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

ACADEMIC MASTER HARMONIZE

National program 2022 update

Domain	Sector	Specialty
Science And Technologies	Process Engineering	Environmental Process Engineering

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مواءمة

ماستر أكاديمي

Updated 2022

التخصص	الفرع	الميدان

علوم و تكنولوجيا	هندسة الطرائق	هندسة الطرائق للبيئة

I – Master’s identity sheet

Access conditions

Sector	Harmonized Master	Access licenses to the master's degree	Ranking according to license compatibility	Coefficient assigned to the license
Process Engineering	**Materials Process Engineering**	Process Engineering	**1**	**1.00**
		Materials Engineering	**2**	**0.80**
		Chemistry of materials (SM field)	**3**	**0.70**
		Materials physics (SM field)	**3**	**0.70**
		Inorganic chemistry (SM field)	**4**	**0.65**
		Other licenses in the ST domain	**5**	**0.60**

II – Half-yearly teaching organization sheets of the specialty

Semester 1: Environmental Process Engineering

	Matter	Credit	Coeffi	Weekly hourly volume		Additional Work	Evaluation method

Teaching unit	Titled			Course	DW	PW	Half-yearly Hourly Volume (15 week.)	in Consultation (15 week.)	Continuous monitoring	Exam
Fundamental TU **Coded** : FTU 1.1.1 **Credits** : 8 **Coefficient** : 4	**Water Chemistry**	**4**	2	1h30	1h30		45h00	55h00	40%	60%
	Atmospheric pollution	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental TU Coded : UEF 1.1.2 **Credits** : 10 **Coefficient** : 5	Fluid-Fluid Unit Operations (extraction, distillation, absorption and stripping)	6	3	3h00	1h30		67h30	82h30	40%	60%
	Heat exchangers	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological TU Coded : MTU 1.1 **Credits** : 9 Coefficients : 5	P W on Water Chemistry	2	1			1h30	22h30	27h30	100%	
	P W Unit Operations (Fluid-Fluid)	2	1			1h30	22h30	27h30	100%	
	P W Heat Exchangers	2	1			1h30	22h30	27h30	100%	
	Process engineering simulators	3	2	1h30		1h00	37h30	37h30	40%	60%
Discovery TU Coded : DTU 1.1 Credits : 2coef : 2	**Matter of your choice**	1	1	1h30			22h30	2h30		100%
	Matter of your choice	1	1	1h30			22h30	2h30		100%

Transversal TU Coded : UET 1.1 Credits : 1, Coef. 1	**Technical English and terminology**	1	1	1h30			22h30	2h30		100%
Total semester 1		**30**	**17**	**13h 30**	**6h00**	**5h 30**	**375h00**	**375h00**		

Semester 2: Environmental Process Engineering

Teaching unit	Matter Titled	**Credits**	**Coefficient**	**Weekly hourly volume** Course	DW	PW	**Half-yearly Hourly Volume**	Additional Work in Consultation (15 week.)	**Evaluation method** Continuous monitoring	Exam
Fundamental TU Coded : FTU 1.2.1 Credits : 10 Coefficients : 5	Drinking water production	6	3	3h00	1h30		67h30	82h30	40%	60%
	Solid waste management and treatment	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental TU Coded : FTU 1.2.2 Credits : 8 Coefficients : 4	Adsorption and Membrane Separation Processes	4	2	1h30	1h30		45h00	55h00	40%	60%
	Physico-chemical treatment of wastewater	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological TU Coded :MTU 1.2 Credits : 9 Coefficients : 5	Porous and Dispersed Media	3	2	1h30	1h00		37h30	37h30	40%	60%
	PW Water Treatment and Adsorption Processes and Membrane	2	1			1h30	22h30	27h30	100%	
	Treatment and Conditioning of Process Water	4	2	1h30	1h30		45h00	55h00	40%	60%

Discovery TU Code : DTU 1.2 Credits : 2coef. 2	**Matter of your choice**	1	1	1h30			22h30	2h30		100%
	Matter of your choice	1	1	1h30			22h30	2h30		100%
Transversal TU Coded : UET 1.2 Credits : 1 coefficient : 1	Compliance with standards and rules of ethics and integrity	1	1	1h30			22h30	2h30		100%
Total semester 2		**30**	**17**	**15h00**	**8h30**	**1h30**	**375h00**	**375h00**		

Semester 3 : Environmental process engineering

Teaching unit	Matter	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume	Additional Work in Consultation (15 week.)	Evaluation method	
	Titled			Course	DW	PW			**Continuous monitoring**	**Exam**
Fundamental TU Coded : FTU 2.2.1 Credits : 8 Coefficients : 45	Theoretical foundation and biological treatment of wastewater	4	2	1h30	1h30		45h00	55h00	40%	60%
	Gaseous Effluent Treatment	4	2	1h30	1h30		45h00	55h00	40%	60%
	Technical Thermodynamics	4	2	1h30	1h30		45h00	55h00	40%	60%

Fundamental TU Coded : UEF 2.1.2 Credits : 10 Coefficients : 5	Multiphase reactors and bioreactors	6	3	3h00	1h30		67h30	82h30	40%	60%
Methodological TU Coded :MTU 1.2 Credits : 9 Coefficients : 5	PW Biological wastewater treatment/bioreactors	2	1			1h30	22h30	27h30	100%	
	Process intensification	2	1	1h30			22h30	27h30		100%
	Treatment of polluted soils	2	1	1h30			22h30	27h30		100%
	Experiment plan	3	2	1h30		1h00	37h30	37h30	40%	60%
Discovery TU Code : DTU 1.2 Credits : 2 coef. 2	Matter of your choice	1	1	1h30			22h30	2h30		100%
	Matter of your choice	1	1	1h30			22h30	2h30		100%
Transversal TU Coded : UET 2.1 Credits : 1 coefficient : 1	Documentary research and dissertation design	1	1	1h30			22h30	2h30		100%
Total semester 3		**30**	**17**	**16h30**	**6h00**	**2h30**	**375h00**	**375h00**		

General guidance on the choice of discovery materials:

1. Techno-economic evaluation of processes
2. Environmental management
3. Environmental audit and impact study
4. Ecology and biodiversity
5. Renewable energies
6. Industrial risks and natural disasters
7. Chemical and Biochemical sensors
8. Climate change
9. Environmental changes and biological invasion
10. Biofuel cells
11. Sonochemical
12. Activation Process
13. Energy storageBiomass and biofuels
14. Environmental standards and conventions
15. Environmental standards and conventions
16. process modeling and optimization
17. Microbiology and environmental biochemistry

Semester 4

Internship in a company or in a research laboratory culminating in a dissertation and a defense.

	HYHV	Coeff	Credits
Personal work	550	09	18
Internship in a company or laboratory	100	04	06
Seminars	50	02	03
Other (Management)	50	02	03
Total Semester 4	750	17	30

This table is given for information purposes only.

Evaluation of the End of Master Cycle Project

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

III - Detailed program by matter for the S1 semester

Semester: 1

Teaching unit: UEF 1.1.1

Subject 1: Water Chemistry

VHS: 45h00 (course: 1h30, Directed work: 1h30)

Credits: 4

Coefficient: 2

Teaching objectives:

Provide the chemistry bases necessary for the analysis and resolution of an environmental problem; physicochemical characterization of water with a view to evaluating its quality and treatment.

Recommended prior knowledge:

Mineral and analytical chemistry and solution chemistry

Content of the material:

Part One – Chemistry of natural waters **10 weeks**

1- General

Properties of suspended matter

2- Double layer theory; Stability of colloidal suspensions; Turbidity and turbidity units; Determination of suspended solids

- Materials in solution

Major, fundamental and characteristic elements
- Units used in water analysis
- Verification of water analysis
- Salinity or mineralization
- Hardnesses and hydrotimetric titers
- Alkalimetric titers and alkaline composition of water
- Calcocarbonic balance and carbonic balances
- Aggressiveness of water (Langelier index and graphs, Ryznar index, Determination of pHs by calculation, Puckorius scaling index, Stiff and Davis index, Larson index, Leroy index, Aggressiveness index)

Part Two – Wastewater Chemistry **5 weeks**

1- Generalities and definitions

- Characterization of waste and waste water
  Oxidizable material content
  * Biochemical oxygen demand (BOD5)
  * Chemical oxygen demand (COD)
  * Carbone organique total (COT)
- Kjeldahl nitrogen (NTK)
  - Weight content
  * Suspended solids (MES)
  * Volatile Suspended Matter (MVS)
  percentage DCO/DBO_5

Evaluation method: Continuous monitoring:40 % ; Exem: 60 %.

Bibliographic references :

1. Monique Tardat-Henry, Jean-Paul Beaudry, Chimie des eaux, Editions Le Griffon d'argile, 1992.
2. Patrick Brezonik, William Arnold, Water Chemistry: An Introduction to the Chemistry of Natural and Engineered Aquatic Systems, Oxford University Press, USA, 2011.

Semester: 1
Teaching unit: FTU 1.1.1
Matter 2: Atmospheric pollution
VHS: 45h00 (Course: 1h30, Directed work: 1h30)
Crédits: 4
Coefficient:2

Teaching objectives:

Acquisition of basic knowledge regarding the functioning of the atmospheric system and providing essential foundations for understanding the major issues associated with air pollution.

Recommended prior knowledge:

Basic notions in general chemistry, chemical kinetics, thermodynamics.

Material content:

1- Introduction

Chemical composition of the Earth's atmosphere, evolution of contents, residence time of chemical species, vertical division of the atmosphere (layers, temperature and pressure gradient).

2- General information on air pollution:

Air pollutants, regulated and unregulated, units for expressing the concentration of pollutants, conversion between gravimetric and volumetric units, emissions standards (Algerian and WHO).

3-Sources and effects of air pollution:

Anthropogenic (transport, industry, energy) and natural (volcanism, lightning, pollen, etc.) sources. The effects (on health, plants and materials.)

