Graduate School
Nancy / Saint-Etienne

CHAPTER 1: GENERAL INFORMATION

I) MINES universities / Graduate Schools: missions.

The Engineering Schools which make up the MINES Graduate School are Higher Education Establishments whose fundamental goals are, just as for all the members of the GEM group, the transmission, creation and development of knowledge and skills.

These universities, of which there are two to date (MINES Nancy and MINES Saint-Etienne), are to be joined by other European institutions, thus allowing the group to fulfill its title:

MINES = **M**ulti-and **I**nter-disciplinary **N**etwork of **E**ngineering **S**chools.

More specifically the role of these Schools is to:

- train future professionals to Masters and PhD level, providing them with high-level general, scientific and technical skills which will allow them to occupy positions of responsibility in industry, industrial research and the public services
- develop relations between higher education and the economic and industrial world in order to contribute towards improving the competitiveness of companies.

The accomplishment of the above relies on constantly improving the quality of the coursework in response to business needs, especially in the current context of a globalization that is synonymous with increasing complexity, changes and uncertainties.

A COMMUNITY OF STUDENTS

The students in the program are highly selected, as in France they are in the top 5% of those studying sciences of their generation. Classes are intentionally kept small each year in order to keep the Schools at a human scale. Such conditions allow for the individualized supervision of each student's program, thus giving students the ideal conditions in which to choose and construct their professional project. The size of the class promotes a community spirit, and a sense of identity, further developed through various sports activities and student associations and lasting throughout the students' years at the School. This sense of belonging continues even after graduation. In fact, the Alumni association plays an active role in the professional lives of Graduates as well as in the Schools themselves.

INNOVATIVE TEACHING

Companies obviously require engineers to have a solid scientific background, but over and above that, they need professionals, people capable of anticipating demand, and imagining products which fulfil a need, or a functional use that is not always clearly expressed. They also need people , who can evolve in areas and situations of deep uncertainty where there are no examples, models or predefined solutions which can be applied mechanically. Graduates of the program need to have acquired not only the scientific knowledge necessary for their whole future career, but also general work methods which allow them to continually draw upon from the incessant progress in technology and develop their activities in the complex and unstable environment of today's professional world. Graduates must also be well-prepared to move in a global context as this is the direction of all economic activity in the future.

All these elements obviously apply to any Graduates of the GS : "Ingénieurs" having completed a Joint Master, Masters or PhDs. Nevertheless, special attention is paid to the Masters courses for which teaching methods are particularly adapted. It should be emphasized here that information and communication technologies are highly developed and

profitably used. One example is the use of numerous simulators ; the program uses, for example, project simulators of such a high quality that they are also used for professional in-service training. Such technologies also allow collaboration with parties whose geographical situation is no longer an important consideration. These work methods, which are already in used by companies, will surely increase rapidly over the coming years, however, the Schools will never lose sight of the fact that such new technologies are simply a means of achieving their goal. The teaching methods that have been developed at the MINES School over the course of years are numerous and varied : students learn by working in teams, using role-playing techniques, doing company audits and carrying out projects, to name but a few of the methods used.

INTERNATIONALIZATION OF THE MINES

Every French student carries out a part of their studies abroad. This time may be spent doing one or several of various activities: an academic course (often in the form of a "double" diploma in partnership with another university), an internship within a company, an internship within a research laboratory...

In parallel, many students from abroad choose a course at the MINES, increasing the international dimension of the Schools. The number of foreign students is continually increasing, reaching today almost 20% of the student body. This is linked to the numerous partnerships developed both to enable students to go abroad as well as to welcome foreign students in our lecture halls. Currently over one hundred such agreements have been signed between the MINES and European, North American, Latin American, African and Asian partners. Finally, there are over ten "double" diploma agreements signed with Europe and North America.

FACTS

- 1100 Masters students in Nancy and 980 in St. Etienne
- 225 PhD students in Nancy and 175 in St. Etienne
- Permanent staff: 80 research-lecturers and researchers in Nancy, 100 research-lecturers and researchers in St. Etienne.
- Lecturers: around 300 people from partner-universities, reputed research organizations or industry.

II) Organization

The organization of the MINES Graduate School is defined by the idea of a network which fulfills 3 goals.

- Each MINES School is of a manageable size allowing the students to be supervised individually. Due to this fact there is a constant dialogue between teaching and administration staff, which helps students from other countries to adapt more rapidly to the study system.

- The MINES Schools are situated in regions of economic growth and, therefore, actively participate in the development of the area. Ties with regional companies are strong, and enhanced by the School's high standing in the area.

- The size of the MINES network favors synergies along with the development of an ambitious joint policy. As concerns entry to the program, the MINES Schools have a joint admissions policy ; namely entry to the basic Joint Masters program is based on a highly selective entrance examination common to both Schools. A student beginning his/her studies in one of the Schools may finish those studies in another member-School. Information and communication technologies will allow the Schools to share numerous learning activities such as correspondence courses, on-line study groups for project work, etc. In the field of research, the MINES Schools have a long history of collaboration in all domains (research projects in common fields, shared industrial contracts, supervision of doctoral theses, etc.

Last but not least, libraries and resource centers are obviously an integral part of any successful Graduate School, the MINES being, of course, no exception. Modern information-search tools (e.g. Web of Science) are common throughout.

III) Offered Graduate programs

European countries are currently constructing a common higher education system. The Bologna declaration of June 1999 specified that each country should adopt a higher education system based on two university levels. The first is defined as undergraduate studies, lasting a minimum of 3 years and subsequently allowing students to work in the European professional market. The second is Graduate studies consisting of a Masters and then a possible PhD.

In accordance with these stipulations the MINES offers a variety of choice in Graduate programs, which result in 3 types of diploma:

- **PhD**, only available to those students already having completed a Masters program

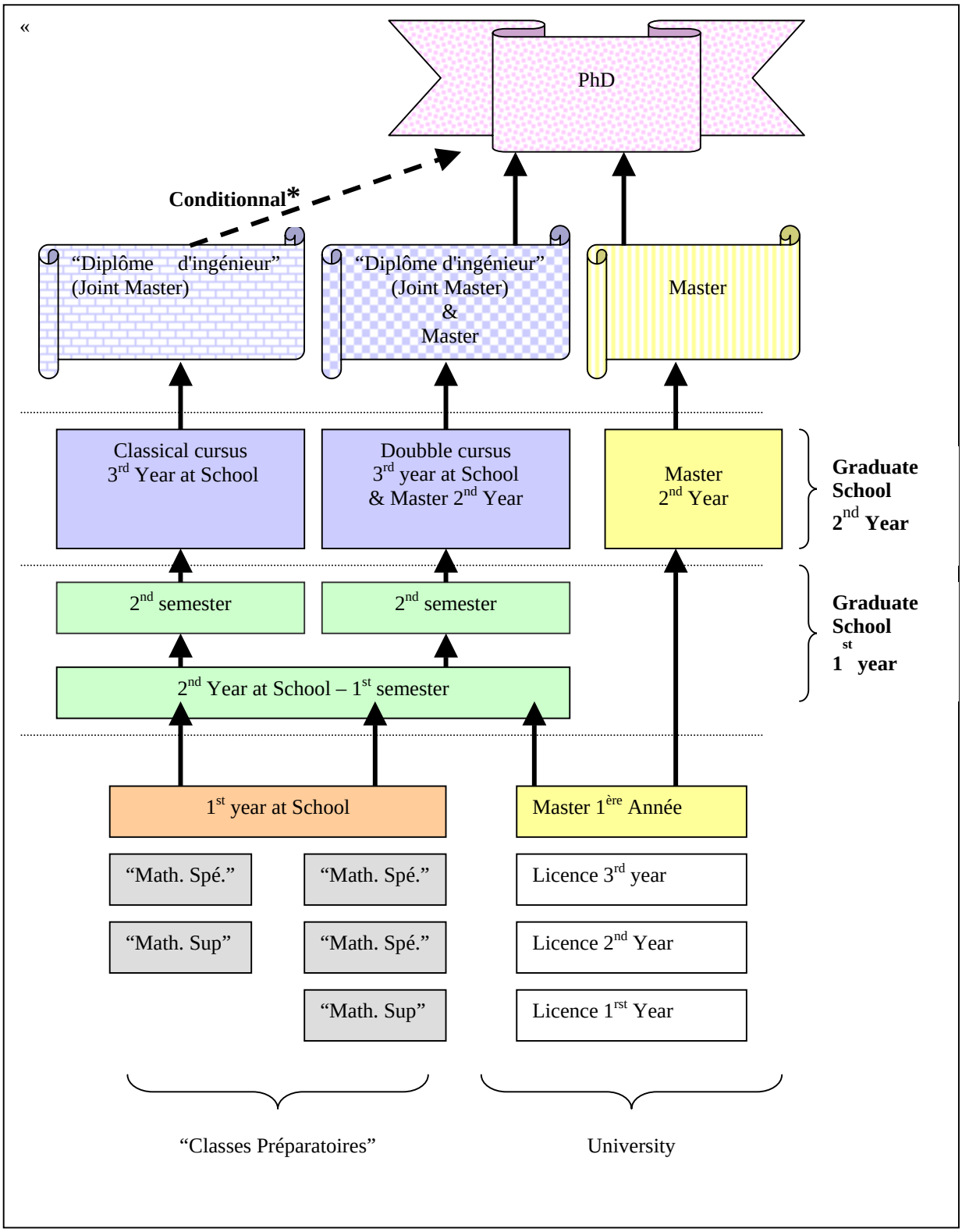
- three types of Masters programs

  - The **"Diplôme d'Ingénieur"** which is a **Joint Master** (**JM**). The student studies two majors, one of a technological nature of the student's choice and the other of a methodological nature within the field of Executive Engineering
  - a **Master of Science** (**MS**), which is the precursor of a PhD (the student can follow this program while studying for certification as a professional engineer)
  - a **Master of Science in Engineering** (**MSE**) which is a specialised course for those students who already have a Master's or Bachelor's Degree and previous professional experience.

- **"Mastères spécialisés"**

This is a post-masters course labelled " Mastère spécialisé ". It consists of 400 hours of academic study followed by a work placement (industrial thesis).

The following diagrams 1 and 2 illustrate how students gain access to the different programs (JM, MS, and PhD) offered by the Graduate School. Diagram 1 concerns French and European students, while diagram 2 applies to non-European students.



* with a compulsory of a research Graduate project

Diagram 1 : access to the GS for french and european students

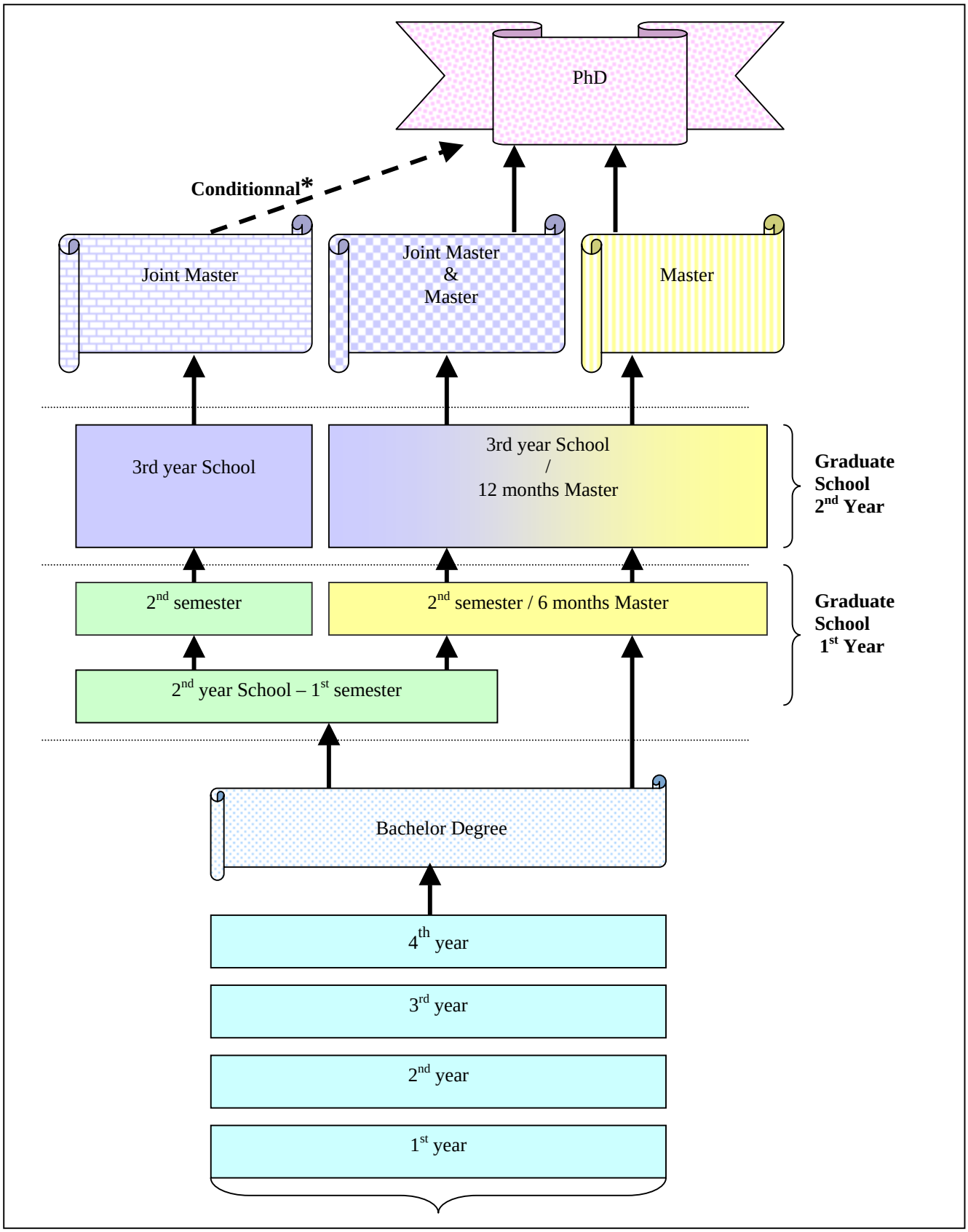


Diagram 2 : access to the GS for non-european students

III,1) THE "DIPLÔME D'INGÉNIEUR CIVIL DES MINES" – JOINT MASTER

OBJECTIVE OF THE JM

The objective of the studies leading to the "Ingénieur Civil des Mines" Diploma is to train high-level professionals known in French as "ingénieurs généralistes." The holder of a MINES Joint Masters, henceforth be referred to as an "Ingénieur" is expected to design, set up, organize and manage large-scale industrial operations in an increasingly globalized social and economic environment. The "Ingénieur" is familiar with the methods and tools used to manage projects and is therefore intended to join the ruling elite of French and international companies. He or she is able to function in all fields of activity: computer science, car manufacturing, aeronautics, energy, metallurgy, banking, insurance, consulting, engineering, auditing, etc. All these sectors, however, are faced today with the formidable challenge of globalization, which opens new avenues for our economies but also generates paralyzing contrasts. The organizational culture of the company is put to the test by the amazing fluidity of information exchange, which exacerbates the differences between interlocutors and strains communication. A case in point is the use of electronic mail, which provides immediate access to information, radically changes staff relationships, and consequently upsets the organization of the company.

Before stating what a fully qualified "Ingénieur Civil des Mines" is, let us make clear what he/she is not! He is not a professional who has been overfed with wide-ranging academic study and is consequently and supposedly familiar with many techniques and therefore capable of adapting to any field if need be. Our concept favors an integrated approach rather an accumulation of knowledge because companies do not need engineers crammed with encyclopedic knowledge but professionals able to understand the customer's needs, to manage teams, choose the technological solution that best suits the context, foresee the production problems that the design of a product can generate, take into account the possible consequences on the environment and consequently the life span of a product, and finally be able to define the strategy of the company.

Such challenges can only be met if the academic training of the student is accompanied by field experience and situation analysis. That is why projects, studies, consulting, industrial internships are increasingly developed. They allow the student to have a multi-dimensional approach and enable him/her to take into account and analyze all the factors involved.

Finally, the training of engineers aims at meeting two requirements. The first priority is to endow our Graduates with state-of-the-art skills that will give them prime access to the job market. This is the main goal of the Technology Major. The second priority is to prepare them for careers that will increasingly involve managerial responsibilities. This is achieved through a broad-spectrum curriculum leading to the Major in Executive Engineering which, together with the Technology Major, make up the certification as a professional engineer.

THE STUDY PROGRAM

Two types of programs are offered:

- **The integrated five-year cycle**: accessed through a highly selective competitive examination, since only 5% of the best scientific students in France are admitted. In compliance with the Bologna European Convention, this cycle covers two phases:

The undergraduate cycle starts with a two-year intensive mathematics and physics curriculum, followed by a year at the School, which is essentially devoted to developing skills in such scientific subjects as computer science, probability, fluid mechanics, as well as applying previously acquired knowledge to the field of engineering, and introducing management skills. By the end of the undergraduate course, the students have acquired a solid background in mathematics and physics, since 1200 hours are set aside for these two subjects.
The superior cycle is followed in the Graduate School. It begins in September and lasts for three semesters plus two summer sessions during which the students work on the two projects validating their placement in industry. Completing the projects is required for certification as a professional engineer.

- **The two-phase cycle:** Holders of a Bachelor's Degree or an equivalent diploma obtained in another university may also apply to the Graduate School. Upon admission they follow the same studies as the students of the integrated cycle.

THE TECHNOLOGICAL MAJOR

This Major is equivalent to those taken by students studying towards a Master in any university (chemical engineering etc.). Altogether, eleven Majors are offered by the five departments of each MINES School. The students study towards

these Majors for part of the first year and most of the second year. The last twenty weeks of the course are spent working on the Graduate Project. In most cases, this project work is done in industry. See the paragraph IV,2 of this chapter.

THE EXECUTIVE ENGINEERING METHODOLOGICAL MAJOR

This is the Major that makes the diploma really unique. It focuses on the methods and tools used in industrial and system engineering as well as on management and general skills. Innovative teaching methods aim at simulating real-life situations. A small portion of these courses are attended by all the students. Included in this Major is a ten-week assignment as an assistant engineer. This Graduate project is often carried out abroad.

AN OPEN CURRICULUM

The curriculum aims at meeting two objectives (which may turn out to be contradictory). On the one hand, it is very important that the curriculum should correspond to the student's wishes, although these may vary considerably from one student to the next and sometimes even lack coherence. On the other hand, the skills acquired by the student must be in keeping with the objectives advertised in the program so that the Graduate meets the demands of industry. Several tools are used in order to make sure that the students' choices are appropriate :
All the students in an entering class have to take the core-curriculum courses.
The courses offered by the Graduate School are devised in such a way that students acquire not only academic knowledge but also professional skills.
Courses can only be combined to a certain extent. This is particularly the case for the Technological Major, which may even leave no room for any choice.
These questions are usually solved on an individual basis, bearing in mind that admission to the Technological Major is effective from the first or the second semester of the second year in the Graduate School. All changes in the curriculum have to be approved by the student's adviser, who then submits them for approval to the Dean of Studies.

ADMISSION REQUIREMENTS

The "Ingénieur Civil des Mines" certification is a high-level diploma and is therefore intended for students holding a scientific Bachelor's Degree, since a very good level of mathematics and physics is required. (see undergraduate program in appendix)

LANGUAGE USED

The classes are mainly in French.

SUMMARY

The "Ingénieur Civil des Mines" diploma is a Joint Masters comprising two Majors:

- A Technological Major chosen in the first or second semester in the Graduate School and offering several concentrations.
- An Executive Engineering Methodological Major, which is unique in its kind and includes courses taken by all the students in the year group.

