ULT Chemical Engineering

Subjects Modules for S4

Semester 2 Year 2

U.4.1Chemical Engineering Operations

Unit Operation II: Physical I

(Distillation-absorption-Extraction)

Module designation	**Chemical Engineering Operations**
Module level, if applicable	2nd year of chemical engineering
Code, if applicable	U.4.1
Subtitle, if applicable	-
Courses, if applicable	- **Unit Operation II : Physical I (Distillation-absorption-Extraction)**
Semester (s) in which the module is taught	-Semester 2 (S4)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Mr. Mohamed Ridha KHIARI
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 33 hours of classroom course/semester 9 hours practical workshop/ Semester
Workload	Total 77 hours/semester (35 hours of Self-Study/semester)
Credit points	3 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Heat transfer, Fluid mechanics, Thermodynamic, Regulation and control, Applied thermodynamic, mass & energy balance

Module objectives/intended learning outcomes	**Objectives:** 1. The module aims to give engineering students the knowledge of the theory and the equilibrium laws, 2. define and categorize the main unit operations and separation and purification apparatus used in industry 3. explain several specific examples of industrial applications for each of these unit operations 4. precisely describe the principle of operation both at the macroscopic level (incoming flows, outgoing flows) and at the microscopic level (particle, interface, molecule) by identifying the physico-chemical phenomena, the thermodynamic constraints and the kinetic limits which dictate the separation **Learning Outcomes:** Students will be able to : 1. Make material and energy balances, 2. Determine the theoretical number of stages by the method of McCabe -Thiele. 3. Identify the operating parameters that dictate the efficiency of separation and purification processes 4. Establish and calculate mass balances and energy balances for batch, semi-continuous and continuous processes and size installations to carry out unit operations

Content	**Chapter I. ABSORPTION** 1- Theoretical notions 2- Determination of simple absorption elements 3- Effectiveness of the operation 4- Apparatus **Chapter II. LIQUID -LIQUID EXTRACTION** 1- Theoretical notions 2- Counter-current extraction 3- Cross current extraction 4- Effectiveness of the operation 5- Factors involved in the extraction 6- Apparatus **Chapter III CORRECTION** 1- Liquidvapour balance 2- Discontinuous rectification 3- Correction contained 4- Efficiency 5- Azeotropic and extractive grinding applications **(9 hours of Practical workshop in Laboratory-Unit operations II: Physics I)** <u>1. Continuous distillation of an ethanol-water mixture</u> *Objectives:* -Follow the start-up of the distillation column, -Determine the equilibrium point of the column, -Calculate the number of theoretical trays, -Determine the efficiency of the column, - Make a conclusion about continuous distillation. <u>2. Liquid-liquid extraction of acetic acid from a (Methyl IsoButyl Ketone)MIBK-Acetic acid mixture</u> *Objectives :* -Monitor the operating regime of the extraction column. -Visualize the point of equilibrium of the column. -Calculation of overall mass balances and on acetic acid. -Determine the number of theoretical stages. <u>3. Adsorption and desorption of acetic acid in aqueous solution</u>. *Objectives :* The solution loaded with solute to be adsorbed (acetic acid) is introduced at the top of the column. It is placed in prolonged contact with the bed of activated carbon present in the column. The flow can be either at atmospheric pressure or under pressure, depending on the viscosity of the mixture to be separated.
Study and examination requirements and forms of examination	Written Mid-term Exam (25%) + Practical Exam (25%)+ Written Final Exam (50%)

Media employed	Course Material (Hard/ Soft copy) for classroom & Online (Moodle ULT) Video projection Practical Workshop in Laboratory
Reading list	Unit Operations of Chemical Engineering.Peter Harriott, McCabe and smith.2020. Unit Operations of Chemical Engineering.Dennis C. PrieveCarnegie Mellon University, Spring Semester, 2017.

U.4.1Chemical Engineering Operations

ProUnit Operation III: Physical II

(Adsorption-Drying-Crystallization)

Module designation	**Chemical Engineering Operations**
Module level, if applicable	2nd year of chemical engineering
Code, if applicable	U.4.1
Subtitle, if applicable	-
Courses, if applicable	- **Unit Operation III : Physical II (Adsorption-Drying-crystallization)**
Semester (s) in which the module is taught	-Semester 2 (S4)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Mr. Belgacem CHANDOUL
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 33 hours of classroom course/semester 9 hours practical workshop/ Semester
Workload	Total 77 hours/semester (35 hours of Self-Study/semester)
Credit points	3 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Heat transfer, Fluid mechanics, Thermodynamic, Regulation and control, Mass transfer. Transfer & transport phenomena

Module objectives/intended learning outcomes	**Objectives :** 1. Define and categorize the main unit operations and separation and purification apparatus used in industry 2. Explain several specific examples of industrial applications for each of these unit operations 3. Precisely describe the principle of operation both at the macroscopic level (incoming flows, outgoing flows) and at the microscopic level (particle, interface, molecule) by identifying the physico-chemical phenomena, the thermodynamic constraints and the kinetic limits which dictate the separation 4. Establishing and calculating mass balances and energy balances for batch, semi-continuous and continuous processes and sizing installations to carry out unit operations 5. Giving the students the necessary background for the selection, analysis and design of some of the most common separation processes. **Learning Outcomes:** Students will be able to : 1. Describe precisely the principal operation on a macroscopic and microscopic level. 2. Identify physicochemical phenomena, the thermodynamic constraints and the kinetics limits which dictate the separation, 3. Establish and calculate mass balances and energy balances and sizing installations allowing unit operations to be carried out. 4. Interpret and adapt the main mathematical developments leading to the useful equations to size these 3 unit operations, 5. Apply the empirical, analytical and graphical methods conventionally used to size unit operations.

