techniques for defining water-related tax bases. Analyze the method of collecting water taxes.

Unit Title: TTU2.1

Field: Process Engineering

Specialty: Wastewater Treatment and Reuse

Semester : S3

Distribution of the overall time volume of the TU and its subjects	Lecture : 22h30 T 0 Lab 0 Individual work: 22h30
Credits and coefficients allocated to the TU and its subjects	Credits : 1 Coef. : 1 Subject 1: Scientific and Technical English 2 Credits : 1 Coefficient : 1
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	This course aims to consolidate the language concepts already acquired while strengthening reading skills, the use of scientific and technical documents in the field, as well as writing in English.

Unit Title: DTU2.1

Field: Process Engineering

Specialty: Wastewater Treatment and Reuse

Semester : S3

Distribution of the overall time volume of the TU and its subjects	Lecture : 15h T : 7h30 Lab 0 Individual work: 87h30
Credits and coefficients allocated to the TU and its subjects	Credits : 4 Coef. : 3 Subject 1: Environmental Assessment and Inspection Crédits : 2 Coefficient : 2 Subject 2: internship 3 in a professional environment (2 weeks) Credits : 2 Coefficient : 1
Assessment Method (Continuous or Exam)	Environmental Assessment and Inspection: Continuous and Final Examination Internship 3: Internship Grade and Report Presentation
Description of the modules	▪ Environmental Assessment and Inspection: Learn the different categories, techniques, and models of environmental assessment (strategic environmental assessments, environmental impact assessments, hazard assessments, environmental safety zones, environmental crisis assessments), and a brief on assessments related to water resources. Learn the methods, techniques, and scientific tools of environmental inspection, particularly at the level of treated wastewater treatment and reuse facilities. ▪ Internship 3: This third internship lasts two weeks. It is carried out as an assistant engineer and focuses on professional situations involving a predominantly technological or technical-economic problem. This internship assesses the student's ability to approach, resolve, and solve problems encountered.

Semester S4
Second semeseter of 2nd year (second cycle)

Unit Title: FTU2.2.1
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S4

Distribution of the overall time volume of the TU and its subjects	Lecture : 45h T : 30h LAb : 30h Individual work: 30h
Credits and coefficients allocated to the TU and its subjects	Crédits : 9 Coef. : 4 **Subject 1: Modeling of processes applied to the reuse of treated wastewater** Crédits : 5 Coefficient : 2 **Subject 2: Quality of aquatic environments** Crédits :4 Coefficient : 2
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	▪ Modeling of processes applied to the reuse of treated wastewater: Modeling of processes applied to the reuse of treated wastewater. ▪ Quality of receiving environments: Understanding the quality of receiving environments and assessing the impact of discharges on the receiving environment.

Unit Title: FTU2.2.2
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S4

Distribution of the overall time volume of the TU and its subjects	Lecture : 22h30 T : 15h Lab : 15h Individual work:15h
Credits and coefficients allocated to the TU and its subjects	Credits : 4 Coef. : 2 **Subject 1: Design and sizing of wastewater treatment plants** Credits : 4 Coefficient : 2
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	Learning how to design and size wastewater treatment plants, using computer programs to assist in the sizing of structures (e.g., Watercad, Epanet, Ghydraulic, etc.), and infrastructure related to wastewater treatment plants. Learning how to integrate the concepts of sustainability and efficiency when designing and sizing WWTPs. Mastering the concept of risk (risk reduction) when designing and sizing WWTPs.

Unit Title: MTU2.2.1
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S4

Distribution of the overall time volume of the TU and its subjects	Lecture : 45h T : 30h Lab : 15h Individual work: 30h
Credits and coefficients allocated to the TU and its subjects	Credits : 6 Coef. : 2 **Subject 1: Cartography and GIS** Credits : 3 Coefficient : 1 **Subject 2: Reuse of wastewater and sludge** Credits : 3 Coefficient : 1
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	➢ Cartography and GIS: Acquire the skills to organize, manage, process, and present geographic data in the form of plans and maps (intuitive and scalable cartography). Introduction to geographic information systems (GIS). Theoretical and experimental knowledge necessary to understand spatial reference, the implementation and analysis of relational databases, and types of geometric structures (vector and raster). Basic knowledge of data acquisition (e.g., GPS, rendering, scanned maps, etc.), the preparation and editing of geospatial data. Experimentation with metric and topological spatial analysis operations. This course includes significant Lab work using ArcGIS (or equivalent software) and MS Access (databases). Students must have good computer skills. ➢ Wastewater and Sludge Reuse: In this subject, students will learn the benefits of reusing treated wastewater and sludge. The advantages and constraints associated with this practice will also be studied.

Unit Title: MTU2.2.2
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S4

Distribution of the overall time volume of the TU and its subjects	Lecture : 45h T 00 Lab : 22h30 Individual work: 7h30
Credits and coefficients allocated to the TU and its subjects	Credits : 3 Coef. : 2 Subject 1: Metrology Credits : 3 Coefficient : 2
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	Étude des incertitudes de mesure et expression des résultats, étude des capteurs et chaine de mesure.

Unit Title: TTU2.2
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S4

Distribution of the overall time volume of the TU and its subjects	Lecture 45 T 0 Lab 0 Individual work: 22h30
Credits and coefficients allocated to the TU and its subjects	Credits : 4 Coef. : 2 **Subject 1: Business Management** Credits : 2 Coefficient : 1 **Subject 2: Scientific and Technical English 3** Credits : 2 Coefficient : 1
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	▪ Business Management: Learn business and infrastructure management techniques and models, with a focus on wastewater treatment and reuse infrastructure and management. Master the dimensions of administration, finance, and partnerships. ▪ Scientific and Technical English 3: This course aims to provide students with a fairly advanced level of English, enabling them to conduct scientific work in English, particularly on the topics of wastewater treatment and reuse.

Unit Title: DTU2.2

Field: Process Engineering

Specialty: Wastewater Treatment and Reuse

Semester : S4

Distribution of the overall time volume of the TU and its subjects	Lecture : 15h T : 7h30 Lab 0 Individual work: 87h30
Credits and coefficients allocated to the TU and its subjects	Credits : 4 Coef. : 3 Subject 1: Water and environmental legislation Credits : 2 Coefficient : 2 Subject 1: internship 4 in a professional environment (2 weeks) Credits : 2 Coefficient : 1
Assessment method (continuous or exam)	Water and Environmental Legislation: Continuous and Final Exam Internship 4: Internship Grade and Report Presentation
Description of the modules	▪ Water and Environmental Legislation: Understand and understand the national and international legislative, regulatory, and normative frameworks related to wastewater treatment and its reuse by various socio-economic sectors. ▪ Internship 4: Internship 4 lasts two weeks. It is carried out as an assistant engineer and focuses on experimental work involving a problem of a technological or technical-economic nature. This internship assesses the student's ability to approach, resolve, and solve problems encountered.

Semester S5
First semester of 3rd year (second cycle)

Unit Title: FTU3.1.1
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S5

Distribution of the overall time volume of the TU and its subjects	Lecture :22h30 T :45h Lab :37h30 Individual work:127h30
Credits and coefficients allocated to the TU and its subjects	Credits:13 Coef.:6 Subject 1: Operation, control and monitoring of wastewater treatment plants Credits:13 Coefficient:6
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	Operation and control of wastewater treatment plants: Understand the management of wastewater treatment facilities. Have a global vision of the plant. Move to the stage of optimization and rationalization of resources. Suggest necessary or temporary modifications in a plant according to needs and resources. Learn the techniques of control and monitoring of WWTPs.

Unit Title: FTU3.1.2
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S5

Distribution of the overall time volume of the TU and its subjects	Lecture :45h T :33h45 Lab :33h45 Individual work:15h
Credits and coefficients allocated to the TU and its subjects	Credits:10 Coef.:4 Subject 1: Artificial intelligence in the reuse of treated wastewater Credits:5 Coefficient:2 Subject 2: Environmental and health risk assessment Credits:5 Coefficient:2
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	▪ Artificial Intelligence in Treated Wastewater Reuse: Learn data analysis and machine learning to provide answers and solutions for optimal and safe reuse of treated wastewater. Master the creation of systems that learn, or improve their performance, based on the data they process in the field of treated wastewater reuse. Understand the scientific tools and models used by machine learning. ▪ Environmental and Health Risk Assessment: Learn to identify, characterize, and assess the various environmental and health risks associated with wastewater treatment and its reuse by socio-economic sectors (agriculture, industry, cities, tourism, etc.). Develop skills that enable engineers to reduce health and environmental risks in this type of facility and activity.

Unit Title: TTU3.1
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S5

Distribution of the overall time volume of the TU and its subjects	Lecture :45h T :22h30 Lab 0 Individual work:22h30
Credits and coefficients allocated to the TU and its subjects	Credits:3 Coef.:3 Subject 1: Engineering and project management Credits:2 Coefficient:2 Subject 2: Scientific and Technical English4 Credits:1 Coefficient:1
Assessment mode (continuous or exam)	Continuous and Final exam

Unit Title: FTU3.1.1
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S5

Distribution of the overall time volume of the TU and its subjects	Lecture : 22h30 T : 45h Lab : 37h30 Individual work: 127h30
Credits and coefficients allocated to the TU and its subjects	Credits : 13 Coef. : 6 Subject 1: Operation, control and monitoring of wastewater treatment plants Credits : 13 Coefficient : 6
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	Operation and control of wastewater treatment plants: Understand the management of wastewater treatment facilities. Have a global vision of the plant. Move to the stage of optimization and rationalization of resources. Suggest necessary or temporary modifications in a plant according to needs and resources. Learn the techniques of control and monitoring of WWTPs.

Unit Title: FTU3.1.2
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S5

Distribution of the overall time volume of the TU and its subjects	Lecture : 45h T : 33h45 LAb : 33h45 Individual work: 15h
Credits and coefficients allocated to the TU and its subjects	Credits : 10 Coef. : 4 Subject 1: Artificial intelligence in the reuse of treated wastewater Credits : 5 Coefficient : 2 Subject 2: Environmental and health risk assessment Credits : 5 Coefficient : 2
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	▪ Artificial Intelligence in Treated Wastewater Reuse: Learn data analysis and machine learning to provide answers and solutions for optimal and safe reuse of treated wastewater. Master the creation of systems that learn, or improve their performance, based on the data they process in the field of treated wastewater reuse. Understand the scientific tools and models used by machine learning. ▪ Environmental and Health Risk Assessment: Learn to identify, characterize, and assess the various environmental and health risks associated with wastewater treatment and its reuse by socio-economic sectors (agriculture, industry, cities, tourism, etc.). Develop skills that enable engineers to reduce health and environmental risks in this type of facility and activity.

Unit Title: TTU3.1
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S5

Distribution of the overall time volume of the TU and its subjects	Lecture : 45h T : 22h30 Lab 0 Individual work: 22h30
Credits and coefficients allocated to the TU and its subjects	Credits : 3 Coef. : 3 Subject 1: Engineering and project management Credits : 2 Coefficient : 2 Subject 2: Scientific and Technical English 4 Credits : 1 Coefficient : 1
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	▪ Engineering and Project Management: Develop the student's ability to design and plan projects, with a focus on water resources projects. Strengthen the engineer's ability to implement a project management and monitoring dashboard. Develop the engineer's ability to lead a multidisciplinary team in the execution of their missions and activities. ▪ ▪ Scientific and Technical English 4: This course aims to further strengthen the student's language skills, enabling them to write and express themselves adequately in English, and to address any issues related to their English language training.

Unit Title: DTU3.1
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S5

Distribution of the overall time volume of the TU and its subjects	Lecture : 22h30 T : 22h30 LAb 0 Individual work: 30h
Credits and coefficients allocated to the TU and its subjects	Credits : 4 Coef. : 2 Subject 1: Renewable energies applied to the treatment and reuse of wastewater Credits : 4 Coefficient : 2
Assessment mode (continuous or exam)	Continuous and Final exam
Description of the modules	The course offers a new aspect of wastewater treatment and reuse through the integration of renewable energies and sustainable processes.

Semester S6

Second semester 3rd year (second cycle)

Unit Title: DTU3.2
Field: Process Engineering
Specialty: Wastewater Treatment and Reuse
Semester : S6

Distribution of the overall time volume of the TU and its subjects	Lecture : T : LAb Individual work: 600h
Credits and coefficients allocated to the TU and its subjects	Credits : 30 Coef. : 15 **Subject :** Final Year Project, including a three-month professional internship Credits : 30 Coefficient : 15
Assessment method (continuous or exam)	FYP: presentation of a dissertation and public defense before a jury
Description of the modules	Completion of a final-year research project (PFE or startup project or patent) on a wastewater treatment and/or treated wastewater reuse issue. This project must include a three-month field phase, either in a company, institutional, or academic setting. The PFE of the TREU university center of excellence must rely on innovative techniques and methodologies using digitalization, artificial intelligence, modeling, or any other innovative approach. The PFE must propose a solution test directly related to the needs of socioeconomic sectors, particularly those related to water security. The PFE must be presented before a public jury composed of members skilled in the themes and/or issues of the center of excellence. The PFE must demonstrate that the engineer has acquired skills and knowledge during the training and is able to test them in the final-year project.

Semester S1
Detailed Course Syllabus
First Semester of the 1st Year of
the Second Cycle

Semester :1
Teaching Unit : FTU1.1.1
Subject 1: Physico-Chemical Processes Applied to Wastewater Treatment
Total Hours (VHS): 60 (Lectures: 22.5 hours, Problem Sets: 15 hours, Labs: 22.5 hours)
Credits : 5
Coefficient :2

Learning Objectives

Master physicochemical processes such as sedimentation, precipitation, coagulation-floculation, and electrocoagulation for wastewater decontamination.

Prerequisite Knowledge

Fundamentals of chemistry.

Course Content

Chapter I: Sedimentation (3 weeks)
Technological application domains.
Characteristics of suspensions.
Granular particle sedimentation: settling velocity, Stokes' law.
Plug-flow sedimentation.
Kynch's theory.
Flocculent particle sedimentation.
Design of a settling tank.

Chapter II: Flotation (2 weeks)
Implementation of flotation.
Flotation kinetics and modeling.
Thermodynamics of flotation.
Reaction mechanisms.
Implementation of a Dissolved Air Flotation (DAF) system.

Chapter III: Coagulation-Flocculation (3 weeks)
General Principles and Application Domains
Coagulation-Flocculation-Precipitation
Coagulation
Principles and mechanisms.
Types of coagulants used.
Influence of operational parameters (agitation, agitator types) via Jar Test.
Design of a coagulator.
Flocculation
Principles and kinetics.
Flocculation mechanisms (perikinetic and orthokinetic).
Camp's theory.
Design of a flocculator.

Chapter IV: Depth Filtration (3 weeks)
Theoretical study of constant-pressure filtration (ΔP).
Kozeny-Carman equations.
Depth filtration processes (dual-media filters, inline filtration, direct filtration).
Design of sand filters.

Chapter V: Disinfection (2 weeks)
General concepts of disinfection and regulations for potable water production.
Aqueous oxidation using chlorine derivatives, chlorine dioxide, and ozone.
Breakpoint chlorination curve.
Reactivity with inorganic and organic compounds.
Industrial implementation in treatment processes.

Chapter VI: Electrochemical Depollution Processes (2 weeks)
Fundamentals of electrochemistry.
Mass and charge transfers in electrochemical reactors.
Charge transfer processes at metal/electrolyte interfaces.
Conditions for electrochemical phenomena.
Electrochemical kinetics.
Electrocoagulation process.

Labs
Coagulation-flocculation.
Plug-flow sedimentation.
Particle size analysis.
Filtration.
Disinfection.

Assessment Methods
Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

- *Qasim, S. R., Motley, E. M. et Zhu G. (2000). Water Works Engineering : Planning, Design, and Operation. Prentice Hall.*
- Bernard Legube, Production d'eau potable, Filières et procédés de traitement, Collection: Technique et Ingénierie, Dunod, 2015
- Claude Cardot, Les traitements de l'eau, Ellipses, Collection : Technosup, 1999, 1ère édition
- Willy Masschelein, Processus unitaires du traitement de l'eau potable, Tec et Doc - Lavoisier, Cebedoc, 1997
- Raymond Desjardins,Le traitement des eaux, deuxième Edition, presse universitaire de Montréal, Canada
- Dégremont,Memento Technique de l'eau,10 eme édition, Lavoisier
- COEURETF.,STORCK(1993),ElémentsdeGénieElectrochimique,TECandLavoisier,paris.
- KORENJ.P.., SYVERSEN.,(1995**),**State-of-theartelectrofloculation,filtrationandseparation.

Semester : 1
Teaching Unit: FTU1.1.1
Subject 2: Water Chemistry
VHS: 45 h (Lectures: 15h, Problem Sets: 15h, Lab 15h)
Credits : 3
Coefficient : 2

Course Objectives
The *Water Chemistry* course equips students with the necessary tools to understand the processes governing chemical species in water systems. Fundamental information about water itself and the chemical composition of water in environmental systems will be covered in this course.

Recommended Prerequisites
Basic knowledge of chemistry

Course Content
1. GENERAL PRINCIPLES
    - The water molecule, the water cycle, water sources, and the significance of water analysis.
2. MEASUREMENTS AND UNITS IN WATER ANALYSIS
    - Systems of units, units for major elements in water, and units for trace elements in water.
3. ORIGIN OF CHEMICAL SPECIES IN WATER
    - Weathering processes, biological processes, liquid-gas chemical processes, and solid-liquid chemical processes.
4. WATER EQUILIBRIA
    - Electrical neutrality, calcium-carbonate equilibria, water ionization, dissociation of carbonic acid, and dissolution/precipitation of calcium carbonate.
5. ANALYSIS OF RAW NATURAL WATERS
    - Physicochemical parameters of water (temperature, pH, conductivity).
    - Chemical parameters (acidity, alkalinity, hydrotimetric indices, dissolved salts, solid matter), and micropollutants.
6. INTERPRETATION OF WATER ANALYSIS

Laboratory Sessions (15 hours)
1. Measurement of physical water parameters (temperature, pH, conductivity, turbidity).
2. Measurement of chemical water parameters (Total Acidity [TA], Total Alkalinity [TAC], Total Hardness [TH], Calcium [Ca], Magnesium [Mg], Sodium [Na], Potassium [K]).
3. Total nitrogen quantification.
4. Phosphate quantification in wastewater.
5. Chloride quantification via precipitation.

