Undergraduate Technological Degree

THERMAL AND ENERGY AND EGINEERING

Association
des Directeurs
d'IUT

1. Course objectives

Employment following a final year on a related degree course or one offering a different specialisation; or further post-graduate study thanks to its university-level content. The subjects covered by the *DUT* diploma course in Thermal and Energy Engineering (TEE) aim at the training of multi-skilled technicians participating in the responsibility of activities relative to production, distribution, the use and management of thermal energy in industry, transport and the construction industry.

These activities concern the technical aspects of thermal systems, in applications in climatic and industrial energy engineering, and also cover other constantly growing aspects of energy management and renewable energies, and their impact on the environment and sustainable development.

In energy systems, the technological component is very important for the development and optimal use of efficient materials, in a general context of rapid change in energy sources, society expectations and environmental constraints.

Thus the Thermal and Energy Engineering speciality is an interface between scientific and technical knowledge, making for a privileged domain for the implementation of teaching through technology.

Energy and thermal engineering are governed by specific scientific laws whose central core is made up of three components from the field of physics, which are: thermodynamics, heat transfer and fluid mechanics.

These subjects are only partially taught at high school, or even not at all. Knowledge of them is indispensable, to a sufficient theoretical degree, in order that the whole of the physical phenomena which govern energy processes and their influence be quantified. They have therefore a most important place within the TEE diploma course, but only demand basic high-school-level preliminary knowledge.

In this regard, technological analysis of energy systems provides concrete illustrations and a permanent study subject for understanding the interactions between physical phenomena.

Several disciplines rely upon these scientific bases to deal with the principles and techniques implemented in climatic engineering, industrial energy engineering or transport. These techniques also call upon knowledge from other disciplines such as mechanics, materials, electricity and settings and indispensable tools like mathematics, informatics, metrology, technological knowledge and know-how from design and manufacturing sectors. A particular focus is placed upon personal and human training by developing all aspects of expression and communication and the English language, as well as autonomy and the acquisition of study methods and by accompanying the student in the definition of his or her personal and professional project.

It is clear today that energy and thermal engineering will continue to evolve rapidly and durably in both sources and needs, and will require an ever-growing expertise in environmental management.

The teaching of knowledge and technologies in TEE takes this fast-changing context into consideration. It also takes into consideration the fact that the graduate may intend to continue on to short or long further studies and that throughout his or her professional life he or she will need to change and adapt.

2. Reference system of activities and skills

DUT Thermal and Energy Engineering diploma graduates are senior technicians:

- Who have acquired scientific and technical skills in the energy domain whether renewable or from conventional sources, and in particular of thermic origins.
- Who are apt at applying these skills in production, distribution, the use and optimum management of all energies for industry, the building industry and transport.
- Who are capable of proposing efficient, durable energy solutions which are respectful of the environment and regulations, whilst knowing how to optimize investment and functioning costs.
- Who show independence and initiative, capacities of communication and interaction with partners and clients.

They exercise their professional activity mainly within the private sector, big groups or small and medium-sized companies, but also within public organisations and regional authorities:

- In thermic and energy engineering research and development departments, or consulting agencies.
- In industry, the building industry, for the tasks of creation, operation, installation, monitoring or maintenance…
- With manufacturers and distributors as study technicians, project managers and sales technicians.

They must be able to take into account during their projects, energy and climate-control materials or installations, in accordance with regulations (particularly thermic regulations of buildings), safety rules and taking into account of the environment.

They can also be directly involved in these materials and installations in design, construction, implementation, conformity check, monitoring of operation and maintenance:

- **Specific equipment**: air-conditioning systems and air treatment units, refrigerating units and heat pumps, hot water tanks, furnaces, solar heating, gas or steam turbines, internal combustion engines,
- Co-generators, compressors, propulsers, flow nozzles and reactors, thermic insulators...
- **Specific installations**: thermic energy conversion systems, chemical, nuclear, renewable energy production systems, (photovoltaic, wind energy, geothermic, biomass production…),
- Energy distribution (heat networks, iced water, compressed air…), thermic treatment, drying, addition or extraction of heat in industrial processes (metallurgy, aeronautics, micro-electronics, agro foods, chemicals…).

