

Undergraduate Technological Degree

COMPUTING

1. Course Objectives

Technical University Information (IUT) departments train professionals who participate in the design, production and implementation of IT solutions corresponding to users' needs.

Senior IT technicians carry out their activities in companies and organizations: computer engineering service companies, telecommunications, banks, insurance companies, retail, industries, public services and software publishers, *etc.*

They provide their specialist IT skills (Web, mobile, embedded, management, *etc.*) to companies or administrations (industrial production, finance, accounting, human resources, logistics, *etc.*).

Activities pursued by holders of IT *DUT* are extremely diverse and correspond to the software life cycle:

- Starting with the customer request, they assist applications designers in the project analysis phase.
- They design software, validate it, monitor and maintain it.
- They configure and adapt software packages.
- They write technical and software documentation.
- They develop, install, administer and maintain computer systems and networks.

At the end of the course, qualified computer specialists carry out their missions independently. In a large department or company, this may be under the management of a project leader.

2. Activities and Skills Tables

a. Positions, activities, and skills

The skills acquired during the course enable senior technicians to work as computer specialists, according to their aptitudes and personal choices, focusing on two families of activities:

- **Activity family 1:** analysis, development, diagnostics and software support – Form ROME M1805 – IT studies and development.
- **Activity family 2:** administration, management and operation of equipment, technical assistance for users, customers, services – Form ROME M1801 – IT systems administration and M1810 – Information systems' production and operation.

b. Graduates key qualities

IT DUT graduates are competent from a technological and methodological point of view, understand the socio-economic environment in which they exercise their profession, possess good general cultural knowledge, are good communicators, including in English, and are aware of the need to maintain a technological watch.

Their computing skills are based on solid theoretical teaching, practical work using the latest technologies, projects that reflect industrial situations and an internship of at least 10 weeks at the end of the course.

In addition, IT DUT graduates are equipped with reasoning and mathematical modeling skills, skills in economics and the management of companies and administrations, in expression-communication and in English.

Thus with their acquired skills in computer science, their knowledge of the operation of companies, their capacities to communicate orally and in writing in professional situations, and with a minimum level of English sufficient to work in an English-speaking environment, IT DUT graduates are well equipped to start their professional lives working as senior technicians (cf ROME Forms indicated) in one of the two major activity families described in the rest of this document.

ACTIVITY FAMILY 1: ANALYSIS, DEVELOPMENT, DIAGNOSIS, AND SOFTWARE SUPPORT

BASIC ACTIVITIES	BASIC SKILLS (BEING ABLE TO)
FA1-A ANALYSIS OF A COMPUTER SOLUTION	<ul style="list-style-type: none">Analyze customers' and users' needs and write a functional specification (specifications, deadlines, and costs, <i>etc.</i>).Analyze technical and functional problems and suggest fixes, technical updates, <i>etc.</i>Prepare and write technical specifications for computer applications.Contribute to the assessment of loading, risks and resources (time, staff, costs <i>etc.</i> budgets) and schedule the execution of an order or a computer project.Contribute to the selection of suppliers/contractors.Contribute to the negotiation of contract terms and monitor progress of the work, products, <i>etc.</i>).
FA1-B TECHNICAL DESIGN OF A COMPUTER SOLUTION	<ul style="list-style-type: none">Design and produce a mock-up for presentation.Determine the choice of software and infrastructure architecture and select the technologies required: hardware, software, configurations.Produce a technical document.Design an application linking to a database.Contribute to the selection of computer components (software packages, database, specific developments, <i>etc.</i>).
FA1-C PRODUCTION OF A COMPUTER SOLUTION	<ul style="list-style-type: none">Develop an application linking to a database.Implement the solution with the languages and technologies chosen.Integrate the computer components (software, databases, specific developments, <i>etc.</i>).Adapt and configure Integrated Management Software Packages (ERP <i>Enterprise Resource Planning</i>).Contribute to the supervision and coordination of computer systems, studies or developments (collaborators, sub-contractors).
FA1-D VALIDATION TESTS FOR A COMPUTER SOLUTION	<ul style="list-style-type: none">Design tests.Define and run technical and operational test phases and procedures for computer programs and applications.

FA1-E OPERATION AND MAINTENANCE OF A COMPUTER SOLUTION

- Provide support during validation.

FA1-F PREPARATION OF QUANTITATIVE AND QUALITATIVE DIAGNOSTICS, SOFTWARE TECHNICAL SUPPORT.

- Implement software solutions in an operating environment (servers, workstations, operating systems).
 - Produce software production documentation.
 - Participate to users' training.
 - Maintain an application.
 - Participate in technical support.
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- Introduce reporting tools.
 - Ensure good use is made of knowledge bases.
 - Help with the identification and analysis of incidents or malfunctions described by users.
 - Define procedures to introduce the support process.
 - Optimize support process.
 - Manage and facilitate a technical support group. Coordinate support projects.
 - Collect information that can be used to develop the technological environment or software features.
 - Analyze the quality of service offered to users.
 - Contribute to change management.

ACTIVITY FAMILY 2: ADMINISTRATION, MANAGEMENT AND OPERATION OF EQUIPMENT, TECHNICAL ASSISTANCE FOR USERS, CUSTOMERS, SERVICES

BASIC ACTIVITIES

BASIC SKILLS (BEING ABLE TO)

FA2-A ADMINISTRATION OF SYSTEMS, SOFTWARE AND NETWORKS.

- Administer a system (on a time-sharing or transactional basis, embedded systems, messaging, multi-processor, network, Website, DBMS (Data base management system), DMS (decision making support).
 - Carry out remote maintenance work on user equipment.
 - Introduce technical procedures for the operation, use and security of computer equipment.
 - Implement monitoring, security and operating tools for computer equipment.
 - Assign and make available software and hardware network resources (allocation, reallocation).
 - Define and monitor access rights according
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to user or service characteristics.

- Analyze and calibrate information system performance and recommend measures to improve quality and security.
- Identify and diagnose malfunctions, incidents and non-conformities and implement corrective measures.
- Advise and assist computer development and production teams or users in the choice and implementation of technical solutions.
- Contribute to the monitoring and updating of information system configuration and architecture.
- Contribute to the selection and installation of computer equipment (software, hardware, *etc.*).

FA2-B ADVICE AND TECHNICAL ASSISTANCE FOR USERS, CUSTOMERS AND SERVICES

- Schedule the progress of work and implement processing.
 - Install and integrate hardware (workstations, network equipment, peripherals, *etc.*) into the production environment and configure logical and physical resources.
 - Monitor and analyze the progress of work and the operation of systems, networks, tools and peripherals.
 - Manage security.
 - Supervise and verify the status of computer resources, backup and archive data.
 - Identify and diagnose the nature and origin of incidents and implement corrective measures.
 - Trigger or schedule maintenance and monitor the compliance of operating/production work on computer resources.
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4. General organization of the course

a. Course description

Intended public

Due to the nature of the activities that make up the information technology business, the course is mainly intended for holders of general and scientific technology baccalaureates, in particular holders of the S and STI2D baccalaureates (with a "Digital Information System" specialism).

Semesters, teaching units, modules, course paths

Course content provided by the Computing DUT is:

- Fundamental for acquiring knowledge, basic concepts and methods of working.
- Applied, to facilitate learning of these concepts and the deployment of professional know-how.
- Scalable, to integrate technological progress and the requirements of the professional world.
- Open, to develop the faculties of communication that are essential for IT specialists when exercising their profession.

Course content is arranged in disciplinary fields in the area of computing and in disciplinary fields with regard to scientific, social and human culture.

Course content is delivered in the form of main lectures (CM) with the whole year group, supervised work classes (TD – in groups of 26 students) and practical work classes (TP – in groups of 13 students).

Teaching includes 1800 supervised hours and 300 hours of project work, and is organized over four semesters composed of 10 teaching units (UE) comprising 53 modules. A minimum of a 10 week internship in a company or organization gives experience in a professional situation at the end of the course.

A coefficient is assigned to each module. In each UE, the distribution of teaching hours and the coefficients assigned to the modules avoids excessive weight being placed on one in comparison with the others.

As initial training over 4 semesters excluding block-release, the academic content is given over a minimum of 60 weeks. The organization of studies under other schemes (special year, block release, continuous training) is subject to national recommendations.

The training course path leading to a DUT comprises a major, which guarantees the DUT's core skills, and additional modules. These additional modules are designed to supplement students' course paths, whether they wish to enter employment immediately or continue with other studies in a higher education context.

Regardless of the course path followed by students, the additional modules are an integral part of the DUT. The additional modules required for immediate entry into employment are described in this document. They can be identified in the rest of this document by the reference "C" after their number.

The additional modules designed to facilitate continuing studies are offered to students who have the ability and want them, in the context of adapting their course path in the light of their personal and professional plans (PPP). Prepared by the IUT based on recommendations from the national pedagogical commission, they have the same characteristics, in terms of timetable and coefficient coming within the testing of knowledge, as the modules designed for immediate entry into employment.

Disciplinary fields

The "computing" disciplinary fields (approximately 50% of course content)

"Algorithms - Programming - Languages"

This disciplinary field covers the whole software development spectrum of activity. In addition to the presentation of basic theories of program construction (algorithms, breakdown into problems and sub-problems, validation mechanisms), the presentation of different programming paradigms (in particular procedural and object) and several programming languages are explored and used (at the teaching teams' choice) to apply the different concepts. Professional development environments are also presented and used.

"Hardware architecture - Operating systems - Networks"

This disciplinary field concerns both basic knowledge concerning hardware (data coding, computer internal operation), professional multi-tasking and multi-user operating systems (use, administration, service use via programming), as well as networks and their standards (organization, operation, elements of administration, techniques for programming shared applications).

"Web - Internet - Mobility"

This disciplinary field focuses on the set of technological solutions driven by the development of the World Wide Web. On the one hand it presents technologies used for developing complete Web services, and on the other hand, under the generic term "mobility", it covers the development of applications for platforms other than desktop computers: smartphones, tablets, and other items of equipment.

"Database management systems"

This disciplinary field delivers the basic understanding required to implement and use databases. Basic theory is provided by presenting the relational model and the associated formal languages. The standard language used for defining, manipulating and querying databases, SQL (*Structured Query Language*) constitutes the central element of the teaching, with an introduction to database access via a programming language and an approach involving the configuration and administration of a database management system.

"Analysis, design and applications development"

This disciplinary field provides knowledge with regard to models and methods used for the analysis and design of applications solutions based on software development or the implementation of integrated management packages of the *ERP Enterprise Resource Planning* type. It involves the use of tools and workshops permitting associated implementation via actual solutions. This disciplinary field also covers concepts relating to information systems and additional concepts to do with software engineering, an initiation into project management, man-machine interaction (GUI - Graphical User Interface) and the implementation of general elements of culture with regard to software production, in particular with regard to sustainable development and access (bestpractice).

The disciplinary fields covering scientific, social and human culture (approximately 50% of course content)

"Mathematics"

This disciplinary field, involving theoretical support for information and communication technologies, provides knowledge linked to the computing field: arithmetic for cryptographic theory, linear algebra for coding theory, analysis and geometry for signal and image processing, probabilities and statistics for management computing and data processing, not forgetting the graphs, languages and grammars for language theory and the study of networks. Overall, this content also helps develop an aptitude for scientific expression and communication, as well as an aptitude for formalisation and modeling.

"Economy - Management - Organization - Law"

This disciplinary field particularly covers the study of the general and industrial economy, employment and "information technology" law, the sciences of management and organization, and more generally an understanding of various information systems and their management, as well as social and human issues relating to the development of information and communication technologies.

The **"Expression - Communication"** disciplinary field, fundamental for the construction of other knowledge and skills, covers content leading to an awareness of issues to do with communication, mastery of debate, communication in a professional environment, promoting employability, exploiting information and communication technologies, enriching ones culture and understanding the modern world.