Assessment Methods
Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

1. *Patrick L. Brezonik and William A. Arnold, An Introduction to the Chemistry of Natural and Engineered Aquatic Systems, Oxford University Press, 2011*
2. *Vernon L. Snoeyink , David Jenkins, Water Chemistry 1st Edition, Edition John Wiley and Sons*
3. *Erik R. Christensen, An Li, Physical and Chemical Processes in the Aquatic Environment, 2014, Edition Wiley*
4. *Laura Sigg, Philippe Behra, Werner Stumm, Chimie des Milieux Aquatiques cours et exercices corrigés, 5ème Ed. Dunod, , 2014*

5. *Philippe Behra, Chimie et environnement: Cours, études de cas et exercices corrigés, Dunod, 2013*
6. *V. P. Evangelou, Environmental soil and water chemistry: principles and applications, Wiley, 1998*
7. *Michael E. Essington, Soil and Water Chemistry: An Integrative Approach, CRC Press, 2005*
8. *J. Tölgyessy, Chemistry and Biology of Water, Air and Soil: Environmental Aspects, Elsevier, 1993*
9. *Clair Sawyer, Perry McCarty, Gene Parkin, Chemistry for Environmental Engineering and Science, McGraw-Hill Education, 2003, 752 pages*
10. *Stanley E. Manahan, Water Chemistry: Green Science and Technology of Nature's Most Renewable, CRC Press, 2011*
11. *BalramPani, Textbook of Environmental Chemistry, IK International, New Delhi, 2007*
12. *Patrick Brezonik, William Arnold, Water Chemistry: An Introduction to the Chemistry of Natural and Engineered, Oxford University Press, 2011*
13. *David E. Newton, Chemistry of the Environment, Facts on File Editor, NY, 2007...*

Semester :1
Teaching Unit: FTU1.1.2
Subject 1: 3. Unit Operations in Water Treatment
VHS: 45 h (Lectures: 15h, PS:15h, Lab: 15 h)
Credits : 4
Coefficient : 1

Course Objectives:
This teaching unit adopts a process engineering approach, enabling students to explore unit operations applied to water treatment.

Prerequisite Knowledge:
Mass transfer, Chemical kinetics, Physicochemical processes applied to water treatment

Course Outline

1. **Review (2 weeks)**
   - Overview of processes and material balances
   - Equilibrium functions and operational balances
   - Concept of theoretical plates and transfer units

2. **Sedimentation (1 week)**
   - Principles of sedimentation
   - Equipment and sizing procedures

3. **Flotation (2 weeks)**
   - Theoretical principles of flotation
   - Equipment and sizing procedures

4. **Adsorption (3 weeks)**
   - Theoretical principles of adsorption
   - Adsorption isotherms
   - Hydrodynamics in adsorption beds
   - Key industrial applications

5. **Extraction (2 weeks)**
   - Theoretical principles of extraction
   - Solid-liquid extraction
   - Liquid-liquid extraction

6. **Ion Exchange (2 weeks)**
   - Theoretical principles of ion exchange
   - Water softening and demineralization
   - Techniques and equipment

7. **Crystallization (1 week)**
   - Theoretical principles of crystallization
   - Simple crystallization
   - Fractional crystallization
   - Thermal and material balances

8. **Solid Drying and Dehydration (2 weeks)**
    - Theoretical principles of drying
    - Boiling drying, entrainment drying, lyophilization (freeze-drying)
    - Techniques and equipment

9. **Distillation (2 weeks)**
    - Theoretical principles of distillation
    - Liquid-vapor equilibrium of binary mixtures
    - Applications of liquid-vapor equilibrium
    - Batch rectification and continuous rectification

Laboratory Sessions:

1. Adsorption on Activated Carbon in Batch Mode
- Adsorption Isotherms

2. Adsorption on Activated Carbon in Continuous Mode
- Hydrodynamic Adsorption in an Adsorbent Bed

3. Piston Settling
4. Ion Exchange
- Water Softening
- Demineralization

Assessment Methods
Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

MAUREL Alain ;(2006) Dessalement de l'eau de mer et des eaux saumâtres (2° Éd.) Editions Lavoisier
Jozsef T., (2002), Adsorption, Theory, Modeling, and Analysis, Marcel Dekker IncMilleF. P., laflotation,Ed. Broché.
DaufinG.,ReneF,AimarP,(1998),Séparationsparmembranesdanslesprocédésdel'industriealimentaire,Techniques et Documentation.
HowellJ.A.,SanchezV.,FieldRW,(1993),Membranes in bioprocessing–Theory and applications, Chapman&Hall.
HumphreyJ.L.,KellerGE,(2001),Procédésdeséparation:techniques,sélectiondimensionnement,Dunod, Paris.

MallevialleJ.,OdendaalPE,Wiesner MR,(1996) Water treatment: Membrane processes, AWWA, McGraw-Hill.
Mémento technique de l'eau(1995),Degrémont, Lavoisier,Techniques et Documentation.

Génie chimique et des procédés , Procédés de séparation et de réaction, Stéphane Bostyn, Olivier Chedeville, Henri Fauduet, Dunod, 2019

Semester: 1
Teaching Unit: FTU1.1.2 Matière 2:
Subject : Fluid Mechanics
VHS: 37h30 (Lectures: 15h, Prblem Sets:7.5 h, Lab:15h)
Coefficient : 1
Credit :3

Course Objectives
The objectives of this course are:

- To learn how to analyze typical problems encountered in fluid mechanics.
- To solve fundamental problems involving incompressible fluid flow.
- To calculate head losses and other quantities of interest (flow rates, forces).
- To define the complete set of characteristics for a hydraulic network.

Recommended Prerequisites: Mathematics, integral calculus; foundational knowledge of fluid mechanics and dynamics (FMD).

Course Content

Chapter 1: Review (3 weeks)
General laws and principles of fluid mechanics:

1. Conservation of Mass Equation
2. Conservation of Momentum Equation
3. Conservation of Energy Equation

Chapter 2: Estimation of Head Losses (3 weeks)

- General expression of head losses
- Linear head losses
- Singular (local) head losses

Chapter 3: Pumps (4 weeks)

- Overview
- Characteristics of centrifugal pumps
- Suction cavitation and Net Positive Suction Head (NPSH)
- Similitude relationships
- Pump assembly and configuration

Chapter 4: Water Hammer Phenomenon (4 weeks)

- Explanation of the phenomenon
- Nature of pressure waves
- Calculation of wave celerity
- Conservation of mass in flow affected by a pressure wave
- Characteristic equation
- Case studies and practical applications

Laboratory Sessions

- Lab 1: Viscometer
- Lab 2: Determination of Linear and Singular Head Losses
- Lab 3: Flow Rate Measurement
- Lab 4: Water Hammer and Mass Oscillations
- Lab 5: Verification of Bernoulli’s Theorem

- Lab 6: Jet Impact Analysis
- Lab 7: Flow Through an Orifice
- Lab 8: Flow Visualization Around an Obstacle
- Lab 9: Determination of Reynolds Number: Laminar and Turbulent Flow
- Lab Test

Assessment Methods
Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

R.Comolet,'Mécaniquedesfluidesexpérimentale',Tome1,2et3,Ed. MassonetCie.

R.Ouziaux,'Mécaniquedesfluidesappliquée',Ed.Dunod,1978

N. Midoux, Mécanique et rhéologie des fluides en génie chimique, Ed. Lavoisier, 1993.

R. Comolet, Mécanique des fluides réels - Tome 2, Ed. Dunod, 2006.

M. Fourar, Equations générales, solides élastiques, fluides, turbomachines, similitude, Ed. Ellipses, 2ème Edition 2015.

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Cours et problèmes, 2ème édition. France Mac Graw Hill, Paris, 2e edition edition, 2000.

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P. Pernès. Hydraulique unidimensionnelle. : 2, Coups de bélier et phénomène d'oscillation.Cemagref, Antony (Hauts-de-Seine); Strasbourg, April 2004.

P. Pernès. Hydraulique unidimensionnelle : Partie 1, Analyse dimensionnelle et similitudeGénéralités sur les écoulements unidimensionnels Ecoulements en charge Ecoulements

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R. O. Sinniger and W. H. Hager. Constructions hydrauliques - Ecoulements stationnaires.

Traité de Génie Civil de l'Ecole polytechnique fédérale de Lausanne. Presses Polytechniqueset Universitaires Romandes (PPUR), Lausanne, April 1989.

J. Vazquez and M. Dufresne. Hydrostatique et hydraulique en charge. Formation Mastère

Eau Potable et Assainissement. Engeesedition, 2012.

P. Finaud-Guyot, Mécanique des fluides Hydraulique en charge Hydraulique à surface libre. Polytech Montpellier, 2019

Semester: 1
Teaching Unit: MTU 1.1
Subject 1: Water and Sludge Analysis and Characterization Techniques
VHS: 45h (Lectures: 15h, PS: 15 h, Lab:15h)
Coefficient : 2
Credit 4

Course Objectives

The objectives of this course are: Select appropriate analytical methods. Prepare samples. Implement various techniques for analyzing wastewater and sludge. Interpret analytical results.

Recommended Prerequisites:
Water chemistry; fundamentals of wastewater treatment.

Course Content

Chapter 1: Sampling and Sample Collection (2 weeks)
- Sampling techniques
- Sample collection
- Sample preservation

Chapter 2: Physical Parameters (2 weeks)
- Color
- Suspended solids
- Temperature
- Turbidity

Chapter 3: Chemical Characteristics (3 weeks)
- Conductivity, dissolved oxygen
- Chemical Oxygen Demand (COD)
- Oils and fats
- Nitrogen: nitrite, nitrate, ammonia, organic nitrogen, Kjeldahl nitrogen (NTK)
- Phosphorus: mineral and organic forms, total phosphorus
- Chlorides (Cl^-)
- Sulfates (SO_4^{2-})
- Heavy metals

Chapter 4: Biological Parameters of Wastewater (3 weeks)
- Biochemical Oxygen Demand (BOD)
- Microbial life in wastewater:
  a. Bacteria
  b. Protozoa
  c. Fungi
  d. Viruses
  e. Algae
  f. Rotifers
  g. Nematodes

Chapter 5: Sludge Characteristics (3 weeks)
- pH
- Dry solids content

- Organic matter (OM)
- Carbon-to-nitrogen ratio (C/N)
- Total nitrogen (N-NTK)
- Phosphate (P_2O_5)
- Agronomic factors (Ca, Mg, K, Na)
- Metals and pathogens (for valorization purposes)

Chapter 6: Interpretation of Results (2 weeks)

Laboratory Sessions

- **Lab 1**: Suspended solids
- **Lab 2**: Chemical Oxygen Demand (COD)
- **Lab 3**: Biochemical Oxygen Demand (BOD)
- **Lab 4**: Nitrogen and phosphate analysis
- **Lab 5**: Analysis of Ca, Mg, K, and Na
- **Lab 6**: Sludge dry solids content and organic matter (OM)
- **Lab Test**

Assessment Methods
Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

L'analyse de l'eau : Eaux naturelles, eaux résiduaires, eau de mer, Contrôle et interprétation**,** Jean Rodier, Bernard LegubeEditeur(s) : Dunod, Collection : Technique et Ingénierie, Nombre de pages : 1824 pages, Date de parution : 07/09/2016 (10e édition), EAN13 : 9782100754120
Claude Cardot, Les traitements de l'eau, Ellipses, Collection : Technosup, 1999, 1ère édition
Mémentotechniquedel'eau(2004),Degrémont,Lavoisier,TechniquesetDocumentation, 10eme édition, EAN13 : 9782743007171

Semester : 1
Teaching Unit: MTU1.1
Subject 2: Process Technology Applied to Wastewater Treatment
VHS: 45 h (Lectures: 22 h30, PS: 22h 30)
Coefficient :2
Crédit :3

Course Objective

The objective of this course is to equip students with essential technical knowledge, enable mastery of cutting-edge technologies, and apply the most suitable methods in the field of wastewater treatment.

Recommended Prerequisites: Basic knowledge of wastewater treatment.

Course Content

Chapter 1: Pretreatments (4 weeks)

1. **Screening**
   - Hydraulic design and clogging
   - Automatic control and screen protection
   - Types of screens:
     - Manual screens
     - Upstream-cleaning screens
     - Downstream-cleaning screens
2. **Grit Removal**
   - Overview
   - Circular grit removers
   - Aerated rectangular grit removers
   - Metallurgy-type grit removers
   - Hydrocyclones
3. **Grease and Oil Removal**
   - 3.1 Grease separators:
     - Circular grit-grease separators
     - Rectangular grit-grease separators
     - Rectangular grease separators with aerator-mixers
   - 3.2 Oil separators:
     - Operating conditions
     - Gravity pre-oil separators
4. **Oil and Floating Matter Recovery Systems for Ponds or Lagoons**

Chapter 2: Flocculation – Sedimentation – Flotation (4 weeks)

1. **Reagent Injection**
   - Rapid-mix propeller agitators
   - Static mixers
   - The *Turbactor*
2. **Flocculators**
   - Agitated flocculators:
     - Baffled flocculators

        - Propeller-driven flocculators
    - Static flocculators
3. **Settlers**
    - **Static settlers:**
        - Simple settlers
        - *Sédipac* settlers
        - Sludge suction settlers
    - **Sludge contact settlers:**
        - Sludge blanket settlers
        - Sludge recirculation settlers
        - *DENSADEG* thickener-settler
    - **Granular contact settlers:** *Gyrazur*
    - **Sludge evacuation systems:**
        - Internal collection
        - Sludge recovery
        - General configurations
        - Automation
        - Scum removal
4. **Flotation Units**
    - General technology
    - Circular flotation units
    - Rectangular units
    - Sludge thickening flotation systems

Chapter 3: Aerobic Biological Processes (4 weeks)

1. **Activated Sludge**
    - 1.1 Activated sludge basin configurations:
        - Plug-flow basin
        - Complete-mix basin
        - Closed-loop basins
        - Cascade basins
        - Staged-feed basins
        - Contact-stabiliza**tion process**
    - 1.2 Clarifier and recirculation
    - 1.3 Aeration systems:
        - Surface aerators
        - Pressurized air aeration
        - Hybrid aeration
        - Pure oxygen systems
    - 1.4 Compact units:
        - Extended aeration plants
        - *OXYRAPID R*
2. **Fixed-Film Processes**
    - Trickling filters:
        - Traditional media trickling filters
        - Plastic media trickling filters
    - Fixed granular beds:
        - *BIOLITE* media
        - *BIOFOR* (Biological Filtration Oxygenated Reactor)
        - *BIODROF* (Biological Dry Oxygenated Filter)
    - Filtration with pre-dissolved air/oxygen:

- *OXYAZUR*
- *Nitrazur*

Chapter 4: Tertiary Treatment – Filtration Systems (3 weeks)

1. **Granular Media Filter Equipment**
   - Operating conditions
   - Filter families
2. **Pressure Filters**
   - Water-only backwash filters
   - Air-and-water backwash filters
   - Sequential air-water backwash filters
3. **Open Filters**
   - Air-and-water backwash filters
   - Sequential air-then-water backwash filters
4. **Specialized Filters**
   - Valve-free self-cleaning filters
   - *Médiazur* dual-flow filters
   - Upflow oil removal filters – *Colexer*
   - Precoat filters – *Cannon*-type filters

Assessment Methods

Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

L'analyse de l'eau : Eaux naturelles, eaux résiduaires, eau de mer, Contrôle et interprétation, Jean Rodier, Bernard LegubeEditeur(s) : Dunod, Collection : Technique et Ingénierie, Nombre de pages : 1824 pages, Date de parution : 07/09/2016 (10e édition), EAN13 : 9782100754120

Gestion des eaux usées urbaines et industrielles : caractérisations, techniques d'épuration, aspect économique.W.wEckenfelder:Edition Lavoisier. 1982

L'épuration biologique des eaux. Théorie & technologie des réacteurs.F.Edeline:Technique et Documentation CEBEDOC 1988

Water Reuse : Issues, Technologies, and Applications , Takashi Asano, Ed Franklin Burton · 2007

Wastewater Engineering: Treatment and Reuse. George Tchobanoglous, Franklin Louis Burton, H. David Stensel, Metcalf & Eddy, Inc., Franklin Burton. McGraw-Hill Education, 2003 - 1819 pages

Mémento technique de l'eau - Degrémont SA. Tomes 1 et 2, Editeur(s) : Degrémont, Nombre de pages : 1718 pages, Date de parution : 17/05/2005 (10e édition), EAN13 : 9782743007171

Guide pratique des stations de traitement des eaux, Xavier Lauzin Editeur(s) : Eyrolles, Collection : Blanche BTP, Nombre de pages : 266 pages, Date de parution : 29/10/2009 , EAN13 : 9782212125665

Wastewater and Biosolids Treatment Technologies: The Comprehensive Reference for Plant Managers and Operators.Cheremisinoff, Nicholas P, Publisher: Rockville,MD. ABS Consulting Government Insitutes 2003; Description: xxiv,344p. ill. 27cm., ISBN: 086587946X.

Semester : 1
Teaching Unit: MTU 1.1
Subject: Study and Monitoring of Wastewater Treatment
VHS:52h 30 (Lectures: 22h30,PS : 15h, Lab 15h)
Coefficient : 1
Crédit 3

Course Objective

This course provides foundational knowledge for monitoring incoming wastewater treatment processes to detect and quantify elements that may affect purification efficiency. It equips students to anticipate potential malfunctions in various components of a wastewater treatment plant (WWTP). Additionally, the course emphasizes effluent analysis to ensure compliance with environmental regulations for discharged water, thereby safeguarding receiving ecosystems.

Recommended Prerequisites

- Foundational knowledge in chemistry, biology, and fluid mechanics.
- Basic understanding of automation systems and computer science.

Course Content

INTRODUCTION: Overview of a WWTP

I. MEASUREMENT AND CONTROL EQUIPMENT

- Continuous, automated operation of monitoring devices.
- Continuous collection of representative composite samples.
  - Sampling frequency protocols.
  - Sample storage and transportation guidelines.
  - Continuous flow meters and flow rate monitoring.
- **Effluent and Influent Analysis**: Continuous monitoring of:
  - pH, conductivity, redox potential
  - Biochemical Oxygen Demand (BOD)
  - Chemical Oxygen Demand (COD)
  - Total Organic Carbon (TOC)
  - Total Kjeldahl Nitrogen (TKN), ammonium, phosphates, nitrates.

TREATMENT STAGE I: Sludge Management

- Quantifying sludge extraction and disposal (Total Suspended Solids (TSS), BOD).

TREATMENT STAGE II: Aeration Monitoring

- **Aeration Basin Parameters**:

- Dissolved oxygen (oxymeter), redox potential, sludge microbiology.

- **Sludge Settle ability**:
  - Monitoring via Mohlmann Index (Sludge Volume Index, SVI).

TREATMENT STAGE III: Disinfection (5 Weeks)

- **Disinfection Methods**:
  - Optimal chlorine or UV dosage.
  - Analysis of indicator microorganisms (e.g., coliforms) for contamination.