Content	**Chapter 1: GENERAL INFORMATION ON UNIT OPERATIONS** 1. Definition 2. Classification 3. Reminder on balances (mass and energy) 4. Reminder on sorption isotherms **Chapter 2: DRYING** 1. General (definition, Objectives, Technologies, Choice of drying process) 2. Characterization of the products to be dried 2.1. Anhydrous product 2.2. Dry product 2.3. Wet product 2.4. Humidity rate (wet base and anhydrous base) 3. Characterization of the drying air 3.1. Absolute humidity and relative humidity of a gas 3.2. Dew point 3.3. Dry and wet temperature of the gas 3.4. Humid air diagram 4. Drying modes 4.1. Direct or convection drying 4.2. Drying by indirect contact or by conduction 4.3. Radiant drying 4.4. Drying by dielectric losses 4.5. Dry evaporation 5. Drying kinetics 5.1. Drying speed 5.2. Curves and drying phases 5.3. Drying time 6. Calculation of dryers 6.1. Principles 6.2. Basic equations 6.3. Material balance 6.4. Thermal balance **Chapter 3: ADSORPTION** 1. General and definitions 2. Types of adsorption 2.1. Physisorption 2.2. Chemisorption 2.3. Persorption 3. Theoretical and practical considerations 3.1. Adsorption balance 3.2. Adsorption theories 3.2.1. Theory of the mono-molecular layer 3.2.2. Multimolecular layer theory 3.2.3. Theory of film condensation 3.3. Adsorption equations 3.4. Experimental determination of adsorption isotherms 4. Adsorption kinetics 5. Processes and apparatus 5.1. Static adsorption 5.2. Dynamic adsorption 5.3. Dynamic adsorption relationships

	Chapter 4: CRYSTALLIZATION 1. Introduction and definitions 2. Notion of concentration 3. Saturation and solubility - Solubility curves 4. Types of crystallization 4.1. Dry way 4.2. Wet way 5. Kinetics and mechanisms of crystallization 6. Mass and energy balance 7. Crystallization by cooling 8. Solvent evaporation crystallization
	(9 hours of Practical workshop- Unit operations III: Physics II) 1. Evaporation-Crystallization of copper sulfate *Objectives :* Crystallization is a widely used process in industry. It concerns a wide variety of products: pharmaceuticals, foodstuffs and chemicals. The proposed manipulation aims to make the student aware of the various parameters and variables involved in the implementation of crystallization. This study will allow, from mass and thermal balances, to conclude on this unitary process engineering operation. 2. Freeze-drying *Objectives :* The freeze-drying unit is intended for the study of the process of drying food, chemical or pharmaceutical products by freeze-drying (sublimation of ice in vapor). Freeze-drying involves extracting water from a frozen product. The drying is carried out by sublimation, which is direct passage of water from the solid state to the gas state. This process is carried out under vacuum with a product temperature below -10 ° C. The goal ofthis process is to obtain a product which is easily soluble in water and which has the same Characteristics that the original product after rehydration, which is not denatured asproducts dried by heating, which can be stored easily without too many changesenzymatic, bacterial and chemical. This practical work is a working basis for all those concerned with knowing the various risks encountered on such a unit and the safety to be involved.
Study and examination requirements and forms of examination	Written Mid-term Exam (25%) + Practical Exam (25%)+ Written Final Exam (50%)
Media employed	Course Material (Hard/ Soft copy) for classroom & Online (Moodle ULT) Video projection Practical Workshop in Laboratory

Reading list	EmilianKoller, «Aide-mémoire Génie chimique », DUNOD, 4eme édition, 2013 Charreau A. et Cavaille R., « Techniques de l'ingénieur – Génie des procédés», Séchage. Théorie et calculs. Robert L., «Techniques de l'ingénieur - Génie des procédés », Adsorption. Unit Operations of Chemical Engineering.Peter Harriott, McCabe and smith.2020.

U.4.1Chemical Engineering Operations

Simulation: Aspen II (PIPESIM)

Module designation	**Chemical Engineering Operations**
Module level, if applicable	2nd year of chemical engineering degree
Code, if applicable	U. 4.1
Subtitle, if applicable	-
Courses, if applicable	- **Simulation : Aspen II(PIPESIM)**
Semester (s) in which the module is taught	-Semester 2 (S4)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Mr. Baha Eddine GHARBI
Language	English
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	9 hours of Practical Workshop in Lab/ semester 12 hours Project
Workload	Total 51 hours/semester (30 hours of Self-Study/semester)
Credit points	2 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Fluid mechanics, Handling of modelling software, thermodynamics models
Module objectives/intended learning outcomes	**Objectives :** 1. Introduce PIPESIM software to students 2. Understand the modelling techniques used 3. Use engineering documents such as pipeline layouts and technical data sheets 4. Perform pipeline design, 5. Enter the input/output parameters of devices flows 6. Analyse and interpret simulation results **Learning Outcomes:** Students will be able to : 1. Model single-phase and two phase fluid flows in pipeline 2. Collect geographical data of a given pipeline using Excel 3. Introduce the geographic data of the pipeline through the GIS system integrated into the software 4. Characterize the transported fluid (PVT)

Content	**Workshop on PIPESIM Software:** **The Steady-State Multiphase Flow Simulator.** **Exercise 1:** General introduction 1 Introduction to PIPESIM software 2 The main characteristics of PIPESIM 3 Modelling of pipeline networks with PIPESIM **Exercise 2:** Modelling of the transmission of natural gas in southern Tunisia **Exercise 3:** Modelling of oil transmission from an offshore station to a treatment station in Nabeul. **Exercise 4:** Modelling the flow of fuel gas (fuel gas) in an oil station **Exercise 5:** Evaluation test **Exercise 6:** Hydrate formation problem in pipelines **Exercise 7:** NGL condensation problem in pipelines **Exercise 8**: Pipeline pigging operation **Project (12 hours of Practical Project/Semester)** A project will be assigned to each student early in the semester. The student will be asked to develop a project plan and will work on project throughout the course. Students will work individualy on a given project from the list below **Project topics:** **Proposal 1 :** Natural gas expedition from KRD-SW-1 station located in DEBBECH to EB-406 station located in EL BORMA: sizing, flow assurance and economic analysis of a gathering pipeline. **Proposal 2 :** Installation of a firefighting unit in DJBEL GROUZ CPF: Plant sitting, water and foam requirements calculation, firefighting network hydraulic simulation, equipment sizing and economic analysis of the firefighting unit.
Study and examination requirements and forms of examination	Format: Continuous Control, Practical Exam (100%).
Media employed	Course Material (Hard/ Soft copy) for classroom & Online (Moodle ULT) Video projection Exercises, PIPESIM software, computer, excel
Reading list	-Hydrates de gaz naturel dans l'assurance du débit édité par Carolyn Ann Koh, AmadeuSum, Gulf Professional Publishing, Oct 12, 2010 - Technology& Engineering - Practical flow assurance : phase behavior, multiphase flow, and organic solids, Zachary Mark Aman, Taylor & Francis, 2017 -Evaluating Gas Network Capacities, edited by Thorsten Koch, Benjamin Hiller, Marc E. Pfetsch, Lars Schewe, SIAM, Mar 17, 2015 – Mathematics

U.4.2 Process & Dynamic

Dynamic of systems and process Control

Module designation	**Process & Dynamic**
Module level, if applicable	2nd year of chemical engineering
Code, if applicable	U.4.2
Subtitle, if applicable	-
Courses, if applicable	- **Dynamic of systems and process Control**
Semester (s) in which the module is taught	-Semester 2 (S4)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Mr. Mohamed Ridha KHIARI
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 42 hours of classroom course/semester
Workload	Total 63 hours/semester (21 hours of Self-Study/semester)
Credit points	2.5 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Applied mathematics, thermodynamic, Mass & energy balance, Applied computing, operations units, Control & Regulation