"English"

This disciplinary field covers two objectives. In the scientific field, on the one hand, to develop

an awareness of the existence of a specialist language, to deepen this knowledge, to develop a capacity to communicate with the professional world in a foreign language and develop ease of speaking and writing professional documents; on the other hand, to develop communication abilities (oral, written), to develop a critical mind and a knowledge of countries' cultural realities (intercultural communication), to refine knowledge of different methods and tools of communication in the working world (meetings, video conferencing, team working, etc.).

Titles of the teaching units (TU) per semester

SEMESTER 1

- TU 11: Basis of computing
- TU 12: Basis of scientific, social and human culture

SEMESTER 2

- TU 21: Further study of computing
- TU 22: Further study of scientific, social and human culture

SEMESTER 3

- TU 31: Advanced computing
- TU 32: Advanced scientific, social and human culture
- TU 33: Methodology and Projects

SEMESTER 4

- TU 41: Additional computing
- TU 42: Additional scientific, social and human culture
- TU 43: Experience of a professional situation

Table of disciplinary fields in each module

OUTSIDE OF PPP MODULES, SUPERVISED PROJECTS AND INTERNSHIPS, WHICH ARE IN ESSENCE CROSS-DISCIPLINARY, EACH MODULE INVOLVES SKILLS IN AT LEAST ONE OF THE SPECIALISM'S DISCIPLINARY FIELDS:

DISCIPLINARY FIELD	NO. OF THE ASSOCIATED MODULES
ALGORITHMS - PROGRAMMING - LANGUAGES	• M1102; M1103; M2103*; M3103
HARDWARE ARCHITECTURE - OPERATING SYSTEMS – NETWORKS	• M1101; M2101; M2102; M3101; M3102; M4101C; M4102C*
WEB - INTERNET - MOBILITY	• M1105*; M3104; M4103C; M4104C
DATABASE MANAGEMENT SYSTEMS	• M1104; M2106; M3106C
ANALYSIS, DESIGN AND DEVELOPMENT OF APPLICATIONS	• M2103*; M2104; M2105; M2204*; M3105; M3301*; M4102C*; M4105C
MATHEMATICS	• M1201; M1202; M2201; M2202; M3201; M3202C; M4202C
ECONOMICS - MANAGEMENT - ORGANISATION - LAW	• M1203; M1204; M2203; M2204*; M3203; M3204; M3301*; M4201C
EXPRESSION - COMMUNICATION	• M1105*; M1205; M2205; M3205; M4203

ENGLISH

• M1206; M2206; M3206; M4204

*: module covering two disciplinary fields

b. Summary table of modules and TU per semester**SEMESTER 1**

TEACHING UNIT (TU)	MODULE REFERENCE (M)	MODULE NAME	COEF. /M	COEF. /TU ECTS	CM	TD	TP	TOTAL HOURS STUDENT /TU
TU 11 : BASIS OF COMPUTING	M 1101	Introduction to computer systems	3.5	17	10	20	30	60
	M 1102	Introduction to algorithms and programming	3.5		10	20	30	60
	M 1103	Data structures and fundamental algorithms	2.5		10	15	20	45
	M 1104	Introduction to databases	3.5		10	25	25	60
	M 1105	Design of documents and digital interfaces	2.5			20	25	45
	M 1106	Supervised project – Discovery	1.5		60 HOURS OF PERSONAL WORK			
TOTAL TU 11 :					40	100	130	270
TU 12 : BASIS OF SCIENTIFIC, SOCIAL AND HUMAN CULTURE	M 1201	Discrete mathematics	2.5	13	10	18	17	45
	M 1202	Linear algebra	2		6	12	12	30
	M 1203	Economic environment	1.5		10	10	10	30
	M 1204	Functioning of organisations	2.5		10	20	15	45
	M 1205	Expression-Communication – Fundamentals of communication	2			15	15	30
	M 1206	English and Computing	1.5			15	15	30
	M 1207	PPP - Understanding the professional world	1			10	10	20
TOTAL TU 12 :					36	100	94	230
TOTAL HOURS SEMESTER 1			30	30	76	200	224	500

SEMESTER 2

TEACHING UNIT (TU)	MODULE REFERENCE (M)	MODULE NAME	COEF. /M	TOTAL COEF. /TU ECTS	CM	TD	TP	TOTAL HOURS STUDENT /TU
TU 21 : FURTHER STUDY OF COMPUTING	M 2101	Architecture and programming of the basic mechanisms of a computer system	1.5	16	8	10	12	30
	M 2102	Network architecture	1.5		8	10	12	30
	M 2103	Basis of object-oriented programming	3.5		10	20	30	60
	M 2104	Basis of object-oriented design	2.5		10	15	20	45
	M 2105	Introduction to graphical user interfaces (GUI)	2.5		10	15	20	45
	M 2106	Database programming and administration.	2.5		10	15	20	45
	M 2107	Supervised project – Project description and planning	2		80 HOURS OF PERSONAL WORK			
TOTAL TU 21 :					56	85	114	255
TU 22 : FURTHER STUDY OF SCIENTIFIC, SOCIAL AND HUMAN CULTURE	M 2201	Graphs and languages	2.5	14	11	16	18	45
	M 2202	Analysis and digital methods	2		8	12	10	30
	M 2203	Accounting, financial, legal and social environment	3.0		12	18	15	45
	M 2204	Computer project management	1.5		8	12	10	30
	M 2205	Expression-Communication – Communication, information and debate	1.5			15	15	30
	M 2206	Communicating in English	2.5			23	22	45
	M 2207	PPP – Identifying ones skills	1			10	10	20
TOTAL TU 22 :					39	106	100	245
TOTAL HOURS SEMESTER 2			30	30	95	191	214	500

SEMESTER 3 :

TEACHING UNIT (TU)	MODULE REFERENCE (M)	MODULE NAME	COEF. /M	TOTAL COEF. /TU ECTS	CM	TD	TP	TOTAL HOURS STUDENT /TU
TU 31 : ADVANCED COMPUTING	M 3101	Principles of operating systems	2.5	12	15	14	16	45
	M 3102	Network services	1.5		8	10	12	30
	M 3103	Advanced algorithms	1.5		8	10	12	30
	M 3104	Server side web programming	2.5		15	14	16	45
	M 3105	Advanced object design and programming	2.5		15	14	16	45
	M 3106C	Advanced databases	1.5		8	10	12	30
TOTAL TU 31 :					69	72	84	225
TU 32 : ADVANCED SCIENTIFIC, SOCIAL AND HUMAN CULTURE	M 3201	Probabilities and statistics	2.5	12	15	16	14	45
	M 3202C	Mathematical modelling	1.5			16	14	30
	M 3203	Law to do with information and communication technologies (ICT)	1.5		10	10	10	30
	M 3204	Management of information systems	2.5		15	15	15	45
	M 3205	Expression-Communication – Professional communication	1.5			15	15	30
	M 3206	Collaborating in English	2.5			23	22	45
TOTAL TU 32 :					40	95	90	225
TU 33 : METHODOLOGY AND PROJECTS	M 3301	Methodology for the production of applications	3.0	6	14	22	24	60
	M 3302	Supervised project – Experience of a professional situation	2.0		100 hours of personal work			
	M 3303	PPP – Clarifying ones project	1.0			10	10	20
TOTAL TU 33 :					14	32	34	80
TOTAL HOURS SEMESTER 3			30	30	123	199	208	500

SEMESTER 4:

TEACHING UNIT (TU)	MODULE REFERENCE (M)	MODULE NAME	COEF. /M	TOTAL COEF. /TU ECTS	CM	TD	TP	TOTAL HOURS STUDENT /TU
TU 31 : ADDITIONAL COMPUTING	M 4101C	System and network administration	1.5	10	8	10	12	30
	M 4102C	Distributed programming	1.5		8	10	12	30
	M 4103C	Web Programming – Rich client	1.5		8	10	12	30
	M 4104C	Design and development of mobile applications	1.5		8	10	12	30
	M 4105C	Additional computing with a view to immediate employment	1.5		8	10	12	30
	M 4106	Supervised project – Additional elements	2.5		60 HOURS OF PERSONAL WORK			
TOTAL TU 41 :					69	72	84	225
TU 32 : ADDITIONAL SCIENTIFIC, SOCIAL AND HUMAN CULTURE	M 4201C	Enterprise creation workshops	2	12	8	12	10	30
	M 4202C	Operational and decision support research	2		8	12	10	30
	M 4203	Expression-communication – Communicating in organisations	2			15	15	30
	M 4204	Working in English	2			15	15	30
TOTAL TU 42 :					16	54	50	120
TU 43 : EXPERIENCE OF A PROFESSIONAL SITUATION	M 4301	Professional internship	12	12				
TOTAL HOURS SEMESTER 4			30	30	56	104	110	270
TOTAL HOURS SEMESTER 1 + 2 + 3 + 4			120	120	350	694	756	1800

As far as "Alternative Learning" is concerned, article 15 of the order specifies "that in the region of 10% of the supervised learning timetable must be devoted to it and that it must be part of each of the lessons and be the subject of specific modules."

In accordance with the order of 03 August 2005 relating to the DUT, 150 hours of TD and 150 hours of TP are devoted to the teaching of language, expression and communication (EC):

	S1	S2	S3	S4
ENGLISH	30	45	45	30
EC	60 (*)	30	30	30

(*): in the first semester, 30 hours of the "Expression – Communication" disciplinary field are equally divided between module M1207 ("PPP – Understanding the professional world") and module M1105 ("Design of

documents and digital interfaces").

c. Internship and Supervised projects

Internship

The internship is an important part of a student's training. This first contact with the profession's reality enables students to carry out a synthesis of the knowledge acquired at the IUT, to gain awareness of the socio-professional environment and to clarify their personal aptitudes.

The subject of the internship must be identified by the company and validated by the department after consultation. During the course of the internship, the department monitors the internship requiring an exchange of information between the company and the department. This monitoring must be carried out, as far as possible, by visits by teaching staff to the place of the internship.

At the end of their internship, students must defend an internship report in front of a panel comprising the internship director in the company, their tutor and another permanent member of the department's teaching staff. This report and its defence are formal in nature and are subject to qualitative and quantitative evaluation.

The internship is assessed jointly by the company/organisation (company/organisation tutor) and the department (teaching tutor and panel) regarding the following elements:

- The work done in the company/organisation, in the light of agreed objectives.
- The written report, in the required form, highlighting the skills implemented during the internship.
- An oral defence before a mixed panel (company/organisation, department). For these three elements, assessment of students must cover:
- Their capacity to use their academic experience in carrying out their missions.
- Knowledge acquired from their immersion into a professional environment: technical skills and relational skills with reference to the information technology DUT's reference document of activities and skills.

Supporting reference documents:

- Departmental internship charter
- Internship agreement
- Documents of the quality-strategy type
- Internship manager's job description
- Teaching tutor's job description
- Internship assessment grid
- Standard written and oral restitution frames for the mission
- Company/organisation satisfaction survey
- Course year satisfaction survey

Documents produced:

- Student's internship report
- Panel's defence report
- Company/organisation assessment form

Supervised projects

The Supervised project activity covering 300h of work for students over the whole of the course, constitutes an approach to the practice of the business of a senior technician in a company or organisation and as a consequence its objective is to develop future technicians' professional aptitudes, as follows:

- The practical implementation of knowledge and know-how (documentary research, provision of solutions, the production of all or part of a product or service, etc.).
- Cross-disciplinary experience.

- Training and the practical implementation of project management methodology: preparation of a specification, group working, time and deadline management, written and oral communication.
- The development of students' inter-personal skills: independence, the development of qualities specific to team working (initiative, communications skills).

It is desirable to put forward projects of an interdisciplinary nature integrating several subjects from the programme, and that students should write a project summary or a selection of key words in English and in French.

The activity is spread over all the semesters, thus facilitating the gradual aggregation of knowledge and progress in learning up to the production of a real application at the end of the course requiring the implementation of project management methods.

