ULT Chemical Engineering

Subjects Modules for S2

Semester 2 Year 1

U.2.1 Engineering Tools

Applied computing II

Module designation	- **Engineering Tools**
Module level, if applicable	1st year of chemical engineering degree
Code, if applicable	U.2.1
Subtitle, if applicable	-
Courses, if applicable	- **Applied computing II**
Semester (s) in which the module is taught	-Semester 2 (S2)
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	9 hours of practical Workshop (Computing Laboratory), 12 hours of practical Project (Computing Laboratory),
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	Numerical Analysis, Matrix and linear algebra, Excel
Module objectives/intended learning outcomes	**Objectives:** 1. Students will gain a broad perspective about the uses of computers in engineering. 2. Develops basic understanding of the concept of algorithm and algorithmic thinking. Develops the ability to analyze a problem, develop an algorithm to solve it. **Learning Outcomes:** Students will be able to : 1. To solve problems responding to a specification using Matllab programming based on several examples from practical calculation cases. 2. Learn basics of MATLAB programing 3. Use MATLAB to solve computational problems

Content	**Classroom Lecture and Guide Work-Applied computing II** Session 1 : (9 hours of practical Workshop in Laboratory) **Chapter 1:** Simple Calculations with MATLAB **Chapter 2:** Writing Scripts and Functions **Chapter 3:** Loops and Conditional Statements **Chapter 4:** Root Finding **Chapter 5:** Interpolation and Extrapolation **Chapter 6:** Matrices **Chapter 7:** Numerical Integration **Chapter 8:** Solving Differential Equations **Chapter 9:** Simulations and Random Numbers **Projects : 12 hours of practical Project (Computing Laboratory)** Students are divided into groups of 3 . A project will be assigned to each 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. **Proposal 1 :** Polynomial fitting interpolation of an experimental curve by a polynomial model **Proposal 2 :** Solving the equations of transfer, transport and mass phenomena in a continuous medium **Proposal 3 :** Simulation of chemical kinetics conducted in batch, reactor
Study and examination requirements and forms of examination	Format: Continuous Control, Oral Presentation Project (100%)
Media employed	Course Material (Hard/ Soft copy) for Laboratory& Online (Moodle ULT) Practical Workshop in Computer Laboratory Video projection
Reading list	Books and handouts, websites,

U.2.1 Engineering Tools

Control and Regulation

Module designation	- **Engineering Tools**
Module level, if applicable	1st year of chemical engineering
Code, if applicable	U.2.1
Subtitle, if applicable	-
Courses, if applicable	- **Control and Regulation**
Semester (s) in which the module is taught	-Semester 2 (S2)
Person responsible for the module	Dr. Khalil ZAGHDOUDI
Lecturer	Phd. Hatem HOUCINE
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 15 hours of classroom course/ semester 6 hours of practical in laboratory/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 non attendance = elimination for exams
Recommended prerequisites	Basics of physics, Metrology
Module objectives/intended learning outcomes	**Objectives :** 1. Know the techniques for implementing regulation 2. Know the different components in a regulation chain: transmitter, sensor, actuator, correctors…. 3. Representation of a process and terminology **Learning Outcomes:** Students will be able to : 1. Explain and analyse the functional diagram of a regulation loop and the role of each element 2. Develop the block diagram of a regulation system 3. Simulate and implement regulation by: programmable controllers, computer, regulated systems, using the appropriate sensors. 4. Description of a regulation chain: sensors and actuators

Content	**Classroom Lecture and Guide Work-Applied computing II** **Chapter I. Automation** 1. Combinatorial logic 2. Coding 3. Sequential Logic 4. Organization chart 5. API and PL7-2 **Chapter II. Regulation** 1. Reminders 2. Precision and stability 3. Complex set 4. Discrete time regulation **Chapter III. Metrology** **Chapter IV. Sensors and transmitter** **Chapter V. Pressure sensors** **Chapter VI. Level sensors** **Chapter VII. Flow sensors** **Chapter VIII. Temperature sensors** **Chapter IX. Regulating valves** **Practical Workshop-Control & Regulation** 1. Study of the process for flow control by pump control 2. Study of the process for flow control by valve control 3. Study of the WIKA pressure gauge – 4 bar **Project : (14 hours of Self-Study hours /semester)** Students are divided into groups of 3. A project will be assigned 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 Topics** **Proposal 1:** Study of the design of a weather balloon for pressure mesurements**.** **Proposal 2 :** Operate a pressure sensor with a microcontroller **Proposal 3:** Development of a technical control and regulation system for a given installation.
Study and examination requirements and forms of examination	Format: Written Mid-term Exam (25%) + Practical Exam (25%) + Final Exam (50%)

Media employed	Course Material (Hard/ Soft copy) for classroom & Online (Moodle ULT) Practical workshop in Laboratory Video projection
Reading list	-Eric Magarotto, Cours de Régulation. IUT Caen - Département Génie Chimique et Procédés. Université de Caen. 2004. -Bernard BAYLE, Systèmes et asservissements à temps continu Ecole Nationale Supérieure de Physique de Strasbourg année 2007–2008. - Automatique - Contrôle et régulation.Prouvost Patrick. (DUNOD). (2013). ISBN 10: 2100547771

U.2.2 Fundamental Sciences

Structural & Metabolic Biochemistry

Module designation	**Fundamental Sciences**
Module level, if applicable	1st year of chemical engineering
Code, if applicable	U.2.2
Subtitle, if applicable	-
Courses, if applicable	**-Structural & Metabolic Biochemistry**
Semester (s) in which the module is taught	-Semester 2 (S2)
Person responsible for the module	Dr Khalil Zaghdoudi
Lecturer	Phd. Ines KHLIF
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 39 hours of classroom course/semester 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	Thermodynamics, Structural Organic chemistry, Basic of Biochemistry