4- Atmospheric aerosols:

General, composition, formation processes, primary and secondary aerosols, standards related to aerosols, atmospheric chemistry in the

5- Pollution by ozone and its precursors

Tropospheric ozone, ozone precursors, mechanisms of tropospheric ozone formation, effects of tropospheric ozone and its precursors, O3 sampling and analysis techniques.

6- Atmospheric and tropospheric chemistry

Elements of kinetics and photochemistry, radical mechanisms, life time and half-life, photolysis, tropospheric chemistry.

Stratospheric ozone: sources of ozone, catalytic cycles (NOx, ClOx), mechanisms of O3 destruction at high latitudes (ozone hole).

7-. Meteorology and dispersion of pollution

Evaluation method :

Continuous monitoring: 40% ; Exem : 60%.

Références bibliographiques :

1- J.C. Jones, Atmospheric pollution, Book Boon, VentusPublishing, 2008.
2- Louise Schriver-Mazzuoli, La pollution de l'air intérieur, Ed. Dunod, 2009.
3 Zhongchao Tan. Air Pollution and Greenhouse Gases, Springer-Verlag, 2014.

Semester : 1
Teaching unit: FTU 1.1.2
Matter 1: Fluid-Fluid Unit Operations (extraction, distillation, absorption and stripping)
VHS: 67h30 (Course: 3h00, Directed work: 1h30)
Credits: 6
Coefficient:3

Teaching objectives:

At the end of this course, the student should be able to:
- Master the separation techniques of Process Engineering (absorption, extraction and distillation).
- Address the notions of sizing and design of equipment.
- Know the main operating problems (priming, etc.).

Recommended prior knowledge:

Thermodynamics, Differential equations, Transfer phenomena (material transfer, fluid mechanics, etc.).

Material content:

Chapter 1. Absorption and Stripping (5weeks)

- General information on absorption and stripping (absorption, desorption, classification of the main types of absorbers)
- Physical absorption: analysis of an absorption column (liquid-gas balance, gas solubility as a function of pressure and temperature, material balances, minimum liquid flow and operating flow, theoretical and real stage concepts, method of Mac Cabe and Thièle, theories of transfer between phases, concept of transfer units)
  Absorption with chemical reaction (transfer of matter in the presence of an irreversible chemical reaction of order 1.1).
  - Stripping: analysis of a desorption column (material balances, minimum liquid flow and operating flow, theoretical and real stage concepts, Mac Cabe and Thièle method).
- **Chapter 2. Liquid – Liquid Extraction (4 Weeks)**
  Partition coefficient, selectivity, different types of diagrams. Equipment used continuously and discontinuously. Partially soluble solvent: multi-stage co-current and counter-current extraction (Ternary diagram). Insoluble solvent: multi-stage co-current and counter-current extraction (Mac Cabe and Thièle construction), extraction with double feed, extraction with reflux. De-extraction and recycling of the solvent, choice of the de-extraction phase and concept of efficiency.

Chapter 3. Distillation (6 weeks)

- Continuous distillation (Ponchon and Savarit method, distillation of complex mixtures). Batch distillation.
- Sizing a distillation column.

Evaluation method: Continuous monitoring: 40% ; Exam: 60%.

Bibliographic references :

1. Daniel Defives et Alexandre Rojey, Transfert de matière , Efficacité des opérations de séparation du génie chimique, Edition TECHNIP ,1976.
2. Robert E. Treybal,«Mass Transfer Operations»,Third Edition, McGraw –Hill ,1980.
3. Warren L. Mc Cabe,Julian C. Smith, Peter Harriott«Unit Operations of Chemical Engineering », Mc Graw- Hill, Inc, Fifth Edition, 1993.
4. Jean LEYBROS, Extraction liquide-liquide - Description des appareils, Techniques de l'ingénieur Référence J2764 v1, 2004.
5. Unit Operations Handbook, Volume 1, Mass transfer, Edited by John J. Mcketta,1993.
6. Daniel Morvan, Génie Chimique : les opérations Unitaires procédés Industriels Cours et Exercices Corrigés,Editeur : ELLIPSES, Colletion :Technosup, 2009.
7. Pierre Wuithier, Le pétrole ,Raffinage et Génie chimique, 2 ème édition, 1972.
8. Marylee Z. Southard Don W. Green «PERRYS CHEMICAL ENGINEERS HANDBOOK», 9 Edition,2019.
9. J. F. RICHARDSON, J. H. HARKER «CHEMICAL ENGINEERING: Particle Technology and Separation Processes», FIFTH EDITION, VOLUME 2, 2002.
10. Fouad M. Khoury, «Multistage Separation Processes», Third Edition, 2005.

Semester: 1
Teaching unit: FTU1.1.2
Matter 2: Heat exchangers
VHS: 45h00 (Course: 1h30, Directed work: 1h30)
Credits: 4
Coefficient : 2

Teaching objectives:

Complete students' prior knowledge of heat transfer and teach them new concepts such as heat transfer in transient conditions, conduction through fins and in the presence of a heat source as well as heat exchangers, and heat transfer equipment calculation methods

Connaissances préalables recommandées :

Transfert de chaleur, Mécanique des fluides, notions de mathématique (équations différentielles du premier et second ordre, calcul des intégrales, etc.).

Content of the matter:

Chapiter .1. Reminders of the Laws of Heat Transfer (1 week)
Chapter 2 : flow around an obstacle (04weeks)
Flow on a flat plate, flow around a tube, cylinder, sphere, correlations and estimation of the heat transfer coefficient
- Flow around a pack of tubes, correlation

- **Chapter 3: Flow in the tubes (03 weeks)**

Correlations and estimation of the heat transfer coefficient

Chapter 4: Description of heat exchange devices without phase change (1 weeks)

Double-tube exchangers, Shell and shell exchangers (shell, shell and shell-shell assembly) and Plate heat exchangers.

Chapter 5.Calculation of Exchangers (3 weeks)

Study of heat transfer (fundamental equations, average temperature difference, overall transfer coefficient U), Study of pressure losses (Pressure loss inside the tubes, Pressure loss outside the tubes), Methods of calculation (Calculation of a double-tube exchanger, Calculation of a beam and shell exchanger (Kern method)), General considerations on the calculation of a beam and shell device and programming of the calculation.

Chapter 6. Heat Exchange Devices with Phase Change (3 Weeks)

Description of devices, condensation of a pure vapor (Coefficients of film for condensation outside the tubes, Calculation of the condenser, Condensation preceded by desuperheating of the vapor and followed by cooling of the condensate), Condensation of a vapor complex (Calculation of the own transfer coefficient (Ward's method and Kern's method), Pressure loss in the calender, Example of calculation), flooded reboilers with forced circulation (Reboiling of a pure body in the calender,

Reboiling of a mixture in the calender), Level Reboilers with Natural Circulation, Flooded Reboilers with Natural Circulation, example of Calculation of a Reboiler

Evaluation method:

Continuous monitoring : 40% ; Exam: 60%.

Bibliographic references :

1. J.F. Sacadura, Transferts thermiques – Initiation et approfondissement, Ed. Lavoisier, 2015.
2. R.B Bird, W.E. Stewart, E.N. Lightfoot, Transport phenomena, 2ème Ed., Wiley & Sons, 2007. A. Giovannini et B. Bédat, Transfert de chaleur, Ed. Cépaduès, 2012.
3. James R. Welty, Charkes E. Qicks, Robert E. Wilson; Gregory Rorrer, Fundamentals of Momentum, Heat, and Mass Transfer. 4thediti onWiley& Sons, 2001.
4. Leontiev, Théorie des échanges de chaleur et de masse – Édition Mir-Moscou
5. H.W. Mac Addams La transmission de la chaleur - Dunod - Paris
6. F. P. Incropera, D. P. Dewitt - Fundamentals of Heat and Mass Transfer - Wiley, N.Y. - 2002
7. Bontemps, A. Garrigue, C. Goubier, J. Huetz, C. Marvillet, P. Mercier Et R. Vidil – Échangeur de chaleur – Technique de l'Ingénieur, Traité Génie Énergétique
8. P. Wuithier, Le Pétrole, Raffinage et Génie Chimique tome2, Edition technip Paris

semester: 1
teaching unit: MTU 1.1
Matter 1: P W Water Chemistry
VHS: 22h30 (P W: 1h30)
Credits: 2
Coefficient:1

Teaching objectives:

This subject aims to provide the chemistry bases necessary for the analysis and resolution of an environmental problem. It concerns the physicochemical characterization of water with a view to evaluating its quality and treatment.

Recommended prior knowledge:

Chemistry of solutions, mineral and analytical

Content of the subject:

PW 1 : Determination of salinity, pH, conductivity and turbidity
PW 2 : Determination of suspended solids and volatile suspended solids (MVS) [NF EN 872 (june in 2005)].
PW 3 : Determination of the alkalimetric titer and the complete alkalimetric titer [NF EN ISO 9963-1 (February 1996)]
PW 4 : Determination of total hardness, calcium hardness and magnesium hardness [NF T90-003 (August 1984), NF T90-016 (August 1984)].
PW 5 : Determination of ortho phosphates[NF EN ISO 6878 (April 2005)]
PW 6 : Determination of dissolved oxygen
PW 7 : Determination of biochemical oxygen demand (BOD5)
PW 8 : Determination of chemical oxygen demand (COD)
PW 9 : Determination of total organic carbon (TOC)
PW 10 : Determination of ammoniacal nitrogen and Kjeldahl nitrogen (NTK)

PW11 : Methodology for isolating microorganisms from soil, air and water, microbiological analyzes of water

Evaluation method:

Continuous monitoring: 100 % ; Exem : 0%.

Bibliographic references : (Si possible)

1. *Jean Rodier, Bernard Legube, Nicole Merlet, L'analyse de l'eau. Eaux naturelles, eaux résiduaires, eau de mer, édition Dunod, Septembre 2016 - 10ème édition.*

Semester: 1
Teaching unit: MTU1.1
Matter 2: PW Unit operations (Fluid-Fluid)
VHS: 22h30 (PW: 1h30)
Credits: 2
Coefficient:1

Teaching objectives:

•Allow the student to apply the theoretical knowledge acquired on a practical level and to visualize certain phenomena.