- In semester 1, the 60h Supervised project covers training in written and oral communication and the implementation of documentary techniques.
- In semester 2, involving 80 hours, the Supervised project activity covers the implementation of project methodology.
- In semester 3, the Supervised project taking 100h covers the production of an actual application: preparation of a specification, task distribution, planning, implementation. The project can be finished at the end of the semester or continued in semester 4.
- In semester 4, involving a duration of 60h, the Supervised project, in a more individual context, can be used to finish the project from semester 3 or prepare the professional situation phase.

d. Personal and Professional project

The Personal and Professional Project (PPP) is a substantive work which must allow students to gain a clear idea of the business activities included in the "Information Technology" specialism and what they need in terms of personal abilities.

It must help students match their immediate and future professional wishes, their personal aspirations and their capabilities in order to design a course path that is consistent with their chosen business activity or activities and become actors in its orientation. Use of the current national pedagogical programme (analysis and associated research) is recommended.

The objectives are:

- To help students define or clarify a project in terms of professional activity.
- To lead them to confront this project with the realities of the world of work.
- To lead them to develop a critical attitude with regard to information received.
- To encourage them to adopt an active approach with regard to their orientation, in order to facilitate their choices for the years to come.

To be effective, this teaching content is given by a multi-disciplinary teaching team.

e. Pedagogical orientations, pedagogy via technology

The purpose of the course documentation presented in this document is to cover, via a dual contribution from theoretical knowledge and know-how, two families of activities and their associated skills: "analysis, development, diagnosis and software support", "Administration, management and operation of computer equipment, technical assistance for users, customers and services".

In order to acquire initial skills in both these families, it is fundamental to ensure students have permanent contact with the most recent working methods and hardware and software technologies because they are the most used in the industrial world. In order for the approach via technology to be fully effective, the national pedagogical commission therefore recommends:

- The development of well formalised project approaches, in particular in the context of Supervised projects, within the meaning of the standard definitions (eg: iso 10006 – a project is a unique

process that consists of a set of coordinated and controlled activities comprising start and end dates, undertaken with the goal of reaching an objective that complies with specific requirements such as deadline, cost and resource constraints).

- The provision of equipment to enable the effective use of a great number of hardware and software tools (programming languages and environments, operating systems and networks, database systems, specialist software, specialist terminals, *etc.*) And configurations permitting access to software that is the most representative of the industrial world. However, the difficulty of forecasting with regard to information technology and differing local contexts argue in favour of teaching teams being allowed a certain degree of latitude.
- A search for the involvement of professionals from the sector in teaching. For the academic part, their participation must cover 15% of the teaching, in particular in the technical and professional disciplines.

f. Recognition of the current economic situation

Recognising the current economic situation covers six main dimensions:

- Entrepreneurship and the development of innovation.
- Recognition of standards.
- The influence of sustainable development.
- The project approach and project management.
- Taking health and safety into account.
- Economic intelligence.

Entrepreneurship and the development of innovation:

With timetabling in the region of 250 hours (excluding the Supervised project, excluding the personal and professional project), the disciplinary fields involving the economy, law and the management and organisation of companies and administrations, have a significant place in a Computing DUT diploma holder's course. This mechanism naturally leads students to increase their level of understanding of current issues in the economy. In particular, entrepreneurship is the subject of a specific additional module in the 4th semester.

Recognition of standards:

Issues to do with standardization mechanisms in the disciplinary fields relating to information technology are dealt with through description and practice, within modules and international standards in the field: languages, methods of analysis and design, databases, systems, networks, *etc.*). In particular, concepts to do with computer security will be highlighted, within the meaning of the French National Agency for the Security of Information Systems.

The influence of sustainable development:

The development of the use of digital solutions in society as well as in organisations now poses the question of reconciling technological innovations and the consumption of natural resources which are being depleted. Even if digital solutions have led to the availability of information in real time and the limitation of paper consumption and a reduction in travel, they have also had a considerable effect on the environment whether this relates to the manufacture of equipment, its use or its recycling. These effects are all the more significant since computer equipment has a short lifespan, its obsolescence being controlled by software that is ever more demanding in terms of power and memory capacity. Thus, at a time when sustainable development is an issue for society, it becomes important to recognise, in the activities of applications design and maintenance, methods and techniques designed to reduce their ecological footprint (all the modules in the "Information Technology" and "Economy - Management - Organisation - Law" disciplinary fields are affected by this dimension.

The project approach and project management:

Professionals working in the field of information technology, both on the applications development and the hardware or software architecture installation side, must rely on methods and tools that can be used to control and participate effectively in the implementation of projects. A computer project, within the meaning of the ISO and Afnor standards, is undertaken with the goal of achieving an objective that complies with specific requirements (such as deadline, cost and resource constraints); it implements human and material resources that are part of a budget and produces deliverables. This area is at the heart of the course reference documents and is central to the Supervised projects. Located at the intersection of the

disciplinary fields involving information technology and "Economy – Management – Organisation – Law", it is dealt with in particular in a dedicated module in the 2nd semester and completed in the 3rd semester.

Taking health and safety into account:

Information technology is a central tool for organisations. In this respect it affects working conditions. This is why the use of this technology in a professional context has been subject to legislation and regulation for several years in respect of its effect on health at work, as well as on employees' physical safety. The impacts referred to are essentially dealt with in the modules in the "Economy – Management – Organisation – Law", "Web – Internet – Mobility" and "Analysis, design and development of applications" disciplinary fields.

Economic intelligence:

The development of economic intelligence activities (strategic watch, competition watch) exploits, without necessarily violating the law, an information system's vulnerabilities and may jeopardise the competitiveness of any economic actor. As a result of their globalised deployment, their growing interconnectivity and intensive mobile use, information systems are constantly threatened by new technological risks, including intrusion, the theft or destruction of data, the theft of resources or identity and infringement of image and privacy. In this context, the goal of Information System Security is to protect organisations' information assets. It requires many skills, for the most part covered by the DUT programme, under operational aspects (information technology disciplinary fields), organisational measures ("Economy – Management – Organisation – Law " disciplinary field) and actions to raise awareness ("Expression - Communication" disciplinary field).

5. Description of the training modules

a. Semester 1

TU 11	BASIS OF COMPUTING	SEMESTER 1
HARDWARE ARCHITECTURE - OPERATING SYSTEMS - NETWORKS		
<i>M 1101</i>	<i>INTRODUCTION TO COMPUTER SYSTEMS</i>	<i>HOURS 10H CM 20H TD 30H TP</i>
MODULE OBJECTIVES	To know how to use computer systems and understand their operation.	
SKILLS	The skills listed in the activities and skills reference document for the following activities: <ul style="list-style-type: none">• FA2-A: Administration of systems, software and networks.• FA2-B: Advice and technical assistance for users, clients and services.• FA1-B: Technical design of a computer solution.	
PREREQUISITES		
CONTENT	<ul style="list-style-type: none">• Information coding: numbers and characters. Arithmetic and associated processing.• General architecture of a computer system.• Types and characteristics of operating systems.• Use of network client applications: email, file transfer, virtual terminal, shared directories.• Command language: basic commands, introduction to script programming.• Process (creation, destruction, monitoring, etc.), file (types, permissions, etc.) and user (characteristics, creation, deletion, etc.) management.• Principles of the installation and configuration of a system.	
TEACHING METHODS	Network client applications can be simple clients (command line, etc.) or more sophisticated (graphical interfaces, etc.). Possible use of virtualized operating systems. Interactions with mathematics teaching (M1201).	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none">• Detailed study of a personal computer (components, assembly, installation).	
KEYWORDS	Architecture; Operating system; Microprocessor; Command language; Coding.	

BASIS OF COMPUTING		
TU 11	ALGORITHMS - PROGRAMMING - LANGUAGES	SEMESTER 1
<i>M 1102</i>	<i>INTRODUCTION TO ALGORITHMS AND PROGRAMMING</i>	<i>HOURS 10H CM 20H TD 30H TP</i>
MODULE OBJECTIVES	To know how to break a problem down into simpler sub-problems and define simple types to structure a problem's data, paying attention to programming quality criteria.	
SKILLS	<p>The skills listed in the activities and skills reference document for the following activities:</p> <ul style="list-style-type: none"> • FA1-B: Technical design of a computer solution. • FA1-C: Production of a computer solution. • FA1-D: Validation tests for a computer solution. 	
PREREQUISITES		
CONTENT	<ul style="list-style-type: none"> • Concept of sub-programmes: first notions of quality (naming of variables, assertions, documentation, etc.), pre- and post-conditions. • Concept of types and data, definitions of simple types, direct access sequential structures. • Fundamental algorithm structures: choice, repetitions. • Implementation of algorithms in a programming language. • Introduction to black box unit testing. • First approach to the management of error scenarios. • Introduction to debugging. 	
TEACHING METHODS	<p>Freedom of choice concerning the algorithm language, the implementation language, the programming paradigm and the programming tools.</p> <p>When the language permits it, use existing functions, procedures or methods.</p> <p>Interactions with mathematics teaching (M1201).</p>	
POSSIBLE EXTENSIONS		
KEYWORDS	Algorithm; Programme; Type; Breakdown of problems; Quality	

BASIS OF COMPUTING		
TU 11	ALGORITHMS - PROGRAMMING - LANGUAGES	SEMESTER 1
<i>M 1103</i>	<i>DATA STRUCTURE AND FUNDAMENTAL ALGORITHMS</i>	<i>HOURS 10H CM 15H TD 20H TP</i>
MODULE OBJECTIVES	<ul style="list-style-type: none"> To know how to move from the design of an algorithm to its implementation in a programming language, being aware of strategies for reuse and quality. 	
SKILLS	<p>The skills listed in the activities and skills reference document for the following activities:</p> <ul style="list-style-type: none"> FA1-B: Technical design of a computer solution. FA1-C: Production of a computer solution. FA1-D: Validation tests for a computer solution. 	
PREREQUISITES	M1102	
CONTENT	<ul style="list-style-type: none"> Fundamental algorithms with simple structures: finding an element, browsing, sorting, etc. Concept of sequential access and direct access. Having an initial concept of the performance of the algorithms used. Writing and reading to/from files. Abstract types of simple data: understanding and use in simple problems. 	
TEACHING METHODS	<p>Presenting several solutions (algorithms, abstract types) to solve the same problem.</p> <p>Implementing concepts of unit testing, problem breakdown, error and quality management.</p> <p>Learning to reuse existing functions, procedures or methods from the language.</p> <p>Raising awareness of issues to do with the performance of an algorithm in simple cases, without addressing the notions of complexity precisely.</p>	
POSSIBLE EXTENSIONS		
KEYWORDS	Data structures; Abstract types; Sequential access; Direct access; Performance of algorithms	

BASIS OF COMPUTING**TU 11****SEMESTER 1**

DATABASE MANAGEMENT SYSTEMS

<i>M 1104</i>	<i>INTRODUCTION TO DATABASES</i>	<i>HOURS</i> <i>10H CM</i> <i>25H TD</i> <i>25H TP</i>
MODULE OBJECTIVES	To acquire the knowledge required to manipulate a database.	
SKILLS	The skills listed in the activities and skills reference document for the following activities: <ul style="list-style-type: none">• FA1-B: Technical design of a computer solution.• FA1-C: Production of a computer solution.• FA1-D: Validation tests for a computer solution.	
PREREQUISITES	Partially M1201	
CONTENT	<ul style="list-style-type: none">• The relational model (concepts, integrity constraints, functional dependencies).• Relational algebra.• SQL (Structured Query Language): data manipulation language, data definition language.• Approach to the design of data bases: conceptual data model and translation into the relational model.• Elements concerning query testing.	
TEACHING METHODS	Relying on a database management system (DBMS) and its tools (loading, data dictionary, <i>etc.</i>).	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none">• Relational calculation.	
KEYWORDS	Relational model; SQL; Conceptual model	