Module objectives/intended learning outcomes	**Objectives:** 1. Acquire basic knowledge on the main structural, physicochemical and biological properties of biomolecules (carbohydrates, lipids, amino acids and proteins) 2. Acquire the basic knowledge of the main catabolic and anabolic processes in a living cell 3. To enable students to acquire a specialized knowledge and understanding of how enzymes and metabolites in living system works to produce energy and synthesizing different biomolecules 4. Functional properties and importance of carbohydrates, proteins, nucleic acids and lipids. 5. Understanding The physical and chemical properties of the components of living things. **Learning Outcomes:** Students will be able to : 1. Differentiate the anabolic and catabolic pathways and their important enzymatic steps, understand how glycolysis produces metabolic energy as well as producing intermediates for further metabolic reactions. 2. Understand the principles and basic mechanisms of metabolic control and how regulation of biochemical pathways leads to normal integrated metabolism. 3. Classification and structural properties of carbohydrates, proteins, nucleic acids and lipids.

Content	**Classroom Lecture and Guide Work-Structural & Metabolic Biochemistry** **Part 1:** **Chapter I: Carbohydrates** 1. Classification 2. Optical isomerism of monosaccharides 3. Filiation of ketosis and its aldoses 4. Cyclization of monosaccharides 5. Chemical reactions used in the study of carbohydrates 6. Disaccharides and homopolysaccharides: structures and properties **Chapter II : Lipids** 1. Classification 2. Structures, properties and roles of the main lipid molecules: fatty acids, phospholipids, sphingo-lipids, .. 3. Lipid characterization reactions Chapter III : Amino acids 1. Definition, classification, physicochemical properties 2. Ionization of amino acids **Chapter IV : Proteins** 1. Structure and conformation of proteins 2. Functional properties 3. Protein analyzes: chromatographic methods, sequencing, electrophoresis **Part 2 : Metabolic biochemistry** **Chapter I : The biochemical reaction** 1. Bioenergetics 2. Biological catalysis: structure and mechanisms of enzymes action 3. Coenzymes **Chapter II : Main metabolic pathways of carbohydrates and industrial applications** **Chapter III : Cellular energetics** 1. Glycolysis 2. The citric acid cycle 3. Respiratory chain and phosphorylating oxidations **Chapter IV: Main pathways of amino acid metabolism and industrial applications** **Practical Workshop – Structural & Metabolic Biochemistry** <u>Extraction of invertase from baker's yeast and study of the influence of pH on enzymatic activity</u> *Saccharomyces cerevisiae* well used on an industrial scale as well as on a laboratory scale due to its capacity for cell biosynthesis and metabolites, in particular invertase. This enzyme is able to hydrolyze sucrose into glucose and fructose. Objectives : The objective of this Practical workshop is to extract the invertase and determine its enzymatic activity by looking for the optimal conditions for it to be at its maximum. Manufacturers are increasingly attentive to the research and use of enzymes for various applications: food, cosmetics, textiles, energy. Tutorials

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) Practical workshop in Laboratory Video projection
Reading list	1. Biochimie structurale et métabolique, Moussard C. De Boeck (ISBN 9782804152369) 2. Tout sur la biochimie, Weinman S., Méhul P, Dunod(ISBN 9782100701636) 3. Biochimie structurale, Pellon G, Nathn (ISBN 2-09-190669-7) 4. Biochimie structurale et métabolique, Moussard C. De Boeck (ISBN 9782804152369)

U.2.2 Fundamental Sciences

Kinetics Reactions

Module designation	**Fundamental Sciences**
Module level, if applicable	1st year of chemical engineering
Code, if applicable	U.2.2
Subtitle, if applicable	-
Courses, if applicable	**- Kinetic Reaction**
Semester (s) in which the module is taught	-Semester 2 (S2)
Person responsible for the module	Dr. Khalil ZAGHDOUDI
Lecturer	Dr. Khalil ZAGHDOUDI
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 39 hours of classroom course/semester 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	Chemical reaction, endothermic/exothermic reaction, , mathematics, Basics of kinetic reaction, Basics of molecular chemistry

Module objectives/intended learning outcomes	**Objectives:** 1. The module aims to give engineering students the knowledge necessary to understand the kinetic phenomena involved in a chemical transformation. 2. On the other hand to acquire the methods of determining the overall order of a given reaction by taking into account the various kinetics factors **Learning outcomes :** Students will be able to : 1. The use of simple models for predictive understanding of physical phenomena associated to chemical thermodynamics and kinetics. 2. Obtain experience with the use of models (Michaelis-Menten for kinetics, Symmetry and sequential models for allosterism). 3. Demonstrate understanding of the chemical concepts of kinetics, thermodynamics, and equilibrium as applied to biological systems.