III,2) MASTER OF SCIENCE IN ENGINEERING

The MINES Schools offer programs leading to the Master of Science in Engineering. Each of these programs is described in chapter two.

OBJECTIVE OF THE MSE COURSE:

The MSE course leads to a specialized diploma and is intended for holders of a Masters of Science or an equivalent Degree. It can either provide extra grounding or help students to re-enter professional practice.

PROGRAM CURRICULUM

It covers two semesters, amounting to about 600 hours of academic study, followed by a twenty-two-week industrial placement leading to a research paper. The student chooses his electives with the help and agreement of his adviser. (Most courses are compulsory). The program begins in September.

ADMISSION REQUIREMENTS

Applicants to the MSE course have to hold a Masters of Science or a Bachelor of Science combined with at least three years' professional practice.

LANGUAGE USED

Depending on the MSE chosen, the classes are either in English or in French.

III,3) MASTER OF SCIENCE

In partnership with other universities or colleges of engineering, the MINES Schools provide courses leading to an MS, known in France as a Research Masters. Chapter 2 recaps and describes all the Masters offered by the MINES Schools.

OBJECTIVE OF THE MS COURSE

This MS course is the first step towards a doctoral dissertation (or: Phd). It is a doctoral program run by a MINES School and several partner universities or colleges of engineering. It should be noted that the MS also allows the student to enter professional practice.

PROGRAM CURRICULUM

The course covers two semesters amounting to 450 hours of academic study and includes two summer sessions. The first summer session is an introduction to research work and to its connection to business. The second concludes the program. It is devoted to a twenty-two-week project usually carried out in the laboratory of a company or sometimes even in the laboratory of a MINES School. This project familiarizes the student with research work.
The student chooses his electives with the help and agreement of his adviser, depending on the career considered. It should be noted, however, that most courses are compulsory.

ADMISSION REQUIREMENTS

A Bachelor's Degree and sufficient income to support themselves are required of all applicants. Candidates are admitted on the basis of their academic record after going through an audition by a jury. Only ten to twenty students are admitted through this procedure.

LANGUAGE USED

The classes are mainly in French.

III,4) POST-MASTERS NON DOCTORAL PROGRAM

A post-Graduate course can be taken at MINES Nancy. It consists of 380 hours of academic study followed by an industrial placement leading to an industrial thesis. The diploma, known as a "Mastère Spécialisé," is recognised by the Board of Engineering universities (“Conférence des Grandes Ecoles”).

OBJECTIVE

The "Mastère Spécialisé" is a highly specialised Degree intended for holders of a Master of Science Degree. It provides extra academic grounding and can, in some cases, help students to re-enter professional practice

CURRICULUM

It covers two semesters and usually consists of about 400 hours of academic study, followed by a twenty-two week industrial thesis carried out with a business partner. The course starts in September. The student chooses his electives with the help and agreement of his adviser, depending on the career considered. It should be noted, however, that most courses are compulsory.

ADMISSION REQUIREMENTS

The “Mastère spécialisé” diploma can be accessed by students holding a Masters or a Bachelor's Degree and having least three years' work experience.

III,5) PHD

The Doctorate or PhD is a Degree granted by universities, "écoles normales supérieures" and other public institutions of higher education entitled by an order issued by the Ministries of Higher Education and Research.
MINES Doctoral studies are pursued in Doctoral Schools gathering institutions such as universities and engineering Schools having the same geographical location. These studies lead students holding a Master of Science – also called “Master Recherche” – or a DEA towards a Doctoral dissertation. A Doctoral dissertation is ideally completed within a span of three years. Unless the results of the research are confidential, they should be regularly published in renowned international journals.

ADMISSION REQUIREMENTS

The applications submitted by the research teams are received by the director of the Doctoral School once they have been approved by:
The director of the laboratory or the research center where the Doctorate will be completed
The university professor who will supervise the research.
The applicant is also required to have a scholarship that will allow him to support himself all through his Doctoral study.

Standard admission procedure

In order to enroll for a Doctorate, the student must have received a Master of Science geared towards research (also known as Master Recherche in France) If the student holds a Master's Degree in another scientific field than the one in which he is going to do the research, he must be authorized to pursue his research by the professor in charge of the Master of Science corresponding to his research subject.

Dispensatory procedure

If the above-mentioned requirements are not fulfilled, a candidate may enroll provided he has received an equivalent Degree. This procedure also applies to students having studied towards a Master's Degree abroad or having relevant professional practice.

CURRICULUM

The optimal duration of the PhD is 3 years. Relationships between the different partners of the thesis : Doctoral candidates, mentors and administration have an engagement and a thesis contract which resembles a certain number of recommendations to the usage of different partners involved by the enrichment of the Doctorate thesis and concern all the Doctoral candidates, Professors and researchers here at the “Ecoles” de MINES.

This Engagement leads to a serious involvement in the different partners involved in these doctoral studies and define better the roles and responsibilities of each one throughout the length of the thesis. It is flexible in its applications in order to take into account diversity of each of these institutions and hence opens the way to internal adaptations focusing to complete or precise certain of their characteristics. It is the object of the thesis contract.

The doctoral training, outside of research work, is divided into three sectors : scientific training destined to give the students required knowledge to complete his research work, an interdisciplinary training allows the acquisition and the mastering of communications skills or self-expression, and the rights of intellectual property. Moreover, this training prepares the student to his own professional integration either in higher education or in social and economic areas.

The entire education is mandatory ; it is followed during all of the doctoral cursus for every students of the Doctoral School. The authorization of defense of the PhD cannot be given to doctoral candidates who has not fulfilled his obligations of studies.

DEFENSE OF THE THESIS

The doctoral advisor in charge of the training establishes the composition of the jury, mentioning clearly the names and titles of the President and the referees. In addition, he sends this composition for approbation to institutions for verification.

The required documents for the defense (the proposition of the jury must be signed, the defense certificate report must be prepared, the advice of the jury for printing the thesis given and the defense report authorized) are sent to thesis director with those sent to candidate. This fills out the registration requirements, which are then computerized with the aid of our library. They must be joined by three exemplars or the thesis submitted to the secretary of the doctoral school.

The defense is public (except in case of confidentiality linked to industrial contracts). The acceptance or the rejection is pronounced after the jury deliberation. The acceptance gives the possible judged levels: « *cum laude, magna cum laude or summa cum laude*". The President of the Jury establishes a defense report, which is countersigned by every member of the jury. He transmits an evaluation on the possibility of reprinting the thesis as is or after corrections.

IV) Teaching methods

As all GEM universities, MINES universities promote original educational methods which enable students to meet the companies' expectations efficiently once they have obtained their diploma. These educational methods have already been discussed in the general introduction. Nevertheless, MINES universities have specific features.

1) COURSES

As far as the master's program is concerned, fewer than 40 students enroll on 90% of the courses. Besides, there are no more than 20 students in most courses.

2) THE GRADUATE PROJECTS

The master's Degrees prepared in a MINES university are completed by a Graduate Project which is carried out during the summer session.

For Masters of Science or R&D Joint Masters, this project consists in research work in an industrial laboratory. Students thus have a first experience in research. At the end of the project, students have to write a report and give an oral presentation which will be assessed by a jury. The project is both an introduction to research and a selective admission test to the PhD program.

For MSEs and other JMs, the Graduate project is similar to a real industrial project. Students also have to write a report and give an oral presentation assessed by a jury. However, students should be assessed as if they were actual engineers. To do this project, students are usually part of a company and are supervised by a university teacher and someone in the company. Since students have to address a current problem in the company, they generally develop managerial skills in addition to technical and scientific skills.

Finally, JM students have to prepare a second Graduate project during the first summer session in order to have a major in Executive Engineering.

V) Alumni Associations

Founded in 1867, the Alumni Association of *MINES Saint-Etienne* consists of a network of more than 3 000 Graduate engineers working in France or abroad in a wide range of fields : engineers, high level managers and directors both in industry and in the service sector. The association provides continuous support to the Graduate School through the experience and contacts of its members, as well as being of great assistance to the students :

- grants for going abroad given by a foundation involved in the international development of the Graduate School
- loans made with no guarantee of repayment (in addition to the Graduate School's grants)
- accommodation of 351 rooms in a pleasant modern environment
- assistance with the student sporting and cultural societies

Founded in 1920, the Alumni association of *MINES Nancy* consists of a network of more than 2 100 subscribers working in a variety of economic sectors throughout the country. It provides a close link with former students.

The foundation of *MINES Nancy*, founded in 1920, supports the Graduate School's development. It provides grants for going abroad, loans made with no guarantee of repayment and specific grants to support the Graduate School's initiatives.

The Alumni societies of *MINES* and the *Ecole des Mines de Paris* are brought together under the umbrella of *INTERMINES*. With its 13 000 Graduates, this society is able to undertake a variety of activities to help its members integrate the world of work and develop their careers :

- an Internet site devoted entirely to jobs (informines.org) : for subscribed members of the three societies, for future student members and recruiters working in partnership.
- a directory listing all the members, a privileged source of contacts between members and industry. One part is continually updated and can be consulted on the website by recruiters.
- a bimonthly review, an excellent communication tool between former students, the Graduate Schools, students and the economic world.
- professional clubs, high level places to meet and exchange ideas : IT, finance, risk and insurance, environment, energy etc.
- a Career Service ("*Intermines-carrières"*) which, working closely with the website informines.org, offers career development advice or help finding your first job.

VI) Research

Research at the *MINES* is characterized by three main ambitions :

- a high scientific level demonstrated by its publications and communications within the world of science, as well as by the management of numerous laboratories linked to the *CNRS* and the involvement of its research teams in numerous national and international networks.
- A strong connection with the economic world achieved by research contracts and technology transfers with large French and foreign industrial groups, as well as with a number of small or medium size hi-tech companies.
- A strong interaction with training activities.

1) RESEARCH ORIENTED ACCORDING TO A RESTRICTED NUMBER OF APPLICATIONS

As Graduate Schools training engineers and researchers, the *MINES* universities have structured their research along five main lines :

- **Materials Engineering** focuses on processing, the problems of corrosion, biomaterials, ceramics and materials properties (mechanics, functions etc).
- **Process Engineering** focuses on the physico-chemical processes bringing into play powders, sensors for the continual checking of processes, the treatment of wood, the safety problems linked to fluids and the geochemical problems of natural processes, energy, the optimization of energy consumption in processes.
- **Environmental Engineering and Earth Sciences** focuses on clean processes, earth treatment, problems linked to safety, geographic information systems and environmental management particularly in small and medium size industries.

- **Industrial Engineering and Organization**, particularly the networks of small and medium size companies and the organization of developed workshops.
- **Information Technology**, the main areas being safety and validity of information on the Internet, multi-agent systems, the treatment of image, industrial mathematics, algorithmic, networks, critical systems, bioinformatics.

2) A HIGH LEVEL RESEARCH

The research activities are conducted in the Graduate School's laboratories, according to the approved research areas. These areas are defined in relation with the missions assigned to the Schools, the scientific policies proposed by the partner institutions (the *CNRS* in particular), as well as the industrial partners. The laboratories are regularly audited by different authorities (CNRS committees, GEM group audits, etc).

3) RESEARCH STRUCTURED FOR OPTIMAL DOCTORATE ACHIEVEMENT

The doctorate students are generally supervised and guided according to a methodology heavily based on modeling (processes, production systems, materials behaviors, etc), established on an experimental basis and checked by a set of simulations. In a large majority of cases, the subjects lead to industrial collaboration, therefore enabling students to have a strong link with industry, facilitating their future integration into the business world. These doctoral students are greatly encouraged to get involved in teaching activities and must publish their results in scientific reviews in order to open up employment possibilities in public research.

Over the last five years, the distribution of PhD grants was, in Nancy and Saint-Etienne respectively, 50% (45%) Graduate School grants and 50% (55%) external finances (ADEME, regional and industrial grants, the latter including CIFRE grants etc). In 2002, the employment of doctors was for Nancy (and Saint-Etienne) respectively 60% (45%) in the private sector and 40% (55%) in the public sector.

4) RESEARCH SUPPORTED BY A VARIETY OF TECHNICAL EQUIPMENT

The different technical equipment is distributed among the different School laboratories, occupying a total of 6 200 square meters in Saint-Etienne and 10 000 square meters in Nancy. This equipment includes :

- specialized scientific libraries along with central document libraries
- IT support for calculations and modeling (about 600 computers in Saint-Etienne and in Nancy).
- Equipment for working on materials (metals, powders, monocrystals, thin strips, etc).
- Equipment to study processes (reactors, ovens, Chemical Engineering equipment, etc).
- Heavy equipment for characterizations : mechanical tests (traction machines, friction, corrosion under stress, etc), MEB and TEB electronic microscopes, Auger, ESCA and SDL surface analysis, mass spectrometers, IR and UV optical methods, several Diffraction of X-rays equipment, thermal analysis methods with several thermo-balances, DSC, chemical analysis by fluorescence X or ICP, gas analysis by IR chromography or spectrometer, etc.

5) RESEARCH IN PERMANENT COLLABORATION WITH THE ECONOMIC WORLD

In 2002, the total amount of contracts signed by *MINES Saint-Etienne* was approximately 3.3 M Euros and 4.25 M Euros for the laboratories in Nancy. To this figure, one should add the grants for researchers and PhD students made available to the School by different partners : Research organizations or companies. These contracts cover a variety of periods of time, from a project of a few months to ones of several years. Each year, several patents are registered by the different Schools.

6) RESEARCH OF A INTERNATIONAL CHARACTER

Numerous research teams are involved in international collaborations and partnerships. For example, in 2002, *MINES Saint-Etienne* welcomed several foreign post-doc researchers (6 for periods of more than 6 months). The involvement of *MINES Saint-Etienne* in European contracts represented a total sum of 640 K Euros for 15 contracts in 2002. Similarly, *MINES Nancy* welcomed 7 foreign researchers and 20 post-doctoral students in 2002.

CHAPTER 2: COURSES LISTING ARRANGED BY DEPARTMENTS

I) Overview of Graduate programs

GRADUATE PROGRAMS IN ENERGETICS AND CHEMICAL ENGINEERING :

Joint Master in Executive Engineering and :
- Energy and process engineering (Nancy, Saint-Etienne)

Master of Science in :
- Mechanical engineering & energetics (Nancy)
- Chemical Engineering (Saint-Etienne)

PhD in :
- Solid state chemistry and reactivity (Saint-Etienne)
- Powder technology (Saint-Etienne)
- Chemical microsystems and microreactors (Saint-Etienne)
- Industrial crystallization (Saint-Etienne)
- Organic-inorganic multicomponent materials (Saint-Etienne)
- Thermohydraulics and industrial safety (Saint-Etienne)
- Interaction between fluids and mineral materials
- Biomedical engineering (Saint-Etienne)
- Heat and Mass transfer (Nancy)
- Energetics (Nancy)
- Mechanical Engineering (Nancy)
- The mechanical properties of solids (Nancy)

GRADUATE PROGRAMS IN ENVIRONMENTAL, GEOLOGICAL AND CIVIL ENGINEERING :

Joint Master in Executive Engineering and :
- Environmental engineering (Nancy)
- Environmental engineering and sustainable development (Saint-Etienne)

Master of Science in :
- Protection, organization and exploitation of soil and sub-soil.(Nancy)
- Territorial organisation, decision support systems and sustainable development (Saint-Etienne)

« Mastère spécialisé » in :
- Industrial modernization and sustainable development (Nancy)

PhD in :
- Environmental information systems (Saint-Etienne)
- Information systems and sustainable development (Saint-Etienne)
- Control and supervision of Eco-industrial processes (Saint-Etienne)
- Natural and technological risks (Saint-Etienne)
- Geological engineering (Nancy)

GRADUATE PROGRAMS IN APPLIED MATHEMATICS,COMPUTER SCIENCE AND ENGINEERING :

Joint Master in Executive Engineering and :
- Computer engineering (Nancy, Saint-Etienne)
- Bio-informatics (Nancy)
- Applied mathematics and financial engineering (Nancy)

Master of Science in :

- Mathematics (Nancy)
- Applied mathematics (Nancy)
- Mathematical modeling and applications (Saint-Etienne)
- Computer science, software engineering (Nancy)
- Computer science, Web intelligence (Saint-Etienne)
- Image processing, artificial vision and signal processing (Saint-Etienne)

PhD in :

- Networks, information, multimedia (Saint-Etienne)
- Multi-agents systems (Saint-Etienne)
- Image processing and pattern recognition (Saint-Etienne)
- Stochastic modeling and statistical inference (Saint-Etienne)
- Numerical modeling of physical phenomena (Saint-Etienne)
- High performance computations, networks and graphics (Nancy)
- Remote control and intelligent assistants (Nancy)
- Natural language processing, documents and scientific and technical information processing (Nancy)
- Quality and confidence of software and computer systems (Nancy)
- Bioinformatics and genomic applications (Nancy)
- Partial differential Equations (Nancy)
- Probabilities (Nancy)

GRADUATE PROGRAMS IN INDUSTRIAL AND SYSTEMS ENGINEERING :

Joint Master in Executive Engineering and :

- Industrial engineering (Nancy, Saint-Etienne)
- Industrial engineering and management (Saint-Etienne)

Master of Science in Engineering in :

- Industrial economy and international management (Nancy)

« Mastère spécialisé » in :

- Operational Research and decision aid strategy (Nancy)

PhD in :

- Scientific methods of industrial management for decision aid (Saint-Etienne)
- Enterprise and enterprise network modeling (Saint-Etienne)
- Industrial systems modeling (Nancy)
- Performance evaluation (Nancy)
- Production management (Nancy)

GRADUATE PROGRAMS IN MATERIALS SCIENCE AND MECHANICAL ENGINEERING :

Joint Master in Executive Engineering and :

- Materials science and engineering (Nancy)
- Materials science and mechanical engineering (Saint-Etienne)

Master of Science in :

- Physics and chemistry of matter and materials (Nancy)
- Materials science and engineering (Nancy)
- Science and engineering of materials (Saint-Etienne)
- Mechanics and engineering (Saint-Etienne)

PhD in :

- Science and Engineering of Materials Production (Nancy)
- Microstructures and properties (Nancy)
- Surfaces and interfaces (Nancy)
- Treatments and Treatment Processes (Nancy)
- Materials Science and engineering (Saint-Etienne)
- Mechanics and engineering (Saint-Etienne)

II) A short explanation of the classification codes used in the catalog to define courses.

Let's take this example:

M STE ECH 411 Process Engineering
7-3 ECTS - 120 hours - P. Grosseau

M indicates that this is a module, which is linked to several courses. This notation is often applied to course at MINES Saint-Etienne. STE indicates that the module or course is taught at Saint-Etienne.
For another example: NAN is used for the campus at Nancy.
ECH specifies from what the department the course is based. Here is a list of departments or specializations and there corresponding codes:

- ECH : Energetics and CHemical engineering
- EGC : Environmental, Geological and Civil engineering
- AMC : Applied Mathematics,Computer Science and Engineering
- INS : INdustrial and Systems engineering
- MAM : MAterials science and Mechanical engineering

- the first number, here 4, indicates the level of the course :

- 4 for the first year studies at GS.
- 5 denotes for the second year at GS
- 6 for the intensified second year courses (in particular, the MS courses)
- 7 for doctoral studies.

- The two last numbers attibute a course number. If they start by 0 to 4, they concern the first semester, and 5 to 9 is used for the second semester. Here, the example begins with 1, this signifies first semester course.
- The ECTS credits (European Credits Transfer System) are distributed between directed studies (first number) and estimated personal work (second number). For example, 10 ECTS credits could be divided between 7 in directed work and 3 for personal work, which gives 7-3 ECTS credits.
- the number of indicated hours corresponds to presented lectures and courses scheduled during the semester.
- The listing finishes by naming the professor responsible for the course.