BASIS OF COMPUTING		
TU 11	WEB - INTERNET - MOBILITY EXPRESSION - COMMUNICATION	SEMESTER 1
<i>M 1105</i>	<i>DESIGN OF DOCUMENTS AND DIGITAL INTERFACES</i>	<i>HOURS 20H TD 25H TP</i>
MODULE OBJECTIVES	To know how to structure and present digital content.	
SKILLS	<p>The skills listed in the activities and skills reference document for the following activities:</p> <ul style="list-style-type: none"> • FA1-C: Production of a computer solution. and • Design, drafting and production of content for digital media. 	
PREREQUISITES	Partially M1101	
CONTENT	<ul style="list-style-type: none"> • Content-structure-presentation separation. • Web (World Wide Web) technologies for the description of documents and interfaces: HTML (HyperText Markup Language), CSS (Cascading Style Sheets), graphics standards. • Awareness of ergonomics. • Office automation tools for the production of digital documents. • Website compliance with W3C / WAI (World Wide Web Consortium / Web Accessibility Initiative) accessibility standards. 	
TEACHING METHODS	<p>Joint team of teachers in communication and computing. Compliance with norms and standards. Option of using a content manager. Use of compliance measuring tools for Web accessibility.</p>	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none"> • C2I (Computing and Internet Certificate). • Adaptation to devices and browsers. 	
KEYWORDS	HTML; CSS ; Web; Digital documents; Office automation	

BASIS OF COMPUTING		
TU 11		SEMESTER 1
SUPERVISED PROJECTS		
<i>M 1106</i>	<i>SUPERVISED PROJECT - DISCOVERY</i>	<i>HOURS 60H OF PERSONAL WORK</i>
MODULE OBJECTIVES	Development of relational skills and working independence.	
SKILLS	<ul style="list-style-type: none"> • Ability to synthesize written information and its oral presentation. • Mastery of documentary research. • Abilities to synthesize the technical skills acquired. 	
PREREQUISITES	M1105, M1205, M1207	
CONTENT	<p>The skills covered by this first Supervised project module can be obtained by a wide range of themes:</p> <ul style="list-style-type: none"> • Documentary studies and analysis. • Organisation of events by a group of students. • Production of user documentation for an application. • Production of a simple website. 	
TEACHING METHODS	<p>Creation of teams of from 2 to 6 students to lead a general interest project.</p> <p>Project to be conducted in close relationship with expression-communication teaching, of which it constitutes a practical implementation.</p> <p>May constitute an extension of the PPP.</p>	
POSSIBLE EXTENSIONS		
KEYWORDS	Communication; Documentation; ICT (information and communication technologies); Autonomy; Initiative.	

BASIS OF SCIENTIFIC, SOCIAL AND HUMAN CULTURE		
TU 12	MATHEMATICS	SEMESTER 1
<i>M 1201</i>	<i>DISCRETE MATHEMATICS</i>	<i>HOURS</i> <i>10H CM</i> <i>18H TD</i> <i>17H TP</i>
MODULE OBJECTIVES	To introduce mathematical concepts and tools for computer science.	
SKILLS	Formalize, model, implement patterns of reasoning.	
PREREQUISITES		
CONTENT	<ul style="list-style-type: none"> • Vocabulary of set theory. • Relationships, applications. • Logic, Boolean algebra. • Arithmetic and notation. • Reasoning by recurrence. 	
TEACHING METHODS	Illustration with programming, systems, networks, architecture and databases.	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none"> • Concepts concerning Diophantine equations. • Elements of cryptography. 	
KEYWORDS	Applications; Boolean; Congruence; Logic; Notation; Relationships	

BASIS OF SCIENTIFIC, SOCIAL AND HUMAN CULTURE		
TU 12	MATHEMATICS	SEMESTER 1
<i>M 1202</i>	<i>LINEAR ALGEBRA</i>	<i>HOURS</i> <i>6H CM</i> <i>12H TD</i> <i>12H TP</i>
MODULE OBJECTIVES	To understand the concepts of linearity, dimension and structure.	
SKILLS	<ul style="list-style-type: none"> Mastering matrix calculations, using pivot methods, knowing how to work in vector spaces. 	
PREREQUISITES		
CONTENT	<ul style="list-style-type: none"> Matrix calculation. Solving linear equation systems. Finite dimensional vector spaces and linear applications. 	
TEACHING METHODS	Use of dedicated software recommended. Evocation of application contexts (search engines, extraction of information from large databases, etc.).	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none"> Geometric transformations. Examples of reduction of matrices. Cost and robustness of pivot methods. 	
KEYWORDS	Linearity; Gaussian pivot; Matrix.	

TU 12	BASIS OF SCIENTIFIC, SOCIAL AND HUMAN CULTURE ECONOMICS - MANAGEMENT - ORGANISATION - LAW	SEMESTER 1
<i>M 1203</i>	<i>ECONOMIC ENVIRONMENT</i>	HOURS 10H CM 10H TD 10H TP
MODULE OBJECTIVES	To understand the environment and economic stakes of organisations.	
SKILLS	<ul style="list-style-type: none"> • A global vision of contemporary economic problems. 	
PREREQUISITES		
CONTENT	<ul style="list-style-type: none"> • Basic concepts and tools of economic analysis: analysis of the economic cycle. • Contemporary economic issues: consumption, investment, finance, employment, redistribution, globalisation, etc. 	
TEACHING METHODS	Emphasizing the use of recent economic literature and various multimedia resources.	
POSSIBLE EXTENSIONS		
KEYWORDS	Market; Growth; Employment.	

TU 12	BASIS OF SCIENTIFIC, SOCIAL AND HUMAN CULTURE ECONOMICS - MANAGEMENT - ORGANISATION - LAW	SEMESTER 1
<i>M 1204</i>	<i>FUNCTIONING OF ORGANISATIONS</i>	HOURS 10H CM 20H TD 15H TP
MODULE OBJECTIVES	<p>To understand the operation of organizations (particularly of companies) through their environment, their structures and functions.</p> <p>To understand the development and implementation of a business strategy.</p>	
SKILLS	<ul style="list-style-type: none"> • Location of an activity in an organisation. • Justifying an organisation's strategy. • Taking an organisation's structural and strategic characteristics into account when developing computer solutions. 	
PREREQUISITES		
CONTENT	<ul style="list-style-type: none"> • Definition of the organisation, its role and its place in the environment, structures, culture and power. • A company's major functions. • Diagnosis and strategic choices. 	
TEACHING METHODS	<p>Understanding concepts through studying organisations in the computing and information technologies and communication markets.</p>	
POSSIBLE EXTENSIONS		
KEYWORDS	<p>Organizational structures; Corporate strategy; Computermarket.</p>	

TU 12

**BASIS OF SCIENTIFIC, SOCIAL
AND HUMAN CULTURE**

SEMESTER 1

EXPRESSION - COMMUNICATION

<i>M 1205</i>	<i>FUNDAMENTALS OF COMMUNICATION</i>	<i>HOURS</i> <i>15H TD</i> <i>15H TP</i>
MODULE OBJECTIVES	To promote awareness of the main issues to do with communication.	
SKILLS	<ul style="list-style-type: none">• Foundations of verbal and non-verbal communication.• Correction of the French language both oral and written.• Methods of academic work.	
PREREQUISITES		
CONTENT	<ul style="list-style-type: none">• Foundations (linguistic, psychological, sociological and anthropological), codes and practices of communication.• Improvement of the level of French: spelling, conjugation, syntax, vocabulary, punctuation.• Documentary research, use-reuse of information, note taking, quoting of sources.	
TEACHING METHODS	Summary, report, press review, mental map. Oral presentation, public speaking, role play. French language exercises.	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none">• Awareness of the cultural environment.• Forms of artistic practice (literature, theatre, cinema, music, video, visits to museums, plastic arts, workshops, improvisation, etc.).	
KEYWORDS	Verbal and non-verbal communication; Methodology of intellectual work; Correction of language.	

TU 12

**BASIS OF SCIENTIFIC, SOCIAL
AND HUMAN CULTURE**

SEMESTER 1

ENGLISH

<i>M 1206</i>	<i>ENGLISH AND COMPUTING</i>	<i>HOURS</i> <i>15H TD</i> <i>15H TP</i>
MODULE OBJECTIVES	Discovery of the IT world, general and scientific culture.	
SKILLS	<ul style="list-style-type: none">• Describing computer hardware, its operation and its applications.• Expressing oneself on information technology in general.• Using appropriate terminology and grammatical structures.• Further study of general and scientific culture.• Understanding a document of topical and general interest.	
PREREQUISITES		
CONTENT	<ul style="list-style-type: none">• Acquisition of technical and scientific language through:• The use of technical tutorials.• Reading scientific or general articles.• Work on various multimedia media.	
TEACHING METHODS	Use of information and communication technologies for education and language laboratories.	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none">• "Blogs", "wikis", computer programmes, collaborative computerized tools, cross-collaboration.	
KEYWORDS	Information technology; Technical English; General culture; Scientific culture.	

TU 12

**BASIS OF SCIENTIFIC, SOCIAL
AND HUMAN CULTURE**

SEMESTER 1

**PPP
EXPRESSION - COMMUNICATION**

M 1207

UNDERSTANDING THE PROFESSIONAL WORLD

*HOURS
10H TD
10H TP*

**MODULE
OBJECTIVES**

To help students define or clarify a project in terms of professional activity.

SKILLS

- The ability to document one's work.
- Understanding domain organisation in computing.
- Acquiring independence.

PREREQUISITES

CONTENT

- Discovering jobs and course programmes.
- Discovering companies.
- Shaping a professional network.

**TEACHING
METHODS**

Exploiting this PPN.
Creating forms, websites, presentations, conferences/discussions.
Meeting computing professionals.
Using skills you are in the process of acquiring in the "Fundamentals of communication" module.
Using skills you are in the process of acquiring in the "Design of documents and digital interfaces" module.

**POSSIBLE
EXTENSIONS**

- Visits to businesses.
- Immersion day for observation.
- Participation in forums.

KEYWORDS

Jobs; Sectors of Activity

b. Semester 2

FURTHER COMPUTING		
TU 21	HARDWARE ARCHITECTURE - OPERATING SYSTEMS - NETWORKS	SEMESTER 2
<i>M 2101</i>	<i>ARCHITECTURE AND PROGRAMMING OF THE BASIC MECHANISMS OF A COMPUTER SYSTEM</i>	<i>HOURS 10H TD 10H TP</i>
MODULE OBJECTIVES	To know how to develop simple applications implementing the low level mechanisms of an information system.	
SKILLS	<p>The skills listed in the activities and skills reference document for the following activities:</p> <ul style="list-style-type: none"> • FA2-A: Administration of systems, software and networks. • FA2-B: Advice and technical assistance for users, clients and services. • FA1-B: Technical design of a computer solution. 	
PREREQUISITES	M1101, M1102	
CONTENT	<ul style="list-style-type: none"> • Low level programming languages. • Low-level mechanisms of a computer system. • Study of a microprocessor or microcontroller-based system (real or simulated) with its components (memories, interfaces, peripherals, etc.). 	
TEACHING METHODS	<p>Use of C language and/or an assembly language (assembler). Observation of the step-by-step execution of a programme using a simulation/debugging tool on a single processor. The development of simple programmes to illustrate the main low-level mechanisms of an information system. A study of interrupt management mechanisms.</p>	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none"> • Programming of embedded systems. • Compilation process. • Study of the operation of a minimum embedded operating system (OS: Operating System). 	
KEYWORDS	Processor; Memory; Pointers; Interrupts	

FURTHER COMPUTING		
TU 21	HARDWARE ARCHITECTURE - OPERATING SYSTEMS - NETWORKS	SEMESTER 2
<i>M 2102</i>	<i>NETWORK ARCHITECTURE</i>	<i>HOURS 8H CM 10H TD 12H TP</i>
MODULE OBJECTIVES	To understand the organisation and operation of a computer network.	
SKILLS	<p>The skills listed in the activities and skills reference document for the following activities:</p> <ul style="list-style-type: none"> • FA2-A: Administration of systems, software and networks. • FA2-B: Advice and technical assistance for users, clients and services. • FA1-F: Preparation of quantitative and qualitative diagnostics, software technical support. 	
PREREQUISITES	M1101	
CONTENT	<ul style="list-style-type: none"> • Study of network architectures, including OSI (Open Systems Interconnection) models and the TCP/IP (Transmission Control Protocol / Internet Protocol) stack. • Technology of local networks: Ethernet, WiFi (Wireless Fidelity), etc. • Routing, switching, addressing, transport. • Introduction to the installation and configuration of a network. 	
TEACHING METHODS	<p>Room with machines and reconfigurable network equipment or simulated networks.</p> <p>Illustration of the principles discussed with regard to basic services: Web, DNS (Domain Name System), FTP (File Transfer Protocol), SSH (Secure Shell), etc.</p>	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none"> • Wide area networks (WAN: Wide area network), access networks (ADSL: Asymmetric Digital Subscriber Line, fibre optic). • Sensor networks. • Applications, VoIP, (Voice over IP), online games. 	
KEYWORDS	Local networks; Network layers; Protocols.	

