Undergraduate Technological Degree

CHEMISTRY

(OPTION ANALYTICAL AND SYNTHETIC CHEMISTRY - OPTION MATERIALS CHEMISTRY – OPTION INDUSTRIAL CHEMISTRY)

Association des Directeurs d'IUT

1. Objectives

Chemistry is material science, of its constituents and transformations. Chemistry is used in companies, irrespective of their size and their line of business: chemical industries, perfumery, cosmetics, paper and cardboard, medicines, agribusiness, aeronautics, the car industry, electronics, energy, water treatment, surface treatment, nuclear energy, etc. Chemistry has the wonderful capacity to transform matter so as to generate the right amount and quality of the products needed by man. This dual scientific and industrial characteristic generates diversity.

This is why a Chemistry undergraduate has additional knowledge in the fields of analysis, synthesis, materials and processes.

So a student in Semester 3 can choose between the following 3 options, in relation to his or her personal and professional project:

Analytical and synthetic Chemistry
Materials Chemistry
Industrial Chemistry

a. The functions of a Chemistry undergraduate

The course taught in the chemistry departments of the IUTs gives the future graduate every necessary skill to carry out various activities relating to:

Control and Quality Control: the graduate knows the various analytical techniques to ensure the quality of products before, during and after manufacturing.

Research or Research and Development: the undergraduate assists the researcher in identifying, designing or improving the synthesis and the product isolation mode, in the formulation, the physiochemical characterization of products, computerized literature and bibliographical research.

Development and production: the undergraduate makes the interface between the laboratory and production feasible. He or she carries out the analytical results of the production processes, monitors analytical equipment for production and optimizes analytical techniques in connection with the process. Thanks to his or her proficiency in process engineering, he or she ensures the smooth running of production units, of the production laboratory, (…) according to guidelines.

Other jobs such as sales representative, librarian or security officer are within his or her realm. In their jobs technicians have to take new needs and economic challenges into account, and especially the aspects relating to digital technology: programming analytical devices, literature and bibliographical research, reactors driven by programmable controllers, the use, logging and recovery of data.

Whatever the job taken up by the technician in the fields of quality, hygiene, security of people and goods, environment protection and sustainable development (e.g. recycling, green chemistry, vegetal-based chemistry, etc.), the compliance with standards and regulations will be his or her core concern.

b. In general a Chemistry undergraduate must be able to:

Perform as the engineer's assistant
Prepare and supply products and reagents
Carry out and optimize syntheses and formulations
Use relevant data bases
Ensure and supervise the upkeep and maintenance of equipment
Ensure that safety conditions, respect for the environment, quality and sustainable development are enforced
Carry out chemical and physiochemical analyses
Produce an oral or written report of his or her work
Use instructions written in English
Work in team
Show initiative

The activities described and their subsequent responsibilities may lead the undergraduate to take up the following jobs in a number of industrial sectors as a:

Specialist of the application of chemical products
Skilled technician in an analytical or control laboratory
Skilled technician in chemical/physiochemical analyses
Shift supervisor in the chemical industry, team leader in chemistry/pharmaceutical industry
Skilled technician in a research and development (R&D) laboratory
Production technician in the pharmaceutical industry
Skilled technician in formulation
Assistant engineer
Instructor in hygiene security and environment (hse)
Assistant technician in environment, waste and effluents
Assistant production technician of processing industries

In large companies the skilled technician works side by side with engineers in a production or pilot plant, an engineering office or in R&D; in small and medium-sized firms he or she may have to manage every activity relating to his or her specialty.

His or her technical, scientific, economic and human background enables him or her to:

Practice their skills in a wide range of economic or industrial activities,
Work with the various acting agents within the company,
Plan the implementation of an entrepreneurial project,
Participate in the competitiveness of companies in each step of a product life cycle by optimizing technical, scientific, economic and human choices, by complying with the current legislation, taking into account the needs for sustainable development, quality, security and health at work,
Be aware of the problems of economic intelligence and risk management.