We note that for the modules which are linked to several courses, those are coded as the module by deleting the M of the module and by terminating the number with a letter (alphabetically progressing).
In the present case, courses constituting the Module M STE ECH 411 are :

- STE ECH 411A Transfers
- STE ECH 411B Unit Operations
- STE ECH 411C Practical Work
- STE ECH 411D Process industrialization

III) Graduate programs in Energetics and Chemical Engineering

1) MAJORS INCLUDED IN THE « DIPLÔME D'INGÉNIEUR CIVIL DES MINES»

NANCY : MAJOR IN ENERGY AND PROCESS ENGINEERING

This program is only available as a Major for the Joint Master in Executive Engineering & Energy and Process Engineering. The program offers three « concentrations » which have several fundamental course in common.

The Concentration in Energy-Industry

This concentration focuses on the sector of industrial production, where questions of energy use play a capital role. The majority of industrial systems that transform materials in order to create a product (either fluid or solid), or to create energy are concerned by this vast subject.

The goal of the program is to provide students with a methodological structure that will allow them to understand industrial systems from a double viewpoint :

- by the analysis, the study of, and the understanding of the elementary chemical and physical processes that play a role in industrial systems (heat transfer, kinetics, etc.),
- by calculating industrial units through the use of scientific bases and mathematical modeling, and focussing on the conception, design, and optimization or automatization of these units.

The methodology and the concepts introduced in this program can be applied to extremely varied industrial sectors, from refineries and the petro-chemical industry, the glass industry, the nuclear energy industry, to the development and treatment of materials and energy production.

A) THE TECHNOLOGICAL MAJOR (495 HOURS, 47 ECTS)

GS 1 : 4 courses & 1 project

- Fluid mechanics (NAN ECH 411)
- Heat and mass transfer (NAN ECH 412
- Digital simulation of transfer phenomenon (NAN ECH 451)
- Analysis and optimization of industrial processes 1 (NAN ECH 452)

Team project (NAN ECH 400)

GS2 : 3 courses & 1 project

- Transfer Phenomenon in Permeable Atmosphere and Diphase Flow (NAN ECH 514)
- Analysis and optimization of industrial processes 2 (NAN ECH 511)
- Dimensioning and Dynamics of Processes (NAN ECH 512)

Scientific project (NAN ECH 500)

B) THE METHODOLOGICAL MAJOR (444 HOURS, 48 ECTS)

Program in Management - Social & Cultural Awareness (174 hours, 18 ECTS)

5 courses

- Company management 1 (NAN GME 413) (30hrs, 3 ECTS
- Company management 2 (NAN GME 451) (30hrs, 3 ECTS)

- **1 course** (45hrs, 5 ECTS) chosen from the following list (**List L3 M**, page xxx) : Management supervision (NAN GME 511), Macro-economy and finance (NAN GME 512), International trade (NAN GME 513), Bank systems and financial products (NAN GME 514)
- **1 course** (24 hrs, 2 ECTS) chosen from the following list (**List L3 O**, page XXX): Design the city (NAN GME 471), What is Science (NAN GME 472), Building a modern identity(NAN GME 473), Ethics and society (NAN GME 474)
- **1 course** (45hrs, 5 ECTS) chosen in the list of electives activities

Courses in Industrial Engineering (270 hours, 30 ECTS) :

5 courses (5 ECTS, 45 hrs each)

- Operations research (NAN GME 411)
- Statistics (NAN GME 412)
- **A couple of courses** from the **List 2**: Design, Innovation, Production (NAN GME 414 + NAN GME 454), Risk sciences (NAN GME 415 + NAN GME 455), Environment, Clean and sound technology and recycling (NAN GME 416 + NAN GME 456), Protective engineering and social advancement (NAN GME 41 + NAN GME 457), E-business (NAN GME 418 + NAN GME 458), Aeronautics (NAN GME 419 + NAN GME 459), Civil engineering and society (NAN GME 420 + NAN GME 460)
- **2 courses** chosen in the list of electives activities

Elective activities (one per semester ; 45 hours, 5 ECTS each)

- **One of the following courses** (Liste **L4 A):**
  Materials working (NAN GME 421), Digital simulation (NAN GME 422), Numerical analysis (NAN GME 423), Data-processing techniques and solutions for the company (NAN GME 424),
- **One of the following courses** (Liste **L4 B):**
  Physics for the computer (NAN GME 461),Materials for the engineer (NAN GME 462), Automation, instrumentation and industrial process control (NAN GME 463), Tools and environment in industrial process (NAN GME 464), Finance analysis and diagnose (NANGEM 465), Energy economy (NAN GME 468), Optimization (NAN GME 469).
- **One of the following courses** (Liste **L4 C**)::
  Programming pearls (NAN GME 515), Automation and digital control (NAN GME 516), Statistical data-processing (NAN GME 517), Micro-economy and game theory (NAN GME 518), Fracture mechanics (NAN GME 519), International business negotiation (NAN GME 520), Company communication practice (NAN GME 521).

C) MISCELLANEOUS ACTIVITIES :

- An 8 weeks internship abroad whose goal is to get familiar with the environment and culture of foreign companies
- Graduate project (NAN ECH 550)
- Foreign languages training : 210 hours

The Concentration in Gas Energy

In a world economy which continues to have high energy needs, the importance of natural gas will continue to increase. With this in mind, companies with large energy needs also have a high demand for highly trained engineers who have complementary competencies in the field of natural gas use.
Coursework in this program unites fundamental knowledge (fluid mechanics, combustion, thermic energy, simulations, automation, regulation, etc.) with technical knowledge specific to the natural gas industry (production, transportation, storage, thermic engines, etc.)

A) THE TECHNOLOGICAL MAJOR (495 HOURS, 47 ECTS)

GS 1 : 4 courses & 1 project

- Fluid mechanics (NAN ECH 411)
- Heat and mass transfer (NAN ECH 412)
- Production, inventory, transport & distribution (NAN ECH 454)
- Combustion (NAN ECH 453)

Team project (NAN ECH 400)

GS2 : 3 courses & 1 project

- Energy market, politics and economy (NAN ECH 514)
- Dimensioning and Dynamics of Processes (NAN ECH 511)
- Machines and use of fuel (NAN ECH 515)

Scientific project (NAN MAM 500)

B) THE METHODOLOGICAL MAJOR (444 HOURS, 48 ECTS)

See the program described above for the concentration in Energy - Industry

C) MISCELLANEOUS ACTIVITIES

a. An 8 weeks internship abroad whose goal is to get familiar with the environment and culture of foreign companies
b. Graduate project (NAN ECH 550)
c. Foreign languages training : 210 hours

The Concentration in Motors-Energy

Mastering the knowledge of propulsion systems requires an understanding of the scientific and technological aspects of transfer mechanisms and energy transformation.

The existence of data processing tools now makes modeling these mechanisms and solving the complex equations resulting from these models possible.

The goal of this concentration is to produce engineers who will be able to adapt to a large range of different industries. Specifically, the competencies Graduates will have acquired in the field of propulsion will allow them to work in the automobile and aeronautic industries as well as in companies that deal with transportation.

A) THE TECHNOLOGICAL MAJOR (525 HOURS, 46 ECTS)

GS 1 : 4 courses & 1 project

- Fluid mechanics (NAN ECH 411) ; 45 h ; 4,5 ECTS
- Heat and mass transfer (NAN ECH 412) ; 45 h ; 4,5 ECTS
- Digital simulation of transfer phenomenon (NAN ECH 451) ; 45 h ; 4,5 ECTS
- Combustion (NAN ECH 453) ; 45 h ; 4,5 ECTS

Team project (NAN ECH 400) ; 75 h ; 5 ECTS

GS2 : 3 courses & 1 project

- Transfer Phenomenon in Permeable Atmosphere and Diphase Flow (NAN ECH 514)
- Machines (NAN ECH 516) ; 45 h ; 4,5 ECTS
- Electric machines (NAN ECH 517) ; 45 h ; 4,5 ECTS

Scientific project (NAN ECH 500) ; 90 h ; 9 ECTS

B) THE METHODOLOGICAL MAJOR (444 HOURS, 48 ECTS)

See the program described above for the concentration in Energy - Industry

C) MISCELLANEOUS ACTIVITIES :

a. An 8 weeks internship abroad whose goal is to get familiar with the environment and culture of foreign companies
b. Graduate project (NAN ECH 550)
c. Foreign languages training : 210 hours

SAINT-ETIENNE: MAJOR IN ENERGY AND PROCESS ENGINEERING

This program leads to the Joint Master in Executive Engineering & in Energy and Process Engineering. Only certain combinations of modules are offered ; these combinations constitute the concentrations. All module combinations not listed must be approved by the advisor and the Program Head.

This program covers, on the one hand, the application and verification of materials transformation processes (single or multi-phased reactors), and on the other hand, the tools for energy production in automotive and electricity applications. Within this framework, several main focuses are proposed.

The concentration in Industrial processes

The industrial processes concentration is situated at the product end of industrial processes. It is therefore oriented toward students who are more interested by the development conception and implementation dimensioning and the running of installations than by physico-chemical models. Graduates of the program find jobs in process services, technical assistance, and engineering, rather than in research. This concentration offers career opportunities in varied fields ranging from refineries and the petro-chemical industry, to chemistry, pharmaceutics, the food industry, metallurgy, energy, and bio-processes.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS):

- **1 elective module** (120 hours, 10 ECTS) **:** Process engineering (M STE ECH 411) **or** Energetics (M STE ECH 421)
- **1 compulsory module** (90 hours, 9 ECTS) **:** Modeling of processes (M STE ECH 511)
- **1 compulsory module** (90 hours, 9 ECTS) **:** Flowsheeting (M STE ECH 514)
- **1 compulsory module** (90 hours, 9 ECTS) **:** Environmental and process security (M STE ECH 516)
- **1 compulsory project** (90 hours, 9 ECTS) : Design project (M STE ECH 540)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management - Social & Cultural Awareness (186 hours, 15 ECTS):

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*
- **One elective module** chosen among the following **:**

  Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).-

One elective module chosen among the following **:**

Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

- **One elective module chosen among the following ,** (120 hours each) from the List L1,chapter III :

Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), Natural processes (M STE GME 415).

- One elective module chosen among the following :

Danger and Risk assessment (M STE GME 451), Decision making and optimization for industrial processes (M STE GME 452), Elaboration and transformation of Materials (M STE GME 453), Industrial Systems Engineering (M STE GME 454), Physical methods for the characterization of the matter (M STE GME 455).

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in **energy and process engineering** (STE ECH 550).

- **Foreign Languages** : 100 hours

- **Sports activities** : 114 hours

The concentration in Industrial management and processes

The industrial processes and management concentration produces engineers who want to develop processes that take into account the constraints linked to industrial production : flow management, workshop management, layout, etc. Students are introduced to software for professional simulations of production processes : flowsheeting for the physico-chemical part of the process, but also simulation of the entire production cycle.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS)

- **1 elective module** (120 hours, 10 ECTS) **:** Students are advised to choose *Process engineering* (M STE ECH 411) **or** *Energetics* (M STE ECH 421)

But they may choose another module with the agreement of the adviser among *Mechanics* (M STE MAM 411), *Materials* (M STE MAM 412), *Information systems Engineering* (M STE AMC 411)

- **1 compulsory module** (90 hours, 9 ECTS) **:** *Industrial engineering* (M STE ECH 511)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Flowsheeting* (M STE ECH 514)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Environmental and process security* (M STE ECH 516)
- **1 compulsory module** (90 hours, 9 ECTS) : Design project (M STE ECH 540)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management - Social & Cultural Awareness (186 hours, 15 ECTS):

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

- One elective module chosen among the following **(**120 hours each**)** from the List L1,chapter III :

Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

One elective course chosen among the following (30 hours each) from the List L2,chapter III

Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

One elective module chosen among the following **(**120 hours each) from the List L3,chapter III :
Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), Natural processes (M STE GME 415).

One elective module chosen among the following (120 hours each) from the List L4,chapter III **:**
Danger and Risk assessment (M STE GME 451), Decision making and optimization for industrial processes (M STE GME 452), Elaboration and transformation of Materials (M STE GME 453), ***Industrial Systems Engineering*** *(M STE GME 454), Physical methods for the characterization of the matter (M STE GME 455).*

Students are advised to choose the ***Industrial Systems Engineering*** module (M STE GME 415) , but may choose another module with the agreement of the adviser.

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in **energy and process engineering** (STE ECH 550).

- **Foreign Languages** : 100 hours

- **Sports activities** : 114 hours

The concentration in Energy and processes

The energy and processes focus trains engineers to design and to maintain the industrial processes for energy production in industries where energy issues are fundamental. Career opportunities can be found for example in large energy-producing companies in jobs which require control of processes, or in companies whose processes require numerous energy conversion steps (refineries, etc.), or in companies which build or develop thermal machinery.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS) :

- **1 elective module** (120 hours, 10 ECTS) **:** Students are advised to choose *Energetics* (M STE ECH 421)

But they may choose another module with the agreement of the adviser among *Process engineering* (M STE ECH 411) *Mechanics* (M STE MAM 411), *Materials* (M STE MAM 412), *Information systems Engineering* (M STE AMC 411)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Modeling of processes* (M STE ECH 511)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Flowsheeting* (M STE ECH 514)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Energetics* (M STE ECH 517)
- **1 compulsory module** (90 hours, 9 ECTS) : Design project (M STE ECH 540)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management - Social & Cultural Awareness (186 hours, 15 ECTS):

- *Audit* (STE GME 416)
- *Research of Information and Interview Techniques* (STE GME 417)

- **One elective module chosen among the following (**120 hours each**)** from the List L1,chapter III :
Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

One elective course chosen among the following (30 hours each) from the List L2,chapter III
Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

One elective module chosen among the following (120 hours each) from the List L3,chapter III :
*Industrial and Systems Engineering (M STE GME 411), **Finite Elements and Structures** (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), Natural processes (M STE GME 415).*
Students are advised to choose the ***Finite Elements and Structures (M STE GME 412)*** module, but may choose another module with the agreement of the adviser.

One elective module chosen among the following (120 hours each) from the List L4,chapter III **:**
*Danger and Risk assessment (M STE GME 451), Decision making and optimization for industrial processes (M STE GME 452), Elaboration and transformation of Materials (M STE GME 453), **Industrial Systems Engineering** (M STE GME 454), Physical methods for the characterization of the matter (M STE GME 455).*

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in **energy and process engineering** (STE ECH 550).

- **Foreign Languages** : 100 hours

- **Sports activities** : 114 hours

The c**oncentration in Oil production**

The focus in oil production prepares engineers for careers in exploring petroleum resources, as well as design and set up refinery installations. Engineers with this type of profile are found in prospecting companies and companies that exploit petroleum fields, as well as in companies which convert petroleum or gas.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS):

- **1 elective module** (120 hours, 10 ECTS) **:** Students are advised to choose *Energetics* (M STE ECH 421)

But they may choose another module with the agreement of the adviser among *Process engineering* (M STE ECH 411) *Mechanics* (M STE MAM 411), *Materials* (M STE MAM 412), *Information systems Engineering* (M STE AMC 411)

- **1 compulsory module** (90 hours, 9 ECTS) **:** *Sedimentary reservoir* (M STE ECH 513)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Flowsheeting* (M STE ECH 514)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Environmental and process security* (M STE ECH 516)
- **1 compulsory project** (90 hours, 9 ECTS) : Design project (M STE ECH 540)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management - Social & Cultural Awareness (186 hours, 15 ECTS):

- *Audit* (STE GME 416)
- *Research of Information and Interview Techniques* (STE GME 417)

- **One elective module chosen among the following (**120 hours each**)** from the List L1,chapter III :
  Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

One elective course chosen among the following (30 hours each) from the List L2,chapter III
Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

One elective module chosen among the following (120 hours each) from the List L3,chapter III :
Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), ***Natural processes*** *(M STE GME 415).*

Students are advised to choose the ***Natural processes*** *(M STE GME 415)* module, but may choose another module with the agreement of the adviser.

One elective module chosen among the following (120 hours each) from the List L4,chapter III **:**
Danger and Risk assessment (M STE GME 451), Decision making and optimization for industrial processes (M STE GME 452), Elaboration and transformation of Materials (M STE GME 453), Industrial Systems Engineering (M STE GME 454), Physical methods for the characterization of the matter (M STE GME 455).

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in **energy and process engineering** (STE ECH 550).

- **Foreign Languages** : 100 hours

- **Sports activities** : 114 hours

The concentration in Geo-reservoirs and the environment

The concentration in geo-reservoirs and the environment is intended for students seeking professional training in the field of water resources.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS):

- **1 elective module** (120 hours, 10 ECTS) **:** Students are advised to choose *Energetics* (M STE ECH 421)

But they may choose another module with the agreement of the adviser among *Process engineering* (M STE ECH 411) *Mechanics* (M STE MAM 411), *Materials* (M STE MAM 412), *Information systems Engineering* (M STE AMC 411)

- 1 compulsory module (90 hours, 9 ECTS) **:** *Sedimentary reservoir* (M STE ECH 513)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Environmental data & models* (M STE ECH 515)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Land planning* (M STE ECH 518)
- 1 compulsory project (90 hours, 9 ECTS) : Design project (M STE ECH 540)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management - Social & Cultural Awareness (186 hours, 15 ECTS):

- *Audit* (STE GME 416)
- *Research of Information and Interview Techniques* (STE GME 417)

- One elective module chosen among the following (120 hours each**)** from the List L1,chapter III :
Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

One elective course chosen among the following (30 hours each) from the List L2,chapter III
Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

One elective module chosen among the following (120 hours each) from the List L3,chapter III :
Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), ***Natural processes*** *(M STE GME 415).*

Students are advised to choose the ***Natural processes*** *(M STE GME 415)* module, but may choose another module with the agreement of the adviser.

One elective module chosen among the following (120 hours each) from the List L4,chapter III **:**
Danger and Risk assessment (M STE GME 451), Decision making and optimization for industrial processes (M STE GME 452), Elaboration and transformation of Materials (M STE GME 453), Industrial Systems Engineering (M STE GME 454), Physical methods for the characterization of the matter (M STE GME 455).

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in **energy and process engineering** (STE ECH 550).

- **Foreign Languages** : 100 hours

- **Sports activities** : 114 hours

The concentration in Chemical engineering R&D

The focus in chemical engineering research and development is intended for students who want an introduction to research methods, either as a tool to define new processes, or as for optimizing existing processes. Applications are in the field of materials transformation. This focus allows students to **simultaneously** obtain a Master of Science ("Master Recherche") degree in Chemical Engineering, and to become « Research and Development » engineers.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS):

- **1 elective module** (120 hours, 10 ECTS) **;**
Process engineering (M STE ECH 411) **or** *Materials* (M STE MAM 412) or *Energetics* (M STE ECH 421)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Modeling* (M STE ECH 611)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Reactivity of solids* (M STE ECH 612)

- **1 project** (180 hours, 18 ECTS) **:** *Personal research project* (M STE ECH 640)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management - Social & Cultural Awareness (186 hours, 15 ECTS):

- *Audit* (STE GME 416)
- *Research of Information and Interview Techniques* (STE GME 417)

- **One elective module chosen among the following (**120 hours each**)** from the List L1,chapter III :
Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

One elective course chosen among the following (30 hours each) from the List L2,chapter III
Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

One elective module chosen among the following (120 hours each) from the List L3,chapter III :
Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), Natural processes (M STE GME 415).