FURTHER COMPUTING

TU 21

ALGORITHMS - PROGRAMMING - LANGUAGES ANALYSIS, DESIGN AND DEVELOPMENT OF APPLICATIONS

SEMESTER 2

M 2103

BASIS OF OBJECT-ORIENTED PROGRAMMING

HOURS
10H CM
20H TD
30H TP

MODULE OBJECTIVES

To develop a programme in an object-oriented programming language from a detailed design.

SKILLS

The skills listed in the activities and skills reference document for the following activities:

- FA1-B: Technical design of a computer solution.
- FA1-C: Production of a computer solution.
- FA1-D: Validation tests for a computer solution.

PREREQUISITES

M1103

CONTENT

- Fundamental object-oriented programming concepts (encapsulation, composition, polymorphism, inheritance, life cycle of objects).
- Reading a detailed object-oriented design, for example a class diagram in UML (Unified Modelling Language).
- Implementation of unit tests.
- Use of software components, programming interfaces (API: Application Programming Interface) and libraries.
- Awareness of programming, version management and code documentation good practice.

TEACHING METHODS

Collaboration with the M2104 "Basis of object design" module.
Learning an object-oriented programming language.
Use of an object modelling language (for example: UML).
Use of an integrated development environment (IDE), a debugger and a unit testing environment.

POSSIBLE EXTENSIONS

- Persistence of objects.

KEYWORDS

Object; Programming; Unit testing; Software library

FURTHER COMPUTING		
TU 21	ANALYSIS, DESIGN AND DEVELOPMENT OF APPLICATIONS	SEMESTER 2
<i>M 2104</i>	BASIS OF OBJECT-ORIENTED DESIGN	<i>HOURS 10H CM 15H TD 20H TP</i>
MODULE OBJECTIVES	To understand and model a detailed design, produce the associated unit tests and implement it with an object language.	
SKILLS	<p>The skills listed in the activities and skills reference document for the following activities:</p> <ul style="list-style-type: none"> • FA1-A: Analysis of a computer solution. • FA1-B: Technical design of a computer solution. • FA1-C: Production of a computer solution. • FA1-D: Validation tests for a computer solution. 	
PREREQUISITES	M1103	
CONTENT	<ul style="list-style-type: none"> • Object modelling for analysis and detailed design for example in UML (Unified Modelling Language): class diagram, sequence diagram. • Production of unit tests, non-regression issues. • Version management during development. • Code documentation. • Awareness of good design and development practice. 	
TEACHING METHODS	<p>Collaboration with the M2103 "Basis of object programming" module. Learning an object modelling language (UML for example). Use of an object-oriented programming language and an integrated development environment (IDE) comprising modelling, a version manager and a unit testing environment.</p>	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none"> • Awareness of modelling for analysis. • OCL/UML (Object Constraint Language). 	
KEYWORDS	Objects; Object oriented design; Unit testing; Versionmanagement	

FURTHER COMPUTING		
TU 21	ANALYSIS, DESIGN AND DEVELOPMENT OF APPLICATIONS	SEMESTER 2
<i>M 2105</i>	<i>INTRODUCTION TO GRAPHICAL USER INTERFACES</i>	<i>HOURS 10H CM 15H TD 20H TP</i>
MODULE OBJECTIVES	To specify, design and develop interfaces/interaction with users.	
SKILLS	<p>The skills listed in the activities and skills reference document for the following activities:</p> <ul style="list-style-type: none"> • FA1-A: Analysis of a computer solution. • FA1-B: Technical design of a computer solution. • FA1-C: Production of a computer solution. 	
PREREQUISITES	M2103	
CONTENT	<ul style="list-style-type: none"> • Event-driven programming. • User interface specifications, mock-ups. • Concepts of the ergonomics of user interfaces. • Interface programming, use of graphical components. 	
TEACHING METHODS	Collaboration with the M2104 "Basis of object design" module. Awareness of the concepts of digital accessibility. Use of a design framework for programming.	
POSSIBLE EXTENSIONS		
KEYWORDS	Interfaces; Event-driven programming; User; Interactions	

FURTHER COMPUTING**TU 21****SEMESTER 2**

DATABASE MANAGEMENT SYSTEMS*M 2106**DATABASE PROGRAMMING AND ADMINISTRATION.**HOURS*
10H CM
15H TD
*20H TP***MODULE OBJECTIVES**

To master complex queries in SQL (Structured Query Language) and to know how to programme the DBMS side (stored procedures).
To become familiar with administration and data security.

SKILLS

The skills listed in the activities and skills reference document for the following activities:

- FA1-B: Technical design of a computer solution.
- FA1-C: Production of a computer solution.
- FA2-A: Administration of systems, software and networks.

PREREQUISITES

M1103, M1104

CONTENT

- SQL and procedural extension.
- Cursors.
- DBMS administration: users, roles, permissions, views.
- SQL integrated into a programming language.

TEACHING METHODS

Using an SQL procedural extension (PL/SQL, etc.).
Making the link with programming: loops, conditions.
Emphasizing the link with modelling: states, transitions, activities, etc.

POSSIBLE EXTENSIONS

- Dynamic constraints.

KEYWORDS

Data administration; Cursors; Stored procedures

FURTHER COMPUTING

TU 21

SEMESTER 2

SUPERVISED PROJECTS

<i>M 2107</i>	<i>SUPERVISED PROJECT - PROJECT DESCRIPTION AND PLANNING</i>	<i>HOURS 80H OF PERSONAL WORK</i>
MODULE OBJECTIVES	To implement project management methods.	
SKILLS	<ul style="list-style-type: none">• Practical implementation of project management methodology.• Development of the student's skills of independence and initiative.• Development of team-working skills.	
PREREQUISITES		
CONTENT	<p>The project must be on a realistic scale in order to implement all the management activities, tasks and constraints of an industrial project or service, namely:</p> <ul style="list-style-type: none">• Drafting of a specification.• Creation of a team.• Distribution and planning of tasks.• Time and deadline management.• Use of project management software and sequencing tools.• Search for constraints.• Documentation, dissertation and oral presentation. <p><i>Content specific to the specialty:</i></p> <ul style="list-style-type: none">• Use of version monitoring tools.• Computer applications (Website, mobile application, office application).	
TEACHING METHODS	<p>Progressive use of the skills acquired in module M2203 "Computer project management".</p> <p>By team, project of from 4 to 8 students for task distribution.</p> <p>Comparison of the different approaches to project management described, in particular a comparison of project management tools.</p> <p>Recommendation: support from a professional participant to complement the pedagogical approach with the reality of technical and economic business requirements.</p> <p>Optional production phase at this stage, depending on the size of the project.</p>	
POSSIBLE EXTENSIONS		
KEYWORDS	Project ownership, Project management, Needs, Specifications, Pert, Gantt, Team	

TU 22

**FURTHER STUDY OF SCIENTIFIC,
SOCIAL AND HUMAN CULTURE**

SEMESTER 2

MATHEMATICS

M 2201

GRAPHS AND LANGUAGES

*HOURS
11H CM
16H TD
18H TP*

**MODULE
OBJECTIVES**

To discuss the concepts and central tools underlying the mathematics of computing.

SKILLS

- Modelling using graphs and automatic devices.

PREREQUISITES

M1201, M1202

CONTENT

- Directed and non-directed graphs, concepts and tools.
- Typical problems (pathways, assignment, flow, etc.) and examples of resolution algorithms.
- Languages, regular expressions, finite-state automata, typical operations on languages.

**TEACHING
METHODS**

Illustration via databases, management and programming languages.
Search by regular expression.

**POSSIBLE
EXTENSIONS**

- Complexity of algorithms.
- Colouring of graphs.
- Planarity.

KEYWORDS

Tree; Automaton; Connectivity; Path

TU 22

**FURTHER STUDY OF SCIENTIFIC,
SOCIAL AND HUMAN CULTURE**

SEMESTER 2

MATHEMATICS

M 2202

ANALYSIS AND DIGITAL METHODS

*HOURS
8H CM
12H TD
10H TP*

**MODULE
OBJECTIVES**

To understand the fundamental concepts of approximation and convergence.

SKILLS

- Increasing, reducing and managing approximations.

PREREQUISITES

M1201

CONTENT

- Numerical series and functions.
- Limits and convergence.
- Local behaviour (differentiability, approximations).

**TEACHING
METHODS**

Use of calculation software desirable.

**POSSIBLE
EXTENSIONS**

- Interpolation and algorithms of approximation (dichotomy, fixed point, Newton).
- Landau notation.
- Numerical series.
- Introduction to the functions of several variables.

KEYWORDS

Approximation; Convergence; Functions; Series; Variations

TU 22	FURTHER STUDY OF SCIENTIFIC, SOCIAL AND HUMAN CULTURE ECONOMICS - MANAGEMENT - LAW - ORGANISATION	SEMESTER 2
<i>M 2203</i>	<i>ACCOUNTING, FINANCIAL, LEGAL AND SOCIAL ENVIRONMENT</i>	HOURS 12H CM 18H TD 15H TP
MODULE OBJECTIVES	<p>To understand an accounting information system, to read and interpret a balance sheet and a profit and loss account, to understand a company's financial situation.</p> <p>To understand fundamental legal rules and mechanisms, to understand computer specialists' rights and obligations when exercising their profession.</p>	
SKILLS	<ul style="list-style-type: none"> • Developing business dashboards. • Improving the performance of the information system in a company via integrated management software (ERP / Enterprise Resource Planning). • Learning how to select suppliers or clients during commercial negotiations. • Producing a financial and strategic diagnosis for a company and suggesting corrective actions. • Mastering levers capable of improving company competitiveness and performance. • Contributing to the negotiation of contract terms and monitoring progress of the work, products and other elements. 	
PREREQUISITES	M1203, M1204	
CONTENT	<ul style="list-style-type: none"> • Basic accounting information system. • Basis of financial analysis. • Approach to the calculation of costs. • General approach to law: introduction to the study of law, legal organisation, general concepts of contract law. • Concepts of employment law and specific features of a computer specialist's contract of employment. 	
TEACHING METHODS	<p>Accounting, finance: promoting the use of spreadsheets, an ERP, and/or a business simulation.</p> <p>Legal and social: relying on jurisprudence and the analysis of specific cases.</p>	
POSSIBLE EXTENSIONS		
KEYWORDS	Balance sheet; Profit and loss account; Cash flow; Profitability; Accountability; Contract; Evidence; Legal Personality	

FURTHER STUDY OF SCIENTIFIC, SOCIAL AND HUMAN CULTURE		
TU 22	ECONOMICS - MANAGEMENT - ORGANISATION - LAW ANALYSIS, DESIGN AND DEVELOPMENT OF APPLICATIONS	SEMESTER 2
<i>M 2204</i>	<i>COMPUTER PROJECT MANAGEMENT</i>	HOURS 8H CM 12H TD 10H TP
MODULE OBJECTIVES	To permit students to work in an efficient manner in the context of IT projects. To train students in the profession of a project leader.	
SKILLS	<ul style="list-style-type: none"> • Understanding the operation, management and evolution of IT services. • Acquiring the basic skills to be an IT project leader: to be capable of organising and planning successful computer projects as well as monitoring all the resources and constraints involved, in accordance with consistency of costs, deadlines and quality. 	
PREREQUISITES	M1106, M1205, M1207	
CONTENT	<ul style="list-style-type: none"> • The project approach. • The actors involved in project management: the project owner (the sponsor), the project manager, the sub-contractors, the steering committee. • The project team: distribution of roles. • The specification: analysis and understanding of the client's needs. • Task definition, planning and sequencing, allocation of resources. • Scheduling tools: Pert graph, Gantt diagram. • Documentation. 	
TEACHING METHODS	Use of project management software. Development of a project approach.	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none"> • Experience of a professional situation module in S3 and S4. 	
KEYWORDS	Project ownership, Project management, Needs, Specifications, Pert, Gantt, Team	

TU 22

**FURTHER STUDY OF SCIENTIFIC,
SOCIAL AND HUMAN CULTURE**

SEMESTER 2

EXPRESSION - COMMUNICATION

M 2205

COMMUNICATION, INFORMATION AND DEBATE

HOURS

15H TD

15H TP

**MODULE
OBJECTIVES**

To analyse and structure a discourse or an image.
To understand the main issues and strategies of debate for effective communication.