Sludge Conditioning

- Key parameters:
  - Specific resistance.
  - Compressibility index.
- Continuous data analysis and interpretation.

Laboratory Sessions

- **Session 1**: WWTP site visit with technical report.

Assessment Methods
Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

L'analyse de l'eau : Eaux naturelles, eaux résiduaires, eau de mer, Contrôle et interprétation, Jean Rodier, Bernard LegubeEditeur(s) : Dunod, Collection : Technique et Ingénierie, Nombre de pages : 1824 pages, Date de parution : 07/09/2016 (10e édition), EAN13 : 9782100754120
Gestion des eaux usées urbaines et industrielles : caractérisations, techniques d'épuration, aspect économique.W.wEckenfelder:Edition Lavoisier. 1982
L'épuration biologique des eaux. Théorie & technologie des réacteurs.F.Edeline:Technique et Documentation CEBEDOC 1988
Water Reuse : Issues, Technologies, and Applications , Takashi Asano, Ed Franklin Burton · 2007
Wastewater Engineering: Treatment and Reuse. George Tchobanoglous, Franklin Louis Burton, H. David Stensel, Metcalf & Eddy, Inc., Franklin Burton. McGraw-Hill Education, 2003 - 1819 pages

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Mémento technique de l'eau - Degrémont SA. Tomes 1 et 2, Editeur(s) : Degrémont, Nombre de pages : 1718 pages, Date de parution : 17/05/2005 (10e édition), EAN13 : 9782743007171
Guide pratique des stations de traitement des eaux, Xavier Lauzin Editeur(s) : Eyrolles, Collection : Blanche BTP, Nombre de pages : 266 pages, Date de parution : 29/10/2009 , EAN13 : 9782212125665
Wastewater and Biosolids Treatment Technologies: The Comprehensive Reference for Plant Managers and Operators.Cheremisinoff, Nicholas P, Publisher: Rockville,MD. ABS Consulting Government Insitutes 2003; Description: xxiv,344p. ill. 27cm., ISBN: 086587946X.

Semester : 1
Teaching Unit: TTU1.1
Subject : Expression, writing and communication techniques
VHS: 22.5h (Lectures : 1h30)
Coefficient : 1
Credit : 1

Course Objectives
This course aims to develop students' competencies in contemporary writing methodology and expression techniques. It also equips students with the tools, methods, and strategies to enhance communication skills, facilitating their adaptation to professional environments.

Key competencies to acquire:
- Ability to introduce oneself professionally.
- Proficiency in drafting CVs and cover letters.
- Articulating written or verbal opinions on ideas or topics.
- Delivering presentations or project proposals.
- Captivating an audience.
- Public speaking (voice modulation, language use, posture).

Recommended Prerequisites
- Basic proficiency in French.
- Foundational principles of document drafting.

Course Content

Chapter 1: Enhancing Communication Skills (3 weeks)
- Pronunciation (reading scientific or general texts).
- Thematic discussions / vocabulary exercises / role-playing.
- Comprehension and synthesis:
    - Film screenings with note-taking and written summaries of key points.
    - Group debates on film themes:
        - **Session 1**: Film on *Environmental Challenges*.
        - **Session 2**: Film on biodiversity: *6 Minutes to Understand Biodiversity*.
        - **Session 3**: Film on *Wastewater Treatment Plant in Oum El Bouaghi, Algeria / AMENHYD*.

Chapter 2: Writing Techniques and Procedures (2 weeks)
- Fundamentals of writing.
- Punctuation, syntax, and sentence structure.
- Readability and objectivity.
- Intellectual rigor and plagiarism avoidance.

Chapter 3: Technical Writing (Scientific Reports, Summaries, and Scientific Articles) (3 weeks)
- Title pages, table of contents, and introductions.
- Methodology, results, discussion, and conclusions.
- Bibliography, appendices, abstracts, and keywords.

Chapter 4: Information Retrieval, Synthesis, and Application (2 weeks)

- Library research (print format: books, journals).
- Online research (digital: databases, search engines).

Chapter 5: Developing Autonomy, Organizational, and Communication Skills (2 weeks)

- Project and communication frameworks.
- Anticipating actions and implementing projects.
- Interview preparation: *How to present oneself effectively*.

Chapter 6: Oral Presentation Techniques (3 weeks)

- Preparing an oral presentation.
- Structuring an oral presentation.
- Delivering an oral presentation.

Individual Assignments

- **Reports, Letters, and CVs**: 4.5 hours.
- **Oral Presentation of Summary assignement**: 3 hours.
- **Reading Comprehension and Summarization**:
  - **Session 1**: Theme: *Pollution*.
  - **Session 2**: Theme: *Renewable Energy*.
  - **Session 3**: Theme: *Sustainable Development*.
  - **Task**: Read texts and produce summaries (4.5 hours).
- **Thematic Oral Presentations**:
  - Individual 5-page document and 3-minute oral presentation (4.5 hours).

Assessment Methods

Final Exam: 100%

Bibliographic References

(L*ivres et polycopiés, sites internet, etc.)*

1. Jean-Denis Commeignes, 12 méthodes de communications écrites et orale – 4éme édition, Michelle Fayet et Dunod 2013.
2. Dubost M., Améliorer son expression écrite et orale toutes les clés, Edition Ellipses 2014
3. Fayet M., Réussir ses comptes rendus, 3e édition, Eyrolles, 2009.
4. Lebrun J.-L., Guide pratique de rédaction scientifique, EDP Sciences, 2007.
5. Kalika M., Mémoire de master - Piloter un mémoire, Rédiger un rapport, Préparer une soutenance, Dunod, 2016.
6. Greuter M., Réussir son mémoire et son rapport de stage, l'Etudiant, 2014
7. Cartier F., Communication écrite et orale, Edition GEP- Groupe Eyrolles, 2012
8. https://www.youtube.com/watch?v=sFCSvD9oCME
9. https://www.youtube.com/watch?v=ySMcrfOCxo8

Semester : 1
Teaching Unit: DTU1.1
Subject : IT
VHS :37.5h (Lectures : 15h, PS 22h 30)
Coefficient : 1
Credit : 2

Introduction to Office Software

1. Microsoft Word for Windows

A. General Overview

- Interface Layout: Title bar, status bar, ribbon interface.
- File Management: Creating a document, text entry, saving files, working with multiple files, printing.

B. Document Entry and Formatting

- Text Entry: Default text input.
- Proofing Tools: Spell check and grammar correction.
- Document Formatting:
    - Font selection, margins, paragraph spacing, alignment, borders.
    - Inserting headers and footers.
    - Applying bullets, numbering, and multi-column layouts.

C. Tables, Images, and Shapes

- Tables: Inserting and formatting tables within a document.
- Images: Inserting and formatting images.
- Diagrams: Creating schematics using predefined shapes.
    - Incorporating references: Footnotes and bibliographic citations.

2. Microsoft Excel for Windows

A. General Overview

- Interface Layout: Title bar, status bar, ribbon interface, worksheet grid, formula bar.
- Workbook Management: Saving workbooks, handling multiple workbooks.

- Data Operations: Moving, copying, pasting, and quick sorting.
- Page Layout and Printing: Configuring print settings.

B. Functions and Charts

- Common Functions:
    - Basic calculations: SUM, AVERAGE, VARIANCE.
    - Mathematical functions (e.g., SQRT, LOG).
- Chart Creation: Generating graphs from data.

Lab sessions:

- **Office Software Basics:**
    - **Microsoft Word for Windows: Hands-on practice in document creation, formatting, and referencing.**
    - **Microsoft Excel for Windows: Data manipulation, formula application, and chart design.**

Assessment Methods

Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

- De Dan Gookin, Jean-Pierre Cano, Philip Escartin, Word 2021 pour les Nuls, 2022
- De Greg Harvey, Philip Escartin , Excel 2021 pour les Nuls, 2021
- De Benjamin B, Microsoft Powerpoint en 30 minutes: Les bases de Microsoft Powerpoint 2019 en 30 minutes, 2021
- De Joël Green, J'apprends à me servir de Outlook 2019: Messagerie, calendrier, contacts, 2020
- https://www.excel-pratique.com/fr/cours

Semester: 1

Teaching Unit: DTU 1.1

Subject : Electrical engineering

VHS:11h 15 (Lectures : 11h 15)

Coefficient : 1

Credit :2

Course Objectives

The overarching objective of this course is to familiarize students with the foundational principles of electrical engineering, enabling them to understand the operational principles of transformers and electrical machines. This knowledge prepares them to apply these concepts in their future professional roles within industrial enterprises.

Recommended Prerequisites
Physics and Basic concepts of electrical engineering.

Course Content

Chapter 1: Fundamentals of Electricity (2 weeks)
Chapter 2: Electrical Circuits and Power (3 weeks)
Chapter 3: Magnetic Circuits (4 weeks)
Chapter 4: Transformers (4 weeks)
Chapter 5: Introduction to Electrical Machines (2 weeks)

Assessment Methods
Final Exam: 100%

Bibliographic References

Joseph A. EDMINISTER. “Théorie et application des circuits électriques”, SERIE SCHAUM, ISSN : 0769-2727. 1994.

René Meys. “Lignes de transmission : Régimes transitoire et sinusoïdal Applications », Ellipses Marketing (15 août 2006), ISBN-10: 2729829989

Systèmes Electriques : Résumés de cours et problèmes corrigés sur les: Machines à courant continu Réseaux électriques triphasés Transformateurs (French Edition) ”, ISBN-10: 3841739016.2016

Amari Mansour. “Circuits électriques et magnétiques : Cours et exercices corrigés ”, Saint Honoré Editions (31 janvier 2019), ISBN-10: 2407012046

F.Lucas, P.Charruault. “Les machines électriques ”, Delagrave, Génie électrique : collection

F. Lucas, ISSN 0297-536X. 1987.

Dominique Bareille, Jean-pierreDaunis. “ Transformateurs et machine électrique”, ISBN 2100076167. Dunod Paris 2006.

Semester : 1
Teaching Unit: DTU1.1
Subject : Introductory Internship in a Company
VHS : 40 h individual work
Credits : 2
Coefficient : 1

Learning Objectives

- Gain an internal perspective of corporate operations.
- Explore hierarchy, organizational structure, communication, and reporting protocols.
- Understand operational workflows, task planning, and assignment strategies.
- Familiarize with the company's core processes and technologies.

Recommended Prerequisites: None

Course Content

1. Corporate Organization and Hierarchy

- Global organizational chart: Key departments, units, and their functional/operational relationships.

2. Corporate Communication

- Information flow and feedback mechanisms.
- Communication networks (channels and formats: intranet, internet, internal systems).
- Reporting protocols.

3. Corporate Planning

- Preparation of action plans.
- Task scheduling and delegation strategies.

4. Overview of Core Company Processes

- Foundational understanding of the company's primary operational and technical procedures.

Assessment Methods

1- Internship report: 75%.
2- Company assessmant: 25%

Bibliographic References

Michel VILLETTE, Guide du stage en entreprise, La découverte, 2004
Laurent Hermel, Pascale Hermel , Gaëlle Hermel, Réussir son stage en entreprise, Ladécouverte 2009
Michel Villette, L'art du stage en entreprise, La découverte, 1994

Semester S2
Detailed Course Syllabus
Second Semester of the 1st Year (Second Cycle)

Semester : 2
Teaching Unit: FTU 1.2.1
Subject 1: Biological Processes Applied to Wastewater Treatment
VHS: 52 h30 (Lectures: 22h30, PS 15h, Lab 15h)
Coefficient : 2
Credits : 5

Course Objectives

This course addresses bacterial growth kinetics and the modeling of free-floating bacteria biological reactors to demonstrate the influence of fundamental parameters on substrate removal and biomass production. It further explores biological transformation pathways for organic pollution in aerobic and anaerobic environments, as well as nitrogen and phosphorus pollution in wastewater. The course introduces the foundational principles for designing all components of a wastewater treatment plant (pretreatment, primary clarifier, biological reactor, secondary clarifier, etc.), including oxygen demand calculations, aeration system design, sludge production estimation, and methods for diagnosing and optimizing existing installations. Sequenced-feed activated sludge reactors and membrane bioreactors are also briefly introduced.

Expected Competencies

- Perform mass balances for a biological reactor and wastewater treatment plant.
- Understand the impact of operational parameters on biological reactor performance.
- Design an activated sludge wastewater treatment plant (sizing components, calculating reagent and energy consumption, etc.).
- Diagnose the performance of industrial wastewater treatment facilities.

Recommended Prerequisites

Foundations in chemistry, biology, and fluid mechanics.

Course Content

I. Introduction: Water Scarcity Issues in Algeria (1 Week)

II. General Data on Wastewater

- Pollution parameters
- Composition
- Wastewater flow rates
- Regulatory framework

III. Pretreatment (2 Weeks)

- Screening
- Grit removal
- Oil and grease separation
- Sizing of pretreatment units

IV. Primary Treatment: Primary Clarification (1 Week)

- Granular settling
- Piston settling
- Zone settling
- Types of clarifiers

- Clarifier design parameters
- Clarifier I performance evaluation

V. Biological Treatments

V.1. Principles of Biological Treatment (2 Weeks)

- Definition of biological processes
- Aerobic metabolism
- Anaerobic metabolism
- Kinetics of biochemical reactions in aerobic treatment
- Impact of environmental conditions on biological processes

V.2. Intensive Biological Treatments (5 Weeks)

- Free-floating cultures
- Fixed cultures
- Activated sludge (removal of carbonaceous, nitrogenous, and phosphorus pollution)
- Sequencing batch reactors (SBRs)
- Trickling filters
- Submerged fixed beds (biofilters)
- Fluidized beds
- Rotating biological contactors
- Membrane bioreactors (MBRs)
- Processes for reducing biological sludge production

V.3. Extensive Biological Treatments (2 Weeks)

- Types of lagoons (anaerobic, facultative, etc.)
- Constructed wetlands

VI. Secondary Clarification (2 Weeks)

- Fundamental concepts
- Dynamic modeling of clarifier II

VII. Degassing

Laboratory Sessions

- **Wastewater characterization**: TSS (Total Suspended Solids), VSS (Volatile Suspended Solids), COD (Chemical Oxygen Demand), BOD5 (Biochemical Oxygen Demand), TOC (Total Organic Carbon), biogenic elements, and toxic elements.
- **Activated sludge pilot unit**: Determining operational conditions and monitoring biological treatment efficiency.
- **Nitrification and denitrification tests**.
- **Determination of activated sludge respiratory coefficients**.
- **Sludge settleability characterization**: Settling curves and sludge volume index (SVI).
- **Microscopic and macroscopic analysis of activated sludge**: Diagnosing operational issues.

Assessment Methods

Continuous Assessment: 50%

Final Exam: 50%

Bibliographic References:

- **L'analyse de l'eau : Eaux naturelles, eaux résiduaires, eau de mer, Contrôle et interprétation,** Jean Rodier, Bernard LegubeEditeur(s) : Dunod, Collection : Technique et Ingénierie, Nombre de pages : 1824 pages, Date de parution : 07/09/2016 (10e édition), EAN13 : 9782100754120
- **Gestion des eaux usées urbaines et industrielles : caractérisations, techniques d'épuration, aspect économique.**W.w Eckenfelder:Edition Lavoisier. 1982
- **L'épuration biologique des eaux. Théorie & technologie des réacteurs**.F.Edeline:Technique et Documentation CEBEDOC 1988
- **Water Reuse : Issues, Technologies, and Applications** , Takashi Asano, Ed Franklin Burton · 2007
- **Wastewater Engineering: Treatment and Reuse.** George Tchobanoglous, Franklin Louis Burton, H. David Stensel, Metcalf & Eddy, Inc., Franklin Burton. McGraw-Hill Education, 2003 - 1819 pages

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- **Mémento technique de l'eau - Degrémont SA.** Tomes 1 et 2, Editeur(s) : Degrémont, Nombre de pages : 1718 pages, Date de parution : 17/05/2005 (10e édition), EAN13 : 9782743007171
- **Procédés physico-chimiques et biologiques - Cours et problèmes résolus -** Claude Cardot.Génie de l'environnement, Editeur(s) : Ellipses, Collection : Technosup ; Nombre de pages : 256 pages ; Date de parution : 01/09/1999, EAN13 : 9782729859817
- **Guide pratique des stations de traitement des eaux**, Xavier Lauzin Editeur(s) : Eyrolles, Collection : Blanche BTP, Nombre de pages : 266 pages, Date de parution : 29/10/2009 , EAN13 : 9782212125665
- **Wastewater and Biosolids Treatment Technologies: The Comprehensive Reference for Plant Managers and Operators.**Cheremisinoff, Nicholas P, Publisher: Rockville,MD. ABS Consulting Government Insitutes 2003; Description: xxiv,344p. ill. 27cm., ISBN: 086587946X.

Semester : 2
Teaching Unit: FTU 1.2.1
Subject 2: Water Biochemistry
VHS : 45h (Lectures: 15h, PS: 15h, Lab : 15h
Coefficient :2
Credits : 4

Course Objectives

- Acquire fundamental knowledge of environmental biochemistry.
- Describe the primary properties of biological molecules: carbohydrates, lipids, amino acids, peptides, proteins, nucleic acids, and key heterocycles.
- Outline cellular catabolic pathways leading to the formation of high-energy bond molecules and anabolic pathways for the synthesis of nucleotides, nucleic acids, proteins, lipids, and carbohydrates.

Expected Competencies

Mastery of standard biochemical techniques relevant to engineering applications.

Recommended Prerequisites

Basic knowledge of natural sciences and organic chemistry.

Course Content

I. Introduction to Biomolecules (1 week)

1. Molecular constituents of the cell.
2. Principles of bioenergetics.

II. Carbohydrates (2 weeks)

1. Introduction
2. Roles of carbohydrates
3. Classification of carbohydrates
4. Monosaccharides
5. Glycosides
6. Microbial degradation of cellulosic compounds and the carbon cycle.
7. Electron transport and cycles of phosphorus and oxygen.

III. Proteins (2 weeks)

1. Structure and properties of proteins
2. Structure and properties of amino acids
3. Peptides
4. Microbial degradation of proteins; nitrogen and sulfur cycles.

IV. Enzymes and Enzyme Kinetics (2 weeks)

1. Enzyme structure and mechanisms of action
2. Specificity of enzymatic catalysis
3. Enzyme classification and standardization
4. Enzyme kinetics
5. Selected application examples

V. Lipids (2 weeks)

1. Structure and properties of fatty acids
2. Structure and properties of lipids
3. Microbial degradation of petroleum residues (e.g., n-alkanes).

VI. Energy Metabolism (1 week)

- Carbohydrate, lipid, and protein metabolism.