One elective module chosen among the following (120 hours each) from the List L4,chapter III **:**
Danger and Risk assessment (M STE GME 451), Decision making and optimization for industrial processes (M STE GME 452), Elaboration and transformation of Materials (M STE GME 453), Industrial Systems Engineering (M STE GME 454), Physical methods for the characterization of the matter (M STE GME 455).

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in **energy and process engineering** (STE ECH 650, obtaining simultaneously a Master of Science).

- **Foreign Languages** : 100 hours

- **Sports activities** : 114 hours

2) MASTER'S PROGRAMS LEADING TO A MASTER OF SCIENCE :

SAINT-ETIENNE : CHEMICAL ENGINEERING

CONTACT : Gérard Thomas (thomas@emse.fr)

PARTNERSHIP AND INSTITUTIONAL FRAMEWORK

This Master of Science involves the following institutions and laboratories:

- the "Université de Grenoble I"
- the "Institut National Polytechnique de Grenoble" ("INPG")
- the "Ecole des Mines de Nantes" (research department in Energetic and Environmental Engineering),
- the "Université Jean Monnet" at Saint-Etienne

Such a partnership provides all students with a top-notch scientific environment where they will find the best expertise and counselling support to define and manage their master curriculum.

OBJECTIVE

The MS ("Master Recherche") in Chemical Engineering is intended for students who want an introduction to research practices as tools for defining new processes and for optimizing existing processes. The field of application is that of matter transformation, a field that is present in very diverse industrial sectors: nuclear, pharmaceutical, metallurgical, food, materials, geology, etc. The object of this program is the acquisition of new theoretical knowledge based on modeling, and research methods specific to the academic and industrial environment. The program normally leads students to prepare a PhD in Process Engineering; it includes a 22-week Graduate project.

SCOPE OF ACTIVITY and RESEARCH DOMAINS

- chemichal industry
- nuclear industry
- pharmaceutical
- metallurgical
- food
- elaboration of materials,
- geology

NANCY : MECHANICS AND ENERGETICS

The MS ("Master Recherche") in Mechanics and Energetics aims, on one hand, at deepening theoretical as well as experimental knowledge in Mechanics and Energetics; on the other hand, at opening to different kind of industrial or academic applications. The program normally leads students to prepare a PhD in domains such as fluids and solid mechanics, fundamental mechanics, hydrodynamics, heat and mass transfer, energetics, mechanical engineering.

3) DOCTORAL PROGRAMS :

SAINT-ETIENNE : SOLID STATE CHEMISTRY AND REACTIVITY

Main objectives: measurement of the transformation rate of solid compounds involved in solid state reactions (oxidation, decomposition, phase transformation,…; determination of the reaction mechanisms and modeling of the heterogeneous reactors in the aim of a best mastering of process and product quality.

SAINT-ETIENNE : POWDER TECHNOLOGY

Main objectives : characterization and modeling of the physicochemical, morphological and mechanical properties of granular solids, pure or mixed, reactive or not (mixing, compaction, solid-solid reactions,..); optimisation of the synthesis conditions of solids according to the desired granular morphology.

SAINT-ETIENNE : CHEMICAL SENSORS AND MICROREACTORS

Main objectives : development of new semi-conductor oxide based sensors (and multisensors) for gas detection (thin and thick layer technology) ; development of solid oxide fuel cells (SOFC) and chemical microreactors.

SAINT-ETIENNE : INDUSTRIAL CRYSTALLIZATION

Experimental study and modeling of different steps of a precipitation process : aggregation, agglomeration, fragmentation, settling… ; aggregate mechanical and optical properties; in situ particle sizing in dilute and concentrated suspensions; methane hydrate crystallization in pipes or in natural sediments; hydrate transportation in oil and gas industry; cold transportation using hydrate slurries.

SAINT-ETIENNE : ORGANIC-INORGANIC MULTICOMPONENT MATERIALS

Study of interaction between organic compounds, typically ligno-cellulosic derivatives (wood) and inorganic materials, particularly hydraulic binders (cement, plaster,..). Development of new materials for construction, insulation, coating… Optimisation of physicochemical and mechanical properties.

SAINT-ETIENNE : THERMOHYDRAULICS AND INDUSTRIAL SAFETY

Main objectives : calculation of safety distances after the loss of containment of a reservoir in case of pressurised liquid accidental release and atmospheric expansion in the form of a flashing jet; thermohydraulic models, characterization of two-phase jets and rain-out phenomenon.

SAINT-ETIENNE: INTERACTION BETWEEN FLUIDS AND MINERAL MATERIALS

Characterization and modeling of reactions and reactive transport in fluid-rock system : application to natural oil reservoirs (reservoir quality prediction and acid gas storage); analytical characterization of rare metal bearing ores; recycling of inorganic industrial wastes; study of natural deterioration of materials.

SAINT-ETIENNE : BIOMEDICAL ENGINEERING

Two main topics developed in relation with research groups of the Faculty of Medicine.

- Biomaterials for bone substitutes: synthesis, characterization, biocompatibility of biomaterials used for bone rebuilding.
- Biomodeling: application to mathematical and chemical engineering models (transport-reaction) to the mechanism of the immune response of a human organism submitted to cancer or allergy problems

NANCY : FUNDAMENTAL MECHANICS

Mathematical Modeling, Methods and Resolution: Numerical and Analytical.

NANCY : FLUID MECHANICS AND HYDROMECANICS

Stability, Turbulence, Diphasic, Rheology and Transfer for the Complex and Biological Fluids, Physics and Mechanics of the Fluid interfaces.

NANCY : HEAT AND MASS TRANSFER

High-speed Thermal metrology, Transfer in the divided mediums, Thermal Convection, Thermics urban habitate.

NANCY : ENERGETICS

Optimization of the Energy Systems, Conversion and Storage of Energies, Genius of the Processes, Couplings Electromechanical.

NANCY : MECHANICAL ENGINEERING

Methodology related to the design of the products and the systems of mechanical manufacture.

NANCY : SOLID MECHANICS

Rheology, Wood, Mechanics of Materials and the Structures, Tribology and Mechanics of Surfaces, Biomechanics.

4) COURSES AND MODULES IN ENERGETICS AND CHEMICAL ENGINEERING

SAINT ETIENNE : TABLEAU SYNOPTIQUE DES PROFILS « PROCEDES – ENERGETIQUE »

	SAINT ETIENNE	Procédés industriels	Procédés et gestion industrielles	Procédés et énergétique	Productions pétrolières	Géo-réservoirs et Environnement	R&D en Génie des procédès
ECH 411	Génie des procédés	GS1					
ECH 421	Energétique						
ECH 511	Modélisation	GS2					611 612 640
ECH 513	Géo réservoirs						
ECH 514	Flowsheeting						
ECH 515	Modèles Données Environn.						
ECH 516	Environnement Sécurité						
ECH 517	Energétique 2						
ECH 518	Aménag.Territore						
Liste 1	Electif Management						
Liste 3	Electif Génie Ind.						
Liste 4	Electif Génie Ind.		**G. Syst.indust.**				
Liste 2	Electif Management			**Eléments finis**			

M STE ECH 411 Process engineering

7-3 ECTS - 120 hours - P. Grosseau

The objective of this module is to give to our future engineer general practitioner a horizontal vision of the processes of transformation of the matter enabling him to be able, without being a specialist, to decide and undertake tasks in this sector. The processes are thus approached under their scientific and technical aspect of course but also under the organisational aspect (sensitizing with the related problems to take into account within the framework of the industrial processes: strategy of the development, economic assessment, safety, environment).

List of courses :

- STE ECH 411A Transfers. Introduction of the essential concepts implied into the phenomena of transfer and training of modeling in cutting edge situations. Reviews, transfer of heat, transfer of matter. Macroscopic assessments. Evaluation by written examinations.
- STE ECH 411B Unit operations. Application of the course transfer and redimensioning of the unit, operations of transformation and separation which are the elementary components of the processes of transformation of matter. Evaluation by written examinations.
- STE ECH 411C Practice Labs. this activity aims at immersing the pupils in a situation of pre-industrialization d?un proceeded which must lead them to take into account the technical aspects, safety and environment features, as well as economic and the organization found in working in team..
- STE ECH 411D Industrialization of the processes. to discover the stakes, steps needed and the tools to introduce a new idea orprocess (the synthesis new pharmaceutical molecule for example) and the creating production workshop. Evaluation by oral examinations.

M STE ECH 421 Energetics

6-4 ECTS – 120 hours - J.P. Lowys

This module tackles the problems raised in industry during the production, transport, conversion, and storage of energy. The future engineer must know the rudiments of this discipline and have the language, methods, mindset,and the essential orders of magnitude to be able to converse with a specialist in energetics. Three energy types are seen in detail: electric power (engines and

transformers), thermal energy (physicochemistry of combustion), nuclear energy (generating engines). Other sources of energy Already intrenched:(hydro-electricity) and newly under development: (wind power, photoelectric, fuel cells) are approached either in the form of personal work, or conferences and visits..

List of courses :

- STE ECH 421A Electric machines. Machine with D.C. current, transformer single-phase current, machine synchronous three-phase, motor asynchronous three-phase. Evaluation by practical work (continuous assessment) and written examination..
- STE ECH 421B Heat engines. To acquire a basic knowledge of heat engines: general presentation starting from the thermodynamic cycles, study of combustion in the industrial context. Evaluation by practical work (continuous assessment) and written examination.
- STE ECH 421C Nuclear energy. To know the operation of the generating engines, as well in their physical base as under the technological aspects. Matter and fission, engines and dies, safety and safety. Evaluation by written examination.
- STE ECH 421D Personal project. The student chooses a topic, subject of his project, and works under the tutulage of a professor of the school or an external engineer. Evaluation in form a written report and oral examination.

M STE ECH 511 Modeling of processes

9-0 ECTS - 90 hours – L Perier Camby

This module makes it possible to control the bases of the modeling of the processes: bases of analyse of the processes. Tools of modeling are presented to the pupils, with elements which allow mastery of the analytical tools and study of industrial processes. The modeling tools of granular processes (handling, storage, etc) are also presented.

List of courses :

- STE ECH 511A Advanced transfers. Handing-over on level in transfers to allow effectively the lesson operations and of simulation. Evaluation via a practical case, which is based on scientific article.
- STE ECH 511B Unit operations. Application of the course transfer to the dimensioning of the unit operations of transformation and separation which are the elementary components of the processes of transformation of the matter. Evaluation by written examination.
- STE ECH 511C Powder Technology. To specify the characteristics of the fractured solid matter, interactions between grains and organization of the granular mediums. To know the chains of elaboration of the powders, to describe and characterize the geometrical properties of the mediums granular (or porous), to know the relations between the geometrical and physicochemical properties of the solids. Evaluation by written examination.
- STE ECH 511D Homogeneous engines. to give the first concepts of setting motion of the chemical reaction in homogeneous phase. Introduction to the nomenclatures and essential sizes, balances mass and heat balances, comparison and association of engines, agitation. Evaluation by written examination.

M STE ECH 512 Industrial management

6-3 ECTS - 90 hours – X Boucher

see M STE INS 511

M STE ECH 513 Sedimentary reservoirs

9-0 ECTS - 90 hours – D Garcia

This module tackles the problems raised by containers. How to detect the presence of the fluid tables (aquiferous or oil), how to define a method of exploitation. With the base of these disciplines, fundamental knowledge is to be acquired by student: physical principles of exploration and mechanisms of transfers by flow in porous strata..

List of courses :

- STE ECH 513A Advanced Transfers (see STE ECH 511A) and slipage. Evaluation by oral examination and on on line exam.
- STE ECH 513B Geophysics. Seismic and/or Diagraphics. Acquisition and interpretation. Evaluation by written examination.
- STE ECH 513C Reactions water-tanks. Porous environments. Chemistry of water ph balances etc. Reactive transfer in porous strata (principles, simulations, case). Storages. Evaluation by written examination.

M STE ECH 514 Flow sheeting

0-9 ECTS - 90 hours – JM Herri

This module introduces at the students to utilisation of professional software for flowsheeting: ASPEN +. the flowsheeting indicates the entire operations necessary to control & to make function together the various stages of a physicochemical of transformation of matter or energy. The process is cut out in stages for which operating conditions of operation are fixed. The whole of the stages which constitute a chain must then function together in steady operation.

List of courses :

- STE ECH 514A Flowsheeting 1. To learn the bases, the principles of operation, the procedures elementary of ASPEN +. To illustrate this training for selected examples of processes. Evaluation: oral presentation of the project.
- STE ECH 514B Flowsheeting 2. To put into practice ASPEN + on an original case of refining of oil cuts. Evaluation: oral presentation of the project.

M STE ECH 515 Environmental data & models

6-3 ECTS - 90 hours - V. Laforest

See M STE EGC 513

M STE ECH 516 Environment and security

6-3 ECTS -90 hours – V. Laforest

See M STE EGC 515

M STE ECH 517 Energetics

9-0 ECTS - 90 hours – F Gruy

This module aims at transmitting to the students advanced concepts of energetic in various phases of the processes. Knowledge on the transfers in turbulent media is necessary to understand the complex operation of the chemical engines for example, or to understand the bases of the design and the operation of heat engines and hydraulic used in industrial processes. This module brings complements in the field of the transfers in turbulent medium, the radiative transfers and the neutron transfer in order to better apprehend applications in the combustion chambers, and the systems of electric production.

List of courses :

- STE ECH 517A Transfer in turbulent medium. Conditions of formation of turbulence in the engines, properties of such flows and precautions that their formation requires. Applications in the field of automobiles and aeronautics (combustion chambers) are studied. Evaluation: written examination.
- STE ECH 517B Radiative transfer. Applications in the field of automobile, chemical industry and astrophysics. Evaluation: written examination.
- STE ECH 517C Thermal and hydraulic revolving machines. Properties and modes of calculations of the principal revolving machines met in industry; pumps, turbines, compressers and operating modes. Evaluation: written examination.
- STE ECH 517D Nuclear engines. Neutron transfer, technology of the reference marcks, choice of materials, safety and safeguard, TP on engine. Evaluation: continuous assessment.

M STE ECH 518 Territorial planning

6-3 ECTS - 90 hours – M .Batton-Hubert

See M STE EGC 514

M STE ECH 540 Design project

0-9 ECTS - 90 hours - L. Perier-Camby

The objectives of these projects are multifaceted:

- To give an occasion to the students to apply their knowledge academic within the framework of a complex project in relation to an industrialist sponor's demands.
- To constitute a matrix of work in which intervene people of different sensibilities, resulting from different domains, and whose points of view as well as the way to affront the problems are complementary.
- To place the students grouped in team project in the heart of a device "supplier of resources" or exploiting the technical knowledge of an expert. role key points to avance the project: to pass from a pedagogy by processes to a pedagogy by project.
- To set up or to let set up a structure "project" in a team made up of individuals whowould be not normally chosen to work together: distribution of the roles, hierarchy in team project, working relationships,

formalization of the exchanges are the initiative of the group or of its influential members.

STE ECH 550 Graduate project

0-17 ECTS - 700 hours - L. Perier-Camby

The objectives of the Graduate project are as follows:To validate the topics and the working methods acquired related to the training area (profile to follow),

- To check adequacy of his personal project to the field realities,
- To approach the functions of engineer and to share certain responsibilities for them,
- To prepare with a final integration in a firm

Evaluation through an industrial thesis and an oral presentation of the project.

M STE ECH 611 Modeling

5-4 ECTS - 90 hours –M. Pijolat

This module makes it possible to control the bases of the modeling of the processes in granular mediums by providing the tools necessary to the identification of the reactional phenomena and the mechanisms of transformation.

List of courses :

- STE ECH 611A Advanced Transfers (see STE ECH 511A)
- STE ECH 611B Powder Technology (see STE ECH 511C)
- STE ECH 611C Heterogeneous engines. Description and modeling of the processes brought into play in the heterogeneous engines (systems gas-solid). Evaluation: written examination.
- STE ECH 611D Systemic analysis of the processes. Transfer transfer functions, dynamics of the systems and modeling of the flows in the engines. Evaluation: written examination.

M STE ECH 612 Reactivity of solids

5-4 ECTS – 90 hours – M. Pijolat

Use of the heterogeneous kinetics and thermodynamics of the specific defects for the determination of the reactional mechanisms and the laws speed, applications to concrete cases. Phenomena of surface and adsorption. Illustration by conferences..

List of courses :

- STE ECH 612A Specific defects. Thermodynamic description of the real crystals by quasi-chemical approach (specific defects and balances solid-gas). Kinetics and Mechanisms of the heterogeneous reactions. Influence intensive variables (temperature, pressures partial...). Evaluation: written examination.
- STE ECH 612B Phenomena of surface and adsorption. Thermodynamic aspects and kinetics of adsorption. Characterization of surfaces. Concepts of heterogeneous catalysis.
- STE ECH 612C Directed work. Application of the heterogeneous engines courses to real situations (cf. STE ECH 611C).
- STE ECH 612 D Reactivity of the solids. Case studies: thermal decomposition of the solids, enlargement of the grains d?une powder, reactions between several solid phases, industrial crystallization. Evaluation: written or oral examination.
- STE ECH 612E Series of conferences. Examples of industrial processes of transformation of the matter chosen in various sectors of activity: nuclear industry, cements, pharmacological Process safety. Evaluation: oral examination.

M STE ECH 640 Personal research project

0-18 ECTS - 180 hours – M. Pijolat

The purpose of this module is to initiate student with the methods of research by a personal work on a subject suggested by a teacher-researcher of the laboratory which will l?encadrera throughout all module. The Student will have to adopt a rigorous steps calling upon the document research, the eperiments done and with their interpretation. The subjects of projects are selected in relation to sets of themes of the laboratory in which collaborate of industrialists within the framework of contracts of research. The module also includes one week a technological activity of survey within the framework of the participation of the students in an international congress.

List of courses :

- STE ECH 640A Bibliographical study. Acquisition of the tools of document retrieval published in referred scientific reviews (bases data, key words, order of articles) and effort of synthesis in the analysis of the publications. Evaluation: report written and oral presentation in front of a jury.
- STE ECH 640B Experimental work. Setting of some experimental techniques

available to the laboratory, or realization of a particular device, and analysis of the results obtained. Evaluation: report writen final and oral presentation in front of a jury.

- STE ECH 640C Modeling. To use the basic knowledge acquired in the theoretical courses in order to deal with precise problem raised by the results obtained during the experiments in laboratory. Evaluation: report writes final and oral presentation in front of a jury.
- STE ECH 640D Technological survey mission. One week immersion in an immense congress-exposure on the techniques of analysis of gases, liquids and solids. Work in groups of two to three pupils who have attended the talks, meetings posters and discussions at the stands with the exhibitors in order to collect a technical dossier on a method of analysis. Evaluation: written report.

STE ECH 650 Graduate project

0-17 ECTS - 700 hours – M. Pijolat

The objectives of the Graduate project are:To validate the topics and the working methods acquired related to the training area (followed profile),

- To check if adequate his personal project as to the reality in the field,
- To approach the functions of research engineer or a doctorant,
- To prepare with a final integration in a company or a research laboratory

Evaluation through a research thesis and an oral presentation of the project.