• Know how to work in a team, respect safety rules and control risks linked to materials, installations and processes.

Recommended prior knowledge:

Thermodynamics, Transfer phenomena (matter transfer, fluid mechanics).

Content of the matter:

PW N° 1. Determination of the mutual solubility of two partially miscible liquids, water-phenol.

PW N° 2. Extraction of volatile molecules by hydro distillation.

PW N° 3. Separation of benzoic acid and 2-naphthol

PW N° 4. Study of a batch liquid-liquid extraction process.

PW N° 5. Study of some phase diagrams.

PW N° 6. Absorption of CO2 contained in an air flow by water (“physical” absorption).

PW N° 7. Absorption with chemical reaction and regeneration of the solvent: absorption of CO2 in amino acids.

PW N° 8. Liquid-gas absorption desorption.

PW N° 9. Creation of a water/oil/surfactant ternary diagram.

PW N° 10. Study of the operation of the total reflux column

PW N° 11. Rectification continue.

PW N° 12. Batch distillation.

PW N° 13. Study of a continuous distillation process in a packed column or in a column with perforated plates.

PW N° 14 Separation and purification by fractional distillation: Case of esterification.

Evaluation method :
Continuous monitoring: 100%.

Semester: 1
Teaching Unit: MTU1.1
Matter 3: PW Heat exchangers
VHS: 22h30 (PW: 1h30)
Credits: 2
Coefficient : 1

Teaching objectives:
- Experimentally quantify the various modes of heat transfer.
- Measure the thermal performance of different types of exchangers.
- Experimentally study equipment for the production, transport and use of steam.

Recommended prior knowledge:
Transfer phenomena, fluid mechanics.

Content of matter:

PW N° 1. Heat transfer by conduction (basic unit).
PW N° 2. Linear heat conduction.
PW N° 3. Radial heat conduction.
PW N° 4. Convection and radiation
PW N° 5. Heat transmission by free and forced convection.
PW N° 6. Coaxial heat exchanger.
PW N° 7. Plate heat exchanger: enthalpy balances, efficiency curves, evaluation of transfer coefficients.
TP N° 8. Tube bundle heat exchanger.

Evaluation method:
Continuous monitoring:100%.

Semester: 1
Teaching unit: M TU1.1
Matter 4: Process engineering simulators
VHS: 37h30 (Course : 1h30, PW: 1h00)
Credits: 3
Coefficient : 2

Teaching objectives:

Through this subject, the student learns to design, size and simulate certain industrial processes in relation to process engineering using a calculation code in the form of a simulator. The program will be adapted according to the simulator used.

Recommended prior knowledge:

Thermodynamics, reaction kinetics, transfer phenomena, unit operations and reactors.

Matterl content:

Chap. I : Reminder (2 weeks)

Process engineering simulators, creation of a simulation, selection of the list of compounds, choice of the thermodynamic model, installation and specification of material flows, simulation of pumps, compressors and flash separator.

Chap. II Simulation of reactions and chemical reactors/bioreactors (3 weeks)

Single Conversion Reactions, Multiple Conversion Reactions, Balanced Reactions, Perfectly Stirred Reactors (RPC), Plug Reactors (RP), Bioreactors, Catalytic Reactors and Reactor Association.

Chap. III : Simulation of gas-liquid, liquid-liquid and liquid-solid contactors (3 weeks)

Simulation of absorption/striping phenomena without and with chemical reactions in columns of different configurations (trays and packings), liquid-liquid and liquid-solid extraction.

Chap. IV : Simulation of distillation columns (3 weeks)

Distillation of binary and complex mixtures in columns of different configurations (plate and packed column with total and partial reflux and total and partial condenser).

Chap. V : Simulation of real processes (4 weeks)

Applications to real processes.

Evaluation method: Continuous monitoring: 40% ; Exem : 60%.

Bibliographic references :

1. Mariano Martín Martín, Introduction to Software for ChemicalEngineers, 2014.
2. Xavier Julia, Simulateurs de procédés, techniques de l'ingénieur, J1022 V2.
3. User guide du simulateur utilisé.

Semester: 1
Teaching unit: DTU 1.1
Matter of choice 1: Environmental microbiology

VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient:1

Teaching objectives:
Acquire fundamental knowledge of environmental microbiology.
Recommended prior knowledge:
Basic notions of natural sciences
Content of the matter:

I- Introduction to environmental microbiology
II- Morphology and functional anatomy of bacteria
III- Bacterial physiology
a)- nutrition
b)- growth
IV- Role of microorganisms in the cycle of bioelements
a)- Characteristics of microbial ecosystems.
b) Interspecific interactions
c)- Soil microbiology
d)- Soil microbiology
e)- Air microbiology.
V- Microbiology of domestic water and wastewater.
VI- Study of microbial biodiversity
1. Sampling
2. Microscopy
3. Flow cytometry
4. Selection and isolations
5. Molecular Methods
6. Other Methods

Evaluation method:
Exam : 100%.

Bibliographic references : (Si possible)

1. *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.*
2. *Pauline M. Doran, Bioprocess Engineering Principles, Academic Press, 2eédition, 2013*
3. *K.G. Clarke, Bioprocess Engineering, Elsevier, 2013.*

Semester: 1
Teaching unit: DTU 1.1
Matter of choise 2: Environmental Biochemistry
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient:1

Teaching objectives:
Acquire fundamental knowledge of environmental biochemistry.

Recommended prior knowledge:
Basic notions of natural sciences
Content of the matter:
I- Introduction
a)-Molecular constituents of the cell.
b)-Notions of bioenergetics.
II- Proteins
a)-Structure and properties of amino acids.
b)-Structure and properties of proteins.
III- Enzymology
a)-Structure and mechanism of action of enzymes
b)-Enzymatic kinetics complements
c)-Introduction to the enzyme genre.
IV- Microbial degradation of proteins
Nitrogen and sulfur cycle
V-Les glucides
a)-Structure and properties of bones.
b)-Structure and properties of carbohydrates
c)-Microbial degradation of cellulosic waste and carbon cycle.
d)-Electron transport and phosphorus and oxygen cycle.
VI-Lipids
a)-Structure and properties of fatty acids.
b)-Structure and properties of lipids.
c)-Microbial degradation of petroleum residues, n-alkanes for example

Evaluation method:

Exam (100%)

Bibliographic references : (Si possible)
1.Pllet,P .E. (1968) "La Cellule: structure et fonctions", Masson & Cie, Paris.

2.Françoise Quentin, Paul-françois Gallet, Michel Guilloton, Bernadette Quintard (2011- 2015) Biochimie en 84 fiches. 2e édition. Dunod, Paris.

Semester: 1
Teaching unit : TTU1.1
Matter 1: Technical English and terminology
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:
Introduce the student to technical vocabulary. Strengthen your knowledge of the language. Help them understand and synthesize a technical document. Allow him to understand a conversation in English held in a scientific framework.

Recommended prior knowledge:
Basic English vocabulary and grammar

Content of the matter:

- **Written comprehension: Reading and analysis of texts relating to the specialty.**

Oral comprehension: From authentic popular science video documents, note taking, summary and presentation of the document.

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

- Written expression: Extracting ideas from a scientific document, Writing a scientific message, Exchange of information in writing, writing CVs, letters requesting internships or jobs.

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

Evaluation method:
Exam: 100%.

Bibliographic references :

1. *P.T. Danison, Guide pratique pour rédiger en anglais: usages et règles, conseils pratiques, Editions d'Organisation 2007*
2. *A. Chamberlain, R. Steele, Guide pratique de la communication: anglais, Didier 1992*
3. *R. Ernst, Dictionnaire des techniques et sciences appliquées: français-anglais, Dunod 2002.*
4. *J. Comfort, S. Hick, and A. Savage, Basic Technical English, Oxford University Press, 1980*

III - Detailed program by matter for the S2 semester

Semester: 2
Teaching unit: FTU 1.2.1
Matter1: Drinking water production
VHS: 67h30 (Course: 3h00, Directed work : 1h30)
Crédits: 6
Coefficient:3

Teaching objectives:

The goal of this course is to give students the tools they will need to manage drinking water production processes.

Recommended prior knowledge:

Water chemistry, solution chemistry, electrochemistry, matter transfer.

Content of the matter:

Chapter 1 GENERAL AND STANDARDS (2 weeks)

General qualities of water from various sources of supply; Quality standards; guidelines for water treatment; treatment lines

- **Chapter 2. DRINKING WATER PRODUCTION PROCESSES (5 weeks)**

Micro-sieving (Theoretical aspects; Duration of use and Criteria for choosing a microsieve)
- Coagulation and flocculation (Suspended particles; Coagulation; Flocculation theory)
- Decantation (Types of decantation, Decantation of discrete and flocculating particles; Tube and lamella decantation)
- Flotation (floats, some performances)
- Filtration (General, Characteristics of filter materials, Water flow in a sand filter, two-layer filter)
- Disinfection (General principles; Disinfection by: chlorine, chlorine dioxide, ozone, UV, UV/oxygenated water, etc.)

Chapter 3 SPECIFIC PROCESSES FOR PRODUCING DRINKING WATER (8 weeks)

- Softening by precipitation
- Adsorption and ion exchange
- Elimination of iron and manganese (Balance of iron and manganese; Iron removal and demanganization processes)
- Water stabilization
- Fluoridation and defluoridation of water
- Desalination of sea and brackish water

(Desalination methods: distillation, freezing, electrodialysis, reverse osmosis, etc.)
- Advanced oxidation processes (Fenton, Electrofenton, Photofenton, UV/Ozone, UV/ozone/hydrogen peroxide, sonochemistry, photocatalysis, plasma processes, electron gun, etc.)
- Treatment of swimming pool water (Purpose and Treatment Techniques)

Evaluation method: Continuous monitoring: 40% ; Exam: 60%.