Content	**Classroom Lecture and Guide Work-Kinetic reaction** **Chapter I: Introduction to kinetics** (Objectives, Notions, Definitions) **Chapter II: Elements of chemical kinetics** 1. Introduction 2. Definition of the reaction rate for a closed system 3. The experimental notion of a reaction (Effect of kinetic factors, effect of concentration on the speed of a reaction at T = Constant) 4. Integrated speed laws 5. Effect of temperature on the rate of a reaction 6. Arrhenius Theory, Activation Energy 7. Kinetic factors: Effect of a catalyst (catalysis) • Homogeneous catalysis • Heterogeneous catalysis • The catalyst 1. Properties 2.mode of action of a catalyst 8. Determination of the partial orders and the global order of a reaction • Use of stoichiometric mixtures • Degeneration of the order • Integral method • Differential method • Initial velocity method • Half-reaction time **Chapter III: Compound Reactions** 1. Study of simple / elementary reactions 1.1. Elementary reaction 1.2. Kinetically determining step 1.3. Meaning of the order of a reaction 1.4. Reaction intermediates -Approximation of quasi-stationary states AEQS 2. Study of compound reactions 1.1- Reversible or opposite or balanced reactions 2.2-Parallel reactions 2.2.1. Twin parallel reactions 2.2.2. Competitive side reactions 2.3. Successive reactions **Chapter IV: Reaction mechanisms** 1. Mechanism by stages 2. Chain mechanism 2.1. Initiation stage 2.2. Spread 2.3. Breaking **Chapter V : Liquid phase Kinetics** 1- Caged effect. 2- Bronsted-Bjerrum formula. 3- Influence of the medium on the rate constants.

	Chapitre VI : Enzymatic kinetics 1. Definitions 2. Measurements of enzymaticreaction rates 3. Stationary enzymatic kinetics (reactions with a single substrate) 4. Inhibition (complete and reversible) 5. Michaelian enzymes 6. Michaëlis-Menten velocity equation B. Enzyme inhibition a) Rate equation in the presence of inhibitor b) Competitive inhibition c) Uncompetitive Inhibition d) Non-competitive inhibition
	Practical work- Kinetics Reactions Kinetics followed by Spectrophotometry: Kinetics of acetone iodination **Objectives :** In an acidic medium, one can substitute an iodine atom for a hydrogen atom in α of the carbonyl function. Each study is conducted under conditions such that the concentration of iodine is always negligible compared to those of acetone and H + ions. Consequently, these two concentrations can therefore be considered constant throughout the duration of the measurements. We can then define an apparent rate constant k '= k [Acetone] α [H +] β (order degeneration method). The speed of the reactionisthereforeexpressed as: $V = - d \frac{[I_2]}{dt} = k' [I_2]^{\gamma}$. First, we determine the partial order γ; For this, we follow by spectrophotometry at 490 nm (wavelength for which the absorbance is due to the iodine) the evolution of the iodine concentration over time.
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) Practical workshop in Laboratory Video projection
Reading list	-Cinétique chimique, Eléments fondamentaux, Michel Soustelle, Hermes science publications 2011. - Cinétique et dynamique des réactions chimiques. Mehran Mostafavi.ISBN : 978–2–7598–1296–7.(2015). -Fundamentals of Enzyme Kinetics. Athel Cornish–Bowden. (2012). ISBN: 9783527330744.

U.2.3.Transfer &Transport Phenomena

Applied Thermodynamics

Module designation	**-Transfer & Transport Phenomena**
Module level, if applicable	1st year of chemical engineering
Code, if applicable	U.2.3
Subtitle, if applicable	-
Courses, if applicable	**Applied thermodynamics**
Semester (s) in which the module is taught	-Semester 2 (S2)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Phd. Ftouh KALLEL
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 42 hours of classroom course/ semester 9 hours practical workshop/ Semester
Workload	Total 86 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	Basics of mathematics, thermodynamics
Module objectives/intended learning outcomes	**Objectives:** 1. Link thermodynamic transformation laws and applications in energy transforming machines. 2. formulate thermodynamic problems and to specify possible solutions 3. Apply modern thermodynamic calculation methods to multi-component mixtures and relevant systems. **Learning Outcomes:** Students will be able to : 1. Understand and use new notions of thermodynamics 2. Use the fundamental laws in solving problems involving work and/or heat 3. Take into account the influence of various parameters and the independence between components of a complete system (Analysis and synthesis of thermal cycles)

Content	**Classroom Lecture and Guide Work-Applied thermodynamics** **Chapter I. Introduction to Thermodynamics;** **Chapter II. Thermodynamic study of Pure Substances;** 1. Equilibriumdiagrams (P –T curves, and T-V); 2. Thermodynamic Tables and Variables; 3. Applications (H_2O, Ammonia, Freon, Nitrogen, etc.) **Chapter III. Work and Heat;** **Chapter IV. First and Second Principles of Thermodynamics;** 1. Conservation of mass as well as energy; 2. Internalenergy; 3. Enthalpy ; 4. Thermodynamic efficiency and Coefficient of Performance (COP); 5. Reversible and irreversibleevolution; 6. Entropy; 7. Variation of entropy during reversible and irreversible evolutions; **Chapter V :Real Gases and ideal Gases** 1. Clayperon equation 2. Real Gases thermodynamic model **Chapter VI : Thermal machines (monotherm and ditherm)** 1. Carnot cycle 2. Rankine Cycle 3. Diesel Cycle 4. Mixed cycle 5. refrigeration machines (Heat pump) **Chapter VII: Combustion** **Chapter VIII: Thermodynamic models & simulation** 1. Fugacity (Liquid & solid state) 2. Chemical potential 3. Activity *Applications:* (Thermal power stations as well as refrigeration or typical conservation) **Practical workshop in Laboratory-Applied thermodynamics** **1.** Theoretical bases on refrigeration circuits *Objectives :* 1) Presentation of a refrigeration circuit, its main components, their roles and the refrigerant cycle 2) Definition of a refrigerant and some most used examples 3) Description of the additive elements to the refrigeration circuit and their roles 4) Cycle (T, V) 5) Calculation of interpolations 6) Description of the role of a reversible air conditioner 7) Procedure for writing a report **2.** Refrigeration circuits with parallel evaporators