NANCY : TABLE OF COURSES IN THE CONCENTRATIONS IN PROCESSES & ENERGETICSTABLEAU SYNOPTIQUE DES CONCENTRATIONS EN ENERGETIQUE ET PROCEDES

NANCY Cours d' Energétique	Heures	Energie Industrie	Energie Gas	Energie Moteurs
Projet d'option	75	1	1	1
Projet individuel	45	1	1	1
Cours Techno GS1	45	ECH 411	ECH 411	ECH 411
	45	ECH 412	ECH 412	ECH 412
	45	ECH 451	ECH 453	ECH 451
	45	ECH 452	ECH 454	ECH 453
Cours Techno GS2	45	ECH 511	ECH 512	ECH 514
	45	ECH 512	ECH 513	ECH 516
	45	ECH 513	ECH 515	ECH 517

NAN ECH 411 Fluid dynamics

4-1 ECTS - 45 hours - Hervé Combeau

Advanced course of fluid mechanics relating to the incompressible fluids and the dynamics of gases. The goal of this teaching is d?assurer with the listeners a rigorous scientific knowledge of the elementary phenomena presented and to allow technical exploitation.

NAN ECH 412 Heat and mass transfer

4-1 ECTS- 45 hours - Denis Ablitzer

Description of the importance of the phenomena of transport of heat and mass (case study), concept of assessment: total assessment and differential assessment. Phenomenologic laws for the transport of matter and the transport of heat. Application to the simple cases of the transport of matter by diffusion and the transport of heat by conduction. Concept of resistance. Electric analogy. Stationary regime. Unidimensional case.

NAN ECH 451 Digital simulation of transfer phenomenon

4-1 ECTS- 45 hours- Jean-Pierre Bellot

This teaching brings the bases necessary to the development or the utilisation of codes of digital simulation of the phenomena of transport. It is logically divided into two parts. First is dedicated to the programming and the development of models according to the method of finished volumes. The second part is concerned with the utilisation of commercial codes of CFD (Computational Fluid Dynamics), using the same method of finished volumes.

NAN ECH 452 Analysis and optimization of industrial processes 1

4-1 ECTS – 45 hours - Denis Ablitzer

This course brings an ensemble of the practical and theoretical concepts necessary to the engineer to lead the industrial engines. It's an introduction to the study of the engines for which the energy aspects play a paramount role (optimization of control in temperature). This course also aims at supplementing the concepts acquired in the field relating to the simultaneous transfers of matter and heat.

NAN ECH 453 Combustion

4-1 ECTS – 45 hours- Hervé Combeau

The use of fuel vapor via oxidation of gases in order to release energy in thermal forms. The students will be acquainted with the objectives of the theories of combustion, the practical knowledge of the average servers and industries to lead combustions. Most of the course is common to the pupils of the two axes. Two meetings are made separately.

NAN ECH 454 Production, inventory, transport & distribution

4-1 ECTS – 45 hours - Mostafa Fourar

The developments of this course ensure a general knowledge of the methods and principles, economic importance being highlighted. This course does not aim a technological knowledge of the industrial phenomena. Contents: Beehive process of solid fuels, gasification of coal (coking plant)- in situ gasification of coal, transformation of C into CO + HÒ (reforming with the vapor), production of H2 in an industrial way, biogas, gas to liquid, natural gas (GN), well of production - treatment and gas cleaning (separation of water - deacidification, desulphurization - extraction of crude - denitrogenation)

NAN ECH 511 Analysis and optimization of industrial processes 2

4-1 ECTS – 45 hours - Denis Ablitzer

This course brings the ensemble of the practical and theoretical concepts necessary to engineer to lead the industrial engines. Logical continuation of the course of first half of the year.Transport and Transfer of Heat and Mass, this courseis an introduction to the study of engines for which the energy aspects play a paramount role (optimization of control in temperature). This course also aims at supplementing the concepts acquired in first half of the year in the field relating to the simultaneous transfers of matter and heat.

NAN ECH 512 Dimensioning and dynamics of processes

4-1 *ECTS – 45 hours - Jean-Pierre Bellot*

This course teaches the methods and the data-processing tools necessary to engineer to dimension and lead very industrial processes. It is divided logically into two parts: contributions in design and dimensionings, where the techniques of flowsheeting are presented and used (software ASPEN), stability and dynamic control of the processes, where data-processing tools of virtual reality bring the functions of graphics and of interactivity which allow learning of the dynamics of the process (criterion of stability, identification and order).

NAN ECH 513 Energy market, politics and economy

4-1 ECTS – 45 hours - Fréderic Koeut

The purpose of this course is: to locate the energy policies with their principal economic and environmental stakes, while being based in particular on the problems of gaseous fuels, to make acquire basic competences in the field of the technico-economic optimization of industrial processes strongly consuming energy, with an illustration in industry.

NAN ECH 514 Transfer phenomenon in permeable atmosphere and diphasic flow

4-1 ECTS – 45 hours - Mostafar Fourar

Characterization of its porous environments and modeling of the flows (monophasic, diphasic, to see polyphase) which are produced. The objective of this course is to introduce the basic concepts of the characterization and hydrodynamics of porous environments. These concepts are then illustrated by applications relating to the oil engineering, hydrogeology and the propulsion of the satellites. The study of the diphasic flows (extended to the flows in the machines) is then thorough by examining the whole of the forces acting on an inclusion (solid or fluid) for the eulero-Lagrangian simulation of these flows.

NAN ECH 515 Machines and use of fuels

4-1 ECTS – 45 hours - Hervé Combeau

Cycle turboshaft engines. Case of the gas turbine, thermodynamics interns turboshaft engines, internal combustion engines, air-conditioning, refrigerating machines, fuel cells, …

NAN ECH 516 Machines

4-1 *ECTS – 45 hours Giovanni Radilla*

This course treats various thermodynamic machines so much from the point of view of overall operation (performances, total dimensioning, nominal operation) that from

the point of view of the design (designing of blades for the turboshaft engines).

NAN ECH 517 Electric machines

4-1 ECTS – 45 hours - Giovanni Radilla

The objective of this course is to provide the tools necessary to the comprehension of the phenomena which govern the operation of the electric machines. This module comprises meetings of demonstration making it possible to concretely illustrate the concepts approached by case studies and applications comprising, in addition to the theoretical aspects, of the constraints of maintenance, reliability, etc...

NAN ECH 400 Team project

1 – 5 ECTS –75 hours- Denis Ablitzer

This project relating preferably to an "industrial" subject is intended to apply the knowledge obtained during the first year of the GS. The project is carried out by group of 4 to 5 pupils. The evaluation is by continuous assessment during the control of the project and by a defence of the project.

NAN EGC 550 Graduate project

0-17 ECTS - 700 hours – Jean-Pierre Bellot.

The objectives of the Graduate project are as follows:To validate the topics and the working methods acquired related to the training area (profile to follow),

- To check adequacy of his personal project to the field realities,
- To approach the functions of engineer and to share certain responsibilities for them,
- To prepare with a final integration in a firm

Evaluation through an industrial thesis and an oral presentation of the project.

5) FACULTY AND STAFF

Abbreviations :
ING = “Diplôme d’Ingenieur”
HDR = “habilité à diriger des recherches”

Last	First	Degrees	Position	School
BIGOT	Jean-Pierre	ING, PhD, HDR	professor	STE
BILAL	Essaïd	ING, PhD, HDR	professor	STE
BOUCHARDON	Jean-Luc	ING, PhD	associate professor	STE
BREUIL	Philippe	ING, PhD	executive researcher	STE
COURNIL	Michel	ING, PhD, HDR	professor	STE
GARCIA	Daniel	ING, PhD	associate professor	STE
GROSSEAU	Philippe	ING, PhD, HDR	associate professor	STE
GRUFFAT	Jean-Jacques	ING, PhD	executive researcher	STE
GRUY	Frédéric	ING, PhD, HDR	professor	STE
GUILHOT	Bernard	ING, PhD, HDR	professor	STE
GUY	Bernard	ING, PhD, HDR	professor	STE
GUYONNET	René	ING, PhD, HDR	professor	STE
HERRI	Jean-Michel	ING, PhD	associate professor	STE

LOWYS	Jean-Pierre	ING, PhD	professor	STE
MOUTTE	Jacques	ING, PhD	associate professor	STE
PERIER-CAMBY	Laurent	PhD, HDR	associate professor	STE
PIJOLAT	Christophe	ING, PhD, HDR	professor	STE
PIJOLAT	Michèle	ING, PhD, HDR	professor	STE
SOUSTELLE	Michel	ING, PhD, HDR	professor	STE
THOMAS	Gérard	ING, PhD, HDR	professor	STE
TOUCAS	Andrée-Aimée		executive researcher	STE
TOURNIER	Guy	ING, PhD	executive researcher	STE
TRAN MINH	Canh	ING, PhD, HDR	professor	STE
VALDIVIESO	Françoise	ING, PhD, HDR	associate professor	STE
VIRICELLE	Jean-Paul	ING, PhD	executive researcher	STE
ABLITZER	Denis	ING, PhD, HDR	professor	NAN
BATOZ	Jean-Louis	ING, PhD, HDR	Professor	NAN
BELLOT	Jean-Pierre	PhD , HDR	Associate professor	NAN
CASADESUS	Pierre	ING, PhD	Associate professor	NAN
CHEVRIER	Jean-Charles	PhD, HDR	Professor	NAN
FOURAR	Mostafa	PhD, HDR	Associate professor	NAN
JARDY	Alain	ING,PhD	Associate professors	NAN
KOEUT	Frédéric	ING	Associate professor	NAN
LESOULT	Gérard	ING, PhD	Professor	NAN
RADILLA	Giovanni	ING, PhD	Associate professor	NAN
SESSIECQ	Philippe	ING, PhD	Associate professor	NAN

IV) Graduate programs in Environmental, Geological and Civil Engineering :

1) GRADUATE PROGRAMS LEADING TO THE « DIPLÔME D'INGÉNIEUR CIVIL DES MINES» WITH A MAJOR IN ENVIRONMENTAL OR GEOLOGICAL OR CIVIL ENGINEERING

NANCY : MAJOR IN ENVRIONMENTAL ENGINEERING (GEO-ENGINEERING)

This program is only available as a Major for the Joint Master in Executive Engineering & Enviromental Engineering. This major offers only one concentration in "Geo-engineering" and combines together lectures having common aspects of application of modern knowledge to the large branches industrial activities which are Civil Engineering (construction and installation work), mining (mines, oil...), and certain aspects relating to the protection of the environment (ground water circulation, storages…).

Training in this concentration has as a principle of inquisitive learning of the observational methods of the natural objects, interpretation of quantitative geological data with the mathematical and numerical methods of modeling of operational performance or enormous systems in view to help engineers to take a decision.

A) THE TECHNOLOGICAL MAJOR (495 HOURS, 47 ECTS)

GS 1 : 4 courses (5 ECTS, 45 hrs each) & 1 project (75 h, 6 ECTS

- Geo-technique elements (NAN EGC 411),
- Geology of the Surface: Sedimentary rocks and basins (NAN EGC 412) ,
- Work modeling and geo-techniques (NAN EGC 451) ,
- Petrology: magmatic and metamorphic rocks and associated raw materials layers (NAN EGC 452) ,

Team project (NAN EGC 400),

GS2 : 3 courses (5 ECTS, 45 hrs each) & 1 project (9 ECTS, 90 hrs)

- Geo-statistics and decision making (NAN EGC 511) ,
- Oil and mining resources/ installation (NAN EGC 512) ,
- Environment and water (NAN EGC 513),

Scientific project (NAN EGC 500)

B) THE METHODOLOGICAL MAJOR (444 HOURS, 48 ECTS)

Program in Management - Social & Cultural Awareness (174 hours, 18 ECTS)

5 courses

- Company management 1 (NAN GME 413) (30hrs, 3 ECTS
- Company management 2 (NAN GME 451) (30hrs, 3 ECTS)
- **1 course** (45hrs, 5 ECTS) chosen from the following list (**List L3 M**, page xxx) : Management supervision (NAN GME 511), Macro-economy and finance (NAN GME 512), International trade (NAN GME 513), Bank systems and financial products (NAN GME 514)
- **1 course** (24 hrs, 2 ECTS) chosen from the following list (**List L3 O**, page XXX): Design the city (NAN GME 471), What is Science (NAN GME 472), Building a modern identity(NAN GME 473), Ethics and society (NAN GME 474)
- **1 course** (45hrs, 5 ECTS) chosen in the list of electives activities

Courses in Industrial Engineering (270 hours, 30 ECTS) :

5 courses (5 ECTS, 45 hrs each)

- Operations research (NAN GME 411)
- Statistics (NAN GME 412)
- **A couple of courses** from the **List 2**: Design, Innovation, Production (NAN GME 414 + NAN GME 454), Risk sciences (NAN GME 415 + NAN GME 455), Environment, Clean and sound technology and recycling (NAN GME 416 + NAN GME 456), Protective engineering and social advancement (NAN GME 41 + NAN GME 457), E-business (NAN GME 418 + NAN GME 458), Aeronautics (NAN GME 419 + NAN GME 459), Civil engineering and society (NAN GME 420 + NAN GME 460)
- **2 courses** chosen in the list of electives activities

Elective activities (one per semester ; 45 hours, 5 ECTS each)

- **One of the following courses** (Liste **L4 A):**

Materials working (NAN GME 421), Digital simulation (NAN GME 422), Numerical analysis (NAN GME 423), Data-processing techniques and solutions for the company (NAN GME 424),

- **One of the following courses** (Liste **L4 B):**

Physics for the computer (NAN GME 461),Materials for the engineer (NAN GME 462), Automation, instrumentation and industrial process control (NAN GME 463), Tools and environment in industrial process (NAN GME 464), Finance analysis and diagnose (NANGEM 465), Energy economy (NAN GME 468), Optimization (NAN GME 469).

- **One of the following courses** (Liste **L4 C**)::

Programming pearls (NAN GME 515), Automation and digital control (NAN GME 516), Statistical data-processing (NAN GME 517), Micro-economy and game theory (NAN GME 518), Fracture mechanics (NAN GME 519), International business negotiation (NAN GME 520), Company communication practice (NAN GME 521).

C) MISCELLANEOUS ACTIVITIES :

- An 8 weeks internship abroad whose goal is to get familiar with the environment and culture of foreign companies
- Graduate project (NAN ECH 550)
- Foreign languages training : 210 hours

SAINT-ETIENNE : MAJOR IN ENVIRONMENTAL ENGINEERING & SUSTAINABLE DEVELOPMENT

This program leads to the Joint Master in Executive Engineering and Environmental Engineering & Sustainable Development. Only certain combinations of modules are offered ; these combinations constitute the concentrations. All module combinations not listed must be approved by the advisor and the Program Head.

This program has the goal of preparing student engineers to work in the field of "industrial and territorial environmental" issues within a sustainable development context, while still maintaining the "generalist" approach necessary to that engineers working at a technical and scientific level in order to resolve environmental problems. Project management, legal issues, and regulations are indeed essential to the activities of industries and communities who must set up technical solutions to prevent and reduce environmental pollution and hazards.

Training for this type of career is based on acquiring the scientific decision-making methods that are used for measurement, safety issues, limiting or rectifying damage to the environment (water, soil, air pollution), and for the conception and establishing of planning programs (decontamination, water resources, waste products).

The program provides future environmental engineers with the scientific, technical, and technological competencies to prepare them to react rapidly to the increasing complexity of environmental issues. It stresses the multidisciplinary aspect of the training to respond to multiple and varied situations.

The Concentration in Territorial Planning

The Concentration in Territorial Planning trains engineers for environmental management and planning at a territorial level. It provides knowledge on interaction models between the different elements of the territory, such as the natural environment, industry, transportation systems, or cities, and also provides tools for the modeling of phenomena with a strong spatial component, like air or water pollution, or network management. The process of territorial planning is approached from the angle of the relationship between different territorial actors.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS):

- **1 compulsory module** (120 hours, 10 ECTS) **:** *Industrial ecology* (M STE ECH 451)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Environmental projects management* (M STE ECH 511)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Environmental data & models* (M STE ECH 513)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Land planning* (M STE ECH 514)
- **1 compulsory project** (90 hours, 9 ECTS) : Design project (M STE ECH 540)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management - Social & Cultural Awareness (186 hours, 15 ECTS):

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

One elective course chosen among the following (30 hours each) from the List L2,chapter III
Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

One elective module chosen among the following (120 hours each) from the List L5,chapter III **:**
Processes (M STE ECH 411), Energetics (M STE ECH 421), Information systems Engineering (M STE AMC 411), Mechanics (M STE MAM 411), Materials (M STE MAM 412

One elective module chosen among the following (120 hours each) from the List L3,chapter III :
Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), ***Natural processes*** *(M STE GME 415).*
Students are advised to choose the module ***Natural processes (M STE GME 415)***, but may choose another module with the agreement of the adviser.

One elective module chosen among the following (120 hours each) from the List L4,chapter III **:**
Danger and Risk assessment *(M STE GME 451), Decision making and optimization for industrial processes (M STE GME 452), Elaboration and transformation of Materials (M STE GME 453), Industrial Systems Engineering (M STE GME 454), Physical methods for the characterization of the matter (M STE GME 455).*
Students are advised to choose the module ***Danger and Risk assessment*** *(M STE GME 45)1,* but may choose another module with the agreement of the adviser.

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in **Environmental Engineering and Sustainable Development** (STE EGC 550).

- **Foreign Languages** : 100 hours

- **Sports activities** : 114 hours

The concentration in Help to planning agencies and policy makers

This concentration prepares the future engineers to work in services companies in the field of environmental issues. It is intended specifically for students who wish to begin their careers in the eco-industry (water and waste treatment) or in consulting services specialized in urban environmental issues. In addition to general competencies related to project management, or environmental law, the modules of this concentration provide competencies in the environmental applications of process engineering

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS):

- **1 compulsory module** (120 hours, 10 ECTS) **:** *Industrial ecology* (M STE ECH 451)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Environmental projects management* (M STE ECH 511)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Environmental data & models* (M STE ECH 513)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Environment and process security* (M STE ECH 515)
- **1 compulsory project** (90 hours, 9 ECTS) : Industrial project (M STE ECH 540)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management - Social & Cultural Awareness (186 hours, 15 ECTS):

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

One elective course chosen among the following (30 hours each) from the List L2,chapter III
Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

One elective module chosen among the following (120 hours each) from the List L5,chapter III **:**
Processes (M STE ECH 411), Energetics (M STE ECH 421), Information systems Engineering (M STE AMC 411), Mechanics (M STE MAM 411), Materials (M STE MAM 412

One elective module chosen among the following (120 hours each) from the List L3,chapter III :
Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), ***Natural processes*** *(M STE GME 415).*
Students are advised to choose the module ***Natural processes (M STE GME 415)***, but may choose another module with the agreement of the adviser.

One elective module chosen among the following (120 hours each) from the List L4,chapter III **:**

Danger and Risk assessment *(M STE GME 451), Decision making and optimization for industrial processes (M STE GME 452), Elaboration and transformation of Materials (M STE GME 453), Industrial Systems Engineering (M STE GME 454), Physical methods for the characterization of the matter (M STE GME 455).*

Students are advised to choose the module ***Danger and Risk assessment*** *(M STE GME 45)1*, but may choose another module with the agreement of the adviser.

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in **Environmental Engineering and Sustainable Development** (STE EGC 550).

- **Foreign Languages** : 100 hours

- **Sports activities** : 114 hours

The Concentration in Industry and the environment

This concentration aims to prepare students for careers in environment management within industry. It provides knowledge and competencies in process engineering as applied to the environment, combined with environmental management and industrial safety issues. Environmental law is another essential component of the program.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS)::

- **1 compulsory module** (120 hours, 10 ECTS) **:** *Industrial ecology* (M STE ECH 451)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Modeling of processes* (M STE ECH 512)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Environmental data & models* (M STE ECH 513)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Environment and process security* (M STE ECH 515)

-1 compulsory project (90 hours, 9 ECTS) : Industrial project (M STE ECH 540)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management - Social & Cultural Awareness (186 hours, 15 ECTS):

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

One elective course chosen among the following (30 hours each) from the List L2,chapter III

Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

One elective module chosen among the following (120 hours each) from the List L5,chapter III **:**

Processes (M STE ECH 411), Energetics (M STE ECH 421), Information systems Engineering (M STE AMC 411), Mechanics (M STE MAM 411), Materials (M STE MAM 412

One elective module chosen among the following (120 hours each) from the List L3,chapter III :
Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), ***Natural processes*** *(M STE GME 415).*
Students are advised to choose the module ***Natural processes (M STE GME 415)***, but may choose another module with the agreement of the adviser.