Bibliographic references :

B. Legube « Production d'eau potable », Edition Dunod, Paris
J.B. BEAUDRY « Traitement des eaux » Edition le Griffon d'argile, Sainte-Foy, (Canada)
DEGREMONT « Mémento technique de l'eau » T1 et T2, Edition Technique et Documentation, Paris
Processus unitaires de traitement de l'eau ; W. J. Masschelein
Microbiologie des eaux d'alimentation ; C. Hasley, H. Leclerc
Les traitements de l'eau pour l'ingénieur - Procédés physico-chimiques et biologiques - Cours et problèmes résolus ; C. Cardot
Le traitement des eaux ; R. Desjardins
Traitement et épuration des eaux industrielles polluées : procédés membranaires, bioadsorption et oxydation chimique ; G. Crini, P. M. Badot

Semester: 2
Teaching unit: FTU 1.2.1
Matter2: Solid waste management and treatment
VHS: 45h00 (Course: 1h30, Directed work: 1h30)
Credits: 4
Coefficient:2

Teaching objectives:

The aim is to introduce students to the problem of solid waste, the impact of which on the environment and public health no longer needs to be demonstrated. It is a question of studying the different possibilities for treating waste depending on their nature.

Matter content:

Introduction

Definition of waste, waste classification, characterization, ultimate waste, legislation.

- **Chapter 1: Household waste**
  - Waste collection: Type of collection, collection equipment, collection route, transfer stations.
  - Landfill: Problems with illegal dumping, technical landfill center, waste eligible for CET class I, II and III, technical characteristics of CET (passive safety, active safety and coverage), leachate treatment and biogas recovery, sizing of the CET.
  - Bioconversion of organic waste
  - **Composting**: Advantages of composting, compostable waste, composting parameters, composting phases, composting methods, determination of compost maturity, vermicomposting.
  - **Methanization:** Methanizable waste, importance of methane in industrial processes, methanization phases, methanization parameters, dry and wet fermentation, biogas treatment, types of digesters.
  - **Incineration**: Purpose, products from the incineration of household waste, incineration parameters, post-treatments (gases, fly ash and bottom ash), types of ovens.
  - **Recycling:** Importance of recycling, recycling logos, recyclable and non-recyclable waste, importance of selective sorting in recycling.

Chapter 2: Special industrial waste (DIS)

Definition, types, production sources, dangerousness criterion, nomenclature, storage.
- Treatments:
- Physico-chemical: neutralization, chemical precipitation, oxidation/reduction, sorption, stabilization/solidification, well injection.
- Thermal treatments: incineration, pyrolysis, hydrothermal oxidation, vitrification.

Chapter 3 Healthcare waste with infectious risk (DASRI)

Types of medical waste, legislation, sorting, packaging and marking, storage, transport.

Treatments: by incineration, autoclave sterilization, chemical disinfection, microwave irradiation.

Evaluation method : Continuous monitoring: 40% ; Exam: 60%.

Bibliographic references :

1- George Tchobanoglous, Frank Kreith, Handbook of Solid Waste Management, McGraw-Hill, 2002.
2- Daniel A. Vallero, J. Jeffrey Peirce, Engineering the Risks of Hazardous Wastes, Ed. B.H. 2003.
3- Lawrence K. Wang, Nazih K. Shammas Yung-Tse Hung, Advances in Hazardous Industrial Waste Treatment, CRC Press, 2009.

Semester: 2
Teaching unit: FTU 1.2.2
Matter1: Adsorption processes and Membrane separation
VHS: 45h00 (Course: 1h30, Directed work: 1h30)
Credits: 4
Coefficient:2

Teaching objectives:

The objective is to give:

- The theoretical bases necessary to implement an adsorbent and the sizing of adsorbers of various types: discontinuous, semi-continuous and continuous.
- In-depth theoretical and practical knowledge in the field of membrane techniques and familiarize them with the latest technological advances in membranes.

Recommended prior knowledge

Transfer phenomena (material transfer, fluid mechanics, etc.), surface chemistry and heterogeneous catalysis.

Content of the matter:

First part: Adsorption processes (7 Weeks)

Chapter1 : Main industrial adsorbents, selection criteria, regeneration methods, main industrial applications.
Chapter2 : Adsorption dynamics (preceded by a reminder of the general laws of physical adsorption).
Chapter 3 : Discontinuous processes/continuous processes (breakthrough curve)
Chapter 4 : Adsorption separation processes
Pressure modulated.
-Temperature modulated.
Chapter 5 : The adsorption kinetics and calculates the adsorption speed (pseudo first and second order model in addition to the intraparticle and extraparticle diffusion model.
Second part: Membrane separation processes (8 Weeks)
Chapter 1. Generalities and definitions
Chapitre 2. membranes
Structure, characterization and membrane modules of industrial installations.
Chapitre 3. Technique de séparation membranaire
Microfiltration, Ultrafiltration, Nanofiltration,Osmose inverse et électrodialyse.

Evaluation method:

Continuous monitoring: 40e% ; Exam : 60%.

Bibliographic references :

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

Semester: 2
Teaching unit : FTU 1.2.2
Matter 2: Physico-chemical treatment of wastewater
VHS: 45h00 (Course: 1h30, Directed work: 1h30)
Credits: 4
Coefficient:2

Teaching objectives:

Understand the usefulness of the physico-chemical treatment of wastewater in the treatment chain as a pretreatment and complementary treatment to be able to size and manage the treatment plants

Recommended prior knowledge :

Fundamental notions of chemistry and process engineering

Content of matter :

1- **1- Introduction to wastewater treatment**

- **2- Characterization and Quantification of wastewater**

- Characterization of the quality of wastewater (BOD, COD, MES, Nitrogen, Phosphorus, oils and grease, hydrocarbons, toxic elements, heavy metals, Temperature, pH, etc.)
- Quantification of wastewater (endowment, average flow, peak coefficient, max flow in dry weather, max flow in rainy weather), flow quantification technique
- Evaluation of wastewater reduction techniques at source
- Regulation and mitigation of flow variations (sizing of equalization basins)

- **2- Collection and pumping of wastewater**

-The design of sewer systems for the evacuation of different sources of wastewater (depending on population, flow, load) (types of sanitation networks)
- The design of pumping stations for the transmission of wastewater to treatment plants and the evacuation of treated effluent to the receiving environment

Proposal for wastewater treatment chains

Select and design the different treatment stages according to the composition of the wastewater and the destination of the treated effluent: Protection of receiving environments (wadi, dam, groundwater, sea), protection of public health, reuse of treated wastewater (the agriculture, industry, etc.), recharge of water tables….

- **Physico-chemical treatments**

Wastewater inlet channel (sizing and adjustment technique)
- Screening (objective, different types of screens, calculation of pressure losses and wetted surfaces for a clean and clogged screen, determination of the approach speed and the passage speed, quantity of waste retained))
- Desanding (channel desandr, aerated and tangential, objective, operation, calculation of dimensions, calculation of air requirements, calculation of the quantity of sand retained)
- Deoiling/degreasing (static degreasing, aerated degreasing, objective, operation, calculation of dimensions)
- Chemical treatment (buffer basin and phosphatization, objective, operation, sizing and optimization of doses)
- Sedimentation and decantation (objectives, discrete sedimentation, flocculent sedimentation, lamellar sedimentation, zone sedimentation and compressive sedimentation), sizing of primary and secondary decantation basins (shape, inlet, outlet weir, bottom, sludge extraction system etc. ….)
- Aeration and agitation (aeration and agitation technique, implementation and control parameters)

Evaluation method:

Continuous monitoring: 40% ; Exam : 60%.

Bibliographic references :

Semester: 2
Teaching unit : MTU 1.2
Matter 1: Porous and Dispersed Media
VHS: 37h30 (Course : 1h30, Directed work: 1h00)
Credits: 3
Coefficient : 2

Teaching objectives:
All of these lessons should provide a good understanding of Process Engineering operations for the treatment of liquids and gases.
Recommended prior knowledge:
Unit operations
Content of matter :

Chapter 1 : Introduction to Porous and Dispersed Media
- Natural Porous Media
- Artificial porous media
- Operations on solids: Grinding; Screening, Sieving.
- Dispersed environments

Chapter 2 : Characterization of porous media
- Grain morphology
- Morphology of a grain population
- Solid particle size distribution
- Classification of solid particles
- Characterization of a grain bed

Chapitre 3 : Mouvements des particules dans les fluides
Characterization of a grain bedChapter 3: Movements of particles in fluids
- Vertical movement of particles
- Calculation of the falling speed of a particle (terminal velocity).
- Sedimentation of a Particle Suspension
- Movement of colloids
- Movement of drops and bubbles

Chapter 4 : Flow of fluids through a porous medium
Reminder: Bernoulli continuity equation
- Darcy's law
- Relationship between Bernoulli's continuity equation and Darcy's law
- Permeability of a porous medium
- Kozney-Carmen model
- Consistency between Darcy's law and the Kozney-Carmen equation
- Burke-Plummer model

Chapter 5 : Filtration
- - Filtration theory.
- - Theory of filtration on support
- - Constant flow filtration
- - Constant pressure filtration.
-

Evaluation method:Continuous monitoring: 40% ; Exem : 60%.

1. **Bibliographic references :**
2. Coulson J.M., J.F Richardson, J.R Backhurst And J.H. Harker, "Chemical Engineering", volume two, Fifth edition, Pergamon Press, 2002.
3. Rhodes, M., Introduction to ParticleTechnology, 2nd Ed., Wiley (2008).
4. Gibilaro, L. G., Fluidization - Dynamics, Butterworth - Heinemann (2001).
5. Perry R. H., D. W. Green And J. O. Maloney, "Perry's Chemical Engineers' Handbook " seventh edition, , McGraw Hill, 1999

6. Kunii D. And O. Levenspiel, "Fluidization Engineering", second ed. Butterworth—Heinemann, 1991.
7. Darton R.C., "Fluidization", ed. by J.F. Davidson, R. Clift and D. Harrison, Academic Press, 1985.
8. McCabe W.L., J.C. Smith and P. Harriott, "Unit Operations of Chemical Engineering", seventh edition, ed. McGraw-Hill, 2004

Semester 2
Teaching unit : MTU 1.2
Matter 2: PW Water Treatment and Adsorption and Separation Processes Membranaire
VHS: 22h30 (PW: 1h30)
Credits: 2
Coefficient:1

Teaching objectives:

The objective is to present the treatment processes and adsorption and membrane separation processes that engineers most often use to produce drinking water.