Module objectives/intended learning outcomes	**Objectives:** 1. Acquire the notion of system dynamics and Dwell Time Distribution 2. Familiarize student with the basic control of continuous-time single-variable systems 3. Explain control and tracking techniques based on PID and improved techniques 4. Show the importance and the dynamic consequences of the control on the processes **Learning Outcomes:** Students will be able to : 1. know how to describe the dynamic functioning of linear systems 2. Be able to design a feedback loop and tune a PID controller 3. Know improved methods compared to the PID regulator 4. Establish performance criteria for real reactors based on the concept of DTS
Content	**Chapter I. Dynamic process modelling** 1.1. State representation 1.2. Transfer functions 1.3. Frequency analysis 1.4. Bode diagrams 1.5. Characterization of a system by frequency analysis **Chapter II. Study of usual open-loop linear systems** 1.1. First order systems 1.2. Second-order systems 1.3. Pure delay systems 1.4. Distributed parameter systems **Chapter III. Notion of Systems Dynamics applied to DTS** 1.1. Characterization and identification of ideal reactors 1.2. Modelling of complex systems **Chapter IV. Feedback linear control** 4.1. PID controller 4.2. Dynamics of feedback controlled processes **Chapter V. Stability analysis** 5.1. Analysis in state space 5.2. Stability analysis of feedback systems 5.3. Stability criterion of Bode and Nyquist **Chapter VI. Synthesis of regulators by looping** 6.1. Choice and adjustment of PID regulators 6.2. Improved PIDs 6.3. Order by internal model **Chapter VII. Improved control systems** 1.1. Pure delay compensation, inverse response 1.2. Cascade, selective, shared, feedforward control
Study and examination requirements and forms of examination	Written Mid-term Exam (40%) + Written Final Exam (60%)

Media employed	Course Material (Hard/ Soft copy) for classroom& Online (Moodle ULT) Video projection Practical Workshop in Lab Matlab software
Reading list	-« Commande des procédés », Jean-Pierre Corriou, Lavoisier Tec&Doc (2003) -Méthodes numériques et optimisation (J.P.Corriou, Lavoisier Tec&Doc, 2010). -Techniques de Commande avancée. ACHOUR AbdelYazid. Université A.MIRA-BEJAIA. - Commande et optimisation de systèmes dynamiques. Frédéric Bonnans, Pierre Rouchon. EAN : 9782730212519.

U.4.2 Process & Dynamic

Applied Process optimization

Module designation	**Process & Dynamic**
Module level, if applicable	2nd year of chemical engineering
Code, if applicable	U.4.2
Subtitle, if applicable	-
Courses, if applicable	**- Applied Process Optimization**
Semester (s) in which the module is taught	-Semester 2 (S4)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	PhdFeriel REZOUGA
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 12 hours of classroom course 9hours practical workshop/ Semester
Workload	Total 42hours/semester (21 hours of Self-Study/semester)
Credit points	1.5 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Applied Mathematics, Applied computing,
Module objectives/intended learning outcomes	**Objectives :** 1. Introduce students to optimization theory and decision support. 2. Build mathematical models for complex decision problems **Learning Outcomes:** Students will be able to : 1. Solve mathematical models using an algebraic technique 2. Acquire an in-depth knowledge of certain techniques and tools currently considered as basic methods in Operations Research.

Content	**Chapter 1. Linear Programming** 1. General form of a Linear Program 2. Canonical and standard form of a Linear Program 3. Matrix Writing of a Linear Program 4. Modelling a Problem 5. Application exercises **Chapter 2. Resolution of a Linear Program:** 1. Graphic Method 2. Simplex method 3. Application exercises **Chapter 3. Extension of Linear Programming: Duality** 1. Dual Linear Problem 2. Production problem 3. Mixing problem 4. Properties of duality 5. Application exercises **Chapter 4: Optimization under constraints** 1. Relaxation method a. Description of the method b. Special case of quadratic functions 2. Gradient methods a. Best-step gradient method b. Other gradient-type methods 3. The conjugate gradient method a. The quadratic case b. Case of any function J **Chapter 5. Post-Optimization Analysis** 1. Economic interpretation 2. Sensitivity analysis of results Application exercises **9 hours of Practical workshop in Laboratory /semester** I- Linear programming 1- The conditions and stages of formulation of a PL 2- Examples II- The graphical method (EXCEL) 1- Graphic representation of constraints 2- Graphic representation of the objective function 3- Finding the optimal solution 4- Examples III- Use of resolution software and analysis of results 1- EXCEL solver a) Installing the 'Solver' add-on b) Preparation of the Excel sheet c) Description of the Solver window d) Solver Setup e) Exercises 2- Optimization software: CPLEX a) Initialization b) OPL (Optimization Programming Language) c) Creation and resolution of a simple model - Creation of the project and the model - OPL Syntax - Resolution - Exercises

Study and examination requirements and forms of examination	Format: Written Mid-term Exam (25%) + Practical Exam (25%)+ Written Final Exam (50%)
Media employed	Course Material (Hard/ Soft copy) for classroom& Online (Moodle ULT) Video projection Practical Workshop in Lab
Reading list	-Précis De Recherche Opérationnelle : Pr. R. Faure (Dunod) -Précis de recherche opérationnelle ; Robert Faure, Bernard Lemaire, Christophe Picouleau.(2014). - Optimisation Discrète ; Alain Billionnet (2007).