One elective module chosen among the following (120 hours each) from the List L4,chapter III **:**
Danger and Risk assessment *(M STE GME 451), Decision making and optimization for industrial processes (M STE GME 452), Elaboration and transformation of Materials (M STE GME 453), Industrial Systems Engineering (M STE GME 454), Physical methods for the characterization of the matter (M STE GME 455).*
Students are advised to choose the module ***Danger and Risk assessment*** *(M STE GME 45)1*, but may choose another module with the agreement of the adviser.

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in **Environmental Engineering and Sustainable Development** (STE EGC 550).

- **Foreign Languages** : 100 hours

- **Sports activities** : 114 hours

The concentration on R&D in urban and industrial environment

This concentration allows students to obtain simultaneously a Master of Science ("Master Recherche") in territorial organisation, decision support systems and sustainable development. It is intended specifically for students who wish to begin their careers by working in the field of research. The competencies that students need to acquire are those necessary for an eco-industry manager/expert or a future teacher/researcher in the field of environmental issues: eco-industrial processes, clean technology, modeling of pollutant transfer (water/air/soil), evaluation of environmental impacts and hazards.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS)::

- **1 compulsory module** (120 hours, 10 ECTS) **:** *Industrial ecology* (M STE ECH 451)
- **1 elective module** (90 hours, 9 ECTS) **:** *Environmental projects management*(M STE EGC 511) ***o****r Modeling of processes* (M STE ECH 512)
- **1 compulsory module** (90 hours, 9 ECTS) **:** *Environmental data & models* (M STE ECH 513)
- **1 elective module** (90 hours, 9 ECTS) **:** *Land planning* (M STE EGC 514) **or** *Environment and process security* (M STE ECH 515)
-1 compulsory project (90 hours, 9 ECTS) : Industrial project (M STE ECH 540)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management - Social & Cultural Awareness (186 hours, 15 ECTS):
- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

One elective course chosen among the following (30 hours each) from the List L2,chapter III
Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

One elective module chosen among the following (120 hours each) from the List L5,chapter III **:**
Processes (M STE ECH 411), Energetics (M STE ECH 421), Information systems Engineering (M STE AMC 411), Mechanics (M STE MAM 411), Materials (M STE MAM 412

One elective module chosen among the following (120 hours each) from the List L3,chapter III :
Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), ***Natural processes*** *(M STE GME 415).*
Students are advised to choose the module ***Natural processes (M STE GME 415)***, but may choose another module with the agreement of the adviser.

One elective module chosen among the following (120 hours each) from the List L4,chapter III **:**
Danger and Risk assessment *(M STE GME 451), Decision making and optimization for industrial processes (M STE GME 452), Elaboration and transformation of Materials (M STE GME 453), Industrial Systems Engineering (M STE GME 454), Physical methods for the characterization of the matter (M STE GME 455).*
Students are advised to choose the module *Danger and Risk assessment (M STE GME 45)1,* but may choose another module with the agreement of the adviser.

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in **Environmental Engineering and Sustainable Development** (STE EGC 650, obtaining simultaneously a Master of Science).

- Foreign Languages : 100 hours
- **Sports activities** : 114 hours

2) MASTER'S PROGRAMS LEADING TO A MASTER OF SCIENCE

NANCY : SUSTAINABLE SOIL MANAGEMENT FOR ENVIRONMENTAL PROTECTION

The MS ("Master Recherche") in Sustainable Soil Management for Environmental Protection is destined for students interested in research practices. This given course is a deepening of scientific knowledge and an initiation to research in different domains of environmental protection of soils and sub-soils management, which we define as environmental civil engineering.
The scientific and professional sectors concerned are recognition of natural medium, construction works (foundations, tunnels, dams, communication routes), employment and management of natural resources (mining, open-mining,water, petroleum), the environment (natural hazards or those linked to the industrial activity, natural medium protection) setting-up of superficial sites and underground (storages).
The laboratories that address education are : Laboratory of « Environnement, Géomécanique et Ouvrages (LAEGO) and the « Centre d'Études et de Recherches en ÉcoGéographie (CEREG) ».
Students who have obtained a Master may submit an application to a PhD in civil Engineering,

Mechanical Engineering, Hydrogeology or in Applied geology in one of the fore mentioned address laboratories of our institutions.
Core modules : NAN EGC 611, NAN EGC 612, NAN EGC 613, NAN EGC 614, NAN EGC 615.

SAINT-ETIENNE : TERRITORIAL ORGANISATION, DECISION SUPPORT SYSTEMS AND SUSTAINABLE DEVELOPMENT

CONTACT : Jacques Bourgois (bourgois@emse.fr)

PARTNERSHIP AND INSTITUTIONAL FRAMEWORK

This Master of Science involves the following institutions and laboratories:

- the “Université Lyon I”
- the "Ecole Nationale des Travaux Publics de l'Etat"
- the “Institut National des Sciences Appliquées de Lyon"

Such a partnership provides all students with a top-notch scientific environment where they will find the best expertise and counselling support to define and manage their master curriculum.

OBJECTIVE

The competencies that students need to acquire are those necessary for an eco-industry manager/expert or a future teacher/researcher in the field of environmental issues: eco-industrial processes, clean technology, modeling of pollutant transfer (water/air/soil), evaluation of environmental impacts and hazards.

SCOPE OF ACTIVITY and RESEARCH DOMAINS

- Systemic approach
- Reduction and treatment of liquid and gaseous wastes
- Emission and dispersion of polluants
- Environmental risks assessment

CORE MODULES

Systemic approach (M STE EGC 610),
Reduction and treatment of liquid and gaseous wastes (M STE EGC 615),
Emission and dispersion of polluants (M STE EGC 620),
Environmental risks assessment (M STE EGC 625),
Graduate project (STE EGC 650).

3) POST-MASTER NON DOCTORAL PROGRAMS

NANCY : INDUSTRIAL MODERNIZATION, RESTRUCTURING AND SUSTAINABLE DEVELOPMENT

This programme has been designed to train chinese cadre and high-functionaries as well as private or public industrial leaders. Who may have responsibilities or the role of imporving industrial restructuring problems or setting-up environmental management sites in their country.

This programme lasts 450 hours in which 350 hours take place in China and 100 hours in France. The programme is dedicated to :

The basises of modern management, the matter of the Chinese economy, the general presentation of the European community framework, the modernization and the management of innovation, the restructuration of the Chinese industry and consequences on environment.

The other part concerns the writing of a report treating a concrete problem in industrial restructuration or regional revamping. The report is the object of a defense in front of a jury.

4) DOCTORAL PROGRAMS

NANCY : GEOLOGICAL ENGINEERING

Research in :

- Geomechanics (THM linkage into saturated porous media and partially saturated)
- Hydrodynamics (diluted solutes transfer with biophysicochemical processes)
- Environmental hazards

SAINT-ETIENNE : ENVIRONMENTAL INFORMATION SYSTEMS

This research field includes :

- predetermination of hydrologic models (gridded vs analytic) based on a specification of the required data in GIS,
- development of methodologies for mitigation and limitation of odors annoyance caused by waste disposal
- designing of metadata systems for the environment.

SAINT-ETIENNE : INFORMATION SYSTEMS AND SUSTAINABLE DEVELOPMENT

This topic aims to lead and develop research activities about the internal processes in the firms and their link with the external environment in order to answer to the sustainable development challenges (governance and stakeholders).

SAINT-ETIENNE : CONTROL AND SUPERVISION OF ECO-INDUSTRIAL PROCESSES

This research activity consists in :

- designing of decision support systems for the limitation of pollutants in waste water treatment plants
- supervision of biogaz landfill and of devices for industrial waste water treatment

SAINT-ETIENNE : NATURAL AND TECHNOLOGICAL RISKS

This topic focuses on :

- generic methods for technological risks assessment
- methodology for designing safety barriers
- definitions of efficiency criteria for safety management and vulnerability assessment

5) COURSES AND MODULES IN ENVIRONMENT, GEOLOGICAL AND CIVIL ENGINEERING.

SAINT-ETIENNE : TABLEAU SYNOPTIQUE DES PROFILS « ENVIRONNEMENT »

	SAINT ETIENNE ENVIRONNEMENT	Aménagement du Territoire	Services aux collectivités	Environnement industriel	R&D en environnement ind.&urbain
EGC 451	Ecologie industrielle				
EGC 511	Gestion de projets env.				ou
EGC 512	Modélisation de procédés				ou
EGC 513	Modèles Données Environn.				
EGC 514	Aménagement du territoire				ou
EGC 515	Environnement & Sécurité				ou
Liste L3	Electif Génie Ind.	Processus naturels	Processus naturels	Processus naturels	Processus naturels
Liste L4	Electif Génie Ind.	Cyndinique	Cyndinique	Cyndinique	Cyndinique
Liste L5	Electif Génie Ind.				
Liste L2	Electif Management				
	Légende		**Cours de 1ère année**		**Cours de 2ème année**

M STE EGC 411 Natural processes

7-3 ECTS – 120 hours – J.L. Bouchardon

The objective of this module is to lead the pupil to better know to describe and better understand the physical, chemical and biological aspects of its natural environment. This comprehension is conceived like an element essential to decision-making in any branch of industry to environmental component, such as the processes, éco-industries, the civil engineering, the engineering of tank or the regional planning

List of courses :

- STE EGC 411 A Investigation of the natural processes. To include the operation of the Ground machines the fundamental mechanisms of the cellular life and the biotransformation, and to acquire the basic specific language, in order to better allow or the engineer, manager, citizen to apprehend the impact of installations on the territory, the biotechnologiques applications and their economic stakes, as well as the problems involved in the environment and the public health. Written examination, oral Presentation.
- STE EGC 411B Biosphere, geosphere. Initiation with the step of observation, necessary to apprehend the complex interactions between the biosphere and the geosphère. In particular, on the level of the grounds (unintermitting) and in the field sedimentary (oceans). Oral report of the observations during the excursion, Evaluation of the notebook of catches of notes during the excursions.
- STE EGC 411C Means of investigation. To learn how to use the physical characteristics of the basement to create the image of it and to reconstitute the structure of it, to present the principles of the behavior of the grounds on the mechanical and hydrodynamic level, then, starting from the laws of behavior, to show the physical influence of the various parameters which characterize the ground. Directed work - exercises of course: Case study, file and oral defence.

M STE EGC 451 Industrial ecology

7-3 ECTS – 120 hours – H. Vaillant

The objective of this module is to bring to the pupils scientific, technical and organisational skills essential to the evaluation of the environmental aspects in their future industrial activity. The lesson centered on the intervention of professionals of the field of environnement and highlights the use of these new skill. The case study comes to supplement this lesson by a personal work on a subject chosen in beginning of the year.

List of courses :

- STE EGC 451A Dynamics of the methods and Dysfunctions. To impart scientific notions that aid in the comprehension of the principal mechanisms governing the biosphere (cycles biogeochemical, dynamics of the ecosystems, water resources, mineral and energy) and of the relationship between human activity (anthropic) and the environment (ecotoxicology, dysfunction of the cycles and the ecosystems). Written examination.
- STE EGC 451B Means of control and reduction of the impacts of the anthropic activities. To give the technical elements of management of the environement (management of waste, clean technologies, recycling and valorization, eco-design and Analysis Cycle of Life (ACV), renewable energies, industrial ecology) allowing control and reduction of the impacts of the anthropic activities. Written evaluation.
- STE EGC 451C Right of the Environment and environmental management. The purpose of this unit is to sensitize the pupils, on the one hand with the concepts of right of l?environnement and, on the other hand, with the broad outline concerning environmental management in industrial context. L?intégration of l?environnement as given economic d?une industrial strategy will be also approached in this course. Lecturers, men of ground and actors of the industrial environment, will come to clarify certain points: the ISO standard 14 001, installations classified for environment (ICPE), saving in environment. This teaching unit will give the administrative, normative essential elements and legislatures of the industrial environment. Directed work will make it possible to the pupils to put in these new competences in environmental management. Continuous assessment in TD.
- STE EGC 451D Case study. To allow the pupils to learn about industrial problems during a case study made, if possible, in connection with an industrialist or an institutional organization whose competences are recognized. The pupils will work into trinomial on a precise topic suggested by tutors school and will write a small report identifying industrial problems and defining potential axes of development. An oral presentation will complete this work written file plus oral defence.

M STE EGC 511 Environmental projects management

6-3 ECTS – 90 hours – N. Gondran

Outlines the particularities specific to the three types of professional situations in which the student-engineer will be inserted To allow the future engineers to acquire the techniques of construction of indicators of sustainable development. Training with the project control eco-industrialists.

List of courses :

- STE EGC 511A Sustainable development. Allows the future engineers to aquire the techniques to construct an ensemble of devices for sustainable development (environmental, economic and social). The studied case will be about small to medium companies within the framework of the installation of a system of management of the sustainable development. This course approaches also the evaluation of the projects in the context of the sustainable development. Evaluation by oral presentation and written report/ratio.
- STE EGC 511 B Eco-industrial project management. Apprenticeship of the project control Eco-industrialists by the setting in action of a simulation of project of definition and installation of the directing diagram for the management of urban waste for the total inhabitants of Saint-Etienne. Oral presentation and written report.

- STE EGC 511 C Vocational guidance. To give an outline to the student of specificities specific to the three types of professional situations of which it will form part: large companies, SME and local communities in order to help it to define its professional project File of synthesis on the conferences, Report and oral presentation of the schedule of conditions.

M STE EGC 512 Modeling of processes

6-3 ECTS – 90 hours – L Perier Camby

See M STE ECH 511

M STE EGC 513 Environmental data & models

6-3 ECTS – 90 hours – V. Laforest

Course on impact study used as a basic tool of the environmental management projects. To know how to approach environmental measurement and data processing. To includethe mechanisms taking part in the development of pollution to the air and learn about the concept of air quality To integrate the concepts urban hydraulics and hydrology.

List of courses :

- STE EGC 513A Impact study. further examination of the impact study like basic tool of environmental management. Presentation of the principal phases of the impact study: Analysis of initial state, Analysis of impacts of the installation, On the environment, On health, Présentation and/or put pursuant to basic sciences of the engineer used within the framework of the impact study, geology, hydrogeology, modeling of the flows and diffusion of the pollutants, assessment matter, written Report and oral examination.
- STE EGC 513B Analysis and processing of data applied to the environment. To know to approach the treatment (description, synthesis, explanation...) of the data and measurements: presentation of the methodology of the aznalysis of environmental data then put into use these tools within the framework of a mini-project related to the major. Noted Reports TD.
- STE EGC 513C Air pollution and analysis of the quality of the air. To including the mechanisms responsable for air pollution and to objectively learn about the concept of quality of the air in order to have an engineering approach in the industrial context to the problems involved in air quality . Written examination and project.
- STE EGC 513D Urban hydraulics. Tools for simulation in urban hydrology, urban Hydrology (network cleansing, believed in urban environment), Monitoring of urban networks Pipe galleries, Management operating system of networks, the base of data Vigilance. Examinations written and oral.

M STE EGC 514 Territorial planning

6-3 ECTS – 90 hours – M. Batton-Hubert

To train the future engineer with handling basic tools of global positioning data to leaveof examples resulting from impact studies, of pollution, management of the territory. A field experience to give to the students in engineering the occasion affront land in its multi-field dimensions. To understand the mechanisms responsable forthe development and the propagation of phenomena of pollution in the hydrosystèmes (rivers, water tables, networks).

List of courses :

- STE EGC 514A Geographical Information Systems. To train the future engineer with the handling of tools of the type bases data geo-positioning starting from examples resulting from management, pollution impact study of the territory: Basic review of relational data, Specificity of the geographical data models: raster vector, analyzes space applied, management of data bases: Outside contributor. Evaluation by written examination.
- STE EGC 514B Regional planning and decision-making process. To give to the students the opportunity to approach installation in its multidisciplinary dimensions: that implies, on the one hand, to assimilate

knowledge as regards territory, of decision-making processes and tools of decision-making aid and, on the other hand, to practise this various knowledge. Written examination, oral presentation, report/ratio, participation in the debate.

- STE EGC 514C Water Hydrosystems and resources. It's concerned via case study, to learn about the problem of the managementof water stocked on a territory, hydrodynamic physical problems with the uses of water on a basin versant.Rhis module counts on the review of basic concepts of hydrodynamics, modeling of the underground flows, integrating the data management and the aspect socio-economic and legal impact of rivers. Written examination.

M STE EGC 515 Environment and process security

6-3 ECTS – 90 hours – J. P. Bigot

To present to the pupils the best methods to learn about the problems arising from the processes of polluting : identification and reduction of pollution.

List of courses :

- STE EGC 515 A Best technologies available. To allow the future engineers to integrate the concepts of best technologies available and clean technology, their points common and their differences, for examples of application for a future use in an activity either industrial, or of research written examination.
- STE EGC 515 B Control and reduction of the pollutants. General principles of sampling, presentation of equipment, chemical sensors. Networks of measurement. Particular case of the radioactive emissions. Reduction of pollution. emissions, modification of processes, examples. In the Case of automobile pollution: Choices of the fuels, Adjustments driving and nature of the pollutants, Probes: electrochemical, Catalytise of post combustion, Alternatives tothe traditional motors. Oral examination or written report.
- STE EGC 515C Processes of treatment and valorization. To know the principal processes of municipal and industrial wastewater treatment and polluted grounds. The future engineers will have to be able to choose the best technique of treatment or valorization according to the characteristics of worn water and the grounds and the objectives required. Oral presentation, report.
- STE EGC 515D Process safety. (in English). The risk of fire: bases, prevention, fighting Study of the consequences of the major industrial accidents. Oral examination.

M STE EGC 540 Industrial project

0-9 ECTS - 90 hours – V. Laforest

The objectives of these projects are multifaceted:

- To give an occasion to the students to apply their knowledge academic within the framework of a complex project in relation to an industrialist sponor's demands.
- To constitute a matrix of work in which intervene people of different sensibilities, resulting from different domains, and whose points of view as well as the way to affront the problems are complementary.
- To place the students grouped in team project in the heart of a device "supplier of resources" or exploiting the technical knowledge of an expert. role key points to avance the project: to pass from a pedagogy by processes to a pedagogy by project.
- To set up or to let set up a structure "project" in a team made up of individuals whowould be not normally chosen to work together: distribution of the roles, hierarchy in team project, working relationships, formalization of the exchanges are the initiative of the group or of its influential members.