Recommended prior knowledge:

Water chemistry, physicochemical methods of analysis

Content of matter :

- ***Water treatment***
- Coagulation-floculation
- Décarbonatation à la chaux
- Echange d'ions
- Décantation
- Clarification
- Filtration
- Stérilisation par chloration (break point) ou ozonation
- Aération (détermination du coefficient de transfert)
- Agitation (optimisation des gradients de vitesse dans les systèmes de traitement)
- Procédés membranaires

Procédés d'adsorption et Séparation Membranaire

- Séparation d'un colorant en phase aqueuse par adsorption.
- Séparation d'un pesticide en phase aqueuse par adsorption.
- Equilibre dans le système hétérogène : détermination expérimentale de l'isotherme d'adsorption du CH_3COOH, dissous dans l'eau, par une substance solide (charbon actif).
- Extraction par membrane liquide émulsionnée.
- Préparation et stabilisation d'une émulsion

Evaluation method:
Continuous monitoring: 100%
Bibliographic references :

- J.B. BEAUDRY « Traitement des eaux » Edition le Griffon d'argile, Sainte-Foy, (Canada)
- DEGREMONT « Mémento technique de l'eau » Edition Technique et Documentation, Paris
- W.W. ECKENFELDER « Gestion des eaux usées urbaines et industrielles » Edition Technique et Documentation ; Paris
- M.J. HAMMER « Water and waste-water technology » Edition John Wiley & sons, New York
- Warren L. Mc Cabe, Julian C. Smith, Peter Harriott «Unit Operations of Chemical Engineering », McGraw- Hill, Inc, Fifth Edition, 1993.
- J. P. Brun, Procédés de séparation par membranes, Transport Techniques membranaires Applications, Masson, Paris, 1988

Semester: 2
Teaching unit: MTU 1.2
Matter 3: Treatment and Conditioning of Process Water
VHS: 45h00 (Course : 1h30 ; Directed work: 1h30)
Credits: 4
Coefficient:2

Teaching objectives:

The aim is to acquire theoretical and practical knowledge on the treatments necessary to use water as an energetic and thermal fluid in order to eliminate the problems of clogging, scaling, corrosion, biological developments, water quality, which arise directly from the use of this fluid.

Recommended prior knowledge:

Water chemistry

Content of the matter:

Chapter I: Water intended for different processes: Quality and characteristics

I.1. Water for the food industry
I.2. Water for the pharmaceutical industry
I.3. Eau pour l'industrie des produits chimiques
I.4. Water for the paper industry
I.5. Problems caused by feed water
I.6. Adequate water treatment

Chapter II : Boiler water treatment

II.2. Boiler water specifications (characteristics, properties)
II2.1. Make-up water problems
II.3. Boiler water treatment
II.3.1. Softening by ion exchange
II.3.2. Demineralization
II.3.3. Degassing
II.3.4. Corrosion inhibitors
II.3.4. Anti-priming packaging
II.4. Treatment sectors

Chapter III : Cooling water treatment

III.1. Cooling circuits (open circuits, totally closed circuits and semi-closed circuits)
III.2. Water cooling
III.3. Problems caused by the use of water in cooling circuits
Scaling, Dirt, Corrosion and microbial growth.
III.4. Cooling water treatment
III.4.1. Adjunctive treatment
III.4.1.1. Precipitation softening
III.4.1.2. Dispersing and recalcitrant agent
III.4.2. Purging Treatment

Evaluation method:

Continuous monitoring: 40% : Exem : 60

Bibliographic references :

1. Boiler water, problems and solutions, PDH course M165

2. Systèmes de refroidissement industriels, Décembre 2001, COMMISSION EUROPÉENNE
3. A. Bhatia, Cooling Water Problems and Solutions: Quick Book, 2015
4. Cooling Water Treatment, Essential Expertise for Water, Energy and Air, 2010, ANNUAL REPORT

Boiler Water Treatment, Principles and Practice, Vol. 1 and 2

Semester: 2
Teaching unit: DTU 1.2
Matter of choice 01: Process regulation and control
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient:1

Teaching objectives:

Recommended prior knowledge:

Content of the matter:

Chapiter I Introduction

- General information on automatic regulation

- Concept of open loop (BO) and closed loop (BF) operation

Chapiter 2 General information on systems
The Laplace transformation (TL)

- Laplace transform of some usual signals

- Transfer function (FT) of a system

- Open loop transfer function (FTBO) and closed loop transfer function (FTBF)

- Block diagram

Chapiter 3 Analysis of first and second order systems Temporal analysis
Study of a first order system

• Study of a second order system

• Study of a system with delay

Chapiter 4 Performance (stability and precision) of servo systems

- Stability of servo systems
- Precision of servo systems

Chapiter 5 Analog control units (analog regulators)

- Basic actions of regulators
- - The proportional action regulator (P)
- - The regulator with proportional and integral actions (PI)
- - The proportional integral action regulator derived PID
- - Examples of regulation of chemical processes

Modeling and regulation of level in a tank: Description and modeling of the tank / Control by PI regulator of the level in the tank

• Modeling and regulation of the concentration in a completely stirred chemical reactor (RAC): Description and modeling of the RAC chemical reactor with jacket / Regulation of the concentration in the RAC chemical reactor with jacket

Chapiter 6 Method for adjusting regulator parameters

PID adjustment by reference model
Conclusion

Evaluation method:

Exam : 100 %

Bibliographic references :

1. Jean Pierre Corriou : Commande des procédés, 3ème édition ; Lavoisier, 2012.

2. George Stephanopoulos, Chemical Process Control: An introduction to theory and practice ; Prentice Hall International, Inc, 1984.

Course additions

Appendix A: The Runge-Kutta method of order 4 (RK4)
Appendix B: Control valves
Appendix C: Diagram of control loops

1

Semester: 2
Teaching unit:DT U 1.2
Matter of choice 02 : Environmental audits and impact studies, Environmental standards and conventions
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient:1

Teaching objectives:

Provide students with the types and objectives of environmental assessments: Environmental impact study, Environmental audit, Certification according to the "Iso 14001 standard"

- Help students become aware of the main theoretical concepts associated with environmental assessment "Concept of sustainable development".

- Know the organizational, administrative, legal and regulatory frameworks within which environmental impact assessments are carried out.

- Lead students to experiment with environmental impact assessment methods.

- Have the appropriate tools for carrying out EIAs.

- Provide students with all international conventions regarding environmental protection

Recommended prior knowledge:
The student must be able to:
- Define and distinguish the main types of environmental assessment
- Define some common concepts useful in EIA
- Understand the merits of EIA methods
- Determine the scale and importance of a potential impact on the environment
- Describe and diagram the main stages of the typical EIA process
- Mention impact assessment tools
- Schematize the administrative process for processing an EIA in Algeria
- Understand the environmental management management tool: the EMS according to the ISO 14001 Standard
- Know the main international conventions

Content of the matter

Chapiter I : Environmental protection as a tool for sustainable development
I. Introduction

I.1 Concept of sustainable development

I.2 Industrial ecology is a real operational component of sustainable development
I.3 Basic principles of sustainable development

I.4 Environmental assessment
Chapiter II : **Environmental impact study and impact assessment tools**
II. 1 Legal framework for environmental protection in Algeria
II.2 Environmental impact study
II.3 Approach and conduct of an environmental impact study

II.4 Environmental assessment tools and methods

II.5 Analysis and prediction of impacts

II.6 Principles of impact mitigation

II.7 Ways to avoid, minimize and compensate for impacts

Chapiter III : Environmental Audit

III.1. Definition

III.2 Fields of application of the Environmental Audit

III.3 Content and structure of an audit document

III.4 General approach to an audit

III.4.1 Phase 1: Awareness and definition of needs

III.4.2 Phase 2: Data analysis

III.4.3 Phase 3: Development of proposals and implementation of selected solutions

III.4.4 Phase 4: Monitoring and evaluation of the results obtained

III.4.5 Phase 5: Make yourself known

III.5 Example of an audit aimed at developing an environmental management plan

Chapter IV: ISO 14001 standard

IV.1 Environmental management system and ISO 14001 standard

IV .1.1 What is environmental management?

IV .1.2 The environmental management tool: the EMS

IV .1.3 Benefits of an environmental management system

IV.2 Reference standards / Certification

IV.2.1 Standardization

IV.2.2 Certification

IV.2.3 ISO and the environment

IV .2.4 Stages of an EMS according to the ISO 14001 standard

IV.3 Evolution of the ISO 14001 version 2015 standard

ChapterV. International Conventions

V.1 United Nations Conference in Rio on international environmental law

V.2 Convention on climate change according to the Kyoto protocol

V.3 Ramsar Convention protection of wetlands

V.3 Maghreb Charter

Evaluation method:

Exam : 100 %

Bibliographic references :

1- ANESS SAADAN, L'évolution du cadre juridique de protection de l'environnement en Algérie thèse de doctorat 2006.