Laboratory Sessions

- **Lab No. 1**: Study of Carbohydrates
- **Lab No. 2**: Identification of Carbohydrates via Physicochemical Reactions
- **Lab No. 3**: Protein Quantification
- **Lab No. 4**: Titration and Characterization of Two Amino Acids
- **Lab No. 5**: Study of Lipids
- **Lab No. 6**: Final Assignement

Assessment Methods

Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

LEHNINGERL.,(1982),Biochimiegénérale
SCRIBANR.,(1984),Biotechnologie,TecetDocLavoisierWeilJH.,(2006),BiochimiegénéraleEditio nDunod.
LEHNINGERL.,(1982),Biochimiegénérale
SCRIBANR.,(1984),Biotechnologie,TecetDocLavoisier.
JOUD.,LIEBOTJE.,(1990),Thermodynamique desprocessusbiologiquesTecetDoc Lavoisier
Doran P.M., Bioprocess Engineering Principles, Academic Press, 2eédition, 2013
Clarke K.G., Bioprocess Engineering, Elsevier, 2013.

Semester: 2
Teaching Unit: FTU 1.2.2
Subject : Water Microbiology
VHS: 52h30 (Lectures: 22h 30; PS : 15h ; Lab : 15h)
Coefficient :2
Credits : 4

Course Objectives

After reviewing the biological diversity of microorganisms in aquatic environments, this course first focuses on bacteriology: microbial growth, the influence of chemical and physical factors on bacterial growth, the role of microorganisms in carbon, nitrogen, and sulfur cycles, the environmental consequences of their activities, the impact of anthropogenic factors, and the application of microbial processes in biological treatment.
In the second part of the course, emphasis is placed on public health risks associated with pathogenic microorganisms in water systems, particularly in relation to water treatment and usage. Case studies of waterborne parasitic, bacterial, and viral diseases are discussed. Finally, legislative frameworks for fecal contamination indicators are introduced.

Expected Competencies:
- Perform bacterial cultures and enumeration.
- Distinguish major metabolic pathways.
- Conduct microbiological risk analyses related to water usage.

Recommended Prerequisites:
Basic knowledge of natural sciences.

Course Content

Chapter I: Introduction to General Microbiology (3 weeks)
Eukaryotic protists (algae, fungi, yeasts, protozoa) – Prokaryotic protists (cyanobacteria, bacteria) – Bacterial taxonomy and ecology – Viruses.

Chapter II: Biochemical Activities of Microorganisms (2 weeks)
Nitrogen cycle, carbon cycle, sulfur cycle, iron cycle, phosphorus cycle – Hydrocarbon degradation: bioremediation.

Chapter III: Water Microbiology (3 weeks)
- **Freshwater** (surface water, groundwater, distribution systems): microbiological aspects.
- **Wastewater** (self-purification, remediation, microbiological aspects of chlorine/ozone/UV disinfection, activated sludge microbial ecology).
- Key microorganisms in contaminated water (bacteria, viruses, protozoa).
- Rapid detection methods for waterborne microorganisms.

Chapter IV: Microbiology of Extreme Environments (1 week)
Halophiles – Thermophiles – Acidophiles.

Chapter V: Antibacterial and Antiviral Agents (2 weeks)

Definitions (ISO standards), antimicrobial/antiviral action, classification of antimicrobial agents, bacterial resistance mechanisms, classification of antiviral agents.

Chapter VI: Examples of Biological Processes Applied to the Environment (2 weeks)

Bioconversion – Biotreatment – Bioremediation – Biotransformation.

Chapter VII: Biofilms (2 weeks)

- Bacterial metabolism and industrial applications.
- Stages of biofilm formation and development conditions.
- Effects of biofilms in environmental systems.

Laboratory Sessions

1. **Lab 1**: Microbiological techniques and procedures.
2. **Lab 2**: Isolation, purification, and preservation of microorganisms.
3. **Lab 3**: Macro- and micromorphological study of bacteria.
4. **Lab 4**: Gram staining and spore staining.
5. **Lab 5**: Classical biochemical tests and API systems.
6. **Lab 6**: Study of environmental factors.
7. **Lab 7**: Microbial growth kinetics.
8. **Lab 8**: Final Assignement.

Assessment Methods

Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

SEAGREN, E. A. and AYDILEK, A.H. 2010. Biomediated Geomechanical Processes, CHAPTER 14 In *Environmental Microbiology, edited by Ralph Mitchell and Ji-Dong Gu, Wiley and Sons Publications, pp:319-348.*

Pauline M. Doran, Bioprocess Engineering Principles, Academic Press, 2^{e}édition, 2013

K.G. Clarke, Bioprocess Engineering, Elsevier, 2013.

Dellaras C., Microbiologie de l'environnement avec législation, Ed. Gaetan Morin, 2000.

Pelmont J., Bactéries et environnement: adaptation physiologique, Ed. OPU, 1995.

Sterrit Robert N. et Lester,John N., Microbiology for Environmental and Public Health Engineers, Ed. E. and F.N. Spon, 1988.

Champiat D. et Larpent J.P., Biologie des Eaux: Méthodes et Techniques, Ed. Masson, 1994.

PELMONT J., (2005), Biodégradations et Métabolismes, les bactéries pour les Technologies de l'Environnement ISBN 2-86883-745 EDP Science

BLOCK J.C., APPENZELLER B.M.R., (2001), Biofilms et distribution d'eau potable, Bull. Soc. Fr. Microbiol, 16, (1), p.7-

Semester :2
Teaching Unit: FTU 1.2.2
Subject : Irrigation Techniques
VHS : 52h30 (Lectures: 1h30, PS:1h30)
Coefficient :1
Credits : 3

Objective
The primary purpose of irrigation and drainage is to regulate the water, saline, thermal, nutrient, and gaseous regimes of soils to ensure favorable conditions for crop development. The **irrigation course** aims to: Assess crop water requirements, Determine irrigation schedules and Study watering methods and techniques.
The **drainage course** addresses: Water excess, Water table rise, Soil salinization and their consequences.
Irrigation and drainage must enhance soil regimes while prioritizing soil conservation and environmental sustainability.

Prerequisites: Chemistry; Subsurface Hydraulics, Hydrogeology, Agro-pedology, Hydrology.

Program Content

Chapter 1: Introduction (3 weeks)
1.1. History of Irrigation and its role in civilizations.
1.2. Global Irrigation Practices.

Chapter 2: Crop Water Requirements
2.1. Soil Water Fundamentals:
- Soil water content and measurement methods.
- Energy state of soil water.
- Dynamics of water in soil.

2.2. Evapotranspiration: Definition and calculation.
2.3. Statistical Analysis of Rainfall to determine the reference year.
2.4. Water Balance.
2.5. Calculating Water Requirements for crops in a rotation system.

Chapter 3: Irrigation Water Quality
3.1. Classification of Conventional Water.
3.2. Classification of Non-Conventional Water.

Chapter 4: Irrigation Theory
4.1. Peak Month determination.
4.2. Specific Flow Rate and characteristic flow rate calculation.
4.3. Irrigation Dose: Definition and Problems application.
4.4. Irrigation Frequency and Duration.
4.5. Parameter Calculation for specific irrigation systems.

Chapter 5: Irrigation Systems
5.1. **Surface Irrigation**:

- Basin irrigation (submersion).
- Border irrigation (infiltration).
- Furrow irrigation (runoff and infiltration).

5.2. **Design and Sizing** of irrigation methods.
5.3. **Network Efficiency**.
5.4. **Surface Irrigation Simulation** (furrows) using SIRMOD software.
5.5. **Sprinkler Irrigation**:

- Medium- and high-pressure systems.
- Network and conveyance system design.
- Hose reels, center pivots, and lateral moves.
- System efficiency.

5.6. **Drip Irrigation**:

- Systems: Drip, micro-sprinklers, perforated laterals.
- Parameter calculation (water requirements, wetted soil percentage).
- Emitter selection, network design, head unit description.
- System efficiency.

Chapter 6: Multicriteria Analysis for Irrigation System Selection
6.1. Data Requirements for irrigation project feasibility.
6.2. Synthesis Table for system selection.

Chapter 7: Salinity Issues and Irrigation
7.1. Soil Salinity.
7.2. Irrigation Water Salinity.
7.3. Leaching principles.

Chapter 8: Environmental Impact of Irrigation
8.1. Hydrological Impacts.
8.2. Water Quality Effects.
8.3. Soil Quality Degradation.
8.4. Socioeconomic Environmental Impact.

Problem Sets

- Statistical analysis of rainfall to determine the reference year.
- Calculation of crop water requirements.
- Specific flow rate, irrigation dose, frequency, and duration determination.
- Design of sprinkler, gravity-fed, and localized irrigation networks.
- Classification of irrigation water.

Assessment Methods
Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

1. Mathieu, Clément et Audoye Paul, (2007) Bases techniques de l'irrigation par aspersion, Paris : Tec & Doc
2. Rieul Léopold & Ruelle, Pierre : (2003) Irrigation: guide pratique, Paris : CEMAGREF, 344p
3. Tiercelin, Jean-Robert : (1998) Traite d'irrigation , Paris : Tec & Doc, 1011p

Semester : 2
Teaching Unit: MTU2.1
Subject 2: Data Analysis and Processing
VHS: 45 h (Lectures: 22.5h, PS: 22h30)
Credits : 3
Coefficient : 2

Course Objectives

- To understand various statistical operations and their applications.
- To learn processes for extracting information or generating knowledge from raw data. These processes, once programmed, are typically automated using computers. While the final outputs are intended for human use, their presentation is often critical to assessing their value.

Recommended Prerequisites:
Students must have completed preparatory coursework in mathematics, statistics, and numerical analysis.

Course Content

1. Univariate Series Analysis
1.1. Descriptive Statistics
- 1.1.1. Qualitative Variables (Tables, Graphs)
- 1.1.2. Discrete Quantitative Variables (Tables, Graphs)
- 1.1.3. Continuous Quantitative Variables (Tables, Graphs)

1.2. Statistical Summaries
- 1.2.1. Measures of Central Tendency
- 1.2.2. Measures of Dispersion
- 1.2.3. Measures of Shape
- 1.2.4. Frequency Distribution Tables
- 1.2.5. Box-Plot Analysis

1.3. Estimation
- 1.3.1. Mean
- 1.3.2. Frequency
- 1.3.3. Variance

2. Bivariate Series Analysis
2.1. Comparison Tests
- 2.1.1. Comparison of Means (Four Cases)
- 2.1.2. Comparison of Proportions
- 2.1.3. Comparison of Variances

2.2. Linear Regression
- 2.2.1. Covariance
- 2.2.2. Regression Line
- 2.2.3. Regression Sum of Squares
- 2.2.4. Regression and Causality

2.3. Chi-Square Test
- 2.3.1. Contingency Tables
- 2.3.2. Independence Tables
- 2.3.3. Case Studies

2.4. Analysis of Variance (ANOVA)
- 2.4.1. Qualitative/Quantitative Correlation
- 2.4.2. ANOVA Table
- 2.4.3. Linear Models
- 2.4.4. ANOVA-Associated Tests

3. Multidimensional Analysis

3.1. Principal Component Analysis (PCA)
- 3.1.1. Matrices
- 3.1.2. PCA Algorithm
- 3.1.3. Projections
- 3.1.4. Inertia
- 3.1.5. PCA Interpretation
- 3.1.6. Multiple Regression

3.2. Factor Analysis
- 3.2.1. Dynamic Cross-Tabulation
- 3.2.2. Correspondence Analysis (CA) Algorithm
- 3.2.3. CA Interpretation

Problem Sets
- PS1: Distribution of Discrete and Continuous Series
- PS2: Statistical Summary Calculations
- PS3: Probability Laws
- PS4: Conformity Tests
- PS5: Statistical Hypothesis Testing
- PS6: Linear Regression Analysis
- PS7: Chi-Square Test
- PS8: Analysis of Variance (ANOVA)
- PS9: Principal Component Analysis (PCA)
- PS10: Correspondence Factor Analysis (CFA)
- PS11: Hierarchical Ascending Classification (HAC)

Assessment Methods

End-of-Semester Exam: 50%

Continuous Assessments: In-class tests, Problem Sets, oral exams, assignments.: 50%

Bibliographic References

- Analyse statistique des données, H. Fenneteau, C. Bialès Edition Ellipses,1998
- Analyse des données,Une approche par comparaison de modèles, Charles M Judd, Gary H McClelland, Carey S Ryan, Dominique Muller, Vincent Yzerbyt, Edition deboeck supérieur

Semester: 2
Teaching Unit: MTU 2.1
Subject : Sludge Treatment of Sewage Treatment Plants
VHS : 60h (Lectures: 22h30, PS: 15h, Lab 7h30)
Coefficient : 2
Credits : 3

Course Objectives

This course focuses on the treatment and valorization pathways for sewage sludge. It covers:

- Operational principles, technological aspects, design fundamentals, and performance evaluation of liquid sludge treatment processes, including: Static and dynamic thickening, Dewatering (filter presses, belt filters, centrifugation), Conditioning, and Stabilization.
- An overview of sludge production and composition, followed by valorization methods: Agricultural spreading, Composting, Incineration, Methanization (regulatory and technological aspects).

Expected Competencies

- Design and size sludge treatment pathways.

Recommended Prerequisites: Biological Processes Applied to Wastewater Treatment.

Course Content

I. Sewage Sludge (WWTP Sludge) (2 weeks)

- Origin, quality, characteristics, and quantity of sludge.
- Algerian legislation governing sludge management.

II. Sludge Treatment (6 weeks)

- **Thickening:**
  - **Static thickening.**
  - **Centrifugation.**
  - **Flotation.**
  - **Drainage.**
- **Stabilization:**
  - Anaerobic stabilization: Methanization.
  - Aerobic stabilization.
- **Hygienization.**
- **Conditioning:** Organic and mineral conditioning.
- **Dewatering:**
  - Filter presses.
  - Centrifugation.
  - Belt filters.
  - Drying
  - Reed bed drying.

  - Solar drying.
- **Thermal drying.**

III. Valorization (6 weeks)

- Agricultural Valorization of Sewage Sludge:
  - Benefits, agronomic value, and risks of application.
  - Composting.
  - Sludge spreading.
- Energy Recovery from Sewage Sludge:
  - Incineration.
  - Co-incineration.
  - Gasification.
  - Pyrolysis.

IV. Disposal in Landfills (CET) (1 week)

Laboratory Sessions

1. **Sludge Characterization:**
   - Dry solids content (%), volatile suspended solids (VSS), mineral matter (MM), volatile fatty acids (VFA), pH, calorific value (CV), carbon-to-nitrogen ratio (C/N), specific resistance, Mohlmann index.
2. **Sludge Methanization Tests (**Problem Set**):**
   - Determination of operating conditions and monitoring of treatment efficiency.

Assessment Methods
Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

- Sludge Engineering: The Treatment and Disposal of Wastewater,F. Dilek Sanin, William Wade Clarkson, P. Aarne Vesilind · 2011
- Wastewater Engineering: Treatment and Reuse. George Tchobanoglous, Franklin Louis Burton, H. David Stensel, Metcalf & Eddy, Inc., Franklin Burton. McGraw-Hill Education, 2003 - 1819 pages
- Treatment and Disposal of Wastewater Sludges, P. Aarne Vesilind · 1979 ·
- Traitement des boues résiduaires: Aspects de déshydratation mécanique et thermique. Jean Vaxelaire. 2004 - 138 pages
- Traitement des boues résiduaires par l'association en série d'une désydratation mécanique et d'un séchage thermique. Jean-Marc Bongiovanni. 1998 - 187 pages
- Epandage de boues résiduaires et effluents organiques : matériels et pratiques. François Thirion, Frédéric Chabot
- L'ozonation et son application au traitement des boues de station d'épuration des eaux usées domestiques en vue d'une disposition par épandage agricole. Stéphane Robic, 1988.
- Mémento technique de l'eau - Tomes 1 et 2, Editeur(s) : Degrémont, Nombre de pages : 1718 pages, (10e édition), EAN13 : 9782743007171

Semester : 2
Teaching Unit: TTU 2.1
Subject : Technical English 1
VHS : 22h30 (Lectures : 1h30)
Coefficient : 1
Credits : 2

Course Objectives

This course is dedicated to Technical English.
The curriculum focuses on linguistic review and/or advanced skill development, enabling students to:

- Express themselves fluently in spoken communication,
- Apply grammatical concepts essential for accurate comprehension,
- Utilize technical vocabulary effectively,
- Communicate proficiently in both written and oral formats.

Recommended Prerequisites
Basic English vocabulary and grammar.

Course Content

1. **Reading Comprehension:** Reading and analyzing texts related to the specialization.

2. **Listening Comprehension:** Engaging with authentic popular science video materials, Note-taking, summarization, and oral presentation of content.

3. **Oral Expression:** Developing and exchanging oral messages (ideas and data), Telephone communication, Gestural communication and non-verbal cues.

4. Written Expression: Extracting key ideas from scientific documents, Writing scientific messages and summaries, Exchanging information in written form.

Assessment Method
Final Exam: 50%

Bibliographic References

P.T. Danison, Guide pratique pour rédiger en anglais: usages et règles, conseils pratiques, Editions d'Organisation 2007
A.Chamberlain, R. Steele, Guide pratique de la communication: anglais, Didier 1992
R. Ernst, Dictionnaire des techniques et sciences appliquées : français-anglais, Dunod 2002.
J. Comfort, S. Hick, and A. Savage, Basic Technical English, Oxford University Press, 1980
E. H. Glendinning and N. Glendinning, Oxford English for Electrical and Mechanical Engineering, Oxford University Press 1995
T. N. Huckin, and A. L. Olsen, Technical writing and professional communication for nonnative speakers of English, Mc Graw-Hill 1991

J. Orasanu, Reading Comprehension from Research to Practice, Erlbaum Associates 1986

1. J. Upjohn, S. Blattes, V. Jans, Minimum Competence in Scientific English, Office des Publications Universitaires, 1994.
2. A.J. Herbert, The Structure of Technical English, Longman, 1972.
3. S. Berland-Delepine, Grammaire méthodique de l'anglais moderne avec exercices, Ophrys, 1982.
4. Test of English as a Foreign Language – Preparation Guide, Cliffs, 1991.
5. R. Fowler, The Little, Brown Handbook, Little, Brown Company, 1980.
6. Cambridge – First Certificate in English, Cambridge books, 2008.
7. K. Wilson, Th. Healy, First Choice, Oxford, 2007.

Semester :2
Teaching Unit: DTU2.1
Subject 1: Health, safety and environment
VHS: 22h30 (Lectures: 15h, PS: 7h 30)
Credits : 2
Coefficient : 1

Course Objectives

This course unit provides a comprehensive overview of Health, Safety, and Environment (HSE), introducing foundational concepts in hygiene, safety, and environmental management, and their impact on workplace practices.