	3. <u>Study of a heat pump in cool mode and in heat mode</u> *Objectives :* - Go back to the theoretical foundations of the operation of a heat pump - Perform measurements to represent the operating cycles of a pump (summer, winter) and study the efficiency of the device.
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) Practical workshop in Laboratory Video projection
Reading list	« Thermodynamique Appliquée » : Van Wylen, Sontag, Desrochers. « Thermodynamique Général et Application » : R. Kling

U.2.3Transfer &Transport Phenomena

Mass Transfer

Module designation	**Transfer &Transport Phenomena**
Module level, if applicable	1st year of chemical engineering
Code, if applicable	U.2.3
Subtitle, if applicable	-
Courses, if applicable	- **Mass transfer**
Semester (s) in which the module is taught	-Semester 2 (S2)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Phd. Mounir MANSOUR
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 21 hours of classroom course/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	Mathematics, Basics of kinetic reaction, Thermodynamics, Fluid mechanics
Module objectives/intended learning outcomes	**Objectives :** 1. Discover the phenomena of mass transfer such asthat they are involved in material transformation industries, in process engineering 2. Discover the phenomena of mass transfer (by diffusion and convection) within a single phase. 3. Discover the phenomena of mass transfer between phases **Learning Outcomes:** Students will be able to : 1. Identify the matter transfer phenomenon for a practical case 2. Justify the various assumption retained for its modelling 3. Resolve mathematical equations describing it (diffusion equation, first law of Fick, second law of Fick, laws of concentration distribution

Content	**Classroom Lecture and Guide Work-Mass transfer** **Chapter I: Introduction** 1. The concept of matter transfer 2. Modes of material transfer 2.1 Dissemination 2.2 Advection 2.3 Convection **Chapter II: Diffusion transfer in a stagnant environment** 1. Composition of a mixture 2. Fick's first law 2.1 in Cartesian coordinates 2.2 in cylindrical coordinates 3. Local balance and diffusion equation 3.1 Local material balance 3.2 Diffusion equation in different coordinate systems 3.3 Fick's second law **Chapter III: Transfer of mass in a non-stagnant environment** 1. The absolute flow of matter (diffusion + advection) 2. Case of evaporation in a column **Chapter IV: Transfer of mass coupled with a reaction** 1. Transfer of matter coupled to a heterogeneous reaction (fluid-solid) 2. Material transfer coupled with a homogeneous reaction **Chapter V: Mass transfer between two fluid phases** 1. WHITMAN's Double Film Theory 2. Notions of Height of Transfer Unit and Number of Units ofTransfer. **Chapter VI: Case study** 1. Unidirectional material transfer in steady state 2. Two-dimensional transfer of matter in steady state 3. Unidirectional material transfer in transient regime
Study and examination requirements and forms of examination	Format: Written- Mid-term Exam (40%) + Final Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for classroom & Online (Moodle ULT) Video projection
Reading list	Transport Phenomena, 2nd Edition, R. Byron Bird, Warren E. Stewart, Edwin N. Lightfoot, John Wiley & Sons, Inc.; December, 2006 Fundamentals of Heat and Mass Transfer, 5th Edition, Frank P. Incropera, David P. DeWitt Wileyt, October, 2001

U.2.3Transfer & Transport Phenomena

Fluid Mechanics

Module designation	**Transfer &Transport Phenomena**
Module level, if applicable	1st year of chemical engineering
Code, if applicable	U.2.3
Subtitle, if applicable	-
Courses, if applicable	- **Fluid mechanics**
Semester (s) in which the module is taught	-Semester 2 (S2)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Phd. Nizar SOMRANI
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 33 hours of classroom course/semester 9 hours of classroom Project/semester 9 hours practical workshop/ Semester
Workload	Total 86 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	Mathematics, Basics of thermodynamics,
Module objectives/intended learning outcomes	**Objectives :** 1. Acquire knowledge of phenomena related to viscosity and fluid flows 2. Develop the skills needed to solve practical problems encountered in the industry **Learning Outcomes:** Students will be able to : 1. Understand the underlying physical phenomena translated into the equation of mechanics of real fluids, 2. Be able to make estimates for classic macroscopic situations limit speed of fall, flow in pipes, sizing of pumps selection and sizing of an agitator

Content	**Section 1: Lecture** **Chapter 1:** Detailed presentation of the components of the fundamental equations of fluid mechanics. **Chapter 2 : The viscosity of a fluid** 1. Concept of perfect fluid and real fluid 2. Viscosity and Newton's Law 3. Kinematic viscosity and applications **Chapter 2 : Flow in Pipes (Incompressible Fluids)** 1. Law of conservation of any property "N" 2. Law of conservation of mass 3. Law of Conservation of Momentum, or Newton's 2nd Law 4. Conservation law of Energy, from the 1st law of thermodynamics and "Bernouilli" equation 5. Calculations of local pressure losses and friction in a network of pipes, **Chapter 3 : Flow of compressible fluids and resolution of Navier Stokes and Euler equations** 1. Mass conservation equation in its differential form and in the various Cartesian, cylindrical and spherical coordinate systems 2. Applications and resolutions of some relevant industrial problems **Chapter 4:**Introduction to the rheological behaviour of fluids **Chapter 5:**Dimensionalization and similarities. **Chapter 6:** Elements on turbulence and the boundary layer. **Chapter 7:**Macroscopic assessment Bernoulli's equation -Frictions: • Case of an object in a fluid • Case of driving • Pressure drops • Organizers of movement • Agitation and Mixing Metrology **Chapter 8 : Pumps** 1. Classification of pumps 2. volumetric pumps 3. centrifugal and mixed-flow pumps 4. Similarities laws 5. cavitation 6. Pump sizing and design