AS AN EXAMPLE, SOME OF THE ACTIVITIES AND SKILLS DONE BY *DUT* THERMIC AND ENERGY ENGINEERING DIPLOMA GRADUATES ARE PARTIALLY DESCRIBED IN THE FOLLOWING *ROME* SHEETS:

CODE ROME	TYPES OF JOBS
F1106	• Engineering and studies in Building and Public Works sector
F1603	• Installation of sanitary and thermic facilities (team management level)
H2701	• Piloting of energy and petrochemicals installation.
I1306	• Installation and maintenance in cold management, air-conditioning
I1308	• Maintenance of heating installations

OTHER SKILLS OR ACTIVITIES WHICH MAY BE RELATIVE TO JOBS DONE BY GRADUATES MAY ALSO BE FOUND IN THE *ROME* SHEETS:

CODE ROME	TYPES OF JOBS
D1407	• Sales executive responsibilities
F1103	• Technical monitoring and diagnosis of buildings
H1101	• technical assistance and support for the client
H1102	• Business management and engineering
I1602	• Aircraft maintenance

Energy engineering is a demanding discipline which lies within several scientific disciplines; a good understanding of the programmes in mathematics and physics is thus desirable. Prerequisites in course modules refer to the Scientific High-School training programmes (all options), STI2D (mainly energy and environment) or Science and Laboratory Technique (measurement and instrumentation).

BASIC ACTIVITIES AND SKILLS IN THERMIC ENERGY ENGINEERING DEPARTMENTS,

ACTIVITIES	SKILLS (BEING ABLE TO)
DESIGN AND SIZING (D) : AIR CONDITIONING OR REFRIGERATING INSTALLATIONS (NETWORKS OF FLUIDS, VENTILATION, HEAT, COLD DISTRIBUTION...) AS AN EXAMPLE: ROME SHEET F1106	• D1. Analysing a design brief and technical clauses in reply to a tenderin energy or climatic engineering. • D2. Calculating thermic, hydraulic and aeraulic dimensions, and knowing the materials and components adapted to different systems. • D3. Using dedicated software (DAO, sizing, application of Thermic Regulations) and adapted technical documents. • D4. Sizing of material, defining its implementation, estimating cost and efficiency. • D5. Taking into account the specifications of different labels of energy consumption. • D6. Writing sizing notes and execution plans. • D7. Producing technical documents (design brief, technical clauses, file of work carried out...). • D8. Ensuring the monitoring of execution of work.
CONSULTATION AND AUDIT (A) : RECOMMENDATIONS, IMPROVEMENT IN RATIONALIZATION OF ENERGY. AS AN EXAMPLE: ROME SHEET F1106, F1103	• A1. Assessing energy needs of a building or site, an industrial process or a means of transport. • A2. Gathering the necessary means (measurements, recordings) and interpreting the results for analysing the energy and power available and establishing an energy balance.

	• A3. Proposing energy saving solutions and the use of renewable energy sources (solar thermic, heat pumps, geothermics, wood, biomass, cogeneration, hydraulic, solar photovoltaic …). • A4. Checking environmental and economic coherence of solutions proposed, in design as well as in function and decommissioning... • A5. Taking into account the interactions between technical, regulatory, job, political, economic and environmental aspects…
INSTALLATION OF AIR-CONDITIONING SYSTEMS IN BUILDINGS (I) : FINISHING WORK OPERATIONS IN HEATING, AIR-CONDITIONING, AND AIR TREATMENT. INSTALLATION OF THERMIC AND REFRIGERATING SYSTEMS (I) : IN THE PRODUCTION AND TRANSFORMATION INDUSTRIES (MECHANICS, AERONAUTICS, NUCLEAR, ELECTRONICS, CHEMICALS, AGRO FOODS…) AS AN EXAMPLE: ROME SHEET I1306, F1603	• I1. Coordinating the creation of a worksite and installation with the studies, installers, logistics… • I2. Interacting with the different construction professionals, project managers, craftsmen. • I3. Managing a team of workers or installers, establishing and managing a work schedule and adjustments. • I4. Showing good organization and responsiveness. • I5. Reading and interpreting execution plans and technical documents. • I6. Implementing the techniques necessary for the creation of installations. • I7. Ensuring follow-up through to execution, putting into operation and reception by the client.
OPERATION, RUNNING AND MAINTENANCE OF INDUSTRIAL INSTALLATIONS OR TEST PLATFORMS IN LABORATORIES (E) : • MANUFACTURING OF THERMIC OR REFRIGERATING MACHINES • CENTRALISED PRODUCTION AND DISTRIBUTION OF ENERGY, HEAT, STEAM, AIR • CONDITIONING, COGENERATION OF ENERGY • MAINTENANCE OF FACILITIES. • CREATION OF MATERIALS QUALIFICATION TRIALS OR IN RESEARCH AND DEVELOPMENT. AS AN EXAMPLE: ROME SHEET I1308, H2701, I1602	• E1. Technical characteristics and operation modes of systems and installations. • E2. Implementation of means of measurement and testing, interpreting the results. • E3. Carrying out technical actions. • E4. Planning operation and maintenance actions on installations. • E5. Defining operation methods, monitoring operations and writing up the results. • E6. **Using means of technical management of installations:** Technical documents, operational interfaces, centralised technical management, instrumentation, recording results … • E7. Applying and checking procedures. • E8. Managing a team of workers.
MARKETING AND PROMOTION, AT THE MANUFACTURER'S AND DISTRIBUTORS, OF ENERGY ENGINEERING EQUIPMENT AND SERVICES AT FIXED OR MOBILE WORK POSTS (C) :	• C1. Advising a client in optimum choice of material in relation to needs. • C2. Defending a technical or financial proposition with knowledge of respective technological advantages of different