2- ANNE-CLAIRE CHAMPENOIS, Inventaire des normes et standards environnementaux Force juridique dans les pays membres du SEEAC 2011Utrecht, Pays-Bas.
3- ARAB LYASMINE, Impact de la certification environnementale ISO 14001 sur la performance environnementale d'une entreprise algérienne, Mémoire de magistère 2012.
4- ARNAUD DIEMER ET SYLVÈRELABRUNE, L'écologie industrielle : quand l'écosystème industriel devient un vecteur du développement durable (2007).
5- BARRY SADLER ET MARY MCCABE, Programme des Nations Unies pour l'environnement PNUE,Manuel de Formation Sur l'Etude d'Impact Environnemental. 2ème édition 2002.
6- DEMRI D, Protection de l'environnement et réglementation en Algérie, laboratoire des sciences et techniques de l'environnement, Département du Génie de l'Environnement, Algérie, 2010.
7- DION M., DOMINIQUE W., Le développement durable, théories et applications au management, Edition Dunod, Paris, 2008.
8- Directive pour la réalisation d'une étude d'impact sur l'environnement d'un projet minier, site Web : www.mddelcc.gouv.qc.ca.
9- EGLANTINE SIMONET, Les Systèmes de Management Environnemental – Synthèse, 2003.
10- ÉRIC BRUNELLE, SME L'élaboration D'un Système De Management Intégré : Qualité Et Environnement Université de Sherbrooke, Québec, Canada, février 2005.
11- GENDRON C., La gestion environnementale et la norme ISO 14001, Les Presses Universitaires de Montréal, Québec, 2004.

12- GODARD O., Développement et environnement, Edition la Documentation française, Cahier français n° 337, 2007.
13- Guide de réalisation d'une étude d'impact sur l'environnement, site web : www.gouv.qc.ca.
14- JACQUES ANDRÉ HERTIG, Etudes D'impact sur L'environnement. Volume 23, 2ème Edition.
15- MESMIN TCHINDJANG, cours Les Etudes d'impacts environnementaux à l'université de Yaoundé 1 - Cameroun.
16- ODILE FAURE ROCHET, AnalyseEnvironnementale les Clés à la Réussite volume 24 edition3.
17- OFFICE NATIONAL POUR L'ENVIRONNEMENT, Guide General, Audit Environnemental.
18- RACHID HAKKOUCours, Etude d'impact sur l'environnement (EIE), Master Eau et Environnement » 2011-2012 (Maroc).
19- ROBERT A. FROSCH ET NICHOLAS E. GALLOPOULOS, des stratégies industrielles viables. (1995).
20- Systèmes-de-Management-et-certification,site web :https://www.marense.com
21- RosaGalvez-Cloutierévaluation des impacts environnementaux (EIE)Faculté des sciences et de genie Université Lava (2011)
22- ULRICH OSBERGAUS aeken germany et DOMINIQUE SELLIER Institut Fresennius, Paris Système de management environnementale selon L'ISO 14001, Manuel de Formation Mai 2001 (Algérie).

1- Legislative texts

2- 1- ISO 14001, "ENVIRONMENTAL MANAGEMENT SYSTEM" requirements and guidelines for its use", AFNOR, Paris, 2004.
3- 2- ISO 14001 "THE KEYS TO AUDIT", AFNOR Certification 2015
4- 3- ISO 14001 VERSION l 2015
5- 4- OFFICIAL JOURNAL OF THE ALGERIAN REPUBLIC No. 43, Law No. 03-10 of July 19, 2003 relating to the protection of the environment within the framework of sustainable development.
6- 5- OFFICIAL JOURNAL OF THE ALGERIAN REPUBLIC No. 77, Law No. 01-20 of December 12, 2001, of December 15, 2201, relating to the planning and sustainable development of **the territory.** OFFICIAL JOURNAL OF THE ALGERIAN REPUBLIC No. 34 Executive Decree No. 07-

145 of May 19, 2007 determining the scope, content and terms of approval of studies and environmental impact notices.

7- 7- OFFICIAL JOURNAL OF THE ALGERIAN REPUBLIC No. 34 Executive Decree No. 07-144 of May 19, 2007 establishing the nomenclature of installations classified for environmental protection.

8- 8- OFFICIAL JOURNAL OF THE ALGERIAN REPUBLIC N° 26; Executive Decree No. 06-141 of April 19, 2006 “defining the limit values for industrial liquid effluent discharges”.

9- 9- OFFICIAL JOURNAL OF THE ALGERIAN REPUBLIC N° 26; Executive Decree No. 06-141 of April 19, 2006 “defining the limit values for industrial atmospheric discharges”.

Semester : 2
Teaching unit : TTU 1.2
Matter : Compliance with standards and rules of ethics and integrity.
VHS : 22h30 (Course : 1h30)
Credit : 1
Coefficient : 1

Teaching objectives:

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

Recommended prior knowledge:

Ethics and professional conduct (the foundations)

Content of matter :

A. Respect for the rules of ethics and integrity,

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

- **2. Integrity and responsible research**

Respect for the principles of ethics in teaching and research

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

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

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

B- Intellectual property

I- Fundamentals of intellectual property

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

II- Copyright

1. Copyright in the digital environment

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

2. Copyright in the Internet and e-commerce

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

3. Patent

Définition. Droits dans un brevet. Utilité d'un brevet. La brevetabilité. Demande de brevet en Algérie et dans le monde.

III- Protection and valorization of intellectual property

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

C. Ethics, sustainable development and new technologies

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

Evaluation method :

Exam : 100 %

Bibliographic references :

1. Charte d'éthique et de déontologie universitaires, https://www.mesrs.dz/documents/12221/26200/Charte+fran__ais+d__f.pdf/50d6de61-aabd-4829-84b3-8302b790bdce
2. Arrêtés N°933 du 28 Juillet 2016 fixant les règles relatives à la prévention et la lutte contre le plagiat
3. L'abc du droit d'auteur, organisation des nations unies pour l'éducation, la science et la culture(UNESCO)
4. E. Prairat, De la déontologie enseignante. Paris, PUF, 2009.
5. Racine L., Legault G. A., Bégin, L., Éthique et ingénierie, Montréal, McGraw Hill, 1991.
6. Siroux, D., Déontologie : Dictionnaire d'éthique et de philosophie morale, Paris, Quadrige, 2004, p. 474-477.
7. Medina Y., La déontologie, ce qui va changer dans l'entreprise, éditions d'Organisation, 2003.
8. Didier Ch., Penser l'éthique des ingénieurs, Presses Universitaires de France, 2008.
9. Gavarini L. et Ottavi D., Éditorial. de l'éthique professionnelle en formation et en recherche, Recherche et formation, 52 | 2006, 5-11.
10. Caré C., Morale, éthique, déontologie. Administration et éducation, 2e trimestre 2002, n°94.
11. Jacquet-Francillon, François. Notion : déontologie professionnelle. Le télémaque, mai 2000, n° 17
12. Carr, D. Professionalism and Ethics in Teaching. New York, NY Routledge. 2000.
13. Galloux, J.C., Droit de la propriété industrielle. Dalloz 2003.
14. Wagret F. et J-M., Brevet d'invention, marques et propriété industrielle. PUF 2001
15. Dekermadec, Y., Innover grâce au brevet: une révolution avec internet. Insep 1999
16. AEUTBM. L'ingénieur au cœur de l'innovation. Université de technologie Belfort-Montbéliard
17. Fanny Rinck etléda Mansour, littératie à l'ère du numérique : le copier-coller chez les étudiants, Université grenoble 3 et Université paris-Ouest Nanterre la défense Nanterre, France
18. Didier DUGUEST IEMN, Citer ses sources, IAE Nantes 2008
19. Les logiciels de détection de similitudes : une solution au plagiat électronique? Rapport du Groupe de travail sur le plagiat électronique présenté au Sous-comité sur la pédagogie et les TIC de la CREPUQ
20. EmanuelaChiriac, Monique Filiatrault et André Régimbald, Guide de l'étudiant: l'intégrité intellectuelle plagiat, tricherie et fraude… les éviter et, surtout, comment bien citer ses sources, 2014.
21. Publication de l'université de Montréal, Stratégies de prévention du plagiat, Intégrité, fraude et plagiat, 2010.
22. Pierrick Malissard, La propriété intellectuelle : origine et évolution, 2010.
23. Le site de l'Organisation Mondiale de la Propriété Intellectuelle www.wipo.int
24. http://www.app.asso.fr/

V- Detailed program by matter of the semester S3

Semester: 3
Teaching unit: FTU 2.1.1
Matter1: Theoretical foundation and biological treatment of wastewater
VHS: 45h00 **(Course:1h30, Directed work: 1h30)**
Creédits: 4
Coefficient:2

Teaching objectives:
Understand the fundamentals of biological wastewater treatment and modeling and sizing of different biological reactors with varied designs

Recommended prior knowledge:
Fundamental notions of biochemistry, microbiology and process engineering

Content of matter:

1. **Introduction :** Objectives and necessity of biological treatment

- **2. Composition and classification of microorganisms**
  Introduction to microbial metabolism and biological reaction (carbon sources and energy sources, nutritional needs of microorganisms)
  -3. **Decomposer metabolism**
  Conversion and Growth Conditions
  - Microbial growth and Monod kinetics (Monod model and biokinetic constants; specific growth rate, substrate utilization rate, oxygen consumption rate)
  - Determination of Monod's biokinetic constants (batch technique, continuous reactor technique)
  - The different pathways of biological degradation of pollution in wastewater (aerobic pathway, anoxia and anaerobic pathway)
  - Modeling of biological purification (competition model, inhibition model, ASM1, etc.)
  - **-3.Biological purification techniques**
  - Free biomass processes
  - Fixed biomass processes

4 **Example of biological purification techniques:**
activated sludge, biological filters, membrane reactors, lagooning systemsLes boues activées
Type of activated sludge (high load, medium load and prolonged aeration) notion of sludge age and mass load;
- Development of the balance of the activated sludge system with return (age of the sludge, mass load, determination of the concentrations of the substrate and the biomass at the outlet, volume of the aeration basin, quantity of excess sludge, oxygen requirement and air)
- Sizing an activated sludge system
- Use of activated sludge for the elimination of carbon load and nitrogen
- Use of activated sludge for the elimination of carbon load, nitrogen and phosphorus.
- Different configurations of activated sludge reactors (biological basin, channel, sequential, piston, etc.)