	Section II: Project (9 hours of Workshop Project/semester) Students are divided into groups of 4 students. A project will be assigned to students groups 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 **<u>Project Topic:</u>** **1. Proposal 1 :** Simulation of the different types of pressure losses **2. Proposal 2:** Study and design of a foil. **3. Proposal 3 :** Study and design of a wind turbine
	Practical workshop- Fluid mechanics **1.** <u>Studies of pressure losses</u> *Objectives :* - Understand the operating principle of the unit, - Put the device into service, -Know the role of each organ of the unit, -Study of the pressure drops in each element of the hydraulic circuit and its evolution according to the circulation flow. **2.** Flow measurement Objectives : The unit has four types of flow measurement: - the float flowmeter - the Venturi tube - the diaphragm - Direct measurement by stuffing. The objective of this manipulation is to know the role of each organ, to calculate the flow rates using each of these four organs and to make a comparison. **3.** <u>Visualization of flow regimes</u> Objectives : The visualization of flow regimes is achieved by injection of a coloured tracerFluorescein or potassium permanganate type. The objective of this manipulation is to theoretically determine the limit values of the flow rate to obtain the laminar regime and theturbulent regime and visualize the effects of flow for the three regimes.
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) Practical Workshop in Laboratory Video projection

Reading list	Hydraulique. Cours et Exercices. Souha Bahlous El Ouafi Centre de Publication Universitaire (CPU) 2002. Mécanique de fluides – Prépas PC-PSI Céline Anthoine – Guillaume Levèvre – Samuel Marque- 1999. Mécanique des fluides. Comolet (Masson).

U.2.4 Organic Synthesis, Structure & Analysis

Organic Chemistry & Catalysis

Module designation	**Organic synthesis, Structure and Analysis**
Module level, if applicable	1st year of chemical engineering degree
Code, if applicable	U.2.4
Subtitle, if applicable	-
Courses, if applicable	- **Organic Chemistry & catalysis**
Semester (s) in which the module is taught	-Semester 2 (S2)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Phd. Yassine MOKADDEM
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 36 hours of classroom course/semester 6 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	Structural Organic Chemistry, Basics of kinetic reaction, Basics of molecular chemistry, Physical chemistry.

Module objectives/intended learning outcomes	**Objectives :** 1. Acquire knowledge about catalysis in organic chemistry 2. understand the importance of catalysis 3. understand how catalysis can occur heterogeneously and homogeneously 4. study the use of some transition metal catalysts 5. understand the importance and mechanism of asymmetric catalysis **Learning outcomes :** Students will be able to : 1. Apply concepts acquired in the field of inorganic, organic and organometallic chemistry to the design of catalysts. 2. Apply the fundamentals of catalysis to the synthesis of chemicals following sustainable and environmentally friendly procedures. 3. Apply concepts acquired in the field of inorganic, organic and organometallic chemistry to the design of catalysts

Content	**Classroom Lecture and Guide Work-Organic Chemistry & catalysis** **I. Catalysis: role of the catalyst, definitions homogeneous / heterogeneous catalysis** **II. Transition metal complexes** **1.** Classification of ligands and Green's formalism **2.** Geometry of complexes **3.** Metal-ligand bond: nature of ligands **III. Elementary reactions and reaction mechanisms (not exhaustive)** **1.** Ligand exchange **2.** Oxidative addition and reductive elimination **3.** Insertion and elimination **4.** Reactions of nucleophiles and electrophiles with complexes **IV. Hydrogenation / Hydroelementation** **1.** Hydrogenation of olefins **2.** Hydroelementation **3.** Isomerization of olefins **4.** Metathesis of olefins **V. Transformation of alkenes and alkynes** **1.** Polymerization of olefins **2.** Nicholas reaction (stoichiometric) **3.** Vollhardt's reaction **VI. Carbonylation and carboxylation reactions** **VII. Palladium-catalyzed reaction** **VIII. Organometallic compounds: General** **1.** Introduction: History, Nomenclature **2.** Types of links **3.** Stabilities of organometallic compounds **4.** Theory of hard and soft acids and bases (HSAB: Pearson's theory) **6 hours of Practical workshop in Laboratory-Organic Chemistry & catalysis** <u>Magnesian synthesis of triphenylmethanol</u> *Objectives:* The objective of this practical workshop is the synthesis of an organomagnesium. This magnesian synthesis is carried out in three stages: -Preparation and dosage of an organomagnesium -Synthesis of triphenylmethanol -Purification and characterization of triphenylmethanol
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) Practical Workshop in Laboratory Video projection

Reading list	- Chimie organique avancée, Carey &Subdberg, DeBoeck Université Eds. - Organic Chemistry second edition, Jonathan Clayden, Nick Greeveset Stuart Warren, Oxford Eds. - Advanced Organic Chemistry, F. A. Carey & R. J. Sunberg, Plenum press 1990. - Organometallics in Synthesis. M. Schlosser, Wiley, NY, 2002. - Les complexes de palladium en synthèse organique, J-M. Campagne & D. Prim, CNRS Ed., 2001. -Transition Metals in the Synthesis of Complex Organic Molecules, L. S. Hegedus and B. C. G. Söderberg, University Science Books 2010.