AS AN EXAMPLE: ROME SHEET D1407, H1101, H1102	thermic systems. • C3. Presenting the advantages specific to different labels of energy consumption. • C4. Providing technical and economic assistance to an installer or project manager. • C5. Managing a client portfolio and maintaining business relationships.
TRANSDISCIPLiNARY SKILLS (BE CAPABLE OF) (T) :	• T1. Understanding the technical characteristics and modes of operation of systems and installations. • T2. Understanding associated physical phenomena. • T3. Determining their functioning performance and limits. • T4. Using a technical document. • T5. Understanding, applying and getting applied the standards and regulations in force and safety rules specific to each installation. • T6. Communicating orally (meetings, presentations, team management, relations with suppliers and clients …). • T7. Communicating in writing (technical documents, analysis and recommendation reports, operation reports, design briefs, work reports, sales offers and reports…). • T8. Updating one's knowledge, ensuring technology and regulation monitoring, mobilising information possibilities by means of professional networks. • T9. Proposing solutions for improving performance, decreasing costs and energy consumption and respecting standards in environmental matters.

3. General course organisation

a. Course description

The *DUT* is a vocational diploma which is part of the supervised university training system, itself part of the Degree – Honours Degree – Doctorate study progression route .

Thus the course curriculum leading to the *DUT* diploma in Thermal and Energy Engineering (TEE) is fixed according to the articles of the order of 3 August 2005 modified, relating to the university technology diploma within the European Community in Higher Education. In this scheme, obtaining of the *DUT* diploma in TEE gives the student 120 ECTS (European Credit Transfer System) divided into 30 ECTS per validated semester.

The principle of capitalisation of credits is defined by the ECTS (European Credits Transfer System). This principle of capitalisation allows the validation of studies, the validation of acquired experience and student mobility within the European Union.

The duration of the course leading to the *DUT* diploma is four semesters. Within each semester, teaching is organised into teaching modules (UE), themselves constituted of modules.

The course which leads to the DUT university technology diploma consists of a major subject, which guarantees the core skills of the diploma, and complementary modules. These complementary modules are designed to complete the student's study route whether he or she wishes to join the job market or to continue his studies with other courses in higher education.

Whichever study route the student may follow, the complementary modules are an integral part of the university technological diploma.

These are offered during semesters 3 and 4 and make up a total of 15 % of the duration of the course. For the vocational study route, they aim to teach a broad spectrum of knowledge of energy systems
(furnaces, thermic machines, exchangers…) and to reinforce practical skills in systems sizing and use of professional resources (fluids networks, professional software …). The complementary modules which favour further studies are offered to the student within the framework of the adaptation of his study route in accordance with his personal and professional project. Created by the *IUT* faculties with reference to the recommendations of the national teaching commission, they have the same characteristics as the vocational modules, in terms of number of hours, and of coefficient of skills assessment, as the vocational modules.

These recommendations of complementary modules for further studies are the object of an annex document.
Widely speaking, the course includes 40% workshops (TP), 20% lectures (CM) and 40% tutorials (TD).