Course Content

1. Introduction
2. Definitions and Concepts Related to Health, Safety, and Environmental (HSE) Aspects
   — Hygiene
   — Safety
   — Environment
3. HSE Framework

3.1. Sustainable Development Approach – HSE Perspective
3.2. Standard Functions of an HSE Framework
3.2.1. Role of the HSE Framework
3.2.2. Objectives of the HSE Department
3.2.3. Core Missions
a) Research
b) Operational
c) Functional or Advisory
3.2.4. Examples of HSE Department Actions
a) Preventive Actions
b) Corrective Actions
3.3. Role of the HSE Prevention Engineer
3.4. Key Elements of HSE Management System Excellence
a) Leadership
b) Organizational Structure
c) Operational Processes
3.5. HSE System Improvement Process
3.5.1. Commitment and Accountability
3.5.2. Risk Management
3.5.3. Occupational Health and Personnel Safety Management
3.5.4. Environmental Management
3.5.5. Contractor Management
3.5.6. Communication and Documentation
3.5.7. Training and Qualification
3.5.8. Incident and Accident Management
3.5.9. Emergency and Crisis Management
3.5.10. Audit and Review
4. Hygiene and Safety Regulations
4.1. Health
4.2. Environment

Assessment Methods : Continuous Assessment: 50%, Final Exam: 50%

Semester: 2
Teaching Unit: DTU 2.1
Subject 3: Membrane Separation Processes
VHS: 67h30 (Lectures:1h30, PS: 1h30 ; Lab :3h)
Coefficient : 1

Course Objectives:

The objective of this course is to provide:

- Theoretical foundations necessary for implementing adsorbents and designing adsorbers of various types: batch, semi-continuous, and continuous.
- In-depth theoretical and experimental knowledge in membrane technologies, as well as familiarity with the latest advancements in membrane science.

Recommended Prerequisites:

Transport phenomena (mass transfer, fluid mechanics), surface chemistry, and heterogeneous catalysis.

Course Content

Chapter 1: General Principles and Definitions (1 Week)
Chapter 2: Membranes (3 Weeks)

- Structure, characterization, and membrane modules.

Chapter 3: Membrane Separation Techniques (5 Weeks)

- Microfiltration, ultrafiltration, nanofiltration, reverse osmosis, and electrodialysis.

Chapter 5: Design of Membrane Systems (2 Weeks)
Chapter 6: Energy Systems (2 Weeks)
Chapter 7: Membrane Performance (1 Week)
Chapter 8: Transport and Transfer Mechanisms through Membranes (1 Week)

Problem Sets**: Membrane Separation Processes**

- Liquid Emulsion Membrane Extraction.
- Preparation and Stabilization of an Emulsion.

Assessment Methods

Continuous Assessment: 50%

Final Exam: 50%

Bibliographic References

1. *Unit Operations Handbook, Volume 1, Mass transfer, Edited by John J. Mcketta, 1993.*
2. *Warren L. Mc Cabe,Julian C. Smith, Pete Harriott «Unit Operations of Chemical Engineering », Mc Graw- Hill, Inc, Fifth Edition, 1993.*
3. *J. P. Brun, Procédés de séparation par membranes, Transport Techniques membranaires Applications, Masson, Paris, 1988.*
4. J. P. Brun, Procédés de séparation par membranes, Transport Techniques membranaires Applications, Masson, Paris, 1988.
5. *Robert E. Treybal,«Mass Transfer Operations»,Third Edition, McGraw –Hill ,1980.*

6. *Al-Zubaidi A.A.J., Parametric Cost Analysis Study of Seawater Reverse Osmosis Systems Design in Kuwait, Desalination, 76(1989) 241-280*
7. *Liberman B,, The importance of energy recovry devices in reverse osmosis desalination, The Future of Desalination in Texas- Volume 2: Technical Papers, Case Studies, and Desalination Technology Resources, 2004.*
8. *Corsin P,, Dessalement de l'eau de mer par osmose inverse: les vrais besoins en énergie, l'eau, l'industrie, les nuisances n°262 (2005) 57-61*
9. *Migliorini G. and Luzzo E,, Seawater reverse osmosis plant using the pressure exchanger for energy recovery: a calculation model, Desalination 165 (2004) 289-298.*
10. *Maurel Alain, Techniques séparatives à membranes: Considérations théoriques, Techniques de l'Ingénieur, traité Génie des procédés J2790, 1988.*

Semester: 2
Teaching Unit: DTU 2.1
Subject: Immersive Internship in a Company
VHS : 40 h individual work
Credits : 2
Coefficient: 1

Objectives

The student is placed in real-world settings within a company or a Wastewater Treatment Plant (WWTP) management department to assume various technical roles through rotations across multiple workstations. The objectives are to:

- Familiarize students with diverse operational activities,
- Expose them to the daily realities faced by workers, technicians, engineers, and managers.

Recommended Prerequisites
Types and composition of wastewater, Wastewater management, Wastewater treatment processes, WWTP logistics, Environmental impacts of wastewater.

Program Content
Internship in Companies and Institutions Involved in Wastewater Management and Treatment

- WWTPs (Wastewater Treatment Plants),
- ONA (National Sanitation Office).

Assessment Method:

1- Internship report: 75%.
2- Company assessmant: 25%

References
Internal company/organization documentation.

Semester S3
Detailed Course Syllabus
Third Semester of the 2st Year (Second Cycle)

Semester : 3
Teaching Unit: UEF 2.1.1
Subject 1: Modeling and Simulation of Processes Applied to REUSE
VHS: 52h30 (Lectures : 22h30, PS 15h ,LAb: 15 h)
Credits : 6
Coefficient : 2

Course Objectives

- Gain familiarity with the concepts of **process modeling and simulation** applied to water treatment.
- Acquire knowledge of the primary **simulation software** used in wastewater treatment.
- Develop foundational skills in designing equipment and processes using specialized software.

Recommended Prerequisites: Mathematics, Physical Chemistry, Fundamentals of Transport Phenomena.

Course Content

Chapter 1 (5 weeks): General Concepts **:** Definition of simulation and mathematical modeling, Overview of commercial simulation software (e.g., HYSYS, Aspen, ProSim, CFX), Core components of a process simulator, Introduction to the selected software platform.

Chapter 2 (5 weeks): Getting Started with the Selected Software, Creating a simulation project, Component selection and database management, Thermodynamic model selection, Navigating the simulation workspace interface, Material stream specification and configuration.

Chapter 3 (5 weeks): Simulation of Key Unit Operations, Pumps, Compressors, Expansion valves, Flash separators, Heat exchangers, Furnaces and reactor.

Laboratory Sessions: **Software-Based Modeling and Simulation**

Assessment Methods
Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

1. Michael E. Hanyark Jr.,«Chemical Process Simulation and the Aspen HYSYS Software », CreateSpace Independent Publishing Platform, 2012.
2. Hossein Ghanadzadeh Gilani, Katia Ghanadzadeh Samper, Reza Khodaparast Haghi, « Advanced Process Control and Simulation for Chemical Engineers », CRC Press, 2012.
3. Alexandre Dimian, « Integrated Design and Simulation of Chemical Processes », Elsevier, 2003.

Amiya K. Jana, « Chemical Process Modeling& Computer Simulation

Semester : 3
Teaching Unit: FTU 2.1.1
Subject 1: Electrotechnics in the Treatment and Reuse of Treated Water
VHS: 52h30 (Lectures: 22h30;PS : 15h ; TLab: 15h)
Coefficient :2
Credit : 6

Course Objectives

This course addresses the principles of hydraulics, automation, control systems, and electrotechnology within the physicochemical and biological treatment processes of wastewater.

Course Content

I. Wastewater Networks

Key Concepts Review

1. Gravity Flow Hydraulics
2. Pumping and Discharge Stations
    - Hydraulics
    - Electrotechnology
    - Automation

II. Pretreatment Processes

Key Concepts Review

1. Screening
    - Process Engineering
    - Hydraulics
    - Automation
    - Control Systems
2. Grit and Grease Removal
    - Process Engineering
    - Hydraulics
    - Electrotechnology
    - Control Systems

III. Primary Treatment

Key Concepts Review

1. Plain Sedimentation
    - Process Engineering
    - Hydraulics
    - Electrotechnology
    - Automation
2. Physicochemical Sedimentation
    - Process Engineering
    - Hydraulics
    - Electrotechnology
    - Control Systems

IV. Secondary Treatment

Key Concepts Review

1. Activated Sludge Process
    - Process Engineering
    - Hydraulics
    - Electrotechnology
    - Automation
    - Control Systems
2. Biofiltration
    - Process Engineering
    - Electrotechnology
    - Automation

V. Sludge Management

Key Concepts Review

1. Sludge Production
    - Process Engineering
    - Hydraulics
    - Electrotechnology
2. Sludge Treatment and Management
    - Process Engineering
    - Hydraulics
    - Automation

Laboratory Sessions

Experimental sessions will be conducted on-site at WWTPs (Wastewater Treatment Plants).

Assessment Methods

Continuous Assessment: 50%

Final Exam: 50%

Bibliographic References

- Techniques appliquées au traitement de I ’eau, Hydraulique, électrotechnique, procédés de traitement Résumé de cours et problèmes résolus, sous la coordination de Claude CARD0T, Edition Ellipse.
- **Gestion des eaux usées urbaines et industrielles : caractérisations, techniques d'épuration, aspect économique.**W.w Eckenfelder:Edition Lavoisier. 1982
- **Mémento technique de l'eau - Degrémont SA.** Tomes 1 et 2, Editeur(s) : Degrémont, Nombre de pages : 1718 pages, Date de parution : 17/05/2005 (10e édition), EAN13 : 9782743007171
- **Guide pratique des stations de traitement des eaux**, Xavier Lauzin Editeur(s) : Eyrolles, Collection : Blanche BTP, Nombre de pages : 266 pages, Date de parution : 29/10/2009 , EAN13 : 9782212125665

- **Guide pratique des stations de traitement des eaux**, Xavier Lauzin Editeur(s) : Eyrolles, Collection : Blanche BTP, Nombre de pages : 266 pages, Date de parution : 29/10/2009 , EAN13 : 9782212125665

Semester :3
Teaching Unit : FTU 2.12
Subject 2: Physical Analysis Methods
VHS: 52h30 (Lectures: 22h30 ; PS: 15h ; Lab : 15h)
Credits : 4
Coefficient : 2

Course Objective
To understand the principles and applications of key physical analysis methods in the field of process engineering.

Recommended Prerequisites:
Basic knowledge of chemical bonding, electronic transitions, analytical chemistry, and solution chemistry.

Course Content

Chapter I: UV-Vis Molecular Spectroscopy (3 Weeks)
- Principles of UV-Vis spectroscopy.
- Theoretical concepts and instrumentation.
- Interpretation of UV-Vis absorption spectra.
- Electronic spectra and absorption in molecular compounds.
- Applications in water analysis.

Chapter II: Infrared Spectroscopy (IR) (3 Weeks)
- Principles of IR spectroscopy.
- Theoretical concepts and instrumentation.
- Presentation of IR spectra and origins of mid-IR absorption.
- Characteristic absorption bands of organic compounds.
- Interpretation of IR absorption spectra.
- Applications in water and sludge analysis.

Chapter III: Chromatographic Methods (3 Weeks)
- Overview of chromatographic methods; general principles of chromatographic separation.
- Types of chromatography: gas phase (GC), high-performance liquid chromatography (HPLC).
- Retention parameters and chromatographic polarity.
- Introduction to capillary columns.
- Comparison of gas-phase vs. liquid-phase chromatography.
- Applications in water analysis.

Chapter IV: Atomic Absorption Spectrometry (AAS) (2 Weeks)
- Fundamentals, instrumentation, and applications.
- Standard addition method for heavy metal quantification in water.

Chapter V: Nuclear Magnetic Resonance Spectroscopy (NMR) (2 Weeks)
- Principles of NMR spectroscopy.
- Theoretical concepts and instrumentation.
- Interpretation of NMR spectra.

Chapter VI: Mass Spectrometry (MS) (2 Weeks)

- Principles of mass spectrometry.
- Theoretical concepts and instrumentation.
- Presentation and interpretation of mass spectra.

Laboratory Sessions (Applications)

- Identification and quantification using HPLC and GC.
- Verification of the Beer-Lambert Law.
- Interpretation of IR absorption spectra: Identification of organic functional groups.

Assessment Methods

Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

1. Francis Rouessac , Annick Rouessac , Daniel Cruché,«Analyse chimique : Méthodes et techniques instrumentales », 7ème Edition Dunod, 2009.
2. Gwenola Burgot, Jean-Louis Burgot,« Méthodes instrumentales d'analyse chimique et applications : méthodes chromatographiques, électrophorèses, méthodes spectrales et méthodes thermiques », 3ème Edition, Tech & Doc, 2011.
3. R.Rosset,« Chromatographie en phase liquide », Masson, 1995, M. Dalibart, L. Servant, « Spectroscopie dans l'infrarouge, Techniques de l'Ingénieur, traité Analyse et Caractérisation », P2845, 2000.
4. instrumentales », 7ème Edition Dunod, 2009.
5. Gwenola Burgot, Jean-Louis Burgot,« Méthodes instrumentales d'analyse chimique et applications : méthodes chromatographiques, électrophorèses, méthodes spectrales et méthodes thermiques », 3ème Edition, Tech & Doc, 2011.
6. R.Rosset,« Chromatographie en phase liquide », Masson, 1995
7. M. Dalibart, L. Servant, « Spectroscopie dans l'infrarouge, Techniques de l'Ingénieur, traité Analyse et Caractérisation », P2845, 2000

Semester: 3
Teaching Unit: FTU 2.2.1
Subject : Purification and Energy Efficiency in REUSE Infrastructure
VHS : 22h30 (Lectures : 22h30)
Coefficient : 1
Credits 2

Course Objectives

Building on the knowledge acquired in *"Water and Sludge Analysis and Characterization Techniques"* (Semester 1) and *"Physical Analysis Methods"* (Semester 3), this course focuses on:

1. Evaluating the effectiveness of wastewater and sludge treatment in wastewater treatment plants (WWTPs).
2. Analyzing the two primary treatment processes used in Algeria:
    - Intensive activated sludge treatment and Extensive natural lagooning systems
3. Assessing the energy efficiency of WWTPs, including:
    - Estimating energy consumption budgets.
    - Calculating associated carbon footprints.

The course aims to equip students to:

- Diagnose WWTP performance through mastery of treatment processes and sludge management.
- Ensure high-quality treated water reuse.
- Optimize infrastructure by analyzing energy consumption, costs, and environmental impacts.

Expected Competencies

— Conduct pollution reduction and energy audits for WWTP components.
— Understand the influence of treatment parameters (BOD, COD, etc.) on treatment efficacy.
— Diagnose treatment performance (water and sludge).
— Propose optimization strategies for WWTPs.

Recommended Prerequisites: Chemical Engineering, Environmental Engineering, Electrical Engineering.

Course Content

I.Introduction: Origin and Composition of Wastewater and Sludge ***(2 Weeks)***

II. Wastewater Treatment Efficiency *(2 Weeks)*

- Treatment Stages: Pretreatment, Primary, Secondary, Tertiary, Quaternary.
- Pollutants and Standards:
- Effluent discharge norms.
- Reuse quality standards.
- Performance Indicators:
- Odor and color.
- Biodegradability (BOD/COD ratio).
- Settling properties (TSS, Imhoff test).
- Dissolved oxygen, nitrogen (ammonia, nitrites, nitrates), phosphorus (orthophosphates), potassium.
- Microbial indicators: Total/fecal coliforms, helminth eggs.

III. Sludge Treatment Efficiency *(2 Weeks)*

- Sludge Management: Thickening, dewatering, storage.
- Key Parameters: Sludge age, stability, dryness.

- Pollutants: Sanitary and environmental risks in reuse.

IV. Risks of Emerging Pollutants in Reuse ***(2 Weeks)***

- Persistent Organic Pollutants (POPs): PCBs, PAHs, pesticides, dioxins.
- Microbial Pollutants: Persistence, bioaccumulation, toxicity.

V. Energy Consumption in Activated Sludge Treatment ***(5 Weeks)***

- WWTP Characteristics: Technology, flow rates.
- Energy Demand Analysis:
    - Electrical equipment and installed power.
    - Operational hours and schedules.
    - Daily, seasonal, and annual consumption.
    - Data collection and analysis.
    - Comparison with natural lagooning systems.

VI. Energy Cost Analysis ***(3 Weeks)***

- Cost Breakdown:
    - Hourly, daily, seasonal, and annual costs.
    - National and international average costs.

VII. Carbon Footprint of Energy Consumption ***(2 Weeks)***

- Greenhouse Gases (GHGs):
- Carbon footprint calculation for electricity use.
- Electricity production technologies.
- Global warming potential (GWP).
- Emission factors.

Assessment Methods

Final Exam: 100%

Bibliographic References

- The water–energy nexus in Middle East and North Africa, A. Siddiqi, L.D. Anadon, Energy Policy 39 (2011) 4529–4540.
- Diagnostic of the electricity consumption its cost and greenhouse gas emission in the wastewater treatment sector of Algeria. S.Igoud; F.Souahi; C-E.Chitour; A.Adjrad; M.Habchi; A.Chouikh, Desalination and Water Treatment 55 Issue 7(2015)1725-1734.
- Wastewater Reuse in Arab Countries. Comparative Compilation of Information and Reference List.

ACWUA Working Group on Wastewater Reuse, March 2010. https://www.ais.unwater.org/ais/pluginfile.php/356/mod_page/content/128/Jordan_Su mmary-Report-CountryCasestudies_final.pdf

- World Health Organisation (WHO), Guidelines for the Safe Use of Wastewater,

Excreta and Greywater IN Wastewater Use in Agriculture, vol. 2. World Health Organization (WHO), Geneva, 2006.

- de traitement des eaux, Xavier Lauzin Editeur(s) : Eyrolles, Collection : Blanche BTP, Nombre de pages : 266 pages, Date de parution : 29/10/2009 , EAN13 : 9782212125665

Semester : S3
Teaching Unit: MTU2.1.
Subject : **Dimensioning Sewerage and Irrigation Networks**
VHS: 45h00 (Lectures: 22h30, PS: 22h30)
Crdits :4
Coefficient : 2

Objectives
This course equips students with the skills to design domestic wastewater or stormwater drainage systems, which may operate under separate or combined configurations.

Prerequisites: Basic knowledge of fluid mechanics and open-channel flow.

Program Content

Chapter 1: Municipal Effluents
1.1. Overview
1.2. Stormwater:
- Qualitative characteristics.
- Quantitative assessment (calculation methods).