U.2.4 Organic Synthesis, Structure & Analysis

Polymers Synthesis

Module designation	**Organic synthesis, Structure and Analysis**
Module level, if applicable	1st year of chemical engineering
Code, if applicable	U.2.4
Subtitle, if applicable	-
Courses, if applicable	- **Polymers Synthesis**
Semester (s) in which the module is taught	-Semester 2 (S2)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Pr. Ali SAMARAT
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 21 hours of classroom course 3 hours practical workshop/ Semester
Workload	Total 45 hours/semester (21 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	Structural Organic Chemistry, Basics of kinetic reaction, Basics of molecular chemistry, Physical Chemistry , catalysis, material sciences.

Module objectives/intended learning outcomes	**Objectives :** 1. Gain knowledge about polymers synthesis pathway. 2. Implement simple polymerization techniques and understand the influence of synthesis conditions on the final structure of the polymer. 3. Compare the different types of polymer materials: amorphous, elastomeric, semi-crystalline and study their physical properties according to their glass transition temperatures andof crystallization 3. Understand the principal the operating principal of characterization devices 4. Choose the right technique for a given material **Learning Outcomes:** Students will be able to : 1. To understand the different synthesis techniques of the main industrial polymers such as polyolefin (PE, PP) Polyvinyl (PS, PVC, and PMMA), Polycondensates (Nylon, PET) 2. To understand those resulting from reactions by ring opening (Silicones, Polycaprolactone). 3. Investigate the different reaction mechanisms involved and the kinetics of polymerization.

Content	**Classroom Lecture and Guide Work-Organic Chemistry & catalysis** **Chapter I Polycondensation** I.1 Control of molar masses I.2 Distribution of molar masses I.3 Kinetics of polycondensations I.4 Systems with functionality greater than 2. Frost point I.5 Polycondensation techniques I.6 Chemical modification of polymers **Chapter II Essential characteristics of reactions on polymers** II.1 Main classes of reactions on polymers II.2 Isomerization II.3 Addition and chelation II.4 Substitution II.5 Elimination II.6 Selective oxidation II.7 Chain breaking reactions II.8 Photochemical reactions II.9 Mechanical-chemical reactions II.10 Reactivity of chemical functions carried by polymers II. 11 Experimental techniques II.12 Synthesis of polymers with a particular structure **Chapter III Telechelic oligomers** III. 1 Block polymers III. 2 Segmented polymers III. 3 Graft polymers **Chapter IV : Carracterization techniques** ***I-Thermo Gravimetric Analysis (TGA)*** 1- Definition 2-The apparatus 3. Exploitation of thermograms 4. Examples of application ***II-Differential Thermal Analysis (DTA)*** 1- Apparatus 2- Advantages and disadvantages 2- General principles 3- Applications ***III- Differential Scanning Calorimetry (DSC)*** 1- Apparatus 2- Advantages and disadvantages 2- General principles 3- Applications **Practical workshop in Laboratory- Synthesis of polymers** Analysis and test on a plastic material.Determination of tensile properties *Objectives :* Understand the general principles for determining the tensile properties of plastics under defined conditions. Tensile testing is used to study the tensile behavior of test specimens and for the determination of tensile strength, tensile modulus and other aspects of stress / tensile strain relationships under defined conditions.

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) Practical Workshop in Laboratory Video projection
Reading list	- Michel Fontanille, Yves Gnanou, chimie et physico-chimie des polymères, Collection Sciences Sup, Dunod, 06. 2014. -Firmin Moingeon, Synthèse de polymères dendronisés par polymérisation anionique vivanteet fonctionnalisation de leur surface, Editions universitaires européennes, 03.2011

U.2.4 Organic Synthesis, Structure & Analysis

Spectroscopic techniques of analysis

Module designation	**Organic synthesis, Structure and Analysis**
Module level, if applicable	1st year of chemical engineering
Code, if applicable	U.2.4
Subtitle, if applicable	-
Courses, if applicable	- **Spectroscopic techniques of analysis**
Semester (s) in which the module is taught	-Semester 2 (S2)
Person responsible for the module	Dr Khalil Zaghdoudi
Lecturer	Phd Mohamed MEZNI
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 21 hours of classroom course/semester 3 hours practical workshop/ Semester
Workload	Total of 45 hours/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 , Basics of molecular chemistry, mathematics, structural organic chemistry, physical chemistry
Module objectives/intended learning outcomes	**Objectives :** 1. Explain the theoretical aspects of key analytical techniques and instruments used. 2. Know and be able to use different techniques of NMR, IR and Raman spectroscopy for organic molecules identification. **Learning Outcomes:** Students will be able to : 1. Interpret IR spectroscopy 2. Explain working basic and using of elemental analysis device 3. Explain working principles and taking spectrum of IR spectroscopy device 4. Explain working principles, taking spectrum and outline of NMR spectroscopy device