As a rough guide, these different teaching sequences correspond to the following number of students per teaching action:

- CM (lectures): all students of the year.
- TD (tutorials): group of 26 students.
- TP (workshops): 13 students. In workshop sessions, the speciality often uses heavy industrial installations, so this number is unlikely to be surpassed (in fact it is half of a tutorial group). Moreover, some workshops on installations presenting certain dangers (high pressure...) may necessitate either a smaller group or an extra supervisor.

To help the various freshers, semester 1 has been made less dense so as to help the implementation of timetables which do not exceed around thirty hours per week, thus leaving weekly periods for personal work.

The programme also includes differentiated modules in S1 and S2 which allow taking into account of the diversity of student profiles.

b. Tables summarizing modules and course units

SEMESTER 1

TEACHING UNIT (TU)	MODULE REFERENCE (M)	MODULE NAME	COEF. /M	TOTAL COEF. /TU	TOTAL HOURS LECTURE	TOTAL HOURS TUTORIAL	TOTAL HOURS WORKSHOP	TOTAL HOURS STUDENT /TU
TU 11 : GENERAL ELEMENTARY STUDIES	M 1101	Applied Mathematics	4	10	18	40	0	**58**
	M 1102	Informatics : spreadsheets	2		0	6	20	**26**
	M 1103	Expression – Communication elementary communication	2		0	18	18	**36**
	M 1104	Modern language 1	2		0	0	16	**16**
	M 1105*	Adaptation to differentiated study routes			0	20	20	**40**
	M 1106*	Tutor-supervised project						**35h per student**
TOTAL TU 11			**10**	**10**	**18**	**84**	**74**	**207**
TU 12 : ELEMENTARY ENERGY ENGINEERING	M 1201	Thermodynamics	4	11	16	26	20	**62**
	M 1202	Electricity	3		14	20	16	**50**
	M 1203	Energy and environment	2		10	10	0	**20**
	M 1204	Mechanics	2		12	20	0	**32**
TOTAL TU 12			**11**	**11**	**52**	**66**	**36**	**164**
TU 13 : ELEMENTARY PROFESSIONAL PRACTICE	M 1301	Measurement, metrology	3	9	8	20	16	**44**
	M 1302	Technology of thermic systems	2		8	0	20	**28**
	M 1303	Engineering departments	3		0	0	48	**48**
	M 1304	Personal and Professional Projet	1		8	8	8	**24**
TOTAL TU 13			**9**	**9**	**24**	**28**	**92**	**144**
TOTAL HOURS SEMESTER 1			**30**	**30**	**94**	**204**	**202**	**500**

(*) Assessment of modules is integrated with that of other modules (details in corresponding sheets).

SEMESTER 2

TEACHING UNIT (TU)	MODULE REFERENCE (M)	MODULE NAME	COEF. /M	TOTAL COEF. /TU	TOTAL HOURS CM	TOTAL HOURS TD	TOTAL HOURS TP	TOTAL HOURS STUDENT /TU
TU 21 : APPLIED GENERAL STUDIES	M 2101	Applied Mathematics	3	11	18	40	0	58
	M 2102	Automatic systems and electric circuits	2		8	0	28	36
	M 2103	Expression – Communication : communication information and arguing case	2		0	12	12	24
	M 2104	Modern language 1	2		0	16	16	32
	M 2105*	Differenciated teaching	1,5		0	26	0	26
	M 2106*	Project management	0		4	4	0	8
	M 2107	Tutor-supervised project	2					(65h per student)
TOTAL TU 21			11	11	30	86	46	223
TU 22 : MECHANICS AND ENERGY ENGINEERING	M 2201	Thermodynamics	3	10	14	18	20	52
	M 2202	Fluids mechanics : hydraulics	3		20	22	16	58
	M 2203	Physics of interior spaces : lighting, acoustics, air quality	2		10	12	8	30
	M 2204	Material Properties	2		16	16	16	48
TOTAL TU 22			10	10	60	68	60	188
TU 23: THERMICS	M 2301	Thermic Transfer	3	9	16	18	20	54
	M 2302	Thermics of premises	2		6	0	36	42
	M 2303	Techniques in thermic engineering	1		0	0	24	24
	M 2304	Electrothermics	2		6	8	12	26
	M 2305	Personal and Professional Project	1		4	4	4	12
TOTAL TU 23			9	9	32	30	96	158
TOTAL HOURS SEMESTER 2			30	30	114	204	212	530

(*) Assessment of modules is integrated with that of other modules (details in corresponding sheets).