ROME JOB CODES WITH A *DUT* IN CHEMISTRY (NON COMPREHENSIVE LIST)

ODE ROME	C	TYPES OF JOBS	PREFERENTIAL OPTION(S) OF THE *DUT* IN CHEMISTRY		
			ANALYTICAL AND SYNTHETIC CHEMISTRY	MATERIALS CHEMISTRY	INDUSTRIAL CHEMISTRY
1201	H	Colorist technician in the food, chemical and cosmetic industry, in fabric printing, in paints	★		★
		Laboratory technician colorist in R&D	★	★	
		Formulator colorist in the cosmetic industry	★	★	★
1206	H	Engineer's technical assistant in design, R&D in industry	★	★	★
1207	H	Technical writer	★	★	★
		Chemistry technical writer	★	★	
		Industry technician writer			★
12010	H	R&D technician in analyses and tests	★	★	★
		Chemistry technician in R&D	★	★	
		Technician in the analysis and tests of metals		★	
		Technician in the testing of materials in R&D		★	
		Technician in R&D experiments	★	★	★
		Technician in scientific instrumentation	★	★	★
		Technician in technological development		★	★
		Technician in forensic science	★	★	
		Laboratory Technician in tests, analytical development and research	★	★	★
		Technician in test measurement in R&D	★	★	★
		Development Technician	★		★
		Technician in process development			★
		Materials technician in R&D		★	
		Technician in materials science		★	
		Metal technician in R&D		★	
		Technician on large research equipment	★	★	★
1301	H	Regulatory compliance inspector	★		★
		Environmental regulation compliance inspector	★		★
			★	★	
		Inspection and compliance test technician	★		★
		Industrial safety compliance auditor			★
1404	H	Production technician			★
		Process technician	★	★	
		Manufacturing technician		★	★
1501	H	Deputy head of an industrial analytical laboratory	★	★	
		Deputy head of an industrial control laboratory		★	★
		Deputy head of an industrial analytical laboratory	★		★
		Industrial analytical laboratory assistant	★		★
		Supervisor in an industrial analytical laboratory	★		★

1503	H	Laboratory analyst in the pharmaceutical industry	★		★
		Physiochemical analyst in industry	★		★
		Physicochemical laboratory analyst	★	★	
		Chemist in an industrial analytical laboratory			
		Chemist in an industrial control laboratory	★	★	★
		Technician in charge of analytical control in the chemical industry			★
		Technician in water quality measurement	★		★
		Technician in industrial environmental chemistry	★	★	★
		Technician in an industrial control laboratory	★		★
		Technician in industrial analyses	★	★	★
		Technician in chemical analyses in industry			★
		Technician in water quality	★	★	★
		Laboratory technician in water analysis	★		
		Laboratory technician in industrial analysis	★		★
		Control laboratory technician in the food, chemical, paper-making, pharmaceutical business			★
		Control laboratory technician in iron and steel	★		★
		Control laboratory technician in energy/petrochemistry		★	
		Laboratory technician in building materials			
		Quality technician in the food industry	★		★
				★	
			★		
2301	H	Line manager in the pharmaceutical industry			★
		Supervisor in the chemical industry			★
		Manufacturing technician in the chemical and pharmaceutical industry	★		★
		Production technician in the chemical and pharmaceutical industry			★
		Technician in the cosmetic and perfume industry	★		★

2. Activities and Skills Tables

Prior to describing the academic content, the curriculum lists the various activities and skills expected from chemistry undergraduate students.

The following tables describe the activities and skills in connection with the subjects taught in the common part of the 4 semesters of the 3 options of the DUT chemistry:

Activities and skills connected to:

Controls and analyses (1) ;

Synthesis/formulation (2) ;

Communication, team work and management (3) ;
QHHSE regulations and sustainable development (4) ;
Continuous quality improvement (5) ;

They are followed by the ones relating to the 3 options, the difference being made in semesters 3 and 4 :
Analytical and synthetic chemistry (6);
Materials chemistry (7);
Industrial chemistry (8);

ACTIVITIES AND SKILLS IN CONNECTION WITH CONTROLS AND ANALYSES:

COMMON ACTIVITIES FOR THE 3 OPTIONS	SKILLS (BE ABLE TO)
PREPARING AND SUPPLYING PRODUCTS AND REAGENTS	Take samples while complying with procedures, referencing and recording them for further analysis Take samples under a suitable form for further analysis Check the quantity, conformity and availability of products and reagents Prepare calibration solutions while complying with protocols
CARRYING OUT CHEMICAL AND PHYSICO-CHEMICAL ANALYSES	Use chemical and physico-chemical analyses so as to check the conformity of raw materials and products with specifications Interpret and use the results obtained
DEALING WITH TROUBLESHOOTING IN CONTROL EQUIPMENT AND SOLVING ANOMALIES IN ANALYTICAL METHODS	Identify and diagnose anomalies and dysfunctions Implement an analytical approach of causes from the occurrence of anomalies and dysfunctions Assess the seriousness of anomalies or dysfunctions and their impact on the running of control equipment and analytical results Choose which remedial action to take
CARRYING OUT AND SUPERVISING THE UPKEEP AND MAINTENANCE OF THE LABORATORY EQUIPMENT	Check the compliance, working, and security condition of measurement instruments and laboratory equipment Carry out the calibration and control of measurement devices Carry out level one maintenance and upkeep of laboratory equipment
DEVELOPING AND VALIDATING METHODS OF PRODUCT ANALYSIS	Determine the analytical methods suitable for products Develop and validate protocols

ACTIVITIES AND SKILLS CONNECTED TO SYNTHESIS/FORMULATION

COMMON ACTIVITIES FOR THE 3 OPTIONS	SKILLS (BEING ABLE TO)

CARRY OUT SYNTHESES AND PURIFICATION IN A LABORATORY AND MANUFACTURING UNIT	Carry out synthetic tests and trials while following a set protocol and technical, regulatory, economic, and QHHSE requirements Carry out single feeding, heating, and liquid solid separation operations on industrial reactors Analyze test results (concentrations, yields, ...), identify inaccuracies, their causes and suggest suitable solutions Assemble the simulation tools of processes and laboratory equipment up to the pilot scale Draw up the balances of matter and energy Draw up process diagrams Work out pressure losses Work out matter and/or thermal transfers
CARRYING OUT AND OPTIMISING FORMULATIONS. OFFERING TAILORED SOLUTIONS (CHOICE OF MATERIALS, OPERATING MODE, SET PARAMETERS) DEPENDING ON THE TECHNICAL SPECIFICATIONS OF THE FORMULATION EXPECTED AND BY COMPLYING WITH TECHNICAL, REGULATORY, ECONOMIC AND QHHSE REQUIREMENTS	Carry out formulation tests and trials by following a precise protocol Analyze test results (concentrations, yields...), identify anomalies, their causes and put forward suitable solutions Assemble the simulation tools of processes and laboratory equipment at a pilot scale

ACTIVITIES AND SKILLS CONNECTED TO COMMUNICATION, TEAM WORK AND MANAGEMENT	
COMMON ACTIVITIES FOR THE 3 OPTIONS	SKILLS (BEING ABLE TO)
STANDARDISING WORK DOCUMENTS	Draft activity reports, balances, summaries... Use documents written in English Standardize procedures, working methods, and operating rules
COLLECTING, PROCESSING AND SHARING INFORMATION	Analyze, synthesize, and use information, technical and scientific literature connected to control, production and development activities (technical manuals and papers, patents, standards...) Collect and analyze information relating to products and technological developments Exchange suitable and necessary information with various in-house personnel (team, management, production, support departments, etc.) as well as external people (customers, suppliers, ...) Process and transcribe the information accurately so that control and development activities can be traceable Use computerized systems to collect, process and transmit information
COMMUNICATION AND TEAM WORK	Communicate with different people while taking into account their enquiries and information (in English too) Adapt to the requirements of the company and team work Adapt working methods and behavior to different working conditions (emergencies, stressful situations)

	Fit within an international team
DISSEMINATING INSTRUCTIONS	Explain instructions, procedures, rules and professional skills to the team members, check they are well-understood and well-implemented