U.4.3Advanced Separation Processes

Membrane Technology

Module designation	**Advanced Separation Processes**
Module level, if applicable	2nd year of chemical engineering
Code, if applicable	U.4.3
Subtitle, if applicable	-
Courses, if applicable	- **Membrane Technology**
Semester (s) in which the module is taught	-Semester 2 (S4)
Person responsible for the module	Dr Khalil Zaghdoudi
Lecturer	Phd. Dorra ENNIGROU
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 39 hours of classroom course 3 hours practical workshop/ Semester
Workload	Total 63 hours/semester (21 hours of Self-Study/semester)
Credit points	2.5 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Fluid mechanics, Mass transfer, Applied heat transfer,

Module objectives/intended learning outcomes	**Objectives :** 1. Give the students the technical background onmembrane technology and to provide wide level of understanding that will allow them todesign, using appropriate combinations of unit processes and water treatment plant 2. Acquire the physico-chemical foundations of separation processes using artificial membranes. 3. Have an overview of the problems related to the process and in particular of hydrodynamics and mass transfer 4. Explain the different driving forces behind existing membrane separation processes 5. Resources and Need for membrane technology in water treatment and otherprocess engineering plants **Learning Outcomes:** Students will be able to : 6. Classify the technical applications of industrially important membrane processes 7. Explain the differences in the use of membranes liquid media, gases and in liquid/gas mixtures 8. Use the relevant membrane for various chemical processes. 9. Apply membrane technology in process industries 10. Use appropriate method to reduce membrane fouling

Content	**Chapter I: General Notions on Membranes** -Nature - structure - Modules - Water shortages and need for membrane technology **Chapter II : Classification of membranes** -Membrane processes - Principle of membrane filtration **Chapter III : Manufacturing and Characterization of Organic Membranes** - Dense - Asymmetrical - Hollow fiber **Chapter IV : Microfiltration membranes:** - Introduction to frontal and cross flow filtration, - Development of knowledge and understanding of solid liquid separations and cake filtration, - General membrane equations and adaptation to cake filtration, - Calculation of cake properties, - Time of filtration, - Bed depth and process optimization, case studies **Chapter V Ultrafiltration membranes:** -Introduction to ultrafiltration processes, - Mass transfer and concentration polarization effects, - Simple gel theory, - Osmotic pressure effects, - Effects of membrane charge, -Optimization of separations, -Case studies - Applications of MF and UF - Membrane performance - Membrane fouling - Trans-membrane pressure - Filtration/Fouling mechanisms **Chapter VI : Nano filtration:** - Introduction to Nano filtration processes, - Equilibrium partitioning, pore modelsfor neutral solute rejection, - Effects of membrane charge, - Confinement issues and effects on physical properties, - Pore size distributions, - Case studies **Chapter VII: Fundamentals of Small Molecule Permeation Through Dense Polymers** - Solute-membrane interactions - Free volume theory - Donnan's equilibrium **Chapter VIII : Quantitative Aspects** -Modelings - Selectivity and flow - Restrictions **Chapter IX : Industrial applications** - Gas diffusion and permeation - Pervaporation - Reverse osmosis - Ultrafiltration - Electrodialysis - Electrolysis

	3 hours of Practical Laboratory workshop/Semester <u>Determination of the selectivity of the membrane</u> *Objectives :* Determination of the selectivity of the membrane by a test at constant pressure and by test at constant conversion rate. Verification of mass balances.
Study and examination requirements and forms of examination	Written Mid-term Exam (25%) + Practical Exam (25%)+ Written Final Exam (50%)
Media employed	Course Material (Hard/ Soft copy) for classroom & Online (Moodle ULT) Video projection Practical Workshop in Lab
Reading list	-Membrane Modification: Technology and Applications" by CRC Press (ISBN-13:978-1439866351), 2012. N. Hilal, M. Khayet and C. J. Wright. - Membrane Distillation: Principles and Applications, M. Khayet and T. Matsuura, Elsevier, 2011. - "Methods employed for control of fouling in MF and UF membranes: A Comprehensive Review", N. Hilal, O. Ogunbiyi, N. J. Miles and R. Nigmatullin. Separation Science and Technology. Volume 40 (10)(2005) pp 1957-2005. -'A review of atomic force microscopy applied to cell interactions with membranes'. N. Hilal, W. R. Bowen, L. Al-Khatib and O. Ogunbiyi. Trans IChemE, Part A, Chemical Engineering Research and Design. Volume 84(A4) (2006) pp 282-292.

U.4.3 Advanced Separation Processes

Advanced Separation Processes

Module designation	**Advanced Separation Processes**
Module level, if applicable	2nd year of chemical engineering
Code, if applicable	U.4.3
Subtitle, if applicable	-
Courses, if applicable	- **Advanced separation processes**
Semester (s) in which the module is taught	-Semester 2 (S4)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Phd. Belgacem CHANDOUL
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 21 hours of classroom course
Workload	Total 42hours/semester (21 hours of Self-Study/semester)
Credit points	1.5 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Thermodynamics, Mass transfer, Mass & energy balance, Fluid mechanics, Applied Heat transfer.

Module objectives/intended learning outcomes	**Objectives :** 1. Present new and advanced separation processes whose degree of use on an industrial scale is expanding. 2. Provide a qualitative view of the specific problems that arise nowadays in terms of separation 3. Illustrate, using case studies, examples emphasizing the overall problem of process choice. **Learning Outcomes:** Students will be able to : 1. Extend knowledge of basic fluid separation processes to more complex systems commonly encountered in the chemical processing industry. 2. Apply modern separation techniques in various applications 3. Use the technological methods in problem solving in process plant 4. Discuss the selection of processes and to demonstrate new trends in separation technology. 5. Select a separation process according to a set of constraints (nature of the mixture to be separated, targeted performance, operating conditions) 6. Use of ChemSep simulation tool to become familiar with various commercial chemical processes and the simulation techniques required for design and optimization of chemical process plants
Content	**Chapter I : General Aspect** 1. Introduction 2. classification 3. choice of separation method 4. Energy requirements. 5. Multi component transport and equilibria **Chapter II : Separation and purification** 1. By adsorption 2. By ion exchange 3. Application to gases and liquids. **Chapter II: Chromatographic processes: Simulated mobile beds.** **Chapter III : Electro-membrane processes** **Chapter IV: Gas permeation – Electrodialysis.** **Chapter V: Reactive and catalytic distillation Concept** **Chapter VI : Foam fractionation process and application in waste water treatment** **Chapter VI: Supercritical fluids Separations** **Chapter VII: Modeling of seperation processes using ChemSep software.**
Study and examination requirements and forms of examination	Format: Written Mid-term Exam (40%) + Written Final Exam (60%)

Media employed	Course Material (Hard/ Soft copy) for classroom & Online (Moodle ULT) Video projection ChemSep software
Reading list	-Henley E.J., J.D. Seader and D. K. Roper: Separation Process Principles, third ed., Wiley 2011 (SH). -Perry's Chemical Engineers' Handbook. New York: Mc Graw-Hill, 2007, 8th edition. Ch.12, Psychrometry, Evaporative Cooling and Solids Drying; Ch. 13, Distillation; Ch. 14, Equipment for Distillation, GasAbsorption, Phase Dispersion and Phase Separation. - Seader J.D., Ernet J. Henlay, and Keith, D., Separation Process Principles, Wiley (2010). -www.chemsep.org

ELECTIVE UNITS

U.4.4 Medicinal Chemistry (Elective Unit)