SEMESTER 3

TEACHING UNIT (TU)	MODULE REFERENCE (M)	MODULE NAME	COEF. /M	TOTAL COEF. /TU	TOTAL HOURS CM	TOTAL HOURS TD	TOTAL HOURS TP	TOTAL HOURS STUDENT /TU
TU 31 : GENERAL TRAINING AND PROJECT	M 3101	Applied Mathematics	2	9	10	20	0	30
	M 3102	Expression – Communication : Professional communication	2		0	12	12	24
	M 3103	Modern Language 1	2		0	16	16	32
	M 3104	Informatics : Programming	1		4	0	20	24
	M 3105	Tutor-supervised project	2					(100h per student)
TOTAL TU 31			9	9	14	58	60	210
TU 32 : TRANSFER AND FLUID S	M 3201	Thermic trasnfer	4	10	28	28	28	84
	M 3202	Mechanics of fluids : aerodynamics	3		16	16	16	48
	M 3203C	Combustion and furnaces	2		12	12	16	40
	M 3204	Technical studies	2		0	10	12	22
TOTAL TU 32			10	10	56	56	72	194
TU 33 : THERMODYNAMIC SYSTEMS	M 3301	Regulation	3	11	12	26	24	62
	M 3302	Refrigerating machines	2		12	12	16	40
	M 3303	Air treatment, air conditioning, ventilation	3		16	16	24	56
	M 3304C	Aeraulic sizing	1		0	0	14	14
	M 3305	Personal and Professional Preoject	1		8	8	8	24
TOTAL TU 33			11	11	48	62	86	196
TOTAL HOURS SEMESTER 3			30	30	118	176	206	500

SEMESTER 4

TEACHING UNIT (TU)	MODULE REFERENCE (M)	MODULE NAME	COEF. /M	TOTAL COEF. /TU	TOTAL HOURS CM	TOTAL HOURS TD	TOTAL HOURS TP	TOTAL HOURS STUDENT /TU
TU 41 : VOCATIONAL PREPARATION	M 4101C	Expression-Communication : communication in organisations	1	9	0	12	12	**24**
	M 4102	Modern Language 1	2		0	12	12	**24**
	M 4103C	Fluids and networks	1		10	10	0	**20**
	M 4104C	Energy management	2		10	20	0	**30**
	M 4105C	Professional software	1		0	0	24	**24**
	M 4106C	Technical studies	2		0	16	36	**52**
TOTAL TU 41			**9**	**9**	**20**	**70**	**84**	**174**
TU 42 : INDUSTRIAL ENERGY ENGINEERING AND PROJECT	M 4201C	Thermic machines	3	9	20	20	16	**56**
	M 4202	Heat exchangers	2		14	14	12	**40**
	M 4203C	Tutor-supervised project	4					**(100 per student)**
TOTAL TU 42			**9**	**9**	**34**	**34**	**28**	**196**
TU 43: FINDING A JOB	M 4301	Placement	12	**12**				**(10 weeks minimum)**
TOTAL TU 43			**12**	**12**				
TOTAL HOURS SEMESTER 4			**30**	**30**	**54**	**104**	**112**	**270**
TOTAL SEMESTERS 1 + 2 + 3 + 4			**120**	**120**	**360**	**688**	**732**	**1800**
TOTAL TRANSDISCIPLINARY MODULES					**20**	**134**	**134**	**288**
TOTAL SPECIALITY MODULES					**360**	**554**	**598**	**1512**

Conform to the order of 3 August 2005 relative to the DUT diploma, a volume of around 10% of teaching hours on the course can be given to « Learning Differently ». This volume is an integral part of the different modules and is identified in the tables in the form of specific modules: adaptation to differentiated study routes in first year, technical studies in second year.

c. Placement and Tutored-supervised projects

An approach to professionalization via the tutor-supervised project

The tutor-supervised project activity, which takes up a total of 300 hours for the student, is an approach to the practice of the senior technician's job in a company or organisation and aims to develop the professional skills of the future graduate such as the implementation of knowledge and know-how (documentary research, proposition of solutions, creation of all or part of a product or service…), experience of trans-disciplinary work – apprenticeship and implementation of project management: how to write a design brief, team work, time and deadline management, written and oral communication, the development of skills in human relations, independence, the development of teamwork qualities (initiative, aptitude in communication…).

Progression takes place over the four course semesters: the project is individual or in pairs in semester S1, in groups from semester S2 to allow the implementation of project management methods introduced in a specific module. The volume of student hours is greater in semesters S3 and S4, to allow the development of projects which are more complete, including a practical phase and continuing on to in-depth work at the end of S3.