ACTIVITIES AND SKILLS CONNECTED TO QHHSE REGULATIONS AND SUSTAINABLE DEVELOPMENT	
COMMON ACTIVITIES FOR THE 3 OPTIONS	SKILLS (BEING ABLE TO)
APPLYING AND ENFORCING QHHSE REGULATIONS	Identify the requirements of regulations and standards (ICPE, IPPC, REACH, ISO, OHSAS, BPL, BPF, RoHS...), preparing Technological Risk Prevention Plans (PPRT), Spot non-conformity in control, production and R&D activities, in compliance with security, environment protection and quality requirements and alert people Apply and enforce regulations linked to security, environment protection, quality and procedures Check that procedures are in line with control and production activities and suggesting improvements Record any deviation or non-compliance, analyze causes jointly with support departments and management, initiate and follow up on remedial actions
IDENTIFYING RISKS	Assess occupational hazards for people, facilities, and the environment Implement suitable precautionary and remedial actions
IDENTIFYING AND ANALYSING THE REQUIREMENTS OF SUSTAINABLE DEVELOPMENT	Identify and analyze requirements, risks, and non-compliance connected to sustainable development in control, production, and R&D activities Identify the environmental impacts of manufacturing processes, control, and R&D activities Manage a water treatment plant in compliance with the current regulations in each sector

ACTIVITIES AND SKILLS (5) CONNECTED TO THE CONTINUOUS IMPROVEMENT APPROACH	
COMMON ACTIVITIES FOR THE 3 OPTIONS	SKILLS (BEING ABLE TO)

TAKING PART IN IMPROVEMENT APPROACHES AT THE WORK PLACE	Initiate an analytical approach of causes from the report on anomalies, dysfunctions, or failed objectives Put forward improvements depending on priorities Initiate improvement measures by involving the team members Contribute to cross functional project teams

ACTIVITIES AND SKILLS CONNECTED TO THE OPTION « ANALYTICAL AND SYNTHETIC CHEMISTRY »

SKILLS SPECIFC TO THIS OPTION « ANALYTICAL AND SYNTHETIC CHEMISTRY »	SKILLS (BEING ABLE TO)
CARRYING OUT CHEMICAL AND PHYSICOCHEMICAL ANALYSES	Carry out analyses on trace elements Carry out analyses on liquids, solids and gases Carry out structural analyses of organic and inorganic molecules Implement spectral, chromatographic, and automatic titration methods Implementing coupled analytical methods Justify quantification methods Adapt analytical methods to products
MONITORING LABORATORY ANALYTICAL EQUIPMENT	Implement control and monitoring of laboratory analytical equipment Carry out calibration and control of measuring devices Identify and diagnose an anomaly or malfunction Assess the seriousness of the anomaly or malfunction and its impact on the equipment operation and the result accuracy Choose appropriate remedial actions for analytical equipment Carry out level one maintenance and upkeep of analytical production equipment Prepare and organize equipment availability within the framework of preventive or remedial action
CARRYING OUT AND OPTIMISING ORGANIC, ORGANOMETALLIC AND INORGANIC SYNTHESES	Suggest solutions (choice of materials, operating modes, set parameters) depending on the molecule desired and in compliance with technical, regulatory, economic and QHHSE requirements Carry out elaborate multistep synthetic tests and trials with protection/deprotection according to a set protocol
CARRYING OUT SYNTHESES AND PURIFICATIONS IN A PILOT UNIT	Carry out single rectification operations, liquid-liquid, solid-liquid extractions on industrial reactors Ensure regulation and control of a reactor or single rectification operations, solid-liquid extractions on industrial reactors

ACTIVITIES AND SKILLS CONNECTED TO THE OPTION « MATERIALS CHEMISTRY »	
SKILLS SPECIFC TO THIS OPTION « MATERIALS CHEMISTRY »	SKILLS (BEING ABLE TO)
DESIGN AND DEVELOP METALLIC, POLYMERIC AND CERAMIC MATERIALS	Identify the various steps in the development of a material (extracting, developing, manufacturing, assembling, recycling) Use specific techniques such as plastics processing, sintering, surface treatment
CHARACTERISATION OF MATERIALS	Identify the mechanical, chemical, electrical, thermal and magnetic properties of the main categories of materials Use devices for the measurement of these properties Use techniques of sample preparation (polishing) for analysis Choose the suitable analytical methods for materials Identify the (crystalline, semi-crystalline or amorphous) microstructure of a material Characterize the metallurgical state of a material: carbon rate, hardening rate, thermal treatments, etc. Use chemical and physicochemical analyses so as to check the conformity of the finished product Check the surface reactivity of materials
TAKE PART IN THE REMEDIAL ACTION FOR THE PROTECTION OF MATERIALS	Use various methods of assessment of materials durability (corrosion, wear and tear, friction) Identify the coating ability and the particular difficulties linked to a given substrate Initiate an analytical approach of the reasons why a material degrades
SUSTAINABLE DEVELOPMENT AND CONTRIBUTION TO MATERIALS RECYCLING	Integrate ecodesign in the material development Analyze the material life cycle Choose the sorting and recycling methods according to the materials Choose the right solutions to minimize the use of polluting and hazardous products in the design of materials