STE EGC 550 Graduate project

0-17 ECTS - 700 hours – V. Laforest

The objectives of the Graduate project are as follows:To validate the topics and the working methods acquired related to the training area (profile to follow),

- To check adequacy of his personal project to the field realities,
- To approach the functions of engineer and to share certain responsibilities for them,
- To prepare with a final integration in a firm

Evaluation through an industrial thesis and an oral presentation of the project.**M STE EGC 610 Systemic approach**

6-6 ECTS – 200 hours – J. Bourgois

To propose to the pupils a general aspect of the environement and the impacts related to the branches of activities. Each pupil will have to validate among the following courses *6 ECTS minimum and 12 ECTS maximum.*

List of courses :

- STE EGC 610A Energy, transport and industrial environment (4.5 -4.5 ECTS). Cycle life of the energy dies (extraction, transformation, consumption, treatment of the residues), environmental impacts of the energy dies (oil, nuclear power) and of the great industrial activities (metallurgy, chemistry), industrial pollution, waste management and processing, legislation and regulation.
- STE EGC 610B Installation and urban environment (3-3 ECTS). Urban environmental regulation, city planning, urban cleansing, setting motion a PDU or a ZAC.
- STE EGC 610C Materials and environment (1.5-1.5 ECTS). Recycling of polymeric materials, the subject of valorization matter of waste, use of raw materials of substitution in the building trades and public works, evaluation of the associated environmental risks
- STE EGC 610D Total environmental evaluation, ecoconception (3-3 ECTS). The various environmental impacts and their evaluation mode, analyzes of cycle of life, study of the dangers, concept of the sustainable development.
- STE EGC 610E Dynamics of ecosystems (1.5-1.5 ECTS). Typology, structure and operation of the ecosystems, human activities and ecosystems, protection of the ecosystems.

M STE EGC 615 Reduction and treatmentof liquid and gaseous wastes

6-6 ECTS– 100 hours – J. Bourgois

To make acquire with the pupils of knowledge of treatments of the rejections in order to minimize the impacts on l?environnement. Each pupil will have to validate among the following courses *6 ECTS minimum and 12 ECTS maximum.*

List of courses :

- STE EGC 615A Polluted site and waste processing (3-3 ECTS). Treatments mechanical, thermal, chemical and biological of waste and the polluted sites.
- STE EGC 615B Treatment of the liquid rejections (1.5-1.5 ECTS). Study of the unit processes, operation of purification stations .
- STE EGC 615C Treatment of gases and fumes (1.5-1.5 ECTS). Composition of the fume d?incineration, regulation, studies of the various processes.
- STE EGC 615D Reduction of the harmful effects and clean technologies (3-3 ECTS). Study of the various types of harmful effect (acoustic, olfactive, aesthetic?), evaluation of the environmental impacts, modification of the processes to reduce these impacts.

M STE EGC 620 Emission and dispersion of polluants

6-6 ECTS– 100 hours – J. Bourgois

Study of the modeling of the transport and attenuation of pollutants in various mediums (water/air/sol). Each pupil will have to validate among the following courses *6 ECTS minimum and 9 ECTS maximum.*

List of courses :

- STE EGC 620A Chemical and biogeochemical mechanisms (3-3 ECTS). Study of the mechanisms in the grounds (adsorption/disorption, complexation, leaching, biological breakdown, transfer colloidal).
- STE EGC 620B Hydrology (1.5-1.5 ECTS). Water cycle, metrology, analyzes temporal and space data, operation of the basins slopes, flows of risings, stock management of water.
- STE EGC 620D Free modeling of the transfers in water, atmosphere and porous environment (3-3 ECTS). Typology of modeling (deterministic, stochastic), condition of the utilisation of the models, transport of the interstitial water pollutants, in the atmosphere or in a porous environment.

- STE EGC 620E Thermal transfers (1.5-1.5 ECTS). Review on the conductive, radiative transfers and convectives, application to drying and heat treatments.

M STE EGC 625 Enviromental risks assessment

6-6 ECTS – 145 hours – J. Bourgois

Study of the environmental risks, metrology and made information space. Each pupil will have to validate among the following courses *6 ECTS minimum and 12 ECTS maximum*

List of courses :

- STE EGC 625A Processing data, SIG (1.5-1.5 ECTS). Geographical definition of information, geo-referencing, geographical management of the data bases, case study.
- STE EGC 625B Analytical chemistry applied to environement (3-3 ECTS). Total parameters of pollution (DCO, COT, MO, MES), chromatography, spectroscopy.
- STE EGC 625C Toxicology and evaluation of the medical risks (3-3 ECTS). Acute toxicology and factors of variation, chronic toxicology, poisons bioaccumulatives, amounts of reference and tolerance levels,
- STE EGC 625D Evaluation of the ecotoxicological risks (1.5-1.5 ECTS). Global methodological solutions, evaluation of the exposures of the ecosystems target, evaluation of the effects, characteristics finale of the risks and uncertaintys.
- STE EGC 625E Representation of the risks and social acceptability (1.5-1.5 ECTS). Concept of objective risk and perceived risk, definition of social acceptability to act or hesitate, plays of actors.

STE EGC 650 Graduate project

0-17 ECTS – 700h – J. Bourgois

The objectives of the Graduate project are:To

- validate the topics and the working methods acquired related to the training area (followed profile),
- To check if adequate his personal project as to the reality in the field,
- To approach the functions of research engineer or a doctorant,
- To prepare with a final integration in a company or a research laboratory

Evaluation through a research thesis and an oral presentation of the project.

NANCY

NAN EGC 400 Team project

1-6 ECTS - 75hours - Christian Marignac

Camp ground (1 week) of geological cartography and geotechnical developmenta project (establishment of a highway).

NAN EGC 411 Elements of geotechnics

4-1 ECTS - 45 hour -. David Amitrano

Physical properties and geometrical of the rocks and the grounds. Rock mechanics ground and behavior. Hydraulic behavior of the rocks and the grounds. Calculations of stability.

NAN EGC 412 Surface geology: cliffs and sedimentary basins

4-1 ECTS- 45 hours - Bernard Laumonier

Geological objects and processes, total tectonics. The sedimentary phenomenon. Alterites, elements of geomorphology. Detrital and chemical sedimentation. Diagenesis, porosity, permeability. Sedimentary basins and sequential stratigraphy. Tectonics of the basins. Application to petroleum industry.

NAN EGC 451 Geotechnics and modeling of the works

4-1 ECTS - 45 hours - Veronique Merrien-Soukatchoff

Modeling Concepts Finite elements Methods, final PEA analyzes, elements borders.

modeling via block method, elements distinct. Calculations of foundations, tunnels, retaining walls. Evaluation by continuous assessment.

NAN EGC 452 Deep geology magmatic and metamorphic rocks and associated raw materials layers

4-1 ECTS - 45 hours - Christian Marignac

Mineralogy of silicates. Petrography and petrology of the magmatic rocks. Volcanic risk. Magmatic mineralisations in the mafic and ultramafic rocks. Hydrothermal mineralisations related to the acid magmatism. Petrography and petrology of the metamorphic rocks gold bearing "Shear-zones". Evaluation by continuous assessment and bibliographical talk.

NAN EGC 511 Geostatistics and and decision-making aid

4-1 ECTS - 45hours - David Lopez

Mathematical bases of the geostatistic and fuzzy logic. Software tools to assess mining reserves. Methods of geostatistic modeling. Evaluation by continuous assessment.

NAN EGC 512 Mining and oil resources, installation

4-1 ECTS - 45hours – Jack-Pierre Piguet

Exploitation of the mines and careers, oil reservoirs. Construction of underground works, introducing safety during the mining, environmental protection. Evaluation of a bibliographical study (written + oral).

NAN EGC 513 Water and environment

4-1 ECTS - 45hours - Véronique Merrien-Sokatchoff

Water Cycle. Hydrogeology. Underground hydrodynamics. Evaluation by continuous assessment.

NAN EGC 550 : Graduate project

0-17 ECTS - 700 hours – Christian Marignac

The objectives of the Graduate project are as follows:To validate the topics and the working methods acquired related to the training area (profile to follow),

- To check adequacy of his personal project to the field realities,
- To approach the functions of engineer and to share certain responsibilities for them,
- To prepare with a final integration in a firm

Evaluation through an industrial thesis and an oral presentation of the project.

NAN EGC 610 Rock mechanics

2-1 ECTS – 25 hours – Françoise Homand

Thermodynamics of the open continuous mediums and formulation the linear law of behavior thermoporoelastic; Experimental determination of the coefficients of coupling; Principle of resolution of the problems of evolution. Modeling by continuous approach; Tests for the development of a model (ways of requests); The model of Lade applied to rocks; damage Modeling of the discontinuous mediums; Morphology of fractures; Mechanical behavior of discontinuities; rupture Criteria.

NAN EGC 612 Soil mechanics

2-1 ECTS – 25 hours – Fahrima Masrouri

Behavior of the water-logged soils and modeling; Isothermal transfers in polyphase medium; Behavior of the unsaturated grounds and modeling. environment Geotechnics an example, storages of waste: Waste materials put in sewers; Design of waste storage centers Natural and artificial barriers of sealing; Systems of drainage of water and the Leachate; Instrumentation and followed works; Rehabilitation of polluted sites.

NAN EGC 613 Numerical modeling

2-1 ECTS – 25 hours – Jack-Pierre Piguet

Modeling concepts (what is the function of the model, types of models, validation/fitting). Numerical modeling of continuous mediums (finished differences, finite elements, elements borders); Review of principles, construction of the model, numerical resolution, examples. Numerical modeling of the discontinuous medium; Types of models; Presentation of the methods by static balance (block-key) and presentation of the method of the distinct elements; Examples.

NAN EGC 614 Modeling of the underground hydrosystems

2-1 ECTS – 25 hours – M. Constantin Oltean

Mathematical models of the dynamics of the water and the transport of aqueous solutions in the porous environments: presentation of the partial derivative equations (diffusivity, dispersion-advection). Resolution of the equation of diffusivity by the method the finite differences: detailed presentation of the method (implicit scheme and explicit); Resolution of the equation of diffusivity by the finite element method; Resolution of the equation of dispersion-advection: limit of applicability of the traditional methods - stochastic method; Implementation of hydrodynamic models: concepts of chock as model, identification of the parameters, operational limit of the models; Modeling of the propagation of pollutants in subsoil waters: case studies.

NAN EGC 614 Underground hydrology, of surface and processing data

2-1 ECTS – 25 hours – Michel Bues

Subsoil waters and natural variability; Stochastic processes and series related to time; Space variability and random fields; Dynamic responses of the aquifer and model models of quality of subsoil waters; Space variability and flow; Process of transport in heterogeneous medium; Characterizations stochastic and geostatistic of the medium; Characteristics fractals of the fractured medium and the flows; Quality control and homogenization of the rainfall records; Analyze statistical annual and monthly flows by the laws normal and of Galton; Analyze statistical extreme flows, believed and low water levels by the laws of Gumbel and Pearson III; Analyze risings by total model and reconstitution of the complex risings; Determination of the exceptional risings; Quantitative aspects of the physical and morphometric study of a catch basin. Hydrological modeling: design and applications.

NAN EGC 615 Biophysicochimic processes in the porous environments

2-1 ECTS – 25 hours – Michel Bues

Miscible displacements of fluids with heterogeneities of phases and/or structure: phenomena of hydrodynamic instabilities due to contrasts in density and viscosity; Chemical assessments in heterogeneous medium: balance surface-solution; Kinetics of the process of solid interaction liquid; Physico-chemical interactions in the presence of a flow: competition enters the dispersive effects and the mass transfers between phases; Transport of matter via ions and colloids; Transport of aqueous solution with reactional processes of order biophysicochimic; Mass transfer in porous environment unsaturated: case of nitrates; Water within the interface ground-vegetation-atmosphere.

6) FACULTY AND STAFF

Abbreviations :
ING = “Diplôme d’ingénieur”
HDR = “habilité à diriger des recherches”

Last	First	Degrees	Position	School
BIGOT	Jean-Pierre	ING, PhD, HDR	professor	STE
BILAL	Essaïd	ING, PhD, HDR	professor	STE
BOURGOIS	Jacques	ING, PhD, HDR	Professor	STE
BRODHAG	Christian	ING, PhD, HDR	Professor	STE
GRAILLOT	Didier	ING, PhD, HDR	Professor	STE
FORMISYN	Pascal	PhD, HDR	Professor	STE
GONDRAN	Natacha	ING, PhD	Executive researcher	STE
LAFOREST	Valérie	ING, PhD	Associate professor	STE
PIATYSZEK	Eric	ING, PhD	Executive researcher	STE
BATTON-HUBERT	Mireille	ING, PhD	Associate professor	STE
DECHOMETS	Roland	ING, PhD, HDR	Associate professor	STE
BOUCHARDON	Jean-Luc	ING, PhD,	Associate professor	STE
TARDY	Alicja	ING	Executive researcher	STE
LONDICHE	Henry	ING, PhD, HDR	Professor	STE
AMITRANO	David	PhD	Associate professor	NAN
BUES	Michel	PhD, HDR	Professor	NAN
DECK	Olivier	PhD	Associate professor	NAN
LAUMONIER	Bernard	PhD	Associate professor	NAN
LOPEZ	Philippe	PhD	Associate professor	NAN
MARIGNAC	Christian	ING, PhD, HDR	Professor	NAN
MASROURI	Fahrima	ING, PhD, HDR	Professor	NAN
OLTEAN	Constantin	ING, PhD	Associate professor	NAN
PIGUET	Jack Pierre	ING, PhD, HDR	Professor	NAN
SOUKATCHOFF	Véronique	ING, PhD, HDR	Associate professor	NAN

V) Graduate Programs in Applied Mathematics,Computer Science & Engineering

1) GRADUATE PROGRAMS LEADING TO A "DIPLÔME D'INGÉNIEUR CIVIL DES MINES" WITH A MAJOR IN "APPLIED MATHEMATICS & COMPUTER SCIENCE"

NANCY : MAJOR IN COMPUTER ENGINEERING

This program is only available as a Major for the Joint Master in Executive Engineering & Computer Engineering. The program offers two « concentrations » which have several fundamental course in common.

The concentration in Information systems engineering

The importance of computer science is no more a show business and a great mixture of the trades attached to it forced to make a choice.

This choice holds into account owing to the fact that one of the characteristics of computer science is communicating and general spirit of the course which influence the graduating engineers of this concentration to functions of project leader in the area of design and installation from information systems.

The essential basics are taught and relate to the systems and networks, software architecture, bases of algorithms and programming, in the construction and modeling of the software.

A) THE TECHNOLOGICAL MAJOR (495 HOURS, 47 ECTS)

GS 1 : 4 courses (5 ECTS, 45 hrs each) & 1 project (75 h, 6 ECTS

- *Software design* (NAN AMC 411),
- *Foundations of computing* (NAN AMC 412),
- *Modeling of Information Systems* (NAN AMC 422),
- *Operating systems and networks* (NAN AMC 421),

Team Project (NAN AMC 400),

GS2 : 3 courses (5 ECTS, 45 hrs each) & 1 project (9 ECTS, 90 hrs)

- *Control and Project Management in Computer Systems* (NAN AMC 512),
- *Ubiquitous Computing* (NAN AMC 511),
- *Quality and risk of information systems* (NAN AMC 514),

Scientific project (NAN AMC 500)

B) THE METHODOLOGICAL MAJOR (444 HOURS, 48 ECTS)

Program in Management - Social & Cultural Awareness (174 hours, 18 ECTS)

5 courses

- Company management 1 (NAN GME 413) (30hrs, 3 ECTS
- Company management 2 (NAN GME 451) (30hrs, 3 ECTS)
- **1 course** (45hrs, 5 ECTS) chosen from the following list (**List L3 M**, page xxx) : Management supervision (NAN GME 511), Macro-economy and finance (NAN GME 512), International trade (NAN GME 513), Bank systems and financial products (NAN GME 514)

- **1 course** (24 hrs, 2 ECTS) chosen from the following list (**List L3 O**, page XXX): Design the city (NAN GME 471), What is Science (NAN GME 472), Building a modern identity(NAN GME 473), Ethics and society (NAN GME 474)
- **1 course** (45hrs, 5 ECTS) chosen in the list of electives activities

Courses in Industrial Engineering (270 hours, 30 ECTS) :

5 courses (5 ECTS, 45 hrs each)

- Operations research (NAN GME 411)
- Statistics (NAN GME 412)
- **A couple of courses** from the **List 2**: Design, Innovation, Production (NAN GME 414 + NAN GME 454), Risk sciences (NAN GME 415 + NAN GME 455), Environment, Clean and sound technology and recycling (NAN GME 416 + NAN GME 456), Protective engineering and social advancement (NAN GME 41 + NAN GME 457), E-business (NAN GME 418 + NAN GME 458), Aeronautics (NAN GME 419 + NAN GME 459), Civil engineering and society (NAN GME 420 + NAN GME 460)
- **2 courses** chosen in the list of electives activities

Elective activities (one per semester ; 45 hours, 5 ECTS each)

- **One of the following courses** (Liste **L4 A):**

Materials working (NAN GME 421), Digital simulation (NAN GME 422), Numerical analysis (NAN GME 423), Data-processing techniques and solutions for the company (NAN GME 424),

- **One of the following courses** (Liste **L4 B):**

Physics for the computer (NAN GME 461),Materials for the engineer (NAN GME 462), Automation, instrumentation and industrial process control (NAN GME 463), Tools and environment in industrial process (NAN GME 464), Finance analysis and diagnose (NANGEM 465), Energy economy (NAN GME 468), Optimization (NAN GME 469).

- **One of the following courses** (Liste **L4 C**)::

Programming pearls (NAN GME 515), Automation and digital control (NAN GME 516), Statistical data-processing (NAN GME 517), Micro-economy and game theory (NAN GME 518), Fracture mechanics (NAN GME 519), International business negotiation (NAN GME 520), Company communication practice (NAN GME 521).

C) MISCELLANEOUS ACTIVITIES :

- An 8 weeks internship abroad whose goal is to get familiar with the environment and culture of foreign companies
- Graduate project (NAN ECH 550)
- Foreign languages training : 210 hours

The concentration in Project Management in Computer Systems

This concentration has the role to meet the needs for those who aim for careers in stipulating software solutions. The engineers graduating from this concentration have a role to be able to be based on their training in general engineering to fix an adequate solution to the computer problem. A good consultant must know the nature and properties of the product which he prescribes, which implies that the basic computer science lectures are obviously present in this course.

Beside these lectures giving a basic information systems background, the course within the concentration stresses the design and information systems engineering.

A) THE TECHNOLOGICAL MAJOR (495 HOURS, 47 ECTS)

GS 1 : 4 courses (5 ECTS, 45 hrs each) & 1 project (75 h, 6 ECTS)

- *Foundations of computing* (NAN AMC 412),

- *Information systems engineering* (NAN AMC 413),
- *Operating systems and networks* (NAN AMC 421),
- *Software architecture by components assemblage* (NAN AMC 452),

Team Project (NAN AMC 401),

GS2 : 3 courses (5 ECTS, 45 hrs each) & 1 project (9 ECTS, 90 hrs)

- *Control and Project Management in Computer Systems* (NAN AMC 512),
- *Quality and risk of information systems* (NAN AMC 514),
- *Information system design* (NAN AMC 515),

Scientific project (NAN AMC 501)

B) THE METHODOLOGICAL MAJOR (444 HOURS, 48 ECTS)

See the program described above for the concentration in « Information systems engineering »

C) MISCELLANEOUS ACTIVITIES :

a. An 8 weeks internship abroad whose goal is to get familiar with the environment and culture of foreign companies
b. Graduate project (NAN AMC 550)
c. Foreign languages training : 210 hours

NANCY : MAJOR IN BIO-INFORMATICS

This course is open as a Major of the Diplôme d'Ingénieur (Joint Master), the first year is common to the Information systems engineering major or to the Project Management in Computer Systems major. During this first year the transverse lecture (for instance NAN GME 458) is replaced by lectures to update knowledge in biology. During the second year lectures of data base and sequencing, analysis of sequences and analysis of genomes will be taught. A detailed attention will be paid to the use of the practical tools for molecular biology and bio informatics.