Fine Chemistry

Module designation	**Medicinal Chemistry**
Module level, if applicable	2nd year of chemical engineering
Code, if applicable	U.4.4
Subtitle, if applicable	-
Courses, if applicable	**- Fine Chemistry**
Semester (s) in which the module is taught	-Semester 2 (S4)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Pr. Ali SAMARAT
Language	French
Relation to curriculum	Professional module (Elective),
Type of teaching, contact hours	Lecture, 36 hours of classroom course 6 hours practical workshop/ Semester
Workload	Total 63 hours/semester (21 hours of Self-Study/semester)
Credit points	2.5 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Structural Organic Chemistry, Organic Chemistry & Catalysis, Physical chemistry. Material sciences.
Module objectives/intended learning outcomes	**Objectives :** 1. Reinforced the basic knowledge of fine chemistry to approach the field of the synthesis of more complex molecules by applying synthetic strategies. 2. Differentiate a synthesis from retro-synthesis 3. Perform multi-step synthesis **Learning Outcomes:** Students will be able to : 1. Propose the mechanism of the Aldol reaction as known to form new C-C bond. 2. Give the obtained product during an oxidation/reduction reaction from a given reagent and vice versa, 3. Use Evan's chiral copula as a synthetic method to prepare a single enantiomer from achiral substrate, 4. Synthetize aromatic nitrogenous heterocycles (Pyrroles and pyridines)

Content	**Chapter I- General introduction:** A. Definitions B. Examples of multi-step syntheses of active ingredients 1. The Gleevec 2. The Lipitor **Chapter II- Aldol Condensation reaction:** A. Enolate ions B. Keto-enolic balance C. Reactivity of enolates 1. Alkylation 2. Aldol condensation *Exercise* **Chapter III- Oxidation and reduction reactions:** A. Oxidation reactions 1. General 2. Reactions revealing unsaturation's a. Chromium oxidation b. Swern oxidation c. Dess-Martin oxidation *Exercise* 3. Reactions involving the breaking of a C-C bond a. Case of a 1.2 Diol b. Ozonolysis c. With hot concentrated KMnO4 d. With cold diluted KMnO4 *Exercise* B. Reduction reactions 1. Reduction of alkenes and alkynes a. Case of alkenes b. Case of alkynes 2. Reduction of C = O a. Case of aldehydes and ketones b. Case of carboxylic acids and esters *Exercise* *Tutorials* **Chapter IV. Asymmetric synthesis** A. Introduction: Importance of asymmetric synthesis B. Evans Chiral Copulae 1. Structure and use 2. Preparation of Evans' chiral copula *Exercise* 3. Mechanism of action 4. Examples of electrophilic addition a. Alkylation b. Amination c. Bromination / Azidation 5. Deprotection and obtaining a single enantiomer C. Examples of multi-step syntheses containing heterocyclic synthesis steps

	Chapter V. Heterocyclic synthesis A. Alkaloids and generalities B. Nitrogen heterocycles and nomenclature C. The best known methods for the synthesis of aromatic nitrogenous heterocycles 1. Synthesis of Pyrroles a. Properties of the pyrrole cycle b. Paal-Knorr synthesis c. Hantzsch synthesis 2. Synthesis of pyridines a. Pyridine ring properties b. Hantzsch synthesis **Chapter VI: Organometallics** 1. Vinyllithien, synthesis (metal-metal exchange) and reactivity. 2. Transmetallation with vinylstannane *Exercise* *Tutorials* **6 hours of Practical workshop in Laboratory-Fine chemistry** 1. Synthesis of Paracetamol *Objectives :* -Synthesis of Paracetamol - Purification of the synthetic product, - Analysis of the synthetic product. 2. Synthesis of wentergreen essence Objectives : -Reaction synthesis using 2 steps: acetylation of salicylic acid and exterification reaction of salicylic acid with methanol.
Study and examination requirements and forms of examination	Written Mid-term Exam (25%) + Practical Exam (25%)+ Written Final Exam (50%)
Media employed	Course Material (Hard/ Soft copy) for classroom& Online (Moodle ULT) Video projection Practical Workshop in Lab
Reading list	- Chimie organique avancée, Carey &Subdberg, DeBoeck Université Eds. - Chimie organique-Hétéroéléments et stratégies de synthèse. Nicolas Rabasso. De Boeck

U.4.4 Medicinal Chemistry (Elective Unit)

Pharmacology

Module designation	**Medicinal Chemistry**
Module level, if applicable	2nd year of chemical engineering
Code, if applicable	U.4.4
Subtitle, if applicable	-
Courses, if applicable	- **Pharmacology**
Semester (s) in which the module is taught	-Semester 2 (S4)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Phd. Ghazi TABKA
Language	French
Relation to curriculum	Professional module (Elective),
Type of teaching, contact hours	Lecture, 21 hours of classroom course/semester
Workload	Total 42hours/semester (21 hours of Self-Study/semester)
Credit points	1.5 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Organic chemistry, thermodynamics, kinetics reactions.
Module objectives/intended learning outcomes	**Objectives :** 1. Understand the basics of medicinal chemistry, biophysical properties. 2. Biological activity parameters 3. Drug metabolism 4. Acquire knowledge on the mechanisms of action of drugs **Learning Outcomes:** Students will be able to : 1. Distinguish between active ingredient and drug 2. Distinguish between the different administration pathways 3. Know the specifics of each phase of the ADME processes 4. Knowing how to determine the various characteristic pharmacokinetic parameters in the case of a single or repeated administration 5. Explain how a receptor works and quantify its binding to a ligand.

Content	I. General Aspect in pharmacology **1.** Generalities **2.** Medication • History • Definition • Composition • Denomination • Generic drugs 3. Phases of drug design 4. Routes of administration and dosage forms • Pathway of administration • Dosage forms and examples II. Pharmacokinetics 1. Definition and comparison of pharmacokinetics / Pharmacodynamics 2. Descriptive pharmacokinetics: ADME processes A. Absorption • Influence of the route of administration • Mechanisms of absorption • Passive broadcast • Filtration • Easy passive dissemination • Active transportation • Factors influencing absorption • Concept of bioavailability (relative and absolute) • Distrubution B. Distrubution • Parameters influencing distribution • Protein binding and balance between free form and bound form • Concept of volume of distribution Dv C. Metabolization • Phase I and II reactions / Introduction of the pro-drug notion • Cytochromes P450 D. Elimination III. Quantitative pharmacokinetics: determination of pharmacokinetic parameters 1. Case of IV administration 2. Case of extravascular administration
Study and examination requirements and forms of examination	Written Mid-term Exam (40%)+ Written Final Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for classroom & Online (Moodle ULT) Video projection

Reading list	-Pharmacologie (2ème édition), M. Moulin et A. Coquerel. MASSON. -Advanced Practical Medicinal Chemistry, Ashutosh Kar, New Age International Ltd. (2004). -Foye's Principles of Medicinal Chemistry by David A. Williams, Thomas L. Lemke, William O. Foye (2008), Kluwer publication.