ACTIVITIES AND SKILLS CONNECTED TO THE OPTION « INDUSTRIAL CHEMISTRY »	
SKILLS SPECIFC TO THIS OPTION « INDUSTRIAL CHEMISTRY »	SKILLS (BEING ABLE TO)

TREAT THE ANALYTICAL RESULTS OF THE MANUFACTURING PROCESS	Use analytical techniques thanks to an automated measuring chain Interpret and exploit analytical results Identify the out-of-specification results and assess their impact on the process Take level one remedial action on the control equipment and the manufacturing process
FOLLOW-UP OF ANALYTICAL PRODUCTION EQUIPMENT	Carry out the calibration, follow-up and control of the production analytical equipment (online analytical equipment...) Identify and diagnose an anomaly, a malfunction Assess the seriousness of the anomaly or the malfunction and its impact on the control equipment operation and the process Choose the appropriate remedial action on analytical and control equipment Carry out first level upkeep and maintenance operations on the production analytical equipment
OPTIMISATION OF PRODUCTION ANALYTICAL TECHNIQUES CONNECTED TO THE PROCESS	Analyze operation of the production process and the analytical techniques linked to gauges and production data Develop and optimize production analytical techniques Suggest improvement action and technical modifications relating to analytical techniques and manufacturing processes
CARRYING OUT SYNTHESES AND PURIFICATIONS IN A MANUFACTURING UNIT	Carry out single rectification operations, liquid-liquid, solid-liquid extractions on industrial reactors Ensure the regulation and control of a reactor or single rectification operations, liquid-liquid, solid-liquid extractions on industrial reactors

3. Course Organisation

a. Course description

The Chemistry departments of IUTs provide, within the initial and continuous education scheme, theoretical and practical vocational education whose first objective is to train skilled technicians. In order to reach this goal, the course should focus on the future graduate's ability to work with minimal supervision and use analytical skills when experimenting and exploiting the results. This education should provide him or her with in-depth knowledge of the various fields of chemistry, of their key as well as technological aspects.

The Undergraduate Technology Degree (*DUT*) in Chemistry is a national vocational diploma (120 ECTS) which is part of the Bachelor's-Master's-Doctorate curriculum taught at the University. The *DUT*, which consists of units/ECTS, allows graduation, the validation of field experience and student mobility within the European Union.

The *DUT* in Chemistry currently consists of 3 options:
Analytical and synthetic chemistry
Materials chemistry
Industrial chemistry.

The graduation process can be completed through:
4 full time semesters
Apprenticeship scheme (work-based or apprenticeship learning scheme)
Special one year course scheme
Vocational credit transfer (Life long learning process) or work-based and occupational skills.

These various graduation processes cater to the demands of different population groups and have a different pedagogical structure. They each prepare the student for the same graduation process since the syllabuses are the same (with some adjustments specific to the relevant option).

The total teaching load amounts to 1,800 hours distributed over 60 weeks:
Semester 1: 15-16 weeks (465 h)
Semester 2: 17-18 weeks (522 h)
Semesters 3 and 4: 26-28 weeks (813 h)
This supervised course is supplemented by:
300 h of supervised projects distributed over 4 semesters (4 x 75 h)
A minimum 10-week placement at the end of semester 4
The supervised course consists of:
Lectures (CM) attended by the whole class

Supervised work (TD) attended by 26 students
Practical work (TP) attended by 13 students

However, Chemical engineering practical work classes will consist of 7-9 students due to safety reasons under the supervision of one teacher if they are to be conducted on industrial equipment in a unit operations learning laboratory (distillation, gas absorption, liquid-liquid extraction, chemical reactors...) These teaching modules with a limited number of students are followed by an asterisk in the tables of the following pages.

Courses are organized into semesters which are broken down into teaching units (TU). Each TU consists of 2 figures relating to the semester and the syllabus:

The first two semesters follow the same syllabus as specializations only occur in semester 3.