SKILLS

- Adapting one's discourse to different communication situations and an interlocutor's needs.
- Analysing and producing an explanatory line of argument that is structured and deals with the issues involved, including in situations of collaborative working.
- Understanding and designing visual communication media.

PREREQUISITES

M1105, M1205

CONTENT

- Debating, ethics and manipulation.
- Synthesis, explanation, reformulation.
- Foundations of the semiology of the image (still or moving images).

**TEACHING
METHODS**

Study of articles or books relating to cultures and civilisations.
Study of still or moving images, Websites or "blogs", advertising, graphics standards, etc.
Preparation of professional documents: letters, executive summaries, reports, technical documentation.
Debate, discussion, presentations, press reviews.

**POSSIBLE
EXTENSIONS**

- Image production (posters, etc.), artistic expression.
- Introduction of observations, experiences, questionnaires.

KEYWORDS

Debate; Synthesis; Image

TU 22

**FURTHER STUDY OF SCIENTIFIC,
SOCIAL AND HUMAN CULTURE**

SEMESTER 2

ENGLISH

<i>M 2206</i>	<i>COMMUNICATING IN ENGLISH</i>	<i>HOURS</i> <i>23H TD</i> <i>22H TP</i>
MODULE OBJECTIVES	Professional and intercultural communication – The world of computing.	
SKILLS	<ul style="list-style-type: none">• Knowing how to participate in a group discussion.• Knowing how to write letters, emails and memos, and how to communicate by telephone.• Mastering appropriate terminology and grammatical structures.	
PREREQUISITES		
CONTENT	<ul style="list-style-type: none">• Meeting templates.• Telephone conversations.• Simulations of professional situations.• Working using a variety of multimedia media.	
TEACHING METHODS	Using information and communication technologies for education and language laboratories. Working in small numbers in a laboratory.	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none">• Participation in forums, business research, travel and exchanges, cross-collaborations.	
KEYWORDS	Information technology; Professional communication; Enterprises	

**FURTHER STUDY OF SCIENTIFIC,
SOCIAL AND HUMAN CULTURE**

TU 22

SEMESTER 2

PPP

<i>M 2207</i>	<i>PPP – IDENTIFYING ONE'S SKILLS</i>	<i>HOURS</i> <i>10H TD</i> <i>10H TP</i>
MODULE OBJECTIVES	To identify one's skills.	
SKILLS	<ul style="list-style-type: none">• Developing a critical attitude.• Ability to analyse.	
PREREQUISITES	M1207	
CONTENT	<ul style="list-style-type: none">• Knowing oneself better (knowledge, social skills, know-how).• Presentation.• Analysing one's motivation and professional criteria (mobility, independence, remuneration, etc.).	
TEACHING METHODS	Skills evaluation. Skills portfolio, e-portfolio.	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none">• Video presentation.	
KEYWORDS	Skills evaluation; Motivation	

c. Semester 3

ADVANCED COMPUTING		
TU 31	HARDWARE ARCHITECTURE - OPERATING SYSTEMS - NETWORKS	SEMESTER 3
<i>M 3101</i>	<i>PRINCIPLES OF OPERATING SYSTEMS</i>	<i>HOURS 15H CM 14H TD 16H TP</i>
MODULE OBJECTIVES	To understand the architecture of an operating system, especially multi-tasking.	
SKILLS	<p>The skills listed in the activities and skills reference document for the following activities:</p> <ul style="list-style-type: none"> • FA2-A: Administration of systems, software and networks. • FA2-B: Advice and technical assistance for users, clients and services. • FA1-C: Production of a computer solution. 	
PREREQUISITES	M2101	
CONTENT	<ul style="list-style-type: none"> • Resource sharing (for example, scheduling). • File management system. • Memory hierarchy (including paging mechanisms, virtual and cache memory). • Task implementation: processes and threads. • Input-output systems. • Introduction to network programming (implementation of the sockets library). 	
TEACHING METHODS		
POSSIBLE EXTENSIONS	<ul style="list-style-type: none"> • Possible extensions: • Programming of advanced scripts. • Performance measurements. • Resolving deadlock problems. 	
KEYWORDS	Virtual memory;Inputs/Outputs	

ADVANCED COMPUTING		
TU 31	HARDWARE ARCHITECTURE - OPERATING SYSTEMS - NETWORKS	SEMESTER 3
<i>M 3102</i>	<i>NETWORK SERVICES</i>	<i>HOURS 8H CM 10H TD 12H TP</i>
MODULE OBJECTIVES	Interconnecting networks and implementing services.	
SKILLS	<p>The skills listed in the activities and skills reference document for the following activities:</p> <ul style="list-style-type: none"> • FA2-A: Administration of systems, software and networks. • FA2-B: Advice and technical assistance for users, clients and services. • FA1-F: Preparation of quantitative and qualitative diagnostics, software technical support. 	
PREREQUISITES	M2102	
CONTENT	<ul style="list-style-type: none"> • Interconnection of networks, filtering and address translation: Network Address Translation (NAT), network bridge, gateway, etc.). • Awareness of network security: firewalls, DMZ (demilitarised zone), etc. • Installation and basic configuration of standard network services. 	
TEACHING METHODS	Room with machines and reconfigurable network equipment or simulated networks.	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none"> • Quality of service, real-time protocols. • Performance measurements. • Wireless networks. • Authentication management in the network services covered. 	
KEYWORDS	Local networks; Network services; Networkadministration	

ADVANCED COMPUTING		
TU 31	HARDWARE ARCHITECTURE - OPERATING SYSTEMS - NETWORKS	SEMESTER 3
<i>M 3103</i>	<i>ADVANCED ALGORITHMS</i>	<i>HOURS 8H CM 10H TD 12H TP</i>
MODULE OBJECTIVES	To know how to use certain advanced data structures, how to implement some, and to know how to implement the algorithms that manipulate them.	
SKILLS	<p>The skills listed in the activities and skills reference document for the following activities:</p> <ul style="list-style-type: none"> • FA1-B: Technical design of a computer solution. • FA1-C: Production of a computer solution. • FA1-D: Validation tests for a computer solution. 	
PREREQUISITES	M1103, M2201	
CONTENT	<ul style="list-style-type: none"> • Recursive data structures (description, implementation, etc.). • Recursive and iterative algorithms acting on these structures. • Use of advanced data structures. 	
TEACHING METHODS	<p>Trees: in particular structures used to represent data, including XML (Extensible Markup Language), syntax trees.</p> <p>Examples of advanced data structures: dictionaries (including hash tables), index structures, sets, etc.</p> <p>Emphasising the use of existing structures and features.</p>	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none"> • Study of the complexity of the algorithms and structures manipulated. 	
KEYWORDS	Tree structures; Recursion; Associative structures	

ADVANCED COMPUTING

TU 31

SEMESTER 3

WEB - INTERNET - MOBILITY

<i>M 3104</i>	<i>SERVER SIDE WEB PROGRAMMING</i>	<i>HOURS</i> <i>15H CM</i> <i>14H TD</i> <i>16H TP</i>
MODULE OBJECTIVES	To know how to develop a server side Web application.	
SKILLS	The skills listed in the activities and skills reference document for the following activities: <ul style="list-style-type: none">• FA1-B: Technical design of a computer solution.• FA1-C: Production of a computer solution.• FA1-F: Preparation of quantitative and qualitative diagnostics, software technical support.	
PREREQUISITES	M1105, M2102, M2103, M2104, M2106	
CONTENT	<ul style="list-style-type: none">• Interaction with the client, including URLs (Uniform Resource Locator), queries, forms, transmission of parameters, data, etc.• Web Applications, for example: containers, sessions, applications.• Structure of the application (modularity) and organisation of access to data: databases, directories, Web services, etc.• Identification/authentication.• Awareness of the design and production of Web APIs.• Awareness of security (injection, filtering).	
TEACHING METHODS	Using architectural models for the Web, for example MVC (Model-View-Controller). Using templates/design patterns, in particular to access data.	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none">• Awareness of the use of a design framework.• Comparison of Web architectures.• Cloud computing and associated architectures.• Introduction to programming on the client.	
KEYWORDS	Web Programming; Client/Web server Interaction; Access to data.	

ADVANCED COMPUTING		
TU 31	ANALYSIS, DESIGN AND DEVELOPMENT OF APPLICATIONS	SEMESTER 3
<i>M 3105</i>	<i>ADVANCED OBJECT DESIGN AND PROGRAMMING</i>	<i>HOURS 15H CM 14H TD 16H TP</i>
MODULE OBJECTIVES	To produce a detailed design by applying design patterns, to implement it using object-oriented programming good practices.	
SKILLS	<p>The skills listed in the activities and skills reference document for the following activities:</p> <ul style="list-style-type: none"> • FA1-A: Analysis of a computer solution. • FA1-B: Technical design of a computer solution. • FA1-C: Production of a computer solution. 	
PREREQUISITES	M2103, M2104	
CONTENT	<ul style="list-style-type: none"> • Further object modelling for analysis, design and programming. • Understanding and implementation of design patterns, elements of software architecture. • Advanced concepts of object-oriented programming (for example: single responsibility, open-closed principle, notions of dependency and coupling). • Awareness of integration tests. 	
TEACHING METHODS	Use of an integrated development environment (IDE) comprising modelling, a version manager and a unit testing environment. Concepts must be addressed through specific examples.	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none"> • Retro-design. 	
KEYWORDS	Object; Modelling; Design patterns; Goodpractice	

ADVANCED COMPUTING

TU 31

SEMESTER 3

DATABASE MANAGEMENT SYSTEMS

<i>M 3106C</i>	<i>ADVANCED DATABASES</i>	<i>HOURS</i> <i>8H CM</i> <i>10H TD</i> <i>12H TP</i>
MODULE OBJECTIVES	Understanding advanced concepts concerning the quality of schemes and system aspects.	
SKILLS	The skills listed in the activities and skills reference document for the following activities: <ul style="list-style-type: none">• FA1-C: Production of a computer solution.• FA2-A: Administration of systems, software and networks.• FA1-D: Validation tests for a computer solution.	
PREREQUISITES	M2106	
CONTENT	<ul style="list-style-type: none">• Quality of schemes, problem of redundancy, normal forms.• Integrity constraints and management rules, triggers.• Presentation of the functional architecture of a database management system (DBMS).• Transactions, atomicity and concurrent access management.• Optimisation: index, queries and execution plan.• Links with the programming languages.	
TEACHING METHODS	Concepts must be addressed from a practical angle, in particular those related to transactions and to optimisation. Making the link with algorithms concerning trees and hash tables (M3103 "Advanced Algorithms").	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none">• Study of complexity.	
KEYWORDS	Standardisation; Transactions; Query optimisation	

TU 32

**ADVANCED SCIENTIFIC, SOCIAL AND
HUMAN CULTURE**

SEMESTER 3

MATHEMATICS

M 3201

PROBABILITIES AND STATISTICS

*HOURS
15H CM
16H TD
14H TP*

**MODULE
OBJECTIVES**

To model, analyse and process information.