1.3. Domestic Wastewater:
- Discharge regimes and characteristics.
- Determination of flow rates.

1.4. Public Service Water
1.5. Industrial Wastewater
1.6. Non-Stormwater Inflows

Chapter 2: Sewer Networks
2.1. Principles of Network Layout
2.2. Types of Sewer Systems
2.3. Network Schematics

Chapter 3: Components of Sewer Networks
3.1. Circular Conduits
3.2. Ovoid Conduits
3.3. Pipe Testing Procedures
3.4. Connection Joint Types
3.5. Pipe Material Selection
3.6. Pipe Installation

Chapter 4: Sewer Network Design
4.1. Slope Concepts
4.2. Design Elevations
4.3. Determination of Collector Diameters
4.4. Hydraulic Parameter Calculation

Chapter 5: Ancillary Structures

5.1. Service Connections
5.2. Manholes and Inlets
5.3. Sewer Outlets
5.4. Flow Separation Structures
5.5. Ventilation Devices
5.6. Retention Basins

Chapter 6: Trench Installation of Collectors
6.1. Mechanical Behavior of Collectors
6.2. Installation in Different Soil Types
6.3. Joint Construction
6.4. Leakage Testing of Collectors
6.5. Trench Backfilling

Lab session:
Course Project:

- Design of a wastewater drainage system.
  Problem set:
- Case studies addressing real-world challenges.

Assessment Methods
Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

1. SCHMIDT, P., PELISSIER, A. (2008) Guide pratique de l'eau et de l'assainissement, paris : berger-Levrault, 416pages.
2. SATIN, M., SELMI, B., BOURRIER, R. (2006) Guide technique de l'assainissement, paris : le moniteur, 726pages.

Semester :3
Teaching Unit: MTU2.1
Subject 1 : Water Economics, Accounting, and Taxation
VHS:45h(Lectures:22h30, PS :15h, Lab 7h 30)
Coefficient : 4
Credits : 2

Objective
This course aims to equip engineering students with the knowledge required to analyze the economic aspects of hydrotechnical projects at all levels and stages, including: Site prospecting, Feasibility studies of alternatives, Construction and operation of hydraulic structures.

Recommended Prerequisites:
General Economics, Statistics.

Course Content

Chapter I: Review of Fundamental Economic Principles
1.1. Objectives of Economic Theory.
1.2. Microeconomics and Macroeconomics.
1.3. Economic Agents.
1.4. Key Economic and Administrative Concepts: Supply and demand, Quality-based demand, Quantity-based demand, Water requirements.

Chapter II: Introduction to Hydro-Economics
2.1. Definition of Hydro-Economics.
2.2. Definition of Water Economics.
2.3. Scope and Tasks of Hydro-Economics.
2.4. Structure of Hydro-Economics.

Chapter III: Management of Hydraulic Economics
3.1. National Economy Management and Hydraulic Planning.
3.2. Principles of Hydraulic Economics Management.
3.3. Organization of the Hydraulic Sector and Administrative Oversight.
3.4. Concession Regimes and Easement Frameworks.
3.5. Bodies Responsible for Implementing Hydraulic Policies.

Chapter IV: General Organization of Hydraulic Enterprises
4.1. Organizational Structure and Charts.
4.2. Investment Plan.
4.3. State Subsidies.
4.4. Forms of Subsidies.
4.5. Financial Plan.

Chapter V: Capital and Budget
5.1. Definition of Capital and Budget.
5.2. Depreciation of Fixed Assets.
5.3. Depreciation Methods.
5.4. Capital Discounting.
5.5. Inventory Valuation.

Chapter VI: Accounting Procedures for Hydraulic Enterprises

6.1. Balance Sheet Components.
6.2. Equipment, Furniture, and Real Estate.
6.3. Legal Reserves and General Reserves.
6.4. Types of Provisions.
6.5. Credit Categories:

- Long-Term Credit (LTC),
- Medium-Term Credit (MTC),
- Short-Term Credit (STC).

6.6. Inventory and Accounts Receivable.
6.7. Direct and Indirect Taxes, Value-Added Tax (VAT), Costs, Profits.
6.8. Operating Account and Final Result.

Assessment Methods

Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

1.

1. PAULET, J. PIERRE (1992) Dictionnaire d'économie, édition Eyrolles, 265 pages.
2. TEMMAR, H.(1974) Structures et modèle de développement de l'économie de l'algérie, SNED, 318 pages.
3. ADDA, J.(1998) La mondialisation de l'économie T1 : génèse , Repères, 124 pages
4. ADDA, J.(1998) La mondialisation de l'économie T2 : problèmes, Repères, 123 pages

Semester : 3
Teaching Unit: TTU 2.1
Subject : Technical English2
VHS : 22h30 (Lectures : 1h30)
Coefficient : 1
Credits : 2

Course Objectives:
This course is dedicated almost exclusively to oral activities: presentations, debates, and communication exercises. Emphasis is placed on scientific English, with presentations and debates grounded in scientific research on wastewater treatment and reuse. Activities include note-taking and individual assessments at the end of the semester.

By the end of the course, students will be able to:
— Communicate effectively in oral settings,
— Produce synthesis reports using English-language media.

Recommended Prerequisites
Basic English vocabulary and grammar.

Course Content

1. Written Comprehension: Reading discipline-specific documents (e.g., scientific articles, technical reports).
2. Oral Comprehension: Debating current topics in the field using authentic science communication videos (e.g., documentaries, expert interviews).
3. Oral Expression

- Developing and exchanging oral messages (ideas, data).
- Structured communication exercises (e.g., role-playing, collaborative problem-solving).

4. Written Expression

- Extracting key ideas from scientific texts.
- Writing scientific communications (e.g., abstracts, summaries).
- Exchanging technical information in written form.

Assessment Methods
Final Exam: 100%

Bibliographic References

- *P.T. Danison, Guide pratique pour rédiger en anglais: usages et règles, conseils pratiques, Editions d'Organisation 2007*

8. *A.Chamberlain, R. Steele, Guide pratique de la communication: anglais, Didier 1992*
9. *R. Ernst, Dictionnaire des techniques et sciences appliquées: français-anglais, Dunod 2002.*
10. *J. Comfort, S. Hick, and A. Savage, Basic Technical English, Oxford University Press, 1980*
11. *E. H. Glendinning and N. Glendinning, Oxford English for Electrical and Mechanical Engineering, Oxford University Press 1995*
12. *T. N. Huckin, and A. L. Olsen, Technical writing and professional communication for nonnative speakers of English, Mc Graw-Hill 1991*
13. *J. Orasanu, Reading Comprehension from Research to Practice, Erlbaum Associates 1986*

Semester: 3
Unité d'Enseignement : DTU2.1
Subject : Environmental assessment and inspection
VHS : Lectures 22h30, Coefficient : 2
Credits :2

Course Objectives

The broad field of environmental studies is approached in this course through various tools used for environmental evaluation and inspection. Since the 1970s, environmental assessment has evolved into multiple studies incorporating social components, transitioning from simple project evaluations to assessing the impacts of development Policies, Plans, and Programs (PPPs) on the environment. This course explores the evolution of the discipline, differentiates between existing evaluation frameworks, establishes methodologies for conducting assessments, and presents case studies. Finally, it reviews Algeria's national environmental status and examines the *Environmental Impact Study Guide* developed by the Ministry of Environment and Renewable Energy.

Expected Competencies:

- Understand and master evaluation tools for environmental assessment.
- Integrate social components into environmental evaluations.
- Analyze case studies and apply lessons to real-world scenarios.
- Evaluate Algeria's national environmental context.
- Apply knowledge to the National Strategy for REUE.

Recommended Prerequisites: Environmental Engineering, Process Engineering, Chemical Engineering.

Course Content

I. Introduction (1 week)

II. Environmental Evaluation (1 week)

- Definitions
- Historical origins and evolution
- Tools for environmental evaluation (e.g., ISO 14001).

III. Strategic Environmental Assessment (SEA) (1 week)

- Definition and objectives: Ensuring sustainable environments (aligned with UN Sustainable Development Goal 7).
- Methodology:
    1. Preliminary Assessment: Determine if an SEA is required.
    2. Scoping Study: Identify key issues and SEA boundaries.
    3. Impact Assessment: Collect baseline data and evaluate PPP impacts.
    4. Mitigation: Propose risk minimization and opportunity maximization measures.
    5. Monitoring, Evaluation, and Compliance: Design a PPP implementation monitoring plan.
    6. Reporting: Prepare the SEA report.
    7. Quality Review: Ensure report accuracy.
    8. Decision-Making: Integrate SEA findings into PPP implementation.

IV. Environmental and Social Impact Assessment (ESIA) (1 week)

- Definitions
- Project description and baseline environmental/social conditions.
- Environmental and social sensitivity analysis.
- Legal and institutional frameworks.
- Alternatives analysis, public consultation, and mitigation measures.
- Risk assessments (occupational hazards, environmental risks).

V. Life Cycle Analysis (LCA) (2 weeks)

- Normative framework: ISO 14000 series.
- Phases:
    1. Goal and scope definition.
    2. Inventory analysis.
    3. Environmental impact assessment.
    4. Impact interpretation.
    5. Conclusions and recommendations.
- Software tools for LCA.

VI. Environmental and Social Management Framework (ESMF) (1 week)

- Definitions and project description.
- Baseline environmental/social data.
- Policy, legal, and institutional frameworks.
- Stakeholder consultation.
- Risk analysis and mitigation procedures.
- Cost estimation and security risk evaluation.

VII. Environmental and Social Audit (ESA) (2 weeks)

- Definitions and methodology.
- Institutional, legislative, and regulatory frameworks.
- Audit scope:
    - Company operations, infrastructure, production, waste management, HSE measures.
    - Site conditions (physical, biological, socioeconomic).
- Impact identification, analysis, and mitigation.
- Stakeholder engagement and final recommendations.

VIII. Environmental Impact Study (EIS) (3 weeks)

- Algerian EIS Guide (Volumes 1 and 2).
- Project identification and site description.
- Impact prediction, alternatives analysis, and mitigation.
- Decision-making and project monitoring.

IX. Environmental Inspection (EI) (3 weeks)

- Definitions and Algerian legislation.
- Roles, responsibilities, and missions of inspectors.

Assessment Methods

Final Exam: 100%

Bibliographic References

- **Strategic Environmental Assessment 53: Status, Challenges and Future Directions**, Sadler, B. et R. Verheem (1996), Ministry of Housing, Spatial Planing and the Environment, 1996 - 188 pages
- **Guide des Etudes d'Impacts sur L'Environnement**, Ministère de l'Environnement et des Energies Renouvelables Tome I.
- **Guide des Etudes d'Impacts sur L'Environnement**, Ministère de l'Environnement et des Energies Renouvelables Tome II.
- **Environmental Impact Assessment and Strategic Environmental Assessment: Towards an Integrated Approach**, Abaza, H., R. Bisset et S. Sadler (2004), Service économie et commerce, PNUE, Genève.
- **Strategic Environmental Assessment: Concept and Practice : A World Bank Perspective, project,** Banque mondiale (2004), Washington D.C.
- **Evaluation Environnementale Stratégique (EES),** Directives pour lesÉtats et Territoires insulaires océaniens. Apia, Samoa : SPREP, 2020.88 p

Semester: 3
Teaching Unit: DTU 2.1
Subject : Advanced Internship in a Company 1
Volume horaire :80h individual work
Credits : 2
Coefficient : 1

Internship Objectives:
This internship, lasting an average of two weeks, aims to immerse the student in a company specializing in wastewater management and/or treatment. The student will engage in real-world activities within the organization under the supervision of an industry mentor.

Recommended Prerequisites
- Knowledge of environmental stakeholders and their roles.
- Understanding of wastewater management principles and treatment processes.

Program Content
- On-site learning through hands-on engagement in an industrial workplace.
- Professional experience in a designated role under the guidance of an industry mentor.

Assessment Method:
1- Internship report: 75%.
2- Company assessment: 25%

References
Company Documentation (provided by the host organization).

Semester S4
Detailed Course Syllabus
Fourth Semester of the 2nd Year (Second Cycle)

Semester :4
Teaching Unit: FTU2.2.1
Matière 1 : Hydraulics Modeling and Simulation in Water Reuse
VHS: 52h30(Lectures:22h30 , PS:15h, Lab : 15h)
Coefficient : 2
Credits 5

Objectives
The primary objective of this module is to enable the use of computational tools through applications involving open-source programs, specialized software, and design packages for various hydraulic disciplines.
These applications will allow students to consolidate acquired theoretical concepts by analyzing and interpreting results derived from numerical models.

Prerequisites: Basic knowledge of hydraulics, irrigation techniques, GIS (Geographic Information Systems), and computer fundamentals.

Module Content

Chapter 1: Modeling Flow in Saturated and Unsaturated Porous Media
Chapter 2: CROPWAT (Aquacrop) Software for Calculating Irrigation Water Requirements
Chapter 3: Application of EPANET Software for Design and Simulation of Drip Irrigation Networks
Chapter 4: SWMM Software for Sanitation Network Simulation

Laboratory Sessions
Application and Case Simulation in Water Reuse using CROPWAT, EPANET, and SWMM software.

Assessment Methods
Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References
Raes, D. , Steduto, P., Hsiao, T.C., and Fereres, E., 2015. Aquacrop Reference Manual.
Rome , Italy. Website: www.fao.org/nr/water/aquacrop.html
Application Epanet à l'irrigation : https://youtu.be/vn1kYmb94u4

https://sites.google.com/view/hydraulique32/logiciels

Semester : 4
Teaching Unit: FTU 2.2.1
Subject: Aquatic Environment Quality
VHS: 52h30 (Lectures: 22h30, PS : 15h, Lab 15h)
Coefficient : 2
Credits : 4

Course Objectives
This course examines the various types of pollution affecting aquatic environments, their sources, and the physical, chemical, and biological parameters used to assess the quality of these ecosystems.

Recommended Prerequisites: Foundational knowledge of pollution concepts.

Course Content

1. Introduction to Aquatic Environments and Their Physicochemical Characteristics (1 week)

2. Overview of Freshwater and Marine Pollution (1 week)
- Natural pollution
- Anthropogenic pollution
  - **2.1** Physical pollution
  - **2.2** Chemical pollution
  - **2.3** Biological pollution

3. Sources and Origins of Pollution (1 week)

4. Pollutant Pathways and Receptor Environments (1 week)
4.1 Atmospheric emissions and deposition
4.2 Transfer from soils and continental sediments
4.3 Transfer from marine waters and sediments
4.4 Transfer from surface and groundwater

5. Exposed Matrices (1 week)
5.1 Seawater/freshwater
5.2 Suspended matter and sediments/soil
5.3 Biota

6. Physical Indicators of Aquatic Pollution (1 week)
6.1 Turbidity
6.2 Total Suspended Solids (TSS)
6.3 Temperature
6.4 Conductivity

7. Chemical Indicators of Aquatic Ecosystem Pollution (1 week)
7.1 pH (Hydrogen potential)
7.2 Dissolved oxygen
7.3 Organic and inorganic matter
7.4 Nutrient salts: Water eutrophication

8. Biological Indicators of Pollution (1 week)

8.1 Diatoms (microalgae)
8.2 Macrophytes
8.3 Invertebrates (insects, crustaceans, mollusks, worms)
8.4 Fish

9. Macrodebris and Wreckage Degrading Aquatic Ecosystems (1 week)

9.1 Types of macrodebris
9.2 Origins of macrodebris in aquatic environments
9.3 Impact studies on ecosystems

10. Organic and Inorganic Micropollutants (3 weeks)

10.1 Polycyclic Aromatic Hydrocarbons (PAHs)
10.2 Pesticides: Insecticides, herbicides, fungicides, biocides
10.3 Heavy metals: Mercury, lead, cadmium, arsenic, chromium, copper, aluminum
10.4 Persistent Organic Pollutants (POPs): Organochlorines, toxins, TBT
10.5 Polychlorinated Biphenyls (PCBs)
10.6 Detergents
10.7 Dioxins
10.8 Pharmaceuticals
10.9 Microplastics
- Types of plastics
- Degradation mechanisms from macro- to microplastics
- Effects on aquatic flora and fauna

10.10 Radioactive elements
- Natural and artificial radiation sources
- Pathways of radioactive pollution transfer
- Impact of radiation on biological matter

11. Microbiological Contaminants (1 week)

12. Bioaccumulation, Bioconcentration, and Bioamplification in Contaminated Aquatic Fauna (1 week)

13. Solutions for Combating Water Pollution and Protecting Aquatic Ecosystems (1 week)

Laboratory Sessions (15 hours)

1. Measurement of physical parameters in pond water (temperature, pH, conductivity, turbidity).
2. Quantification of Total Suspended Solids (TSS) and particulate organic matter.
3. Quantification of orthophosphates in seawater.
4. Hexavalent chromium analysis in contaminated water via UV-vis spectrophotometry.
5. Extraction, purification, and concentration of Polycyclic Aromatic Hydrocarbons (PAHs) in seawater.
6. Quantitative analysis of PAHs in seawater using spectrofluorimetry.

Assessment Methods

Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

GAUJOUS D., 1999, La pollution des milieux aquatiques : Aide-mémoire, Ed.Tec & Doc

Lavoisier n.2, 220p.

GRAINDORGE J., 2021, Guide des analyses de la qualité de l'eau, Territorial Ed., 358p.

RODIER J., BAZIN C., BOUTIN J.P., CHAMBON P., CHAMPSAUR H., RODI L., 2005, L'analyse de l'eau : eaux naturelles, eaux résiduaires, eau de mer. Ed. Dunod, Paris.8ème édition, 1383p.
COLAS R.,2019, La pollution des eaux, Presses universitaires de France (Réédition numérique FeniXX), 938 KB.
SIGG D-L., BEHRA P., STUMM W., 2022, Chimie des milieux aquatiques, Ed. Dunod, Paris.5ème édition, 28426 KB

Semester : 4
Teaching Unit: FTU 2.2.2
Subject : Design and Sizing of Wastewater Treatment Plants
VHS: 52 h 30 (Lectures: 22.5 h, PS: 15h, Lab 15h)
Coefficient :2
Credits : 4

Course Objectives:
This course will enable students to design and comprehensively size a wastewater treatment plant. Calculation sheets for each unit process will be provided to achieve a complete plant design using Excel.

Recommended Prerequisites: Knowledge of biological processes applied to wastewater treatment.

Course Content

Introduction
Key Design Data
Selection of the Treatment System

1. **Pretreatment Processes**

- Screening
  - Screen sizing and calculation sheet.
- Grit and Grease Removal
  - Sizing of grit and grease removal tanks; calculation sheet.
- Primary Clarifier
  - Primary clarifier sizing and calculation sheet.

2. **Biological Treatment (Activated Sludge Process)**

- Aeration Tank
  - Hourly oxygen requirement calculation.
- Sludge Mass Balance
  - Excess sludge quantity.
  - Excess sludge concentration and flow rate.
  - Recycled sludge flow rate.
  - Sludge age.
- Secondary Clarifier
  - Clarifier sizing and calculation sheet.