SEMESTER 1 AND 2 (CORE CURRICULUM)

S1 CORE CURRICULUM	
TU 11	Chemistry and technology discovery (263 h)
TU 12	General education and scientific discovery (202 h)
S2 CORE CURRICULUM	
TU21	Chemistry and technology deepening
TU22	General and scientific education deepening

FOR SEMESTERS 3 AND 4, TU 32, A FEW TEACHING MODULES IN TU 42 AND TU 43 ARE COMMON TO THE 3 OPTIONS. THEY ARE THEREFORE DESCRIBED ONLY IN THE FIRST OPTION OF THE SYLLABUS:

SEMESTERS 3 AND 4 SPECIALISATION IN ANALYTICAL AND SYNTHETIC CHEMISTRY AND CORE CURRICULUM

SEMESTER 3: SPECIALISATION IN ANALYTICAL AND SYNTHETIC CHEMISTRY (S)	
TU31S	Chemistry and Technology skills development (332 h)
TU 12	General education and scientific discovery (202 h)
SEMESTER 3 CORE CURRICULUM	
TY32	General and scientific education skills development (162h)
SEMESTER 4 :	

SPECIALISATION IN ANALYTICAL AND SYNTHETIC CHEMISTRY (S)	
TU41S	Chemistry and technology expertise (179 h)
TU42S	General and scientific education expertise (140 h) including core curriculum teaching modules
SEMESTER 4: CORE CURRICULUM	
TU43	10-week placement

SEMESTERS 3 AND 4 SPECIALISATION IN MATERIALS CHEMISTRY

SEMESTER 3: SPECIALISATION IN MATERIALS CHEMISTRY (M)	
TU31M	Chemistry and technology skills development (327h)
TU 12	General education and scientific discovery (202 h)
SEMESTER 3 CORE CURRICULUM	
TY32	General and scientific education skills development (162h)
SEMESTER 4 : SPECIALISATION IN MATERIALS CHEMISTRY (M)	
TU41M	Chemistry and technology expertise (184 h)
TU42M	General and scientific education expertise (140 h)
SEMESTER 4: CORE CURRICULUM	
TU43	10-week placement

SEMESTERS 3 AND 4 SPECIALISATION IN INDUSTRIAL CHEMISTRY

SEMESTER 3: SPECIALISATION IN INDUTRIAL CHEMISTRY (I)	
TU31I	Chemistry and technology skills development (306h)

SEMESTER 3 CORE CURRICULUM	
TY32	General and scientific education skills development (162h)
SEMESTER 4 : SPECIALISATION IN INDUSTRIAL CHEMISTRY (I)	
TU41I	Chemistry and technology expertise (173 h)
TU42M	General and scientific education expertise (172 h)
SEMESTER 4: CORE CURRICULUM	
TU43	10-week placement

Teaching units comprise different subjects and are broken down into teaching modules. All the coefficients of teaching modules correspond to the TU coefficient.

Each teaching module mentions its code, the specialization letter (which is different from the core curriculum), a 2-figure number which sets it apart from the others within the TU and the letter C that specifies whether the teaching module is additional in the student's customized course offered by the department.

Each teaching module is then described according to its codification within the EU, mentioning the semester, the total supervised course load, the objectives, the desirable skills within the grid of competencies, and the modalities towards additional certification (in computer science and the Internet, foreign languages, first-aid attendant certificate.)

a. Disciplinary fields:

For thematic reading, the pedagogical program can be divided into disciplinary fields with modules for lectures, tutorials and practical classes that are spread over 4 semesters. Overall practical classes are designed to help the student master the use of equipment and techniques relevant to his or her specialty. Ideally students should work without supervision and suggest tailored solutions. Hygiene, security and environment protection are systematically coupled with the pedagogical program. For each of these disciplinary fields, the general objectives are listed here below.

Expression and communication skills (105 h)

Teaching expression and communication skills is key in the acquisition of interpersonal skills for intermediate professions. Communication skills are a must for the graduate to find work and enjoy job progression in the best conditions. These skills are both essential and cross functional to the building of further knowledge and skills.

The objectives for undergraduates are to:

Be aware of the challenges of communication

Become argumentation expert

Communicate in a corporate environment

Foster professional integration

Use ICT

Enrich their culture and understand contemporary issues

Foreign language: English (120 h)

The course of English aims at supplying the student with professional and general communication skills which have become a must in the globalization of relations.