ELECTIVE UNIT 2

U.4.4 Material Sciences (Elective Unit)

Physical Chemistry of Polymers

Module designation	**Material Sciences**
Module level, if applicable	2nd year of chemical engineering
Code, if applicable	U.4.4
Subtitle, if applicable	-
Courses, if applicable	- **Physical Chemistry of Polymers**
Semester (s) in which the module is taught	-Semester 2 (S4)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Pr. Mohamed JAZIRI
Language	French
Relation to curriculum	Professional module (Elective),
Type of teaching, contact hours	Lecture, 36 hours of classroom course/semester 6 hours practical workshop/ Semester
Workload	Total 63hours/semester (21 hours of Self-Study/semester)
Credit points	2.5 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Polymers synthesis, Structural organic chemistry , Organic chemistry & catalysis, introduction to material sciences, thermodynamics

Module objectives/intended learning outcomes	**Objectives :** 1. Introduce the physico-chemistry of polymers in solution, at interfaces and in emulsion 2. Know Conformations & Thermodynamics of polymer solutions 3. Understand Dynamics of entangled polymers 4. Understand Dynamics of unentangled polymers **Learning Outcomes:** Students will be able to : 1. Understand Thermal Properties of polymers 2. Carry out Morphological characterization 3. Know Mechanical Properties 4. Acquire knowledge in characterization and analysis of the behaviour of polymers used in formulated products 5. Understand the link between structural characteristics and product behavior, particularly at interfaces

Content	**Chapter I. Diversity of polymers and their properties** 1- Notions of mechanics useful for studying polymers. 2- Rubber elasticity (thermodynamic approach). 3- Conformation of a mass polymer chain 4- Static mechanical behaviour of networks **Chapter II. Properties of polymers in solution** 1- Conformation of a polymer chain in solution 2- Viscosity of polymer solutions 3- Measurement of molecular masses **Chapter III. Bulk polymer properties** 1- Glass transition 2- Viscoelasticity 3- Polymer crystallization 4- Miscibility, compatibility of polymers and diluents 5- Applications of the concepts acquired to the specific case of the formulation of a tire tread. **Chapter IV. Elastomers: formulation, rheology and processing techniques** 1- The final product in terms of material properties. 2- Presentation of the different types of elastomers and fillers, 3- Origin of the reinforcement 4- Role of the different ingredients, concepts of formulation of different families of rubber mixtures. **Chapter V. Rheology of elastomers** 1. Different types of devices and methods of characterization: - Advantages, - Limitations - Selection parameters with respect to the various families of problems encountered. 2. Different processing techniques: - Mixing, - Calendaring, - Extrusion, - Assembly, - Molding-baking, - Relationship between process selection and materials to be transformed. **Practical workshop-Physical Chemistry of Polymers** 1. <u>Plastics - Analysis of a plastic material by FTIR and differential scanning Calorimetry</u> *Objectives :* This lab prescribes a method for the thermal analysis of polymers such as thermoplastics and thermosets, including molding materials and Composites, using Differential Scanning Calorimetry (DSC). Differential scanning Calorimetry can determine different properties of polymers.

	2. Rheology *Objectives:* Rheology is the study of the deformation and flow of matter under the effect of applied stress. In this practical work, we propose to study the rheological characteristics of several products (cosmetics, food and paint). Measuring the viscosity of a fluid is part of rheology, which is the science of the flow of matter.
Study and examination requirements and forms of examination	Written Mid-term Exam (25%) + Practical Exam (25%)+ Written Final Exam (50%)
Media employed	Course Material (Hard/ Soft copy) for classroom& Online (Moodle ULT) Video projection Practical Workshop in Lab
Reading list	-Physical Chemistry of Polymers.A Conceptual Introduction. Sebastian Seiffert. De Gruyter 2020. -Surface Chemistry of Surfactants and Polymers.Bengt Kronberg, Krister Holmberg, Björn Lindman.ISBN:9781119961246.(2014). - Matières plastiques - Propriétés, mise en forme et applications industrielles des matériaux polymers,MarcCarrega, Vincent Verney, 3e edition, Dunod,, 2012. -Polymer Extrusion, Pierre G. Lafleur Bruno Vergnes, Wiley, First published: 8 May 2014

U.4.4 Material Sciences (Elective Unit)

Micro- and nanostructured products

Module designation	**Material Sciences**
Module level, if applicable	2nd year of chemical engineering
Code, if applicable	U.4.4
Subtitle, if applicable	-
Courses, if applicable	- **Micro- and nanostructured products**
Semester (s) in which the module is taught	-Semester 2 (S4)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Phd. Malek ATYAOUI
Language	French
Relation to curriculum	Professional module (Elective),
Type of teaching, contact hours	Lecture, 21 hours of classroom course/semester
Workload	Total 42hours/semester (21 hours of Self-Study/semester)
Credit points	1.5 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Organic chemistry, thermodynamics, kinetics reactions. Physical Chemistry
Module objectives/intended learning outcomes	**Objectives :** 1. Discover micro and nano structured products (emulsion, colloidal dispersion) 2. Acquire knowledge in characterization and analysis of the behavior of molecules used in formulated products (mainly surfactants) 3. Understand the link between structural characteristics and product behavior, particularly at interfaces **Learning Outcomes:** Students will be able to : 1. Analyze the behavior of molecules used in formulated products (surfactants) 2. Choose and justify the choice of a compound (surfactant) in the formula of a product 3. Make the link between the structural and behavioral characteristics of products, particularly at interfaces 4. Implement dispersions about specific examples (emulsion, colloidal suspensions). 5. Study processes for dispersed systems