3. **Sludge Treatment**

- Thickening
  - Thickener sizing and calculation sheet.
- Mechanical Dewatering
  - Sizing of filter presses and belt filters.
- Drying Beds

4. **Laboratory Sessions**

- Design Calculations Using Excel.
- Software Application (e.g., industry-standard tools).

Assessment Methods
Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

- **Gestion des eaux usées urbaines et industrielles : caractérisations, techniques d'épuration, aspect économique.**W.w Eckenfelder:Edition Lavoisier. 1982
- **L'épuration biologique des eaux. Théorie & technologie des réacteurs**.F.Edeline:Technique et Documentation CEBEDOC 1988
- **Water Reuse : Issues, Technologies, and Applications** , Takashi Asano, Ed Franklin Burton · 2007
- **Wastewater Engineering: Treatment and Reuse.** George Tchobanoglous, Franklin Louis Burton, H. David Stensel, Metcalf & Eddy, Inc., Franklin Burton. McGraw-Hill Education, 2003 - 1819 pages

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- **Mémento technique de l'eau - Degrémont SA.** Tomes 1 et 2, Editeur(s) : Degrémont, Nombre de pages : 1718 pages, Date de parution : 17/05/2005 (10e édition), EAN13 : 9782743007171
- **Guide pratique des stations de traitement des eaux**, Xavier Lauzin Editeur(s) : Eyrolles, Collection : Blanche BTP, Nombre de pages : 266 pages, Date de parution : 29/10/2009 , EAN13 : 9782212125665
- **Wastewater and Biosolids Treatment Technologies: The Comprehensive Reference for Plant Managers and Operators.**Cheremisinoff, Nicholas P, Publisher: Rockville,MD. ABS Consulting Government Insitutes 2003; Description: xxiv,344p. ill. 27cm., ISBN: 086587946X

Semester: 4
Teaching Unit: MTU 2.2.1
Subject : Mapping and Geographic Information System
VHS : 45h00 (Lectures : 22h30, PS : 22h30)
Credits : 4
Coefficient : 2

Course Objectives:

This course aims to:

- Introduce Master's students to modern geospatial positioning tools and methods for layering and cross-referencing geographic information.
- Develop technical skills in graphic design and cartography to produce high-quality cartographic documents.

Recommended Prerequisites: Topography, Mathematics, Physics.

Course Content

A. Geographic Information Systems (GIS)

1. **Introduction to GIS:**
   - Definition and fundamental principles of GIS.
   - The multidisciplinary and integrative nature of GIS.
   - Brief history of GIS and its application domains.
2. **Data in GIS:**
   - Types of GIS data (graphic vs. non-graphic).
   - Spatial and attribute data structures.
3. **Data Structures in GIS:**
   - Vector format.
   - Raster format.
   - Triangulated Irregular Networks (TIN).
4. **Data Organization in GIS:**
   - Attribute data organization.
   - Object relationships and topology.
   - Object-oriented databases.
   - Expert systems.

B. Cartography

1. **Introduction to Digital Geographic Information:**
   - Definition, typology, and examples.
   - Localization systems and techniques.
   - Coordinate systems, geodetic systems, and Earth surface representation (ellipsoid, geodetic datum).
   - Geospatial databases, aerial photography, and remote sensing imagery.
   - Sources of geospatial data acquisition.
   - Symbolic representation of phenomena: point, linear, and zonal features; color-coded areas.
   - Symbol variations (shape, size, color, orientation) and metadata.
2. **Introduction to Cartography:**
   - Concepts of scale, precision, and map quality.
   - Topographic maps.
   - Nautical maps: Definition and core elements.

- Thematic maps:
  Definitions and cartographic language.
  Workflow: Base maps, data collection/processing, feature placement.
  Visual variables, statistical applications, data discretization.
  Analytical, correlation, and synthesis maps.

Problem Sets

Software: ArcGIS, QGIS (open access).

- PS1: Acquisition and introduction to multisource geospatial data manipulation (formats, visualization, characteristics, georeferencing review).
- PS2: Geoprocessing (creating vector/raster data: digitization, interpolation; import/export, coordinate system conversion, format conversion).
- PS3: Design, implementation, and deployment of a local GIS.
- PS4: Spatial analysis of geospatial data (SQL queries, spatial analysis).
- PS5: Editing vector layers for map integration.
- PS6: Layer symbolization and priority management.
- PS7: Map layout design (line maps and spatial maps).
- PS8: Printing and output preparation.

Assessment Methods
Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

1. *Précis de Télédétection: Principes et méthodes F. Bonn et G. Rochon.. Editions Presses de l'Université du Québec – AUPELF.*
2. *Analyse d'images : filtrage et segmentation. J.P. Cocquerez et S. Philipp. Edition Masson.*
3. *Remote Sensing Digital Image Analysis. J.A. RIchards, X. JIA. Springer,*
4. *Traitement des données de télédétection M.C. Girard et C.M. Girard..*
5. *Editions Dunod, Paris.*
6. *Télédétection : des satellites aux SIG. Edition Nathan Université ROBIN.,*

Semester :4
Teaching Unit: MTU2.2.2
Subject 1: Wastewater and Sludge Reuse
VHS : 45 h(Lectures :22h30, PS:22h30)
Credits :2
Coefficient:1

Course Objectives

- Students will learn the importance of reusing treated wastewater and sludge, as well as the benefits and constraints associated with this practice.
- The objective of this course is to master concepts related to various sludge management and treatment techniques.

Recommended Prerequisites: Foundational knowledge of wastewater purification and biological treatment.

Course Content

A. Reuse of Treated Wastewater

Chapter I (2 weeks):
Challenges in Reusing Treated Wastewater
Integration of reuse into the water cycle:

- Direct reuse (short cycle): Agricultural/forest irrigation, urban applications, aquaculture, industrial applications.
- Indirect reuse (long cycle): Groundwater recharge, low-flow support, wetland restoration.

Chapter II (2 weeks):

- Health Considerations for Reusing Treated Water
- WHO Guidelines (2006) for preventing waterborne diseases in wastewater reuse.
- Stockholm Framework for controlling waterborne diseases.
- Health risk assessment and strategies to reduce microbial pathogen concentrations (objectives and methods).

Chapter III (2 weeks):
Irrigation Practices and Monitoring
Unrestricted vs. restricted crop irrigation.
Monitoring parameters:

- Chemical constraints (salinity, heavy metals).
- Microbiological constraints (pathogens).
- Additional parameters (irrigation timing, method, post-harvest washing).

Policy aspects of treated water reuse.

Chapter IV (2 weeks):
Industrial Reuse and Project Planning
Designing a treated water reuse project.
Resource and demand assessment, sanitation status evaluation.
Techno-economic analysis and environmental impact studies.

B. Reuse of WWTP Sludge

Chapter I (1 week):
Origin, composition, and characterization of wastewater treatment plant (WWTP) sludge.
Overview of Algerian legislation governing sludge management.

Chapter II (4 weeks):
Sludge Treatment and Disposal
Treatment methods:

- Raw sludge land application, storage, incineration, composting, drying.
- Chemical stabilization and other advanced treatments.

Environmental and operational impacts of sludge management.

Chapter III (2 weeks):
Economic and Environmental Impacts
Impact of industrial sludge application on agricultural soils (legal considerations).
Energy recovery from sludge (e.g., biogas production).

Assessment Methods
Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

OMS, (1989), L'utilisation des eaux usees en agriculture et en aquiculture : recommandations a visées sanitaires. Geneve, OMS, 1989, 84p.

OMS., (1989), L'utilisation des eaux usées en agriculture et aquaculture : Recommandations à avisées sanitaires. Rapport d'un groupe scientifique de l'OMS. Organisation mondiale de la santé, Série de rapportstechniques 778

SALGOT M., E. HUERTAS E., WEBER S., DOTT W., HOLLENDER J. (2005), Wastewater reuse and risk: Definition of key objectives, presented at the International Conference on Integrated Concepts on WaterRecycling, Australia 14 – 17 February 2005

BAUMONT S, CAMARD J-P, LEFRANC A, FRANCONI A. (2004), Réutilisation des eaux usées: risquessanitaires et faisabilité en Île-de-France. Rapport ORS, 220p.

TIERCELIN J R.,VIDAL A., (2006), Traité d'Irrigation, Editions Tec et Doc Lavoisier, 1350 p. BAUMONT S, CAMARD J-P, LEFRANC A, FRANCONI A. (2004), Réutilisation des eaux usées: risquessanitaires et faisabilité en Île-de-France. Rapport ORS, 220p.

LAZAROVA V., GAID A., RODRIGUEZ-GONZALES J., ALDAY ANSOLA J. (2003), L'intérêt de la réutilisation des eaux.

Semester :4
Teaching Unit :MTU2.2.2
Subject: Metrology
VHS:67h30 (Lectures:45h ,LAb:22h30)
Credits :3
Coefficient :2

Course Objectives

This module provides straightforward, implementable methodologies that integrate advancements in sampling techniques, flow measurement, and analytical practices to address the demands of water quality analysis.

Recommended Prerequisites: Analytical Techniques

Course Content

1. **Metrology Terminology and Mathematical Tools for Sensor Performance Evaluation (2 weeks)**
    - Definitions of key metrology terms (e.g., accuracy, precision, standard deviation).
    - Mathematical tools for assessing sensor performance.
2. **Sensor Types for Direct and Indirect Measurement in Water Treatment (2 weeks)**
    - Overview of sensors measuring single parameters (e.g., pressure gauges, flowmeters, pH meters, turbidimeters).
3. **Flow Measurement Using Direct and Indirect Methods with Probes (2 weeks)**
    - Field equipment and techniques for flow measurement **(1 week).**
4. **Sampling Types and Sampling Procedure Errors (1 week)**
    - Daily Flow-Proportional Composite Sampling **(2 weeks).**
    - Water Sampling and Analysis Strategies **(1 week).**
5. **Protocols for In Situ and Laboratory Contaminant Monitoring (1 week).**
6. **Chemical Analysis Techniques and Result Reliability (2 weeks).**
7. **Interpretation and Critical Evaluation of Analytical Results (1 week).**

Field Laboratory Sessions

- Sampling of Urban Wastewater.
- On-Site Flow Measurement.
- Field Analysis.

Assessment Methods

Continuous Assessment: 50%

Final Exam: 50%

Bibliographic References

THOMAS O. Métrologie des eaux résiduaires, Edition Lavoisier

RIVIER C., LALERE B., (2003), Guide méthodologique pour l'estimation *des* incertitudes en analyse chimique, projet Metraux, Laboratoire National d'essais (LNE)

Guide de Métrologie à l'usage des Laboratoires d'Analyses de Biologie Médicale *www.cfmetrologie.com*

Semester : 4
Teaching Unit: TTU 2.2
Subject 1: Business Management
VHS: 22h30 (Lectures: 1h30)
Credits: 2
Coefficient : 1

Course Objectives

To acquire knowledge and methodologies in: Team Management, Task Planning, Defining and Developing QHSE (Quality, Health, Safety, Environment) Policies, Raising Staff Awareness of hygiene, safety, and environmental practices., Evaluating and Addressing Occupational Risks, Implementing Management Systems, Ensuring Compliance with QHSE regulations.

Recommended Prerequisites

Understanding of Corporate Operations, Knowledge of Standards, Awareness of Environmental and Societal Impacts

Course Content

1. Team Management

Understanding group dynamics in the workplace.
Conducting a self-assessment of personal time management.
Organizing collective workflows.
Prioritizing and planning team activities.
Leading and monitoring team performance.
Assessing the impact of organizational changes.
Developing managerial communication strategies.
Managing daily team relations and resolving conflicts.

2. Task Planning

- Task Planning and Tracking
- Breaking down projects into actionable tasks.
- Applying planning techniques.
- Managing internal and external resources.
- Tracking task progress.
- Multi-Project Planning and Monitoring.
- Introduction to Microsoft Project.
- Case Study: Developing a workload schedule.

3. Sustainable Management

- Definitions and principles.
- Designing sustainable projects.
- Aligning management practices with sustainable development goals.

4. Quality Management

- Definitions and Objectives.
- Quality Management Principles.
- ISO 9001 Standard.
- Components of Quality Management Systems.

5. Quality Management System (QMS)

- QMS processes.
- Criteria for effective management systems.

6. Environmental Management

- Definitions and Objectives.
- Advantages and Challenges of environmental management.
- Environmental Management Plans.
- Environmental Management Dashboards.
- Environmental Performance Indicators.

7. Environmental Management System (EMS) Tools

- Definitions and Objectives.
- ISO Standards and Environmental Compliance (e.g., ISO 14001).
- Benefits and Limitations of EMS implementation.
- Steps to Establish an EMS.
- Integrated Management Systems (IMS).

Assessment Methods

Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

1. Alain Astouric.Le management durable : Du concret pour réussir ensemble. Chronique Sociale 2004
2. Frédéric Canard , Management de la qualité : vers un management durable, Gualino Ed., 2012
3. Lance A. Berger, Dorothy R. Berger. The Talent Management Handbook: Creating a Sustainable Competitive Advantage by Selecting, Developing, and Promoting the Best People. McGraw-Hill 2011.
CSCMP, Wendy Tate. The Definitive Guide to Supply Management and Procurement: Principles and Strategies for Establishing Efficient, Effective, and Sustainable Supply Management Operations. Pearson FT Press 2013

Semester : 4
Teaching Unit: TTU 2.2
Subject : Technical English3
VHS : 22h30 (Lectures : 22h30)
Coefficient : 1
Credits : 2

Course Objectives:
The objective of this course is to develop professional English language competencies, including:

- CV/Resume writing and analysis of cover letter templates.
- Internship report drafting and formal requests.
- Articulating and defending written or verbal positions on opinions or ideas.
- Mastering written syntax, spelling, and grammar.
- Preparing and delivering presentations to engage an audience effectively.

Recommended Prerequisites: Basic English vocabulary and grammar.

Course Content

1. **Written Comprehension**: Reading and analyzing discipline-specific texts.
2. **Oral Comprehension and Expression**: Enhancing listening and speaking skills through diverse, current topics.
3. **Oral expression**: Delivering scientific or technical presentations, Crafting and exchanging verbal messages (ideas, data), Telephone communication skills, Non-verbal communication techniques (e.g., gestures, body language).

1. **Written Expression**
   - Drafting professional documents in English (e.g., reports, emails).
   - Preparing professional presentations (integrating oral delivery and written content).

Key Focus Areas

- **Professional Document Writing**: Structure, tone, and clarity in CVs, cover letters, and reports.
- **Presentation Skills**: Audience engagement, visual aids, and technical delivery.
- **Critical Analysis**: Evaluating texts and arguments within a professional context.
- **Language Accuracy**: Grammar, syntax, and vocabulary precision in written and spoken English.

Assessment Methods
Final Exam: 100%

Bibliographic References

P.T. Danison, Guide pratique pour rédiger en anglais: usages et règles, conseils pratiques, Editions d'Organisation 2007
A.Chamberlain, R. Steele, Guide pratique de la communication: anglais, Didier 1992
R. Ernst, Dictionnaire des techniques et sciences appliquées: français-anglais, Dunod 2002.
J. Comfort, S. Hick, and A. Savage, Basic Technical English, Oxford University Press, 1980
E. H. Glendinning and N. Glendinning, Oxford English for Electrical and Mechanical Engineering, Oxford University Press 1995
T. N. Huckin, and A. L. Olsen, Technical writing and professional communication for nonnative speakers of English, Mc Graw-Hill 1991

Semester :4
Teaching Unit :DTU2.2
Subject 1 : Water Legislation and Policy
VHS:22h30 (Lectures:1h30)
Coefficient : 2
Credits : 2

Course Objectives

To provide students with the principles of water legislation and the Water Code, emphasizing regulatory frameworks and their application.

Prerequisites

General knowledge of water legislation in Algeria.

Course Content

Chapter I: Water Code 2005 ***(3 weeks)***

Chapter II: Legal and Institutional Aspects of the Water Management Sector ***(4 weeks)***

Chapter III: Competencies and Duties of Local Authorities in Water Management ***(4 weeks)***

Chapter IV: Water Management in Developing Countries ***(4 weeks)***

Assessment Methods
Final Exam: 100%

Bibliographic References

1. Polycopié pédagogique, législation des eaux, Mr. SIRAT Abdelkader, Maître de Conférences B, USTO-MB

2. **SEMIDE**: Système Euro-Méditerranéen d'information sur les savoir-faire dans le domaine de l'eau. Approvisionnement en eau potable et assainissement au niveau locale .Rapport par pays Algérie, MEDA Water, 2005.

3. **Journal officiel de la république algérienne démocratique et populaire** N° 60, Code des eaux, 04 septembre 2005

4. **Marc Bied-Charreton, Raoudha Makkaoui, Olivier Petit, Mélanie Requier-Desjardins** .La gouvernance des ressources en eau dans les pays en développement : enjeux nationaux et globaux. Mondes en Développement, 2006/3 (135), pp.39-62. ⟨hal-00387213⟩.De Boeck, 2006.

Semester: 4
Teaching Unit: DTU 2.2
Subject : Advanced Internship in a Company 2
VHS :80h individual work
Credits : 2
Coefficient : 1

Course Objectives

This internship, with an average duration of two weeks, aims to integrate students into a company specialized in wastewater management and/or treatment. Students will engage in real-world operational activities under the supervision of an industry-appointed mentor.

Recommended Prerequisites

- Knowledge of environmental stakeholders.
- Understanding of wastewater management and treatment processes.

Course Content

On-site learning through active participation in an industrial setting, where students assume a professional role under the guidance of a company mentor.

Assessment Method

1- Internship report: 75%.
2- Company assessment: 25%

References

Internal company documentation and operational guidelines.

Semester S5
Detailed Course Syllabus
Fifth Semester of the 3rd Year (Second Cycle)

Semester:5
Teaching Unit:FTU 3.11
Subject 3 : Operation, Control, and Monitoring of Wastewater Treatment Plants
VHS:105 h (Lectures:22h 30 ,PS : 45h, Lab :37h30)
Credits :10
Coefficient :6

Course Objectives
This course will enable students to:
- Conduct a comprehensive diagnostic assessment of a wastewater treatment plant (WWTP).
- Monitor the operation and control of all stages within a WWTP.

Recommended Prerequisites:
Biological processes applied to wastewater treatment**.**

Course Content

1. Introduction (2 weeks)
- Overview of WWTP operation.
- General schematic of WWTPs.
- Objectives of WWTP management.

2. Operational Methods and Techniques for WWTPs (2 weeks)
- Maintenance, control, and monitoring of WWTP equipment.
- Role of the WWTP operations manager.