Learning a specialized language will enable the graduate to take part in industrial projects. He or she will be made aware of cultural differences.

The aim of the *DUT* in Chemistry is to improve the student's skills or reach the B2 level within the Common European Framework of Reference for Languages, while taking into account the mixed abilities of baccalaureate holders in year 1. The course will make good use of a variety of tools — including ICT — and authentic sources to develop the 5 core linguistic skills: written and oral expression, continuous oral comprehension and oral interaction. It is desirable to emphasize grammatical correctness and authentic pronunciation and the teaching of stress patterns etc.

Students will be taught how to seek information so that they will acquire further autonomy. To reach this goal cross-disciplinary collaboration makes it possible to implement, use and supplement techniques or methods or knowledge common to several subjects across the curriculum.

Whenever possible, students will be offered the opportunity to attend second foreign language classes to maintain their previously-acquired skills.

Analytical chemistry (180 h S option; 121 h M option; 154 h I option)

The aim of analytical chemistry is to provide the students with practical and theoretical fundamentals necessary for the understanding and learning of the main instrumental analytical methods. The fundamental knowledge and principles related to the various separative, spectometric, electrochemical techniques are taught so as to understand the analytical techniques used in industry. Practical work classes will focus on sample preparation, the statistic processing of data, result validity... After completing the course students should be able to suggest simple analytical strategies for concrete cases.

General chemistry (201 h)

The course in general chemistry aims at giving students at the beginning of year 1 the thorough knowledge necessary to understand phenomena studied in chemistry or chemical engineering. The fundamentals in atomistics and chemistry in solutions will be taught in semester 1, while thermodynamics and kinetics will be taught in semester 2. Practical classes will enable students to have a critical look at the consistency of the results obtained (accuracy, validity, statistical exploitation).

Inorganic chemistry (178 h S option; 430 h M option; 62 hours I option)

Inorganic chemistry aims at giving students in-depth knowledge of the main inorganic compounds while allowing them to take part in the development of new products or synthetic methods and be able to apprehend the foreseeable structures and properties of those products. Inorganic chemistry should focus on chemical reactivity and not on the listing of the various elements. The students are expected to gain thorough knowledge on the most important elements, their chemical combinations, their reactivity and the structure of families of elements, their possible interactions and their industrial applications. Inorganic chemistry makes use of the knowledge gained in atomistics, thermodynamics and chemistry in solutions. Practical classes will first be an opportunity to carry out simple chemical reactions and implement the laboratory basic operations. Then the emphasis will be laid on synthesis and the characterization of inorganic compounds.

Organic chemistry (326 h S option; 259 M option; 160 h I option)

This course aims at giving students in-depth knowledge in terms of general concepts and functions and reaction mechanisms of organic chemistry. The introduction to multi-step synthesis and industrial polymers as well as eco-compatible chemistry will also be provided. Practical classes should enable the students to carry out the synthesis, purification and characterization of an organic product without supervision while following a simple or elaborate protocol taken from scientific literature.

Chemical engineering (230 h S option; 104 h M option; 298 I option)

The course of Chemical engineering supplies the general knowledge necessary to understand and conduct the main processes of the chemical industry, whatever its fields of application. The fundamentals in material balance and thermal balance are essential and rely on the courses in other subjects, especially in chemistry, physics and computer science. This course is based on reaction, transformation, matter separation and purification (reactor, evaporation, extraction, absorption, distillation, crystallization, filtration...) operations. The course also mentions the fundamentals of regulation and automatism. Practical classes, carried out in a pilot plant, train students to understand the main industrial unit operations and enable them to get acquainted with the analyses related, process regulation, specific equipment as well as process mapping. Particular attention is devoted to the implementation of operations.

Industrial chemistry (221 h only for option I)

Industrial chemistry is based on the thorough knowledge of the various branches of chemistry, versatility being one of the pillars of chemistry. The two domains considered are the processing of analytical results, the implementation and optimization of production-based analytical equipment. It is in line with changing patterns in jobs

with production control laboratories and online analyses. Students taking the course have to be able to relate the results to the various analytical techniques understand a problem and act before or after the process accordingly. The course also mentions the fundamentals in regulation and automated manufacturing process. The students taking the course can work in versatile environments, in analytical production, in production, in the quality department.