5 Sludge treatment:
quantification of sludge generated in a biological treatment system, dehydration and treatment of sludge (Thickening, Aerobic digesters, Anaerobic digesters, Drying bed, Filter press)

6-Malfunctions and remediation techniques in biological treatment:
deflocculation of sludge, proliferation and biological foaming (diagnostic technique and implementation of remediation procedures)

Evaluation method:

Continuous monitoring: 40%; Exam: 60%

Semester: 3

Teaching unit: FTU 2.1.1
Matter 2: Gaseous Effluent Treatment
VHS: 45h00 (Course: 1h30, Directed work: 1h30)
Credits: 4
Coefficient:2

Teaching objectives:
Inform students of the different processes for treating gases and dust produced by fixed and mobile units.
Recommended prior knowledge:
All basic knowledge related to treatment processes (absorption, adsorption, filtration, etc.)

Content of matter :

Chapter 1: General information on air pollution and gaseous effluents

Sources of pollution
- The main air pollutants
- Main methods of treatment of these pollutants

- **Chapter 2: Processes for treating gaseous effluents from stationary sources**

Absorption, Gas-liquid contactors, Sizing of packed columns with and without chemical reactions, Sizing of plate columns
- Adsorption
- Thermal oxidation, Catalytic oxidation
- Condensation, Biofiltration, Flaring.

Chapter 3: Processes for treating dust from stationary sources
Bag filters, Cyclone, Venturi, Electrofilter.

- **Chapter 4. Treatment of pollution from mobile sources**

Gasoline and diesel vehicles: pollutants emitted, emissions standards, catalytic converters, two-way, three-way catalysts, etc.

Chapter 5: Gas and particle measurement
(Sampling and analysis)
Evaluation method:
Continuous monitoring : 40%; Exem: 60%
Bibliographic references :

1- Kenneth C. Schifftner, Air Pollution Control Equipment Selection Guide, Lewis publishers, 2002.
2- Nicholas P. Cheremisinoff, Handbook of Air Pollution Prevention and Control, B.H. Ed. 2002.
3- Lawrence K. Wang, Yung-Tse Hung, Nazih K. Shammas, Advanced Physicochemical Treatment Processes, Handbook of Environmental Engineering, Vol. 4, Ed. HumanaPress, 2006.
4- Technique de l'ingénieur : Ti452 génie des procédés et protection de l'environnement, ref internet 42327, 5 eme édition
5- J. L. Coulson, J. F. Richardson, and R. K. Sinnott, chemical engineering, 3rd 99., vol. 6. Butterworth Heinemann, 1999.
6- M. Roustan, Transferts gaz-liquide dans les procédés de traitement des eaux et des effluents gazeux, TEC & DOC. paris: Tec & Doc, 2003.

6- M. Roustan, "Absorption en traitement d ' air," Tech. l'Ingénieur, vol. 33, no. base documentaire Traitement de l'air, p. 18, 2004.
7- P. Trambouze, H. Van Landeghem, and J.-P. Wauquier, Les réacteurs chimiques: conception, calcul, mise en oeuvre, Technip. paris: Technip Paris, 1984.

8- C. Roizard and G. Wild, “Absorption avec réaction chimique,” Tech. l’Ingénieur, vol. 1, no. x, pp. 79–6, 1997, [Online]. Available: https://www.techniques-ingenieur.fr/res/pdf/encyclopedia/42326210-j1079.pdf.
9- P. V. Danckwerts, “Gas-liquid reactions,” 1970.

Semester: 3
Teaching unit : FTU 2.1.2
Matter 1: Technical Thermodynamics
VHS: 45h00 (Course: 1h30, Directed work: 1h30)
Cedits: 4
Coefficient:2

Teaching objectives:
Study thermodynamic cycles and master the operating principles of certain energy technologies, namely: thermal machines, compressors, pumps, etc.

Recommended prior knowledge:
Chemical thermodynamics, fluid mechanics.

Content of matter

Chapter 1. (8weeks)
Carnot cycle of thermal machines, thermal efficiency. Internal combustion engine. Gas turbine. Steam engine (Rankine cycle, HIRN cycle, reheating cycle, withdrawal cycle, with representation in the various diagrams ((T,S), (P,V) and (H,S)).

Chapter 2. (4weeks)
Compressors and pumps (compressor cycle, work, efficiency and calculation of the number of stages. Installation of pumps (characteristic curve, head, NPSH available, NPSH required efficiency).

Chapter 3. (3 weeks)
Cold: Thermodynamic study (reverse Carnot cycle). Real refrigeration cycles. Heat pumps.

Evaluation method:
Continuous monitoring: 40%; Exam: 60%

Bibliographic references

1. Gordon Van Wylen, Richard Sonntag, Thermodynamique appliquée, Editeur Erpi, Collection : Diffusion Pearson Education, 2002.
2. https://hal.inria.fr/file/index/docid/556977/filename/CycleThermoMachines_1011.pdf
3. http://www.emse.fr/~bonnefoy/Public/Machines_Thermiques-EMSE.pdf
4. Olivier Cleynen, Thermodynamique de l'ingénieur, Collection Frama book, 2015.
5. Paul Chambadal, la turbine à gaz, Collection de la direction des études et recherches d'électricité de France, EYROLLES, 1976.
6. Jean Lemale, Les pompes à chaleur, 2éme Edition DUNOD, Paris, 2012, 2014.

Semester: 3
Teaching unit: FTU 2.1.2
Matter 2: Multiphase reactors and bioreactors
VHS: 67h30 **(Course: 3h00, Directed work: 1h30)**
Credits: 6
Coefficient : 3

Teaching objectives:

- The student will have acquired knowledge concerning the operation of heterogeneous poly-phase reactors such as absorbers, catalytic reactors
- The student will have acquired the basic concepts necessary for the implementation of the design and analysis of bioreactors on an industrial scale

Recommended prior knowledge:

Knowledge of basic concepts in homogeneous reactors, chemical kinetics, transfer phenomena and microbiology is recommended**.**

Content of matter :

Part 01: Polyphasic reactors

Chapter 1. Fluid-fluid two-phase reactors

Effect of chemical reaction on matter transfer (Two film theory; Pseudo first order reaction-Hatta number (Ha); Rapid reaction regime-Factor d'accélération E ; Régime de réaction instantaneous-Diagram E versus Ha.); Calculations of two-phase reactors (batch reactors, piston reactors, perfectly stirred continuous reactors).

Chapter 2. Catalytic fluid-solid reactors

Intra-particle diffusion (Thiele number; Efficiency), Efficiency and transfer of external matter (Effect of the diameter of the catalyst grain; Transfer of external matter), Influence of internal diffusion on the reaction (Weisz-Prater criterion); Influence of external matter transfer on the reaction (Mears criterion), Fixed bed reactors. ; Fluidized bed reactors.

Part 02: Bioreactors

I- I-Introduction

II- Reminders of the basic knowledge of microbiology, biochemistry and molecular biology necessary for the calculation of bioreactors

III- II- Modeling reaction rates in biological systems

IV- Microbial kinetics: Monod model, Enzyme kinetics, Inhibition of enzymatic reactions

V- Design and analysis of bioreactors

Types of bioreactors, Basic concepts, Batch bioreactors, Continuous stirred tanks, Piston bioreactors, Comparison of batch bioreactors and continuous bioreactors

Material transfer in bioreactors

Aeration: gas-liquid material transfer, Agitation: material transfer by forced convection

Evaluation mode: Continuous assessment: 40%; Exam: 60%.

Bibliographic references :

1. Roustan M : Transfert gaz/liquide dans les procédés de traitement des eaux et des effluents gazeux, Tec § Doc Lavoisier, Paris (2003) ISBN : 2-7430-0605-6
2. Schweich D : génie de la réaction chimique, Tec ! Doc lavoisier(2001) ISBN : 2-7430-0459-2
3. R.Missen, C.Mims and B .Saville : Chemical reactions engineering and kinetics, John Wiley and Sons, new York (1999)

4. Levinspiel O : chemicalreaction engineering,3ème édition, John Wiley and Sons, New York (1998) ISBN : 0471225424X
5. Villermaux J : Génie de la réaction chimique , conception et fonctionnement des réacteurs, 2ème édition, Tec § Doc Lavoisier , Paris (1993) ISBN : 2-85206-132-5
6. AtkinsonB and MayitunaF : Biochemical engineering and biotechnology hand book, Ed Mac Millan(1991) ISBN : 978-033342-4032
7. Froment G and Bischoff KB : Chemical reactor, analysis and design : John Wiley and Sons, New York (1979)

Semester: 3
Teaching unit : M TU 2.1
Matter 1:PW Biological treatment of wastewater/bioreactors
VHS: 22h30 (PW: 1h30)
Credits: 2
Coefficient : 1

Teaching objectives:

Put into practice the theoretical notions acquired in class

Recommended prior knowledge:

Basic notions of biochemistry, microbiology and process engineering

Content of matter:

1. Characterization of wastewater: COD, BOD5, TOC, biogenic elements, toxic elements
2. Degradation in a Cascade Bioreactor
3. Monitoring of an activated sludge reactor (determination of operating conditions)
4. Monitoring the effectiveness of biological treatment:
- Characterization of sludge settleability: settling curve and sludge index
- Microscopic and macroscopic visualization of activated sludge and diagnosis of malfunction

NB: It is recommended to do at least six practical exercises, chosen from the different groups, depending on the means available.

Evaluation method:

Continuous Exam: 100%.

Bibliographic references :

Semester: 3
Teaching unit: MTU 2.1
Matter 2 : Process intensification
VHS: 22h30 (Course : 1h30)
Credits: 2
Coefficient : 1

Teaching objectives:

1-Understand the principle of process intensification 2-Apply intensification techniques for various processes

Recommended prior knowledge:

Transfer of matter and heat. catalysis. Reactors. unit operations.

Content of matter :

Chapter 1. Basics of Process Intensification

Definitions. Principles and applications of IP. Implementation of process intensification: approach based on equipment or methods.