Content	**Chapter I -** Introduction to quantum physics I. Wave Mechanics II. Formalism of quantum mechanics III. The postulates of quantum mechanics 1. Theories of stationary and time-dependent disturbances 2. Quantum harmonic oscillator 3. Orbital kinetic moments and spins IV. Quantum statistics **Chapter II :** Infrared vibration spectroscopy I. Introduction II. Rotation - Vibration of diatomic molecules II.1- Vibration II.1.1- Vibration energy II.1.2 - Selection rules II.2 - Rotation-vibration - Fine structure II.2.1 - Energy II.2.2 - Selection rules II.2.3 - Fine structure II.2.4 - Rotation-vibration spectrum II.2.5 - Isotopic effect **Chapter III - Vibration of polyatomic molecules** III.1 - Normal modes of vibration III.2 - Active or inactive vibrations - degenerate vibrations III.2.1 - Activity III.2.2 - Degeneration III.3 - Fundamental vibrations III.4 - Types of vibration movements and notations III.5 - Group vibrations **Chapter IV - Applications of infrared vibration spectroscopy** IV.1 - Functional analysis IV.2 - Structural study IV.2.1 - Hydrogen bond IV.2.2 - Inductive and mesomeric effects IV.2.3 - Conjugation IV.2.4 - Cycle voltage IV.2.5 - Isomers IV.3 - Quantitative analysis **Chapter V : Nuclear Magnetic Resonance (NMR)** I. Introduction II. Experimental aspects 1. The NMR signal and the Fourier transform, 2. Quantitative aspects 3. Measurement of relaxation times T1 and T2. 4. NMR experiments in extreme conditions. III. Interactions 1. Dipolar interactions, 2. Chemical shift, 3. scalar coupling and quadrupole interaction *Tutorials I*

	Practical workshop in Laboratory- *Spectroscopic methods of analysis* IR Infrared Spectroscopy *Objectives :* 1. Understand the general principles of infrared. 2. Identify unknown molecules by determining their IR spectra. 3. Know how to compartmentalize an IR spectrum.
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) Practical Workshop in Laboratory Video projection Industrial Visit : Industrial Visit to the National Center for Nuclear Sciences and Technologies. (CNSTN).
Reading list	-P. W. Atkins “Chimie Physique”, De Boeck Université, Paris, 2000. -M. Hessen H. Meier, B. Zeeh “Méthodes spectroscopiques pour la chimie organique”, Masson, Paris, 1995. -Mécanique quantique tome I et II, de Claude Cohen-Tannoudji, Bernard Diu et Franck Laloë, EDP Sciences.

U.2.5Languages & Management

Engineering Ethics

Module designation	**Language and Management**
Module level, if applicable	1st year of chemical engineering
Code, if applicable	U.2.5
Subtitle, if applicable	-
Courses, if applicable	- **Engineering Ethics**
Semester (s) in which the module is taught	-Semester 2 (S2)
Person responsible for the module	Dr. Khalil ZAGHDOUDI
Lecturer	Phd. Amine OUALHA
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	21 hours: Seminar/ Projects
Workload	Total 42 hours/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	No prequistes nedded
Module objectives/intended learning outcomes	**Objectives:** 1. Increase the student's employability 2. Develops the full spectrum of advanced ethical and professional skills 3. Clearly distinguish between personal, theoretical and professional ethics **Learning outcomes :** Students will be able to : 1. Conduct his/her engineering activity ethically 2. Identify the central ethical problem 3. Identify affected parties and theirs interstes 4. Search for possible solutions for the dilemma 5. Evaluate each solution using the interests of those involved, accorded suitable priority. 6. Understand leaders' ethical responsibilities

Content	**Seminar and Group projects** Introduction **I.** Ethics Guide **II.** Thinking about Ethical decisions **III.** Rules vs Principals **IV.** Fundamental Principals **V.** The framework **VI.** Innovation Ehtics **VII.** Innovation Ethics for value based Innovation **VIII.** Technological evolution, innovations and ethical concerns and dilemmas **IX.** A framework for understanding (un) ethical decision-making process **X.** Innovation process models and decision making **XI.** Moral imagination, systems thinking and multiple perspective approach
Study and examination requirements and forms of examination	Format: evaluation & Oral presentation (100%)
Media employed	Course Material (Hard/ Soft copy) for classroom& Online (Moodle ULT) Practicing (oral presentation) Video projection
Reading list	1. Innovation Ethics. African and Global Perspectives. (2014).ISBN 978-2-88931-003-6. 2. Innovation process and ethics in technology: an approach to ethical (responsible) innovation governance. Nathan.Journal on Chain and Network Science 2015; 15(2): 119-134 3. Responsabilité éthique de l'ingénieur dans les systèmes complexes, **IESF** –Société des Ingénieurs et Scientifiques de France

U.2.5Languages & Management

English II

Module designation	**Language and Management**
Module level, if applicable	1st year of chemical engineering
Code, if applicable	U.2.5
Subtitle, if applicable	-
Courses, if applicable	- **English II**
Semester (s) in which the module is taught	-Semester 2 (S2)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Mr. Habib BEN MASAOUD
Language	English
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 21 hours of classroom course/ semester
Workload	Total 42 hours/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	Every student must have a monolingual English dictionary to be used for classroom activities or else an online dictionary downloaded on a smartphone / laptop.
Module objectives/intended learning outcomes	- This is **English for Scientific Purposes**. - Undergraduates are required to master using English adapted to their field of studies. <u>Short term objective</u>: Apart from the basic objective set in the 1st semester, which is to improve comprehension of scientific texts, this semester's course will implement the previously acquired skills and put them into practice in spoken and written productions. <u>Long term objective:</u> - Enhance the students' conversational skills in professional contexts Improve written skills through regular and intensive written assignments