SKILLS

- Understanding the concept of risk and uncertainty, being able to read data involving figures from a critical standpoint.

PREREQUISITES

M2202

CONTENT

- Discrete laws (concept of series).
- Continuous laws (elements of integral calculus).
- Law of large numbers and the central limit theorem.
- Inferential statistics: point estimation and estimation by confidence intervals, regression, tests and p-values.

**TEACHING
METHODS**

Creation and use of simulations.
Use of statistics software.

**POSSIBLE
EXTENSIONS**

- Introduction to Markov chains, Monte Carlo methods.
- Principal component analysis.
- Multiple linear regression.
- Introduction to time series.

KEYWORDS

Estimation; Quality control; Simulations; Statistical tests, Random variables

TU 32

**ADVANCED SCIENTIFIC, SOCIAL AND
HUMAN CULTURE**

SEMESTER 3

MATHEMATICS

M 3202C

MATHEMATICAL MODELLING

HOURS

16H TD

14H TP

**MODULE
OBJECTIVES**

To implement the knowledge gained in mathematics by reflecting on a problem as a group.

SKILLS

- Group working and report back in the form of a concise written report and a presentation.
- Debates and critiques concerning the subject and/or the results obtained.
- Reasoning.
- Analysis of documents and report back (oral and written).

PREREQUISITES

CONTENT

- Collectively formulating a problem and modelling it.
- Finding the mathematical tools necessary, possibly locating them in an historical perspective.
- Formulating a complete or partial solution, possibly implementing it.

**TEACHING
METHODS**

Reinvestment of concepts and known mathematical methods.
Use of suitable software.
Team working with different subjects.
Use of subjects available in open project and solution catalogues and workshops.

**POSSIBLE
EXTENSIONS**

KEYWORDS

Discovery; Unformulated problems; Questioning

TU 32	ADVANCED SCIENTIFIC, SOCIAL AND HUMAN CULTURE	SEMESTER 3
	ECONOMICS - MANAGEMENT - ORGANISATION - LAW	
<i>M 3203</i>	<i>LAW TO DO WITH INFORMATION AND COMMUNICATION TECHNOLOGIES</i>	<i>HOURS 10H CM 10H TD 10H TP</i>
MODULE OBJECTIVES	To understand the legal issues relating to the development of information and communication technologies (ICT).	
SKILLS	<ul style="list-style-type: none"> • Using databases of information and communication technologies law. • Contributing to the negotiation of contract terms and monitoring progress of the work, products, etc. 	
PREREQUISITES	M1105, M2205	
CONTENT	<ul style="list-style-type: none"> • Protection of personal data. • Security of systems and data. • Protection of intellectual creation. • Internet law. 	
TEACHING METHODS	Relying on jurisprudence and the analysis of specific cases.	
POSSIBLE EXTENSIONS		
KEYWORDS	Personal data; Counterfeiting; Copyright; Industrial property	

TU 32	ADVANCED SCIENTIFIC, SOCIAL AND HUMAN CULTURE ECONOMICS - MANAGEMENT - ORGANISATION - LAW	SEMESTER 3
<i>M 3204</i>	<i>MANAGEMENT OF INFORMATION SYSTEMS</i>	HOURS 15H CM 15H TD 15H TP
MODULE OBJECTIVES	To raise awareness of the analysis of the processes involved in the organisation and integration of computer systems. To understand the organisation of resources required to manage a company's computer services effectively.	
SKILLS	<ul style="list-style-type: none"> Identifying and analysing the different processes in an organization. Identifying the activities, jobs and constraints linked to the management of an information system (IS). 	
PREREQUISITES	M2203, M2204	
CONTENT	<ul style="list-style-type: none"> Mapping an organisation's processes. Approach to ISs according to the technological, human, organisational and financial dimensions. Integration of ISs: business process, integrated management software / Enterprise Resource Planning (ERP), supply chain management, etc. Organization of the IT function. Change management and IT project management. Control of IT management: budgeting of costs, profitability of investment projects. 	
TEACHING METHODS	Promoting the use of spreadsheets and integrated management software through case studies.	
POSSIBLE EXTENSIONS		
KEYWORDS	Information; Business processes; Integrated management software (ERP); IS actors.	

TU 32

**ADVANCED SCIENTIFIC, SOCIAL AND
HUMAN CULTURE**

SEMESTER 3

EXPRESSION - COMMUNICATION

<i>M 3205</i>	<i>PROFESSIONAL COMMUNICATION</i>	<i>HOURS</i> <i>15H TD</i> <i>15H TP</i>
MODULE OBJECTIVES	To master the issues and procedures of communication in a professional environment.	
SKILLS	<ul style="list-style-type: none">• Communicating in groups and team working.• Organising and facilitating a meeting.• Knowing how to welcome, listen and popularise.• Understanding the recruitment process.• Preparing and defending an internship or supervised project report.	
PREREQUISITES	M2205	
CONTENT	<ul style="list-style-type: none">• Group dynamics (including leadership, authority) and methods of team working.• Preparation of an application folder (letter, email and CV, electronic CV).• Training for recruitment interviews (telephone or face to face) and selection tests.	
TEACHING METHODS	Interview, psychometric testing. Supporting letter and email, CV. Role-plays, improvisations, debates.	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none">• Interview techniques: identification and clarification of a client's needs.• Training in defending a report.	
KEYWORDS	Recruitment; Internship or project report; Groupdynamics .	

TU 32

**ADVANCED SCIENTIFIC, SOCIAL AND
HUMAN CULTURE**

SEMESTER 3

ENGLISH

<i>M 3206</i>	<i>COLLABORATING IN ENGLISH</i>	<i>HOURS</i> <i>23H TD</i> <i>22H TP</i>
MODULE OBJECTIVES	Preparation for professional life, written and oral in English.	
SKILLS	<ul style="list-style-type: none">• Understanding an offer of employment.• Preparing a CV/supporting letter.• Preparing for a job interview.• Knowing how to produce a technical document.• Knowing how to present products linked to technology.	
PREREQUISITES	M2206	
CONTENT	<ul style="list-style-type: none">• Further mastery of appropriate terminology and grammatical structures.• Analyses of job offers.• Analyses of CVs and letters.• Simulation of interviews.• Presentation of a company, its services, its products.• Presentation of products linked to technology, technical brochures, screen messages.	
TEACHING METHODS	Using information and communication technologies for education and language laboratories. Working using a variety of multimedia media.	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none">• Video CVs, cross-collaborations.	
KEYWORDS	CV; Cover letter; Job interview	

METHODOLOGY AND PROJECTS

TU 33

ANALYSIS, DESIGN AND DEVELOPMENT OF APPLICATIONS ECONOMICS - MANAGEMENT - ORGANISATION - LAW

SEMESTER 3

M 3301

*METHODOLOGY FOR THE PRODUCTION OF
APPLICATIONS*

HOURS
14H CM
22H TD
24H TP

MODULE OBJECTIVES

To analyze the requirements for the design and development of information systems in an organization.
To organize and manage a project - To cover the life cycle, integrating different points of view: the organization and its strategy, users, management, quality and technology, maintenance and operation.

SKILLS

- FA1-A: Analysis of a computer solution.
- FA1-B: Technical design of a computer solution.
- FA1-C: Production of a computer solution.

PREREQUISITES

M2103, M2104, M2106, M1204, M2204
Partially: M3105, M3204

CONTENT

- The information system in organizations.
- Prior studies and analysis of requirements: compendium of business needs, domain, actors.
- Analysis and modeling of business processes, for example: activity diagram, Organizational Process Model / MERISE, BPMN (Business Process Model and Notation).
- Production of technical specifications, use cases, scenarios.
- Standards and metrics for software and quality.
- Additional issues to do with project organization and management, production processes, documentation.
- Estimation of charges and cost models, planning of deadlines.
- Risk management.

TEACHING METHODS

Cross-departmental teaching team - computing and management.
Relying on a life-cycle model.
Organizing the module around a project that covers the life-cycle.
Using team-working tools.

POSSIBLE EXTENSIONS

- Additional ergonomics.
- User training.
- Problems to do with the acquisition of software packages.

KEYWORDS

Analysis; Project management; Quality; Methods; Standards.

METHODOLOGY AND PROJECTS

TU 33

SEMESTER 3

SUPERVISED PROJECTS

<i>M 3302</i>	<i>SUPERVISED PROJECT - EXPERIENCE OF A PROFESSIONAL SITUATION</i>	<i>HOURS 100H OF PERSONAL WORK</i>
MODULE OBJECTIVES	<p>(General) To put students in a senior technician's position, preparing them for their internship.</p> <p>(Operational) In a team, to lead a major professional project implementing the cross-sector application of technical, technological and general knowledge in the specialist area.</p> <p>(Operational) To develop students' relationship skills.</p>	
SKILLS	<ul style="list-style-type: none">• The practical implementation of project management methodology on a subject of importance.• Awareness with regard to company constraints.• Capacity to analyze and synthesize a major subject in the specialist area.• Ability to compare various technical, technological and economic solutions.• Trans-disciplinary experience: practical implementation of knowledge and know-how.• Development of relationship skills: independence, initiative, ability to work in a team.• Ability to report technical information accurately and in summary form: written reports and oral communication, chairing meetings.	
PREREQUISITES		
CONTENT	<p>The project must be on a realistic scale with regard to its feasibility but sufficient to implement the project management and production methodology described in the project management module and experienced in the Supervised project module in semester 2:</p> <ul style="list-style-type: none">• Preparation of a precise specification.• Comparative analysis of various technical and technological solutions.• Use of project management tools experienced in Supervised project 2 for planning and task distribution.• Economic analysis of the various solutions.• Production of the technical solution chosen.• Preparation of stage reports and the summary report.• Oral presentation of the project.	
TEACHING METHODS	<p>By project teams of 4 to 8 students for task distribution.</p> <p>Recommendation: support from a professional participant to complement the pedagogical approach with the reality of technical and economic business requirements.</p> <p>As far as possible, the project will be conducted in partnership with a professional body which may be its sponsor.</p>	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none">• Internship in a company or organization, further studies project.	
KEYWORDS	Specification, Project management, Pert, Gantt, Teamworking	

METHODOLOGY AND PROJECTS

TU 33

SEMESTER 3

PPP

<i>M 3302</i>	<i>PPP – CLARIFYING ONE'S PROJECT</i>	<i>HOURS</i> <i>10H TD</i> <i>10H TP</i>
MODULE OBJECTIVES	<p>To clarify one's professional and personal project. To test one's project against the realities of work. To prepare for employment or continuing studies. To create a training path consistent with one's project.</p>	
SKILLS	<ul style="list-style-type: none">• Adopting an active approach in the light of its orientation.• Writing a supporting letter and a CV.• Being able to stand out and debate.• Being successful at a recruitment interview.	
PREREQUISITES	M2203, M2207, M3206	
CONTENT	<ul style="list-style-type: none">• Understanding the training.• Affirming one's choices and arguing them.• Preparing the search for an internship.• Activating one's professional network.	
TEACHING METHODS	<p>Continuing studies forum. Companies' forum. Professional social networks.</p>	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none">• Job interview simulations with panels of professionals.	
KEYWORDS	Professional employment; Career path; Interviewsimulation	

d. Semester 4

TU 41	FURTHER STUDY OF COMPUTING	SEMESTER 4
	HARDWARE ARCHITECTURE - OPERATING SYSTEMS - NETWORKS	
<i>M 4101C</i>	<i>SYSTEM AND NETWORK ADMINISTRATION</i>	<i>HOURS 8H CM 10H TD 12H TP</i>
MODULE OBJECTIVES	To know how to administer and secure a system and a network.	
SKILLS	The skills listed in the activities and skills reference document for the following activities: <ul style="list-style-type: none">• FA2-A: Administration of systems, software and networks.• FA2-B: Advice and technical assistance for users, clients and services.• FA1-E: Operation and maintenance of a computer solution.	
PREREQUISITES	M3101, M3102	
CONTENT	<ul style="list-style-type: none">• Architecture of a business network.• Installation and configuration of services.• User management• System and network security: access and control lists, authentication, etc.• Secure protocols, virtual private networks.• Directories: LDAP (Lightweight Directory Access Protocol), AD (Active Directory), etc.• Data encryption.• Supervision tools.• Implementation of a backup strategy.	
TEACHING METHODS	Addressing several operating systems.	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none">• Infrastructure for cloud computing.• Interoperability between operating systems.• Business recovery plan.• Deployment tools.• Management of authentication in network services.	
KEYWORDS	Administration; Operating system; Network; Security	

ADDITIONAL COMPUTING

TU 41

HARDWARE ARCHITECTURE - OPERATING SYSTEMS - NETWORKS ANALYSIS, DESIGN AND DEVELOPMENT OF APPLICATIONS

SEMESTER 4

M 4102C

DISTRIBUTED PROGRAMMING

HOURS
8H CM
10H TD
12H TP

MODULE OBJECTIVES

To know how to program a distributed application.