3. Equipment Maintenance and Optimization
- Screens: Control, maintenance, and performance optimization **(1 week).**
- Grit Chambers: Control, maintenance, and performance optimization **(1 week).**
- Grease Removal Systems: Control, maintenance, and performance optimization **(1 week).**
- Primary and Secondary Clarifiers:
  - Sludge settling maintenance.
  - Operational parameter monitoring **(2 weeks).**

4. Biological Treatment Maintenance (2 weeks)
- Activated sludge process: Control and optimization of operational parameters.

5. Remote Monitoring and Diagnostics (1 week)
- Remote visualization and control of WWTP equipment.
- Diagnosing performance issues in industrial wastewater treatment systems to resolve malfunctions and optimize efficiency.

6. WWTP Auditing (1 week)
- Principles and practices for conducting a WWTP audit.

Laboratory Sessions
- Field visits to WWTPs:
  - Assess the overall operational status of the plant.
  - Propose solutions to identified issues.

Assessment Methods
Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

Gestion des eaux usées urbaines et industrielles : caractérisations, techniques d'épuration, aspect économique.W.w Eckenfelder:Edition Lavoisier. 1982

L'épuration biologique des eaux. Théorie & technologie des réacteurs.F.Edeline:Technique et Documentation CEBEDOC 1988

Water Reuse : Issues, Technologies, and Applications , Takashi Asano, Ed Franklin Burton · 2007

Wastewater Engineering: Treatment and Reuse. George Tchobanoglous, Franklin Louis Burton, H. David Stensel, Metcalf & Eddy, Inc., Franklin Burton. McGraw-Hill Education, 2003 - 1819 pages

Mémento technique de l'eau - Degrémont SA. Tomes 1 et 2, Editeur(s) : Degrémont, Nombre de pages : 1718 pages, Date de parution : 17/05/2005 (10e édition), EAN13 : 9782743007171

Guide pratique des stations de traitement des eaux, Xavier Lauzin Editeur(s) : Eyrolles, Collection : Blanche BTP, Nombre de pages : 266 pages, Date de parution : 29/10/2009 , EAN13 : 9782212125665

Wastewater and Biosolids Treatment Technologies: The Comprehensive Reference for Plant Managers and Operators. Cheremisinoff, Nicholas P, Publisher: Rockville,MD. ABS Consulting Government Insitutes 2003; Description: xxiv,344p. ill. 27cm., ISBN: 086587946X

Semester : 5
Teaching Unit: FTU3.1.2
Subject 1: Artificial Intelligence in the Reuse of Treated WastewaterVHS: 75h (Lectures: 22h30; PS: 22h30; Lab: 22h30
Coefficient :
Crédit : 5

Course Objectives

The course comprises two components: **Data Analysis** and **Machine Learning (ML)**.

Data Analysis: Aims to interpret data to derive solutions for domain-specific challenges.

Machine Learning: A branch of artificial intelligence (AI) focused on developing systems that learn or enhance performance through data processing. It involves data interpretation and modeling to enable autonomous decision-making.

Recommended Prerequisites:

Knowledge of numerical analysis, Proficiency in Python and MATLAB programming.

Course Content

1. **Understanding Machine Learning Applications**
    - Introduction to Data Science.
    - Key stages of modeling.
    - Types of automated learning (supervised, unsupervised, reinforcement).
2. **Introduction to Python**
    - NumPy (numerical computing).
    - Matplotlib (data visualization).
    - Pandas (data manipulation).
3. **Machine Learning Techniques and Tools**
    - Translating business needs into ML problems.
4. **Data Cleaning**
    - Data Cleaning with Excel.
    - Data Cleaning with Python.
5. **Data Analysis**
    - Statistical measures: Mean, Variance.

- Data visualization: Histograms.

6. **Classification Methods**
    - Logistic Regression.
    - Model Validation.
    - Support Vector Machine (SVM).
    - Artificial Neural Networks (ANN).
7. **Implementing Machine Learning Algorithms**
    - Building statistical models.
    - Linear Regression programming.
    - Model Validation.
    - Polynomial Regression.
    - Decision Trees.
8. **Laboratory Sessions**

    Lab 1: Identifying modeling stages.

    Lab 2: Classifying types of automated learning.

    Lab 3: Algorithm implementation with Python.

    Lab 4: Translating business requirements into ML problems.

    Lab 5: Data Cleaning with Excel.

    Lab 6: Data Cleaning with Python.

    Lab 7: Data Analysis.

    Lab 8: Classification using Machine Learning.

    Lab 9: Programming exercises (ML models).

Assessment Methods
Continuous Assessment: 50%
Final Exam: 50%

Semester : 5
Teaching Unit: FTU3.1.2
Subject : Environmental and Health Risk Assessment
VHS : 33h45 (Lectures)
Credits : 5
Coefficient : 2

Course Objectives
The course Environmental and Health Risk Assessment equips students with the tools to understand the toxicity of pollutants on environmental components and human health. Exposure tests to these contaminants may be used to evaluate ecotoxicological risks from exposure or absorption.

Recommended Prerequisites: Foundational knowledge of general chemistry and pollution.

Course Content

1. Introduction to Pollutant Risks on the Environment and Human Health
2. Pollutant Classification (1 week)
3. Watercourse Monitoring and Introduction to Ecotoxicology (1 week)
4. Acute and Chronic Toxicity
5. Ecological and Ecotoxicological Risk Assessment (5 weeks)
    - Types of tests for ecotoxicological effect characterization.
    - Bioindicators and biomarkers.
    - Toxicity tests: Exposure and effects.
    - Test organisms; advantages and limitations of bioassays.
    - Biological quality elements: Phytoplankton, macrophytes, phytobenthos.
    - Invertebrate benthic fauna, ichthyofauna.
    - Ecological status of watercourses (IBGN, IBD, IPR) and coastal environments (RSP).
    - Soil pollution monitoring.
    - Ocean pollution and aquatic environment monitoring.
6. Health Risk Assessment of Water Pollution (4 weeks)
    - Effects of microbial pollution on waterborne diseases (bacterial, viral, parasitic).
    - Impacts of organic micropollutants, metals, and radionuclides.
7. Toxicity of Pesticides and Chemical Fertilizers (1 week)
8. Hydrocarbon Toxicity
9. Heavy Metal Toxicity
10. Toxicity of Pharmaceutical Substances in Wastewater (1 week)
11. Speciation of Metals and Organic Molecules
12. Contaminant Absorption in the Environment and Biological Effects (2 weeks)
    - Water and plants.
    - Water and bacteria.
    - Lipophilic molecules.

Assessment Methods
Final Exam: 100%

Bibliographic References

RAMADEF.,1992, Précis d'écotoxicologie, Ed. Masson, Paris.

CAQUETJ.C.,AMIARDD.,RAMADEF.,
1997,Biomarqueursenécotoxicologie,aspectsfondamentaux, Ed. Masson,Paris.
DAGNINOA.,SFORZINIS.,DONDEROF.,FENOGLIOS.,BONAE.,JENSENJ.,VIARENG
OA.,2008,Weight-of-
Evidence,ApproachfortheIntegrationofEnvironmental«Triad»,DatatoAssessEcological Risk and Biological Vulnerability, Integrated Environmental Assessment and Management,vol.4,p.314-326.
GALLOWAYT.S.,2006,Biomarkersinenvironmentalandhumanhealthriskassessment,Marin
ePollution Bulletin,53,p.606-613.

GAUJOUSD.,1995.,Lapollutiondesmilieuxaquatiques;aide-
mémoire.Ed.TechniquesetDocumentation. Ed.Lavoisier,Paris.

MERRINGTONG.,WINDERL.,PARKINSONR.etREDMANM.,2002,AgriculturalPollutio
nSponpress.

Semester: 5
Teaching Unit: TTU3.1
Subject: Engineering and Project Management
VHS : 45h (Lectures : 22h30, PS:22h30)
Coefficient :2
Credits 4

Course Objectives :

To train students in determining the longest path for project completion, planning construction operations, and establishing the critical path and task execution schedule.

Prerequisites: Biological treatment processes, wastewater treatment plant (WWTP) infrastructure, WWTP design and sizing.

Program Content

Chapter I: Fundamentals of Project Management
1.1. **Nature of Management**
1.2. **Project Forecasting and Organization**
1.3. **Project Management Tools**:

- Project Charter,
- Project Management Plan,
- Project Organizational Chart,
- Risk Analysis Matrix,
- Workload Evaluation Sheet,
- Communication Plan,
- Dashboard.

1.4. **Key Competencies for Project Success**:

- Communication and active listening,
- Conducting interviews,
- Meeting facilitation,
- Problem-solving sessions,
- Training sessions,
- Project manager leadership styles.

Chapter II: Work Planning
2.1. Objectives of Planning
2.2. Planning Methods
2.3. Data Collection

Chapter III: Critical Path Method (CPM)
3.1. Definition of CPM
3.2. Objectives of CPM
3.3. Project Decomposition

3.4. Logical Relationships
3.5. Preferential Relationships
3.6. Duration Allocation

Chapter IV: Network Diagrams
4.1. Definition of Networks
4.2. Network-Based Methods
4.3. Arrow Network
4.4. Node Network
4.5. General Case Network Construction
4.6. Converting Arrow Networks to Node Networks
4.7. Converting Node Networks to Arrow Networks

Chapter V: Calculation Methods
5.1. Calculation Grid
5.2. Forward Pass
5.3. Backward Pass
5.4. Critical Path Identification via Calculation Table

Chapter VI: Additional Planning Methods
6.1. Graph-Based Methods
6.2. Bar Chart Method (Gantt Chart)
6.3. Metra Potential Method (MPM)
6.4. PERT (Program Evaluation and Review Technique)
6.5. Precedence Diagram Method (PDM)
6.6. Resource-Based Methods
6.7. Timeline and Schedule Development

Course Projects

- **Project 1**: Defining the scope of work and material resources for a dam constructed with local materials. Project planning using scheduling methods.
- **Project 2**: Defining the scope of work and material resources for a pumping station, pipeline, and reservoir. Project planning using scheduling methods.

Assessment Methods
Continuous Assessment: 50%
Final Exam: 50%

Bibliographic References

1. Raabe Michel , (2001) Manuel du management de projet
   Paris : PENPC, 351p
2. Jean-Claude Corbel **Management de projet,** Fondamentaux - méthodes - outils. **Éditeur Eyrolles, 2012**

Semester : 5
Teaching Unit: TTU 3.1
Subject : Technical English4
VHS : 22h30 (Lectures : 22h30)
Coefficient : 1
Credits : 4

Course Objectives

The objectives of this course are to:

- Familiarize and train students in contemporary methodologies for writing and presenting assignements or projects in English.
- Equip students with the necessary tools to locate, evaluate, and effectively utilize relevant information.
- Guide students through the stages of drafting a scientific document.
- Emphasize the importance of communication and teach students to present their work rigorously and pedagogically.

Recommended Prerequisites:

Basic English vocabulary and grammar, as well as foundational knowledge of writing and presentation methodologies.

Course Content

Chapter 1: Scientific Writing Techniques (4 weeks)

- **Scientific Writing**: Style, grammar, syntax, and spelling, Enhancing general language proficiency in comprehension and expression.

Chapter 2: Reading and Analyzing Scientific Documents (4 weeks)

- Critical evaluation of research papers, reports, and case studies.
- Techniques for extracting key information and synthesizing findings.

Chapter 3: Oral Presentations and Defenses (4 weeks)

- **Structuring and Delivering Presentations**:
  - Academic poster design and presentation.
  - Oral communication strategies for conferences and seminars.
  - Thesis defense preparation and execution.

Chapter 4: Avoiding Plagiarism (3 weeks)

- Ethical use of formulas, text, illustrations, graphs, data, and statistics.
- Proper citation techniques (direct quotes, paraphrasing).
- Formatting complete bibliographic references.

Assessment Methods

Final Exam: 100%

Bibliographic References

1. *M. Griselin et al., Guide de la communication écrite, 2e édition, Dunod, 1999.*
2. *J.L. Lebrun, Guide pratique de rédaction scientifique : comment écrire pour le lecteur scientifique international, Les Ulis, EDP Sciences, 2007.*
3. *A. Mallender Tanner, ABC de la rédaction technique : modes d'emploi, notices d'utilisation, aides en ligne, Dunod, 2002.*
4. *M. Greuter, Bien rédiger son mémoire ou son rapport de stage, L'Etudiant, 2007.*
5. *M. Boeglin, lire et rédiger à la fac. Du chaos des idées au texte structuré. L'Etudiant, 2005.*
6. *M. Beaud, l'art de la thèse, Editions Casbah, 1999.*
7. *M. Beaud, l'art de la thèse, La découverte, 2003.*
8. *M. Kalika, Le mémoire de Master, Dunod, 2005.*
9. J.-L. Lebrun, Guide pratique de rédaction scientifique, EDP Sciences, 2007.
10. M. Kalika, Mémoire de master - Piloter un mémoire, Rédiger un rapport, Préparer une soutenance, Dunod, 2016.
11. M. Greuter, Réussir son mémoire et son rapport de stage, l'Etudiant, 2014
12. F. Cartier, Communication écrite et orale, Edition GEP- Groupe Eyrolles, 2012.

Semester : 5
Teaching Unit: FTU 2.2.1
Subject : Renewable Energy Applied to REUSE
VHS : 22h30 (Lectures: 22h30, PS : 7h30)
Coefficient : 2

Course Objectives
This course introduces innovative approaches to wastewater treatment and reuse through the integration of renewable energy and sustainable processes. The discussion of the **Water-Energy-Food-Environment Nexus (WEFE Nexus)** underscores the necessity of ensuring the sustainability of humanity's vital resources—water, food, and energy—while preserving environmental balance.
Two key approaches are explored:

1. **Reducing Conventional Energy Consumption** in wastewater treatment plants (WWTPs) via biogas, solar photovoltaic energy, and domestic wind energy.
2. **Sustainable Treatment Processes** independent of conventional electricity, including solar-driven sedimentation-digestion, solar evaporation-concentration, solar photocatalysis, and solar pumping.

Expected Competencies

- Understand the challenges of the **WEFE Nexus** and sustainability.
- Evaluate the **energy, financial, and environmental contributions** of renewable energy systems.
- Propose optimizations for sustainable wastewater treatment solutions.

Recommended Prerequisites: Electrical Engineering, Process Engineering, Mechanical Engineering.

Course Content

I. Introduction: Water-Energy-Food-Environment (WEFE) Nexus *(2 Weeks)*

II. Biogas and Electrical Conversion *(3 Weeks)*

- Biogas production processes, composition, and calorific value.
- Digesters and auxiliary equipment.
- Biogas storage and treatment.
- Internal combustion generator sets.
- Co-generation and tri-generation systems.
- Valorization of digested sludge.

III. Solar Photovoltaic Energy *(2 Weeks)*

- Solar resource potential and radiation.
- Operating principles of photovoltaic systems.
- Photovoltaic panels, inverters, and converters.
- Battery storage systems.
- Standalone and grid-connected systems.

IV. Domestic Wind Energy *(2 Weeks)*

- Wind resource assessment.

- Operating principles of wind turbines.
- Horizontal-axis and vertical-axis wind turbines.
- Standalone and hybrid wind energy systems.

V. Sustainable Wastewater Treatment Plants (WWTPs) *(6 Weeks)*

- Solar pumping systems.
- Sedimentation-digestion integration.
- Solar drying of residual sludge.
- Microalgae-based treatment.
- Solar disinfection.
- Solar photocatalysis.
- Solar evaporation-concentration.
- Case studies of operational sustainable WWTPs.

Assessment Methods

Final Exam: 2 Exams

Bibliographic References

- **The water–energy nexus in Middle East and North Africa**, A. Siddiqi, L.D. Anadon, Energy Policy 39 (2011) 4529–4540.
- **Diagnostic of the electricity consumption its cost and greenhouse gas emission in the wastewater treatment sector of Algeria**. S. Igoud; F. Souahi; C-E. Chitour; A. Adjrad; M. Habchi; A. Chouikh, Desalination and Water Treatment 55 Issue 7 (2015) 1725-1734.
- **Wastewater Reuse in Arab Countries, Comparative Compilation of Information and Reference List.** ACWUA Working Group on Wastewater Reuse, March 2010.
- **Biométhane. 1. Une altérnative crédible**. B. Lagrange Ed. Edisud, 1979.
- **Biométhane. 2. Principes-Techniques-Utilisations** B. Lagrange, Ed. Edisud, 1979.
- **Désinfection solaire de l'eau. Guide pour l'application de SODIS.** Rapport SANDEC N° 12/05. Département eau et assainissement dans les pays en développement (SANDEC), Institut fédéral Suisse pour l'aménagement, l'épuration et la protection des eaux (EAWAG), 2005.
- **APESA – Etude : Méthanisation et production de biogaz, Etat de l'art.** Centre
- technologique en environnement et maîtrise des risques (APESA) version 1, 2007.
- Rapport du sommet mondial pour le développement durable. A/CONF.199/20, Nations Unies, New York, Johannesburg (Afrique du Sud), du 26 au 4 août Septembre 2002.

Semester S6

Detailed Course Syllabus

Sixth Semester of the 3rd Year of the Second Cycle

Semester: 6
Teaching Unit: DTU3.2
Subject : Final Year Project, including a three-month professional internship
VHS : individual work : 600h
Coefficient : 15
Credits : 30

Project Objectives

The final year project (FYP, startup project, or patent initiative) aims to conduct research on wastewater treatment and/or the reuse of treated wastewater. This project must include a mandatory three-month fieldwork phase in a corporate, institutional, or academic setting. The FYP, under the auspices of the University Center of Excellence WTR, must employ innovative techniques and methodologies leveraging digitalization, artificial intelligence, modeling, or other cutting-edge approaches.

The FYP must propose and test a solution directly addressing the needs of socioeconomic sectors, particularly those related to water security. The project must be defended in a public presentation before a jury composed of members with expertise in the themes and/or challenges addressed by the Center of Excellence.

The FYP must demonstrate that the engineer has acquired the competencies and knowledge during their training and is capable of applying them effectively within the framework of their final project.

Evaluation Method:

- Submission of a final project report.
- Public defense and oral presentation before an expert panel.

VI - Avis et Visas des organes Administratifs et Consultatifs

Chef de département + Chef de spécialité	
Département Environnement et Aménagement	Chef de spécialité
Date et visa 25-02-2023	Date et visa 25-02-2023

السيد: زروقي محمد
رئيس قسم البيئة و التهيئة

قسم البيئة و التهيئة
Département Environnement Aménagement

Directeur adjoint des enseignements des diplômes et de la formation continue
Date et visa : 25-02-2023

د. مزوار خوضير
مدير مساعد مكلف
والشهادات و التكوين

Directrice de l'école
Date et visa 25-02-2023

الأستاذة: ليندة بن حاجة
المديرة