Industrial chemistry is at the crossroad between analytical and process-related jobs. It meets the needs of precise industrial needs and targeted jobs, such as assistant production technician in process industries.

Mathematics (104 h)

The mathematics course aims at enriching the students' general background, training them for mathematical reasoning and teaching them a working method, enabling them to acquire the mathematical tools and techniques used in other subjects and in their jobs (applied mathematics). After an elementary mathematics module that makes it possible to harmonize the students' knowledge, the course focuses on analysis and linear algebra as well as probabilities and statistics.

For students seeking immediate employment after graduation, the mathematics course is applied to chemistry (chemometrics) and relies as far as possible on examples taken from other subjects, especially chemistry or chemical engineering. For students wishing to continue into higher education, the mathematics course can consist of advanced modules in the fields of algebra and analysis and include information on numerical methods and the use of different types of software for numerical calculations.

Physics (192 hours option S and M; 211 h option O)

The course of physics aims at introducing the fundamentals in metrology, electricity (electromagnetism, alternative current, electronics) and optics relevant to the understanding of chemical analytical equipment and instruments used in production.

The aim is to develop the students' scientific background that will make them readily adaptable for evolving techniques. Through a pedagogical approach, the core modules should equip the students with functional knowledge easily transferrable to their jobs as chemists. In the industrial chemistry option, fundamentals in electrotechnics are also taught via a practice-based pedagogy.

For students wishing to continue into higher education the course of physics can consist of advanced modules.

Computer science – Office automation and programming (48 h)

The chemistry student's course has to take into account an ever changing digital environment. They should be able to edit, process, exploit and disseminate any kind of digital document, launch a documentary research and assess the accuracy of the information collected. They should master the tools of networking, digital communication and production in a collaborative context.

In connection with the course in general education, they will learn to live in a digital environment responsibly and securely, complying with the existing regulations and controlling his or her private, institutional and professional identity.

Supplemented by their implementation in other subjects or projects, the skills gained should enable him or her to be awarded the level 1 C2i certificate during his or her syllabus. He or she will also learn the principles of programming and macro-commands and will have to be acquainted with the drivers and analytical software used in laboratories.

Quality – Hygiene – Health – Security – Environment (QHHSE) (52 h)

The course in hygiene, health, security, environment and quality teaches students the theoretical fundamentals in order to understand a global management system.

The concepts of quality assurance, « quality, environment and security » standards and hygiene and health regulation, are a must in order to understand the working environment.

The course introduces quality tools (good practice and control) and environmental protection tools (treatment of effluents and waste).

Particular attention has been paid to the identification and classification of hazardous and toxic products, as well as to the implementation of prevention, protection and first-aid to casualties.

Other parameters connected to the understanding and control of chemical and fire hazard are also introduced: flash point, explosion limit, exposure limited value...

All those concepts enable students to implement the rules and regulations in force first during practical classes and then at the working place while taking into account the risks and protective measures taken within the framework of an integrated management system.

b. Professionals Intervention, Pathways and Supplementary Modules

Professionals' interventions cover 10 to 2O% of the curriculum. They also participate to the life of the department during admission and credit and degree delivery sub-commission jury sessions, but also regarding finding and supervising placement or the implementation of projects.
Each IUT represents an asset within its economic environment. The teaching staff should be able to adapt teachings to regional industrial operations and to the local potential prospects. These local adaptations can be defined with the professionals. They can make up to 20% of the total number of hours, in compliance with the arrêté du 3 août 2005 related to the DUT and should modify neither the training's general objectives nor its quality level.

During Semesters 3 and 4, students can customize its DUT Chemistry pathway. On the one hand, through the selection of one of the offered three options. On the other hand, through the selection of supplementary modules, fully part of the curriculum and they make up 15 to 20% of the total number of hours. This program aims at students who want to integrate the world of work (IPI pathway). Supplementary modules aimed at students who want to study further will be covered in a specific document (not on the PPN).
They are designed by the IUT taking into account the recommendations given by the commission pédagogique nationale. These supplementary modules show the same characteristics as those aiming at immediate integration in the world of work.

The selected pathway is indicated in the descriptive appendix of the delivered diploma at the end of the training period.