Chapter 2. Equipment for Process Intensification Microreactors: Oscillating baffle reactors, Rotating disk reactors

- Centrifugal absorber

- Rotating packed columns

- Examples of application of this equipment in different processes

Chapter 3. Methods of Process Intensification

Multifunctional reactors (Reactive distillation, Membrane reactors). Hybrid separations (Membrane- absorption, Membrane- distillation). Examples of applications of these different methods**.**

Chapter 4. Alternative energy sources

Solar energy. Ultrasound. Microwave.

Chapter 5. Other methods of process intensification:

New solvents (supercritical fluids, ionic liquids). Examples of application of these solvents.

Evaluation mode:

Continuous assessment: 40%: Exam: 60%.

Bibliographic references :

1. Stanckiewicz, A., and Moulijn. Marcel Dekker, Re- engineering the Chemical Processing Plant- Process Intensification. Inc. N.Y 2003.

Semester: 3
Teaching unit: MTU 2.1
Matter 3: Treatment of polluted soils
VHS: 22h30 (Course : 1h30)
Credits: 2
Coefficient : 1

Teaching objectives:

Sites polluted by infiltration of polluting substances linked to the operation of industrial installations constitute a risk for surface and groundwater and for the use of land as habitat, crops or the establishment of activities. The aim of this course is to inform students of the different existing techniques for decontaminating sites polluted by different organic and mineral compounds

. Recommended prior knowledge:

Content of matter :

Introduction

Chapter I: The soil: formation, properties and rehabilitation

- Soil formation, soil types, properties (physical-chemical-biological), chemical, physical and bacteriological analysis of polluted soils
- Soil contaminants and pollutants: organic and inorganic (characteristics and properties)
- Implementation and regulation techniques

Chapter II: Physico-chemical methods

Soil washing (leaching) - Oxidation and chemical reduction - Stabilization/solidification - Venting - Containment (by covering and sealing, Vertical containment, Hydraulic trap (containment).

Chapter III: Thermal methods

Thermal desorption (Pyrolysis) - Incineration - Vitrification,

Chapter IV: Biological methods

Phytoremediation - Dynamized biodegradation - Controlled natural attenuation - Biotertre - Composting.

Evaluation method:

100% Exam

Bibliographic references :

1- *Jeff Kuo, Practical Design Calculations for Groundwater and Soil Remediation, 2014.*
2- *Khan Towhid Osman, Soil Degradation, Conservation and Remediation, 2014.*
3- *Marc Pansu, Jacques Gautheyrou, Handbook of Soil Analysis Mineralogical, Organic and Inorganic Methods; Springer- 2006.*
4- *John Pichtel,Fundamentals of Site Remediation: For Metal and Hydrocarbon-Contaminated Soils, 2007.*
5- *Helmut Meuser, Soil Remediation and Rehabilitation, Treatment of Contaminated and Disturbed Land, 2013.*
6- *Rainer Stegmann, Gerd Brunner, Wolfgang Calmano, Gerhard Matz, Soil Treatment of Contaminated Soil, Springer, 2001.*

Semester: 3
Teaching unit : MTU 2.1
Matter 4: Experiment plans
VHS: 37h30 (Course: 1h30, PW: 1h00)
Credits: 3
Coefficient : 2

Teaching objectives:
Allow good control of experimental manipulations and make the results more significant.
Recommended prior knowledge:
Basic notions of mathematics
Content of matter:
Chapter 1: General introduction and factorial designs
1. Introduction
2. What is an experimental design
3. Study domain and response surface
4. Factors
5. Concept of interaction
6. Concept of model and multiple linear regression
7. Complete 2k factorial design
7.1. Example of calculating effects
7.2. Graphical representation of the effects
7.3. Matrix Form- Multilinear Regression
8. Application example
Chapter2: Significance testing and model validation
1.Introduction
2. Experimental errors
3. Tests of Significance of Effects
4. Confidence interval of model effects
5. Analysis of variance. Validation of the linear model
5.1. The "ANOVA" table
5.2. Coefficient of determination-Correlation coefficient
6. Application example

Chapter 3: Fractional plans

1. Introduction

2. Designing a fractional plan

3. Fractional Plan Analysis

4. Application example

5. Other plans: Plackett-Burman Plans and Taguchi Plan
Chapter4: Response surface plans
1. Introduction
2. Concept of response surface and isoresponse curves
3.Plans for the study of quadratic models
3.1. Box plan - Behnken

3.2. Centered composite plane
4. Criteria of quality and optimality of an experimental plan
4.1. Calculation of optimal plans
5. Example of application of response surface plans

Chapter5: Mixing plans

1. Introduction

2. Geometric representation of mixtures

3. Area of study in mixing plans

4. Mathematical models of mixtures

5. Analysis of a mixing plan

6. Application example

7. Mixing plans and experimental design: mixed designs

Applications

- Introduction to Minitab software + Obtaining the coefficients of a complete design as well as the graphs of the main effects and interactions+ANOVA.
- Fractional plans in Minitab
- Optimization by response surface plans (Box Benkhen+Central composite)
- Use of mixing plans

Evaluation method:

Continuous monitoring: 40%: Exam: 60%.

Bibliographic references :

Semester: 3
Teaching unit : DTU 2.1
Matter of choice 1 et 2 : Process modeling and optimization
VHS: 45h00 (Course : 1h30 PW: 1h30)
Credits: 2
Coefficient : 2

Teaching objectives:

The objective of this course is to enable students to master the essential knowledge for the optimization, modeling and simulation of continuous processes and to become familiar with the use of simulation software.

Recommended prior knowledge:

Equations governing Transfer Phenomena in Process Engineering in stationary mode, the bases of thermodynamics and kinetics.

Content of matter:

Chapter I: Modeling and simulation

I.1. Introduction to modeling physical phenomena

I.2. Methods for solving systems of algebraic equations.

- Solving the RK and RKS equations of state using Excel and other software for a pure gas and a mixture of gases

- Calculation of L-V balance and isothermal flash separation using Excel or other software.

*- Calculation of the equilibrium compositions of a reaction using Excel or other software.*I.3. Methods for solving systems of differential equations.

- Calculation of perfectly stirred continuous reactors using Excel or other software.
- Calculation of an isothermal tubular reactor with software.

Chapter II: Optimization

II.1. Optimization problems in process engineering

II.2. One-dimensional and multi-dimensional direct search

II.3. Mathematical approach to unconstrained optimization

I.4. Problems with equality constraints and with inequalities constraints

I.6. Solving Constrained Optimization Problems Using Excel®

I.7. Linear programming

- Graphical method

- Simplex methods (with and without basic solution)

Evaluation mode: Continuous assessment: 40%; Exam: 60%.

Bibliographic references :

1. YadolahDodge « Optimisation appliquée » Springer –Verlag France 2005,ISBN : 2-287-21335-X
2. Lorenz T. Biegler. « Nonlinear programming : concepts, algorithms, and applications to chemical processes", 2010 by the Society for Industrial and Applied Mathematics and the Mathematical,Optimization Society
3. Bruce a. Finlayson, "Introduction to chemical engineering computing", 2006 by John Wiley & Sons, Inc

Semester : 3
Teaching unit: TTU 2.1
Matter 1 : Documentary research and dissertation design
VHS : 22h30 (Course: 1h30)
Credits : 1
Coefficient : 1

Teaching objectives:
Give the student the necessary tools to search for useful information to better use it in their end-of-study project. Help them go through the different stages leading to the writing of a scientific document. Show him the importance of communication and teach him to present the work carried out in a rigorous and educational manner.
Recommended prior knowledge:
Writing methodology. Presentation methodology.
Content of matter:

Part I-: Documentary research:

Chapter I-1: Definition of the subject (02 weeks)
- Subject title
- List of keywords relating to the subject
- Gather basic information (acquisition of specialized vocabulary, meaning of terms, linguistic definition)
- The information sought
- Take stock of your knowledge in the field

Chapter I-2: Selecting information sources (02 Weeks)
- Type of documents (Books, Theses, Memoirs, Periodical articles, Conference proceedings, Audiovisual documents, etc.)
- Type of resources (Libraries, Internet, etc.)
- Evaluate the quality and relevance of information sources

Chapter I-3: Locating documents **(01 Week)**
- Research techniques
- Search operators

Chapter I-4: Processing information **(02 Weeks)**
- Work organization
- Initial questions
- Summary of the documents retained
- Links between different parties
- Final plan of the documentary research

Chapter I-5: Presentation of the bibliography **(01 Week)**
- Systems for presenting a bibliography (The Harvard system, The Vancouver system, The mixed system, etc.)
- Presentation of documents.
- Citation of sources

Part II: Design of the dissertation

- **Chapter II-1: Plan and stages of the dissertation** **(02 Weeks)**
- - Identify and delimit the subject (Summary)
- - Problems and objectives of the dissertation
- - Other useful sections (Acknowledgments, Table of abbreviations, etc.)

- - The introduction (Writing the introduction last)State of the specialized literature
- - Formulation of hypotheses
- - Methodology
- - Results
- - Discussion
- - Recommendations
- - Conclusion and perspectives
- - Table of contents
- - The bibliography
- - Annexes

Chapter II-2: Writing techniques and standards (02 Weeks)

- Formatting. Numbering of chapters, figures and tables.
- Cover Page
- Typography and punctuation
- Writing. Scientific language: style, grammar, syntax.
- Spelling. Improvement in general language skills in terms of comprehension and expression.
- Save, secure, archive your data.

Chapter II-3: Workshop: Critical study of a manuscript (01 Week)

Chapter II-4: Oral presentations and defenses (01 Week)

- How to present a Poster
- How to present an oral communication.
- Defense of a dissertation

Chapter II-5: How to avoid plagiarism? (01 Week)

(Formulas, sentences, illustrations, graphs, data, statistics,...)

-The quote

- Paraphrasing

- Indicate the complete bibliographic reference

Evaluation method :

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.*