SKILLS

The skills listed in the activities and skills reference document for the following activities:

- FA1-C: Production of a computer solution.
- FA1-D: Validation tests for a computer solution.
- FA1-E: Operation and maintenance of a computer application.

PREREQUISITES

M3101, M3102, M3105

CONTENT

- Models and issues to do with distributed applications.
- Concurrent programming (multi-process, multi-thread, event driven, etc.).
- Client/server programming libraries.
- Programming Web services.

TEACHING METHODS

Using one or more existing technologies: sockets, Remote Procedure Call (RPC), Remote Method Invocation (RMI), etc.
Deploying the application on different machines.

POSSIBLE EXTENSIONS

- Use of heterogeneous machines.
- Discussing service oriented architectures.
- Presenting the constraints of distributed applications (security, fault tolerance, etc.).

KEYWORDS

Distributed application; Concurrent programming; Client/server programming.

ADDITIONAL COMPUTING

TU 41

SEMESTER 4

WEB - INTERNET - MOBILITY

<i>M 4103C</i>	<i>WEB PROGRAMMING – RICH CLIENT</i>	<i>HOURS 8H CM 10H TD 12H TP</i>
MODULE OBJECTIVES	To know how to program a "rich" client.	
SKILLS	The skills listed in the activities and skills reference document for the following activities: <ul style="list-style-type: none">• FA1-A: Technical design of a computer solution.• FA1-C: Production of a computer solution.• FA1-D: Validation tests for a computer solution.	
PREREQUISITES	M2105, M3104, M3105	
CONTENT	<ul style="list-style-type: none">• Web documents' templates: DOM (Document Object Model).• Dynamic management of the DOM. JavaScript, etc.• Event-driven programming.• Asynchronous queries, data exchange formats.	
TEACHING METHODS	Using a library / a design framework. Discussing techniques of adapting interfaces to various devices (including phone, tablet, desktop screen).	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none">• Access to Web services.• Graphical programming for the Web.	
KEYWORDS	Interactivity; Event-driven; Rich client	

ADDITIONAL COMPUTING

TU 41

SEMESTER 4

WEB - INTERNET - MOBILITY*M 4104C**DESIGN AND DEVELOPMENT OF MOBILE APPLICATIONS**HOURS
8H CM
10H TD
12H TP***MODULE OBJECTIVES**

To learn how to develop applications on mobile devices.

SKILLS**The skills listed in the activities and skills reference document for the following activities:**

- FA1-B: Technical design of a computer solution.
- FA1-C: Production of a computer solution.

PREREQUISITES

M2105, M3102, M3105

CONTENT

- Issues to do with mobility (including battery life, robustness).
- Mobile user interfaces.
- Mobile operating systems.
- Connectivity, use of Web services.

TEACHING METHODSUse of appropriate APIs / design framework.
Making the link with traditional programming and web programming.**POSSIBLE EXTENSIONS****KEYWORDS**Programming; Mobile; *Smartphone*; Touch pad

ADDITIONAL COMPUTING		
TU 41	ANALYSIS, DESIGN AND DEVELOPMENT OF APPLICATIONS	SEMESTER 4
<i>M 4105C</i>	<i>ADDITIONAL COMPUTING WITH A VIEW TO IMMEDIATE EMPLOYMENT</i>	<i>HOURS 8H CM 10H TD 12H TP</i>
MODULE OBJECTIVES	Further technology - To discover or supplement learning of a computer development skill used in a professional environment.	
SKILLS	<p>The skills listed in the activities and skills reference document for the following activities:</p> <ul style="list-style-type: none"> • FA1-B: Technical design of a computer solution. • FA1-C: Production of a computer solution. • FA1-D: Validation tests for a computer solution. 	
PREREQUISITES		
CONTENT	<p>Training or additional training in a programming environment particularly useful for immediate employment:</p> <ul style="list-style-type: none"> • A programming language. • A technology. • A programming library. • A design framework. • A field of application. 	
TEACHING METHODS	Discovering or engaging in further study of an environment useful for immediate entry into specific employment or increasing the hours devoted to one or more of the semester's three computing modules.	
POSSIBLE EXTENSIONS		
KEYWORDS	Additional specific computing	

ADDITIONAL COMPUTING**TU 41****SEMESTER 4**

SUPERVISED PROJECTS

<i>M 4106</i>	<i>SUPERVISED PROJECT – ADDITIONAL ELEMENTS</i>	<i>HOURS 60H OF PERSONAL WORK</i>
MODULE OBJECTIVES	Further knowledge through a Supervised project in accordance with the student's PPP.	
SKILLS	<ul style="list-style-type: none">Cf. module M3302 "Supervised project - Experience of a professional situation".	
PREREQUISITES	M3302, M3303	
CONTENT	<ul style="list-style-type: none">Cf. module M3302 "Supervised project - Experience of a professional situation".	
TEACHING METHODS	This project may be conducted on an individual basis (unlike previous Supervised projects) so that it can easily be matched to the student's personal and professional project. It can be further work on the S3 project or preparation for an internship.	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none">Internship	
KEYWORDS	Supervised project; PPP.	

TU 42	ADDITIONAL SCIENTIFIC, SOCIAL AND HUMAN CULTURE ECONOMICS - MANAGEMENT - ORGANISATION - LAW	SEMESTER 4
<i>M 4201C</i>	<i>ENTERPRISE CREATION WORKSHOPS</i>	HOURS 8H CM 12H TD 10H TP
MODULE OBJECTIVES	To provide further economic, legal and management knowledge required for businesscreation. Preparation of a business creation dossier.	
SKILLS	<ul style="list-style-type: none"> • Creating one's own company. 	
PREREQUISITES	All the "Economics - Management - Organization - Law" modules.	
CONTENT	<ul style="list-style-type: none"> • Study of the opportunity (market study, assessment of potential, etc.). • Study of the legal aspects linked to the creation of a company (company law, employment law, tax law, etc.). • Further management studies (financial management, commercial management, etc.). • The administrative procedures required to set up one's own company. • Preparation of a financial plan (provisional budgets, financing plan, sources of finance, etc.). 	
TEACHING METHODS	Putting students in a situation where they can prepare a business creation plan. Using entrepreneurship promotion networks.	
POSSIBLE EXTENSIONS		
KEYWORDS	Enterprise creation	

**ADDITIONAL SCIENTIFIC, SOCIAL
AND HUMAN CULTURE**

TU 42

SEMESTER 4

MATHEMATICS

M 4202C

*INTRODUCTION TO OPERATIONAL RESEARCH AND
DECISION SUPPORT*

*HOURS
8H CM
12H TD
10H TP*

**MODULE
OBJECTIVES**

To be aware of the existence of basic tools to assist with decision making: linear programming, etc.
To understand the operation and limitations of these methods.

SKILLS

- Modeling a complex situation using a graph or correlated variables.
- Making a reasoned decision by optimizing one or more criteria.

PREREQUISITES

M2201

CONTENT

- Linear programming.
- Discrete optimisation.
- Tree structure methods.

**TEACHING
METHODS**

Illustration with specific problems.
Use of dedicated software.

**POSSIBLE
EXTENSIONS**

KEYWORDS

Decision support, Graph, Optimization

ADDITIONAL SCIENTIFIC, SOCIAL AND HUMAN CULTURE		
TU 42		SEMESTER 4
EXPRESSION – COMMUNICATION		
<i>M 4203</i>	<i>COMMUNICATION WITHIN ORGANISATIONS</i>	<i>HOURS 15H TD 15H TP</i>
MODULE OBJECTIVES	To understand communication within organizations. To construct mediation scenarios and take the intercultural dimension of communication into account (especially in professional situations).	
SKILLS	<ul style="list-style-type: none"> • Production of effective communication media in a professional context. • Team working, cooperation, conflict management. • Skills development in situations of intercultural communication. 	
PREREQUISITES	M3206	
CONTENT	<ul style="list-style-type: none"> • Internal and external communication. • Conducting meetings: preparation, facilitation, minutes. • Approach to cultural differences: noting stereotypes and implicit assumptions. • Optimization of communication by integration of cultural differences. 	
TEACHING METHODS	Role play, case studies, presentations, folders. Preparation of specifications and other professional documents. Study of written documents and audiovisuals, summaries.	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none"> • Place of professional social networks. 	
KEYWORDS	Communication within companies; Intercultural communication; Conduct of meetings	

**ADDITIONAL SCIENTIFIC, SOCIAL
AND HUMAN CULTURE**

TU 42

SEMESTER 4

ENGLISH

<i>M 4204</i>	<i>WORKING IN ENGLISH</i>	<i>HOURS 15H TD 15H TP</i>
MODULE OBJECTIVES	Conceptualization and presentation of a project, a system or a process.	
SKILLS	<ul style="list-style-type: none">• Knowing how to understand or produce a technical document.• Knowing how to present a project, system or process.• Knowing how to present and analyze data in the form of a graph.	
PREREQUISITES	M3206	
CONTENT	<ul style="list-style-type: none">• Further study of appropriate terminology and grammatical structures.• Presentation.• Minutes.• Work on technical documents.• Working using a variety of multimedia media.	
TEACHING METHODS	Using information and communication technologies for education and language laboratories.	
POSSIBLE EXTENSIONS	<ul style="list-style-type: none">• Preparation of projects, of syntheses; demonstration of software; creation of explanatory videos.• Cross-collaboration.	
KEYWORDS	Presentation; Summary; Project/system/process	

TU 43	EXPERIENCE OF A PROFESSIONAL SITUATION		SEMESTER 4
INTERNSHIP			
<i>M 4301</i>	<i>PROFESSIONAL INTERNSHIP</i>	<i>HOURS 10 WEEKS</i>	
MODULE OBJECTIVES	<p>To explore a company/organization from the point of view of its social, techno-economic and organizational aspects.</p> <p>To explore the reality of a senior computing technician's activity.</p> <p>To apply knowledge and know-how acquired during the course.</p> <p>Acquisition of professional know-how.</p> <p>Tasks: studies and/or production in a company/organization in accordance with the Computing DUT program.</p>		
SKILLS	<ul style="list-style-type: none"> • General: the ability to use the whole academic experience in the context of the internship task. • General: development of personal and relationship skills: initiative, team working, independence, etc. • Computing: ability to adapt to the hardware infrastructure and to the development and software operating environment. 		
PREREQUISITES	<p>The whole academic training – project management – experience acquired during the Supervised project.</p>		
TEACHING METHODS	<p>The whole of the internship process must be carried out in the context of a quality type approach, clearly describing the stages involved: the search for internships including negotiations prior to the work of studies and production to be implemented during the internship, the signing of agreements, the progress of the internship, monitoring of internees (intermediate points, visits), the activity report (written report and defence of the report according to a professional approach), the structure of written and oral reports, quality of communication and argument.</p> <p>The process is controlled by an internships supervisor; it involves the whole teaching team for monitoring internees (link with professional tutors, visits to the company/organization).</p>		
KEYWORDS	<p>Professional experience; Professional approach; Specifications; Report; Defense.</p>		