The global coefficient for the tutor-supervised project is 8. Its assessment is based on a table of criteria which allow the measurement of the student's implication within his or her group.

Professionalization is completed with the work placement:

The company or organisation placement, which lasts 10 weeks minimum in S4, finishes the vocational aspects of the *DUT* diploma course. It allows for an important vocational investment related to the technical, technological and human skills expected of the graduate.

The whole of the placement process, from looking for a company or organisation to the oral presentation, is carried out within a quality-type framework which defines responsibilities and procedures, in matters of helping the trainee join his placement organisation and supervision by the tutors.

This process responds to a three-sided charter between the student, the course department and the company or organisation, made official by a placement contract which is conform to regulations. The search for a placement company by the student is essential in that it also prepares the student for future job hunting.

The trainee's project is the object of consultation between the company or organisation and the department in order to measure the feasibility and interest shared by the 3 partners. During the placement period, the student is jointly followed by a tutor from the teaching staff and by a tutor from the company.

The assessment focuses on work carried out in the company or organisation (assessment carried out jointly by both tutors). The written report and the oral presentation will be assessed by a mixed jury made up of "company" and "faculty". The assessment is based on a table of criteria which allow an assessment of skills expected individually, taken from the Graduate Activities and Skills reference. The overall coefficient of the placement is 12.

d. Personal and Professional project

A central thread in the course, the Personal and Professional Project (PPP):

The Personal and Professional Project (PPP) is a foundation task which allows the student to form a precise idea of the jobs in the sector and of the personal skills which these demand.

The notions of career and skills must be developed in particular, beyond questions of qualification and salary. Its goal is to allow the student an overview of his or her current and future professional aspirations, his personal aspirations, his strong and weak points, so he can draw up a study route which is coherent with the targeted job sector.

Finally, the PPP aims to teach career route methodology skills which may be used throughout a career. The student is expected to be the main instigator of the process: the PPP insists on the necessity of a genuine commitment.

All teachers participate, whatever their speciality, in order to provide the student with the techniques, methods and tools necessary to both teach him or her the solutions to problems in career route-finding, job finding and training throughout his or her career, and to carry out his or her choices.

These tools, procedures and methods rely on the educative approach in career-finding and its developments: the student must create his or her project from experiences built, experienced, accumulated and confronted with others. Techniques for job-finding and changing career or any other form of vocational teaching of students may be used at this point in the course.

The coefficient of the student's Personal and Professional Project is 3.

e. Study routes, Teaching through Technology

Whether in the domains of climatic engineering or industrial thermics, for their design, their expertise, their installation, their operating or their marketing, the study of energy and thermic systems associates technological and scientific knowledge very closely.

Thus the Thermal and Energy Engineering diploma (*DUT*) course programme depends on the interactions between these technical and theoretical components that the student will be shown throughout the 4 semesters of study.

As an illustration of these interactions, the design of a fluids network shows how this two-fold base works:

- In relation to technological knowledge of the constituents (safety and control components, valves, pumps,), and to that of choice of materials,
- In relation to the theoretical study of flow in fluids mechanics (hydrodynamics, bernoulli's relationship …),
- In relation to sizing in the engineering department using sizing charts for force loss or the software application equivalent and the creation of network drawings,
- In relation to the knowledge of testing methods,
- Finally in relation to actual manufacturing (copper soldering, duct or sheath folding…) and implementation (balancing with the help of professional equipment).

Moreover, excellent knowledge of an air treatment unit or a thermic motor test bench, for their sizing, operation or maintenance, requires the acquisition of complementary knowledge:

- In component technology (heat exchangers, filters, pumps, ventilators, valves), in thermic system architecture and reading or creation of technical schematics,
- Of the theoretical characteristics of gas and the thermodynamic changes describing their evolution, (mixtures of gas, humid air, combustion, mass and energy balance, transformation cycles, reading and drawing of thermodynamic diagrams …),
- The functioning principles of measuring and control components, as well as data processing (flow, pressure, temperature, humidity, motorized valves, power supply, automatic systems, supervision and centralised technical management …),
- Interpretation of calculation of thermic loads or useful power done in research and development departments,
- Practical implementation on installations of piloting sequences, measurement and analysis of results.