Content	**I. Physico-chemistry and formulation of multiphase fluid systems** 1. Physico-chemistry of interfaces 2. Classes, specificity and behavior of surfactants in solution 3. Micellization, desorption at interfaces, liquid crystal phases 4. Formulation of emulsions and phase inversion 5. Spreading dynamics 6. Formulation and manufacturing of foams II. Processes for dispersed fluid systems 1. Mechanically assisted emulsification, the devices 2. Temporal phenomena modeling test; examples of semi-empirical modeling 3. Micro-emulsification, nucleation and growth: basic principles and mechanisms 4. Kinetics of the growth of the new phase; coupling between different transport mechanismsand transfer and thermodynamic equilibrium at the interface; competition between hydrodynamics and dissemination; modelling, analytical approach and numerical scheme 5. Atomization, drying: characterization of dispersions and atomization devices; mechanisms andatomization characteristics III. Processes for dispersed solid systems 1. Characterization of dispersed systems: particle size, energy and surface potentials 2. Physico-chemical properties of dispersed systems: diffusion, Brownian motion, filmification Nanoparticle manufacturing technologies: sol-gel processes, gas phase condensation,atomization-pyrolysis 3. Microparticle manufacturing technologies: emulsification-evaporation, atomization-drying 4. Stabilization of dispersed systems: DLVO theory and applications
Study and examination requirements and forms of examination	Written Mid-term Exam (40%)+ Written Final Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for classroom & Online (Moodle ULT) Video projection Practical Workshop in Lab
Reading list	-Physical chemistry of surfaces, *A.W. Adamson*, John Wiley and Sons -R. C. Pasquali ; M.P. Taurozzi ; C. Bregni. International Journal of Pharmaceutics, 2008, Vol. 356, 44-51. - A. Boudendouna ; «Méthodologie de la formulation d'une forme orale solide à libération prolongée », Thèse de doctorat de l'université de Toulouse, 2010.

U.4.5Languages & Management

English (TEOIC) II

Module designation	**Languages &Management**
Module level, if applicable	2nd year of chemical engineering
Code, if applicable	U.4.5
Subtitle, if applicable	-
Courses, if applicable	- **English (TOEIC) II**
Semester (s) in which the module is taught	-Semester 2 (S4)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Mr. Noureddine ZAALOUNI & Miss Nadia ZARDI
Language	English
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 42 hours of classroom course/semester
Workload	Total 77 hours/semester (35 hours of Self-Study/semester)
Credit points	3 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Upper intermediate level in both listening and reading skills.

Module objectives/intended learning outcomes	**Objectives:** 1. Prepare students to take TOEIC test by providing related necessary linguistic knowledge. 2. Focus is put on how to approach the different parts of test items and to develop test taking skills, in order to reach the highest score possible. **Learning Outcomes:** Students will be able to : **Competencies:** General Competencies 1. Reach the highest score possible 2. Develop at most his/her Listening and reading skills. Specific Competencies 1. Recognize the different parts of TOEIC. 2. Develop tactics and strategies appropriate to each type of activity, (ex: skimming and scanning). 3. Distinguish tasks to be performed in every activity. 4. Establish a proper pace to follow throughout the exam. 5. Manage allocated time. 6. Follow steps
Content	**Unit 4 Retailing** Vocabulary builder: • Shopping, stores, products, services. • Starting a new business Venture. Grammar check: • Comparatives and superlatives • Tag questions **Unit 5 Industry** Vocabulary builder: • Production, construction, automation. • Factory tour, Industrial problems Grammar check: • Active/ passive form • Definite/ indefinite articles **Unit 6 Trade** Vocabulary builder: • Marketing, shipping, import and export • Financial market, stock exchange, auction house, international port. Grammar check: • Cause and effect • Future forms • Phrasal verbs (part 1) **Unit 7 Money** Vocabulary builder: • Banking, budgets, expenditure • Investment, personal finance Grammar check: • Modalsverbs • Phrasalverbs (part 2)
Study and examination requirements and forms of examination	Written Mid-term Exam (40%)+ Written Final Exam (60%) Students will sit for a two hour paper based TOEIC test, which will be scheduled a week ahead.

Media employed	Course Material (Hard/ Soft copy) for classroom & Online (Moodle ULT) Exercises, videos, recording speech, computer,
Reading list	1- Market leader, David cotton, David Falvey , Simon Ken; FINANCIAL TIMES (Pearson Longman) 2- Tactics for TOEIC® Listening and Reading Test: Grant Trew, OUP Oxford, 2007. 3- Target Score Student's: A Communicative Course for TOEIC® Test Preparation, Charles Talcott & Graham Tullis, Cambridge University Press, 2007 4- Understanding and Using English Grammar, Betty Schrampfer Azar; Prentice Hall Regents; YouTube Videos

U.4.5Languages &Management

Business Management

Module designation	**Languages & Management**
Module level, if applicable	2nd year of chemical engineering
Code, if applicable	U.4.5
Subtitle, if applicable	-
Courses, if applicable	- **Business Management**
Semester (s) in which the module is taught	-Semester 2 (S4)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Miss SOUKEINA TOUITI
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 21 hours of Seminar/Project
Workload	Total 51 hours/semester (30 hours of Self-Study/semester)
Credit points	2 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Basic knowledge's in economy, project management,
Module objectives/intended learning outcomes	**Objectives :** 1. Define management and corporate culture 2. Have a professional interpersonal skill, 3. Understand financial and accounting issues **Learning Outcomes:** Students will be able to : 1. Manage a structure and control the economic, legal and financial aspects to support or even increase its development, and to anticipate the tax and social risks linked to their growth. 2. Implement resources to ensure the start of the business creation and management project or takeover of the business. 3. Implement the adopted strategy and react to unforeseen events. 4. Ensure management control, how to analyze, methods and means to improve the performance of a company 5. Evaluate the feasibility and viability of a business creation project

Content	**Chapter 1: The Enterprise System** - Presentation of the company - The company, a system open to its environment - Business organization - The company and its management **Chapter 2: Analysis of the financial situation of the company from the financial balance sheet** - Understand the balance sheet - Move from the balance sheet to the financial balance sheet - Apply the financial analysis approach - Long-term / short-term liabilities - Measure financial balances - Define the concepts of Working Capital (FR), Working Capital Requirement (WCR), Net Cash (TN) - Identify the main ratios of structure, WCR and liquidity - Carry out the financial diagnosis of a company Application: calculation and interpretation of the balance of the functional balance sheet (FR, BFR and TN) and the main ratios and realization of the financial diagnosis of a company. **Chapter 3: Legal study of the company** -Distinguish between structure and activity - Choose the appropriate legal structure -Meet the main selection criteria - Summary table of the main legal structures - VAT accounting **Chapter 4: Human Resource Management** - Introduction to HR management - Recruitment - Skills and career management - Compensation - Training **Chapter 5: the organization of production in companies** - The production - Procurement and inventory management - Selective management of supplies and stocks - Main inventory management tools **<u>Application: Project summary work</u>** - A work of synthesis in the form of a workshop which promotes the transposition in business of the main tools of strategic analysis. - Know the fundamentals of management and business creation. - Analyze your idea and transform it into a project. - Evaluate the possible risks of his project. **<u>Project study workshop</u>** - Define: its strategy; her goals; its targets. - Know: your environment; the competitors already present; the possible sources of a market study.