Content	**Unit 1: Getting Started in Research as an Engineer specialized in Science:** **1-** Having a career in Science **2-** Applying for a Job / Internship / Exchange Programs a. Applications forms b. Difference between a Curriculum Vitae & A Resume c. Writing a CV or a Resume d. What is a Cover Letter? e. Preparing for an interview **Unit 2: Writing Skills (Scientific purposes):** 1- Analyzing and Synthesizing written and Visual Information 2- Reading and Interpreting charts, graphs, numbers 3- Writing Reports **Unit 3 : Public Speaking** 1- Jobs Interviews 2- Interacting in Conferences & Professional Meetings 1- Presentations: Every Student is supposed to deliver a **ten-minute presentation** related to their field of study and interact positively to the audience's feedback. **Proactivity in Public Speaking contexts.** **Application :** - The student is required to have a printed version or soft copy of the course. - The use of laptops and smartphones is authorized since classroom activities rely mainly on **e-learning**. - Extra-personal use of it is **strictly unaccepted**. - Assignments are delivered **on a weekly basis** to the instructor **by mail** and are counted as 20 % of the total students' grades. - Written tasks are done in class under the assistance of the professor to help students gain confidence in them.
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 & Oral Presentation
Reading list	-Williams, Ivor. English for Science and Engineering. Professional English Series, 2007. -Donovan Peter. Basic English for Science. English Language Oxford University Press, 2008. -Ibbotson, Mark. Professional English in Use: Engineering. Cambridge University Press, 2009.

U.2.5Languages & Management

ENTREPRENEURSHIP, PROFESSIONAL PROJECT

Module designation	**Language and Management**
Module level, if applicable	1st year of chemical engineering
Code, if applicable	U.2.5
Subtitle, if applicable	-
Courses, if applicable	- **ENTREPRENEURSHIP, PROFESSIONAL PROJECT**
Semester (s) in which the module is taught	-Semester 2 (S2)
Person responsible for the module	Dr Khalil ZAGHDOUDI
Lecturer	Miss. Hajer ZHIRI
Language	French
Relation to curriculum	Professional module (compulsory),
Type of teaching, contact hours	Lecture, 21 hours of contact hours on Campus/ 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	Project management
Module objectives/intended learning outcomes	**Objectives :** 1. Identify and formulate a clear objective, responding to a specific need 2. Establish criteria for evaluating the impact of the project, 3. Correctly identify the key players, risks and constraints related to a project. **Learning Outcomes:** At the end of the courses students are expected to be able to : 1. will have developed their ability to -Entrepreneurship and innovation -Work as a team with resource people -Take into account the cross-cutting issues of the value proposition, marketing, financing and legal dimension of an innovative project 2. Better understand the employment process 3. Set up a network approach 4. Make professional choices

Content	**Description :** 1. Students are divided into groups of 3 to 4. They are confronted with real professional and managerial project situations, and play different professional roles. 2. Students should Imagine an innovative project as a team, carry out an entrepreneurial process over 6 weeks in order to be able to write and present a business plan. 3. Treated Innovative Project are developed in Mini-Project 4. A half-day of round tables organized in partnership with the alumni to discuss with experienced professionals on their careers **Steps to Follow:** • Definitions and generalities • Project Life cycle workshop => The different phases of the project • Exposure of need • Formulation and validation of objectives • Criteria for evaluating the achievement of objectives • Identification of risks • Development of the risk management strategy • Identification of actors • Drafting of the project charter • Project breakdown • Development of the WBS matrix • Distribution of tasks and responsibilities • Development of the Gantt charter • Project execution • Monitoring: Change management • Presentation of the deliverable • Evaluation of the deliverable according to the criteria set • Project closure report and lessons learned
Study and examination requirements and forms of examination	Format: Continuous Control; Oral Presentation Project (100%)
Media employed	Practicing and Oral presentation Video projection
Reading list	A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Edition 5, Project Management Institut

U.2.6 Projects

Mini Project

Module designation	**PROJECTS**
Module level, if applicable	1st year of chemical engineering
Code, if applicable	U.2.6
Subtitle, if applicable	-
Courses, if applicable	- **Mini-Project**
Semester (s) in which the module is taught	-Semester 2 (S2)
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 hours (laboratory session),
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	-Project Management

Module objectives/intended learning outcomes	**Objectives** 1. Train and professionalize engineers capable of having a global and transdisciplinary vision of their environment. It is a question of giving them tools to make them able to value their ideas and develop them until the elaboration and the implementation. 2. Devellop the team working 3. Training in the writing of a mini-thesis and the oral presentation of a work **Learning Outcomes:** At the end of the courses students are expected to be able to : 1. Learn to develop interdisciplinary skills in the field of project management (time management, planning) and in the scientific and technical field (analysis of the state of the art, bibliography, taking initiative, design and development of an innovative product) 2. Differentiate between a research paper / a review 3. Conduct a bibliographic search 4. Perform a team work on the proposed subjects 5. Present a Poster/ PPT

Content	**Project Working Steps** **Section 1 : (6 hours of seminar)** **I- Topics Selection** Discussion around examples of current topics from different real-world problems from industry. **II- References & Reading List** Presentation of the various sources of credible information for bibliographic work: articles, thesis, **III- Study of Related References** Presentation of examples of scientific articles on different themes 1. Study of the structure of an article: research article and review article (review) 2. Analysis of the different types of information present in an article **III. Search Methodology:** Method to be followed during a bibliographic search **IV. Presentation of the rules for drafting bibliographic references** **V. Scientific Poster** Instructions for the development of a Scientific Poster from bibliographic data **VI. Scientific Presentation** Instructions for developing a scientific presentation from bibliographic data **Section 2 (3hours of round table)** **VII. Discussion** Discussion around the topics chosen by the student teams: interest, quality of information sources ... Development of the project and proposal phase to the steering committee. Critical discussion and defense of the project. Possible order of the material **Section 3 (12 hours of practical work in Laboratory)** **VIII. Practical work in laboratory**
Study and examination requirements and forms of examination	Format: Continuous Control; Oral Presentation Project (100%)
Media employed	Practicing and Oral presentation Video projection
Reading list	Books and handouts, websites, scientific papers