In general the teaching of the three components of physics specific to energy engineering, which are thermodynamics, heat exchange and fluids mechanics, represents around 20% of the 1800 teaching hours taught in lectures, tutorials and workshops.

The teaching of the direct application of these disciplines and the different energy and climatic systems (thermic and refrigerating machines, fluids networks and exchangers, air treatment and thermics of premises …) also represents about 20% of the course.

The remaining 60% is divided more or less equally into:

- scientific disciplines and elementary subjects (mathematics, informatics, metrology…),
- complementary subjects (electricity, mechanics, materials, control systems, combustion…),
- technological knowledge and practical know-how (research and development, manufacturing,

- technical studies…),
- transdisciplinary modules (expression-communication, languages, Personal and Professional Project).

Practical work, which represents 40% of the course, is mainly carried out on authentic materials and installations, of which a list is given in the introduction to the reference of activities and skills (chapter 2).

Technological knowledge is acquired throughout the 4 semesters and is presented either before the theoretical classes as a support in understanding physical phenomena and their interactions, or afterwards in connection with the application of scientific laws for the actions of sizing and operation.

f. Taking into account of current economic challenges

In a few years energy in all its forms has come to represent a major challenge for our planet and conditions the future of our society in the relatively short term. The limited quantity of our fossil fuels and the effects on the environment have amplified the need for optimisation and mastering of procedures in all domains of production, transport and energy use.

Business

Energy is present in all sectors and jobs are present in companies of all sizes.

Consulting, diagnosis, installation in particular are activities which can encourage the creation of new businesses for a TEE graduate, most frequently after an initial experience or the obtaining of a professional degree. This possibility may be presented within the departments by the presence of ex-students or trade professionals.

Standardization

The rapid progress of standardization in the domain of energy is the result of the very tight timescale imposed by the necessity of replacing traditional energies and the mastering of our environmental footprint. This evolution is illustrated for example by the successive changes in thermic building regulations (RT2005, RT2012 and planned RT2020), the growing constraints imposed by national regulations applicable to refrigerating fluids or the implementation of energy management labels in all sectors. The *DUT* diploma in Thermic and Energy Engineering trains students to take into account these changes by giving them the scientific bases for the understanding of standards, regulation labels preparing their implementation via practical work in research and development, thermics of premises, thermic and refrigerating machines.

Health and Safety

Practical work on authentic installations, the use of machines in the workshops, the wiring of junction boxes, the presence of fluids under pressure or at high temperature…provide students with a wide range of situations in which the demands of safety may be illustrated and formalised. Practical work in the second semester in the workshop in mechanics and on junction boxes will lead to study of health and safety risks at work.

Project management

Tutor-supervised projects and technical studies aim to develop student independence and are the opportunity for the application of project management techniques, which will be introduced in a specific module in the second semester. The running of the project, which needs a regular, organised follow-up, is an integral part of the PPP modules.

Business intelligence

Recurring debates on energy autonomy, the place of renewable energies in the energy «mix», the impacts on world economic stability of the oil crashes, the consequences of the nuclear accidents at Tchernobyl and Fukushima are some of the illustrations of the importance of energy issues in modern society. A strategic issue which contains dimensions which are both defensive (ensuring the vital needs of society) and offensive (reinforcing company competitiveness), the challenges of the mastering of energy is a key issue in business intelligence.

The most obvious aspect, to which some of the diploma modules are given, is the necessity for all those concerned to implement a real economic optimisation of their energy consumption.

But another aspect of business intelligence also appears to be essential for companies in the sector which must rise to these technological challenges in a context of world competition.

Its goal is to provide tools which will help them to protect their secrets, improve their reputation, be heard by the legislators and also to make sure that every piece of information available about their competition is gathered. The elements of this second aspect may be approached during conferences or presentations in the context of the PPP modules, of research in the framework of the tutor-supervised project or practical exercises in the framework of the modules on expression-communication.

Sustainable development

Energy production and consumption are some of the great challenges of the 21st century. How can we supply the needs of billions of people, in the knowledge that energy production in general is polluting, that oil and gas reserves are diminishing, that consumption is growing daily in the transport, residential, tertiary and industrial sectors? Thus the energy engineer must manage as best as possible energy resources, raw materials and also air and water. He or she is concerned with the impact of our actions on the environment and more generally on society. Sustainable development is therefore naturally at the centre of our preoccupations. Solutions for production and use of cleaner, more efficient multi-sector energy will be studied during the TEE diploma course, in all domains of application.