	- Carry out a SWOT diagnosis. - Define your action plan at the start of the activity. - Choose the legal framework, the tax and social regime of the company. - Analyze the financial balance of the company and simulate the impact of economic decisions. - Build the financial business plan *Application: Oral presentation*
Study and examination requirements and forms of examination	Format: Continuous Control, Oral Presentation Project (100%)
Media employed	Course Material (Hard/ Soft copy) for classroom & Online (Moodle ULT) Video projection Practices & oral presentation
Reading list	Books and handouts, websites,

U.4.5Languages& Management

Lean Management

Module designation	**Languages & Management**
Module level, if applicable	3 rdyear of chemical engineering
Code, if applicable	U. 4.5
Subtitle, if applicable	-
Courses, if applicable	- **Lean Management**
Semester (s) in which the module is taught	-Semester 2 (S4)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Phd. Amine OULHA
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 21 hours of classroom course/semester 21 hours of project workshop/semester
Workload	Total 77 hours/semester (35 hours of Self-Study/semester)
Credit points	3 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	No recommended prerequisites
Module objectives/intended learning outcomes	**Objectives:** 1. Understand the lean management concept, 2. Understand the 6 sigma concept, 3. acquire the different tools of the lean management, **Learning Outcomes:** Students will be able to : 1. Work through all principles and aspects of the Lean Manufacturing methodology on actual projects 2. Effectively communicate with key stakeholders to evaluate outcomes from applying Lean 3. Apply the different tools of the lean management, 4. Reduce manufacturing times and increase production flexibility.

Content	**Part I : 21 hours of project workshop/semester** **Chapter I The Foundations of Lean Thinking** 1. Understand the state of mind of Lean management. 2. Difference between Lean manufacturing and Lean Management 3. Lean and continuous improvement initiatives. 4. The principle of added value for the customer. 5. The notion of "waste". 6. The process model. **Chapter II How to deploy the Lean management approach** 1. The deployment plan. 2. Performance indicators. 3. Training. 4. Conduct of the group at work. **Chapter III The foundations of Lean Manufacturing** 1. Introduction 2. Origins and history of lean 3. Concepts and tools o 5S and Visual Management o Autonomous Production Unit o Jidoka o Kaizen and PDCA o PokaYoke (Anti-Errors Systems) o Quick Change of Tools (SMED) o Pulled Flow (just in time) o Standardized work o Total Productive Maintenance (TPM) o Value stream o 6 sigma **Chapter IV 6 Sigma Method** 1. Notions of 6 sigma 2. Study of compliance 3. DMAIC process 4. Control cards **Chapter V 5S Method** 1. Origin of 5S 2. Procedure for carrying out a 5S project 3. Definition of 5S 4. The stages of 5S 5. Application examples 6. 5S projects **Chapter VI Establishment of factories** 1. Production typology 2. The different production organizations 3. Design of a modern production unit 4. Analysismethods **Chapter VII Value Stream Mapping** 1. Principles of VSM 2. The stages of the current state 3. Current state drawing in the field 4. Complete data box and information flow 5. Identification of areas for improvement 6. Calculation of flow time and VA time

	Part II: Project Workshop (21 hours of Workshop Project/semester) Students are divided into groups of 4 students. A project will be assigned to students group early in the semester. The students will be asked to develop a project plan and will work on project throughout the course. Students groups will work on a given project from the list below: **Project Topic :** **Proposal 1:** Application of LEAN tools as part of the optimization of the logistics flow of Thermostats in Industry. **Proposal 2 :** Implementation of a Kaizen approach and optimization of yarn consumption. Improvement of the TRS performance indicator in a given plant. **Proposal 3 :** Implementation of a lean six six sigma project on the production line of a detergent product **Proposal 4 :** Measurement and improvement of performance, monitoring of indicators and corrective actions of a production line of a chemical product. **Proposal 5 :** Implementation of the WCM (world class manufacturing) methodology for continuous improvement in the production line
Study and examination requirements and forms of examination	Format: Written Mid-term Exam (40%) + Oral presentation Project (60%)
Media employed	Course Material (Hard/ Soft copy) for classroom & Online (Moodle ULT) Video projection
Reading list	-Lean Management: Outils, méthodes, retours d'expériences, questions/, Christian Hoffman, 2012 -Système Lean: Penser l'entreprise au plus juste, James P. Womack, Daniel T. Jones, -Les basiques du Lean Manufacturing: Dans les PMI et ateliers technologiques, Pierre Bédry, 2009

U.4.6Projects

Annual Project (Conception/Simulation/Design process)

Module designation	**PROJECTS**
Module level, if applicable	2nd year of chemical engineering
Code, if applicable	U.4.6
Subtitle, if applicable	-
Courses, if applicable	- **Annual Project**
Semester (s) in which the module is taught	-Semester 2 (S4)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Phd. Khalil ZAGHDOUDI
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	21 hours of Practical Work in Lab/semester
Workload	Total 51 hours/semester (30 hours of Self-Study/semester)
Credit points	2 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Fundamentals taught during the 3 previous semesters, Mini project, Project management,

Module objectives/intended learning outcomes	**Objectives:** 1. To familiarize future engineers with industrial analysing methods of a common problem and drafting a project. 2. Mobilize existing skills in chemical engineering in the field of specialty chemistry 3. Practise some intra and entrepreneurial skills 4. Develop global thinking and creative thinking and apply them by creating an innovative process / improving an existing process **Learning Outcomes:** At the end of the courses Students are expected to be able to : 1. Propose an improvement of an existing industrial process 2. Propose an improvement of existing analysis or control method in the fields of chemical engineering. 3. Mobilize the knowledge and skills required to design an innovative process from idea to proof of concept and proof of theoretical feasibility 4. Structure and optimize the creativity of a project team 5. Develop and use knowledge and skills in project management dedicated to the design of innovative projects: plan and lead a simple project to design an innovative chemical product/or process
Content	Students are divided into groups of 3 to 4 students. They are confronted with real professional and managerial situations,. Students groups will work on a given project during the semester in order to carry on an innovative process from the beginning to the end (concept/simulate/design). **Teaching methods :** - Team working - Case study - Experiential learning **Project WorkingSteps:** **1.** Search for documentation sources - Reading and interpretation of scientific articles **2.** Writing **3.** Use of process simulation software **4.** Team work awareness **5.** Solve industrial problems through experiments **6.** Propose and find scientific solutions of real industrial cases **7.** Concept **8.** Simulate **9.** Design Process **10. Written Technical report/ technical sheet/** **11. Poster**
Study and examination requirements and forms of examination	Format: Continuous Control, Oral Presentation Project (100%)
Media employed	Video projector, Remote supervision (email, video conferences)

Reading list	Books and handouts, websites, scientific papers as references are provided to each student by his Supervisor depending on the project topic.