NANCY : MAJOR IN ENGINEERING MATHEMATICS AND FINANCIAL ENGINEERING

The subject of applied mathematics exists nowadays in many functional areas which employ engineering mathematicians. The digital simulation is an old tradition in industrial, financial engineering and stochastic modeling which are very much in use during recent times in banks and produce objects of keen demand on the labour market. The scientific engineers having commercial and financial background are very much required in recent times.

In this option a general steady mathematical background is given in the third year. This specialization tends either towards financial mathematics or towards scientific computation. The objective is that the student finishing this course be able to tackle concrete problems and contribute to the modeling of such problems and knows to choose the numerical methods most powerful to solve it.

A) THE TECHNOLOGICAL MAJOR (495 HOURS, 47 ECTS)

GS 1 : 4 courses (5 ECTS, 45 hrs each) & 1 project (75 h, 6 ECTS)

- *Probability for Financial mathematics* (NAN AMC 414),
- *Modeling and forecasting* (NAN INS 452),
- *Equations with partial derivatives* (NAN AMC 415),
- *Numerical tools and modeling* (NAN AMC 453),

Team Project (NAN AMC 402),

GS2 : 3 courses (5 ECTS, 45 hrs each) & 1 project (9 ECTS, 90 hrs)

- *Financial mathematics* (NAN AMC 516),
- *Data analysis and data mining* (NAN INS 512),
- *Stochastic modeling* (NAN AMC 517),

Scientific project (NAN AMC 502)

A) THE METHODOLOGICAL MAJOR :

<u>See the program described above for the concentration in « Information systems engineering »</u>

C) MISCELLANEOUS ACTIVITIES :

a. An 8 weeks internship abroad whose goal is to get familiar with the environment and culture of foreign companies
b. Graduate project (NAN AMC 551)
c. Foreign languages training : 210 hours

SAINT-ETIENNE : MAJOR IN COMPUTER SCIENCE

This program leads to the Joint Master in Executive Engineering & Computer Engineering. Only certain combinations of modules are offered ; these combinations constitute the concentrations. All module combinations not listed must be approved by the advisor and the Program Head.

This major has a triple objective:

-To give all students a "computer sciences for the engineer" background
-To present the technologies used in numerous fields of engineering
-To train students as **computer science engineers**

The concentration in Computer science

The object is to train students for work in computer science engineering. Jobs range from software based solutions design, computer consulting, to working in the computer departments or divisions of businesses where they will be called on to create and apply the data processing tools and structures essential for business growth

A) THE TECHNOLOGICAL MAJOR (435 HOURS, 46 ECTS)

4 compulsory modules, and an industrial project :

- Computer science (M STE AMC 451)
- Cooperation (M STE AMC 511)
- Information (M STE AMC 512)
- Networks (M STE AMC 514)
- Industrial project (STE AMC 540)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

<u>Program in Management - Social & Cultural Awareness (186 hours, 15 ECTS) :</u>

- Audit (STE GME 416)
- Research of Information and Interview Techniques (STE GME 417)

One elective module chosen among the following (120 hours each) <u>from the List L1,chapter III :</u>

Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

One elective course chosen among the following (30 hours each) <u>from the List L2,chapter III</u>:

Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

One elective module chosen among the following (120 hours each) from the List L3,chapter III :

Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), Natural processes (M STE GME 415).

One elective module chosen among the following (120 hours each) from the List L5,chapter III :

Processes (M STE ECH 411), Energetics (M STE ECH 421), ***Information systems Engineering*** *(M STE AMC 411), Mechanics (M STE MAM 411), Materials (M STE MAM 412).*

The Students are advised to choose the *Information systems Engineering* module (M STE AMC 411), but may choose another module with the agreement of the adviser.

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** (STE GME 490), is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in Computer science (STE AMC 550)

.

- **Foreign Languages** : 100 hours

- **Sports activities** : 114 hours

The concentration in IT technologies for companies

This concentration focuses on computer science as it is applied to business management.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS) :

4 compulsory modules, and an industrial project

- Computer science (M STE AMC 451)
- Cooperation (M STE AMC 511)
- Industrial organization and information systems (M STE AMC 513)
- Networks (M STE AMC 514)
- Industrial project (M STE AMC 540)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management - Social & Cultural Awareness (186 hours, 15 ECTS) :

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

One elective module chosen among the following (120 hours each) from the List L1,chapter III :

Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

One elective course chosen among the following (30 hours each) from the List L2,chapter III

Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

.**One elective module chosen among the following (**120 hours each) from the List L3,chapter III :

Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), Natural processes (M STE GME 415).

One elective module chosen among the following (120 hours each) from the List L5,chapter III **:**

Processes (M STE ECH 411), Energetics (M STE ECH 421), ***Information systems Engineering*** *(M STE AMC 411), Mechanics (M STE MAM 411), Materials (M STE MAM 412).*

The Students are advised to choose **the *Information systems Engineering* module (M STE AMC 411),** but may choose another module with the agreement of the adviser.

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** (STE GME 490), is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in Computer science (STE AMC 550)

.

- **Foreign Languages** : 100 hours

- **Sports activities** : 114 hours

The concentration in Computer science R&D

This concentration allows students to obtain simultaneously a Master of Science ("Master Recherche") in Computer Science (specialized in Web intelligence, Information course, cooperation, interaction)

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS) :

4 compulsory modules, and a research project :

- Computer science (M STE AMC 451)
- Cooperation (M STE AMC 511)
- Information (M STE AMC 512)
- Networks (M STE AMC 514)
- Research project (M STE AMC 640)

15 ECTS of elective modules among the following :

M STE AMC 609, M STE AMC 611, M STE AMC 612, M STE AMC 613, M STE AMC 614, M STE AMC 615, M STE AMC 616, M STE AMC 617, M STE AMC 618, M STE AMC 619

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management - Social & Cultural Awareness (186 hours, 15 ECTS) :

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

One elective module chosen among the following (120 hours each) from the List L1,chapter III :

Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

One elective course chosen among the following (30 hours each) from the List L2,chapter III
Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

.**One elective module chosen among the following (**120 hours each) from the List L3,chapter III :
Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), Natural processes (M STE GME 415).

One elective module chosen among the following (120 hours each) from the List L5,chapter III **:**
Processes (M STE ECH 411), Energetics (M STE ECH 421), ***Information systems Engineering*** *(M STE AMC 411), Mechanics (M STE MAM 411), Materials (M STE MAM 412).*

The Students are advised to choose **the *Information systems Engineering* module (M STE AMC 411),** but may choose another module with the agreement of the adviser.

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** (STE GME 490), is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in Computer science (STE AMC 650 obtaining simultaneously a Master of Science).

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- **Foreign Languages** : 100 hours

- **Sports activities** : 114 hours

2) MASTER'S PROGRAMS LEADING TO A MASTER OF SCIENCE IN ENGINEERING

SAINT-ETIENNE : SOFTWARE ENGINEERING AND NETWORKS

This program, labeled "Mastère specialisé" gives students who are already engineers a "diplôme d'ingénieur spécialisé".
It is intended for engineers (or scientists who already have a Master's level of education): engineers taking a sabbatical break from employment to further their training; undergraduate degree holders, engineers who are looking for employment…

The objective of the program is to provide a specialization in **software engineering** and **networks** while maintaining the level of knowledge already acquired by students, thus providing them with a double competency which is highly valued by businesses.
Within this context, students must:

- Obtain a general background in computer engineering and communications (theoretical and fundamental notions) in order to ensure their future development and flexibility.
- Master the techniques of their specialization to satisfy the "immediate" needs of industry
- Constantly keep a "technological watch" to remain at the cutting edge of technological developments, so as to favor the Transfer of Technology that will allow business development.

Coursework takes place over a full year, and starts mid-September. The program is composed of approximately 600 hours of coursework and practical applications + 300 hours of lectures and projects + approximately 18 weeks of a business internship. More than 50% of time is spent at computers and on networks.

The program specifically targets "engineering, networks, multimedia, and data bases", it is organized in four phases: a module of fundamental computer science, Knowledge enhancement courses, a "long software project" (a mini industrial application focused on developing a software package) and a business internship.

3) MASTER'S PROGRAMS LEADING TO A MASTER OF SCIENCE

NANCY: DATA PROCESSING (SOFTWARE INTELLIGENCE)

This MS ("Master Recherche") in Data processing falls under the data-processing doctoral formation of Doctoral School IAEM Lorraine. It constitutes the first year of this doctoral formation and aims training students to reinforce the teams of research of the associated laboratories and at developing the relations with our industrial partners within the framework of common convention CIFRE and research projects. This Master research contributes to the plan state area of the Lorraine Area and more specifically to Software the Intelligence topic.
Doctoral training in data processing, beside insertion in a team of research and sensitizing with a future professional insertion, aims at bringing new knowledge to the doctorants. This shutter extends over three years, the first constituting the lesson of the master research. Pedagogy aims returning the students trained better to the techniques of communication and at allowing them a better professional insertion open to the large laboratories of the organizations of research or to the companies. Lastly, the formation of the master research brings thorough knowledge relating to recognized sets of themes of sciences of the communication and information, in order to develop a potential of highly specialized researchers.
This formation is pressed on dies sets of themes but requires an opening towards the other sets of themes suggested. Lastly, the academic formation is short but continues during the first year of thesis and the second year of thesis. Modules of professionnalisation contribute to bring the complements essential to the researcher of tomorrow. Master is organized out of die, certain activities of standardization of knowledge are common to the dies but the dies have objectives distinct and could be regarded as of Masters independent.

NANCY: DATA PROCESSING (ALGORITHMIC NUMERICAL AND SYMBOLIC SYSTEM)

This MS ("Master Recherche") relates to design and analyzes algorithms. The applicability of such things as cryptography, optimization, the computer graphics and bio-data processing is treated topicality.

NANCY: DATA PROCESSING (PERCEPTION, REASONING AND AUTOMATIC TREATMENT OF THE LANGUAGES)

This MS ("Master Recherche") aims to provide fundamental knowledge necessary to the modeling of the functions and perceptive and cognitive processes human as well as the implementation in the pattern recognition, the automatic treatment of the languages, the man-machine interaction and the co-operation.

NANCY: DATA PROCESSING (SURE SOFTWARE: CONCEPTS, METHODS AND TOOLS)

This MS ("Master Recherche") treats techniques of development of software with strong requirements of safety. These techniques as the proof of the software require to approach fields like mathematical

logics and the automatic deduction. It approaches also aspects of industrialization of the software: environments of programmings, use of "patterns".

NANCY: DATA PROCESSING (TELECOMMUNICATIONS, NETWORKS, SERVICES)

This MS (“Master Recherche”) treats data-processing networks, evaluation of their performance as well as application of techniques of modeling, validation and checking in the networks.

NANCY: MATHEMATICS

This MS (“Master Recherche”) is realized in collaboration with the University Henri Poincaré and more precisely the Institute Elie Cartan. It should be noted that Nancy was the place from where the Bourbaki movement started. Master has a course in pure mathematics and as well as applied mathematics. The second is more in adequacy with the Graduate school and it is it whom we describe.
The course proposes a double training in EDP partial equations with the derivatives) and in probabilities.

SAINT-ETIENNE : MATHEMATICAL MODELING AND APPLICATIONS

CONTACT : Eric Touboul (touboul@emse.fr)

PARTNERSHIP AND INSTITUTIONAL FRAMEWORK

This Master of Science involves the following institutions and laboratories:

- the “Université Jean Monnet" at Saint-Etienne

Such a partnership provides all students with a top-notch scientific environment where they will find the best expertise and counselling support to define and manage their master curriculum.

OBJECTIVE

This MS (“Master Recherche”) is giving students in-depth knowledge and solid competencies in:
- Construction, mathematical analysis and modeling in the different fields of engineering, economic, and financial sciences
- Asymptotic and stochastic methods
- Numerical and analytical resolution methods
- Resolution of free boundary problems and “inverse problems”
- Quantification of uncertainties

SCOPE OF ACTIVITY and RESEARCH DOMAINS

- Spatio-temporal stochastic processes and modeling, regression models, computer experiments.
- Applications address numerous fields (oil production, marketing, financial evaluations, nuclear energy…).
- Numerical evolution models, fluid dynamics and computations, reservoir simulations.

SAINT-ETIENNE : IMAGE PROCESSING, ARTIFICIAL VISION AND SIGNAL PROCESSING

CONTACT : Jean-Charles Pinoli (pinoli@emse.fr)

PARTNERSHIP AND INSTITUTIONAL FRAMEWORK

This Master of Science involves the following institutions and laboratories:

- the “Université Jean Monnet" at Saint-Etienne

Such a partnership provides all students with a top-notch scientific environment where they will find the best expertise and counselling support to define and manage their master curriculum.

OBJECTIVE

This MS ("Master Recherche") has the goal of proposing a solid program in image processing and, because of the transversal nature of the field, also propose complementary training in the areas of vision and signal processing.
At a scientific level, this MS aims to give students a taste for research. To this end, the program includes not only the knowledge essential for a future image-processing specialist, but also the innovative technical or algorithmic methods created by local research teams and recent scientific publications. All this information is illustrated by numerous examples drawn from industry and the biomedical field.

SCOPE OF ACTIVITY and RESEARCH DOMAINS

- Logarithmic image processing
- Morphological image processing
- Adaptive neighborhood multi-sacale image processing
- Visual perception and image processing
- Applications areas:
- Materials characterization
- Chemical process engineering
- Industrial control
- Biomedical engineering
- …

SAINT-ETIENNE : WEB INTELLIGENCE

CONTACT : Olivier Boissier (boissier@emse.fr)

PARTNERSHIP AND INSTITUTIONAL FRAMEWORK

This Master of Science involves the following institutions and laboratories:

- the “Université Jean Monnet" at Saint-Etienne

Such a partnership provides all students with a top-notch scientific environment where they will find the best expertise and counselling support to define and manage their master curriculum.

OBJECTIVE

This MS (“Master Recherche”), proposed in partnership with the Université Jean Monnet, offers specialized training for the study and development of models and techniques geared at efficiently understanding Internet (Web intelligence). The program is composed of scientific study related to the following notions: security, data search, search engines and associated indices, modeling and understanding of the user, access and dynamic composition adapted to services, intelligent agents whose role is to make applications cooperate and interoperate within a vast and heterogeneous network. Research subjects linked to these problems are numerous and dynamic, and require very active (and reactive) research teams. Industrial needs are also numerous and varied. Specialists in this field are needed at the regional, national, and international level.

The goals of this program are:

i) to help students acquire a high-level scientific baggage which will allow them to adapt to the rapidly changing technologies that are the basis of Web Intelligence (theoretical computer science, algorithmic, and network programming, artificial intelligence, software engineering, security issues),

ii) to help students acquire the theoretical and practical knowledge related to the engineering of intelligent systems dependent on the Web, to Web training and adaptation, to technologies linked to information search and management on the Web, to the cooperation and interaction between intelligent systems via the Web.

SCOPE OF ACTIVITY and RESEARCH DOMAINS

- theoretical computer science, algorithmic, and network programming, artificial intelligence, software engineering, security issues
- engineering of intelligent systems dependent on the Web
- technologies linked to information search and management on the Web
- cooperation and interaction between intelligent systems via the Web.

4) DOCTORAL PROGRAMS

NANCY: SOFTWARE INTELLIGENCE

MINES Nancy counts in its curriculum a significant laboratory of data processing (LORIA) which covers the majority of the topics of data processing and its applications except for the materials engineering. These topics can be gathered in 5 families:

- Calculations, networks and graphics with high performances
- Tele-opera tions and intelligent assistants
- Engineering of the languages, the document and scientific and technical information
- Quality and safety of the software and information processing systems
- Bioinformatic and application to genomics

NANCY: MATHEMATICS; APPLIED MATHEMATICS

Various fields of research in: complex, geometry, theory of the numbers; partial derivative equations; probabilities. analyze harmonic, analyzes and geometry.

SAINT-ETIENNE : INFORMATION PROCESSING ON INTERNET

The activities are centered in the field of "Communication and Information Technologies", and more particularly hard data processing Internet. The stakes are complex and multiple. Three special majors are developed:

1. creation, organization, classification and search for information
2. validation, securisation of information
3. contribute to navigation on the Web and concept of interaction around the Web page.

Many programs relate to computer educational assistance.

SAINT-ETIENNE : MULTI-AGENT SYSTEMS

Development of Multi-agent Technologies and Models to specify, analyze and implement complex systems that are mainly distributed, decentralized, open, heterogeneous and situated in dynamic environment. This general objective is achieved through different research topics : decentralization and

autonomy, adaptation and learning, temporal reasoning, trust and openness, multi-agent oriented programming. These studies are applied in two privileged application domains : e-manufacturing and e-health.

SAINT-ETIENNE : IMAGE PROCESSING AND PATTERN RECOGNITION

Logarithmic image processing, morphological image processing, adaptive neighborhood multi-scale image processing, visual perception and image processing, measure-theoretic-based image analysis. Applications areas adress various fields (materials characterizarion, chemical process engineering, industrial
control, biomedical engineering, ...).

SAINT-ETIENNE : STOCHASTIC MODELING AND STATICTICAL INFERENCE

Spatio-temporal stochastic processes and modeling, regression models, computer experiments. Applications address numerous fields (oil production, marketing, financial evaluations, nuclear energy…).

SAINT-ETIENNE : NUMERICAL MODELING OF PHYSICAL PHENOMENA

Numerical evolution models, fluid dynamics and computations, reservoir simulations.

5) COURSES AND MODULES IN APPLIED MATHEMATICS, COMPUTER SCIENCE & ENGINEERING

SAINT ETIENNE : TABLEAU SYNOPTIQUE DES PROFILS « MATHEMATIQUES APPLIQUEES ET INFORMATIQUE»

	SAINT ETIENNE Math.appli. Informatique	**Heures**	Informatique	Informatique d'entreprise	RD Informatique
AMC 451	Informatique	120			
AMC 511	Coopération	90			
AMC 512	Information	90			
AMC 513	Org.Industr.& Syst.d'information	90			
AMC 514	Réseaux	90			
AMC 609 à AMC 619	Cours Master Recherche				
Liste L1	Electif Management				
Liste L3	Electif Génie Ind.				
Liste L4	Electif Génie Ind.				
Liste L5	Electif Génie Ind.		AMC 411	AMC 411	AMC 411
Liste L2	Electif Management				
	Légende	**Cours de 1ère année**			**Cours de 2ème année**

M STE AMC 411 Information systems engineering

7-3 ECTS – 120 hours – O. Boissier

This module aims to supplement general knowledge in data processing by a hands-on training and theoretical on the problems attached to the data processing of company: , corporate network information system, application and management tools electronic of documents, analyzes and design of application, project management of data processing. It is a question of acquiring skills making it possible to approach and understand the problems attached to the architecture of the information processing systems of the companies.

List of courses:

- STE AMC 411A Management and data-processing project control. With professionals of the field, one approaches the concepts of software genius (cycle of life), the specifications of the needs, the development of a schedule of conditions, the problems of quality of the software, costing, of the deadlines, the organization and the project management. That while stressing the characteristics related to the field of data processing (method of tools).
- STE AMC 411B Analysis and design of data-processing applications. Aim: to control technologies, objects, to analyze a problem and to conceive a solution. One approaches the conceptual objects, a language of modeling (UML Software engineering, advanced programming in Java (JDBC), the owners of conception (Design patterns) and the development processes of programs (analyzes, design, development).
- STE AMC 411C Data bases. Introduced the concept of information systems, as well on the plan/modeling, design as implemented. One finds there an systemic approach to information systems, the various data models (entity-relation, relational, object), the functionalities and the use of a DBMS (languages SQL, OQL) and the physical implementations of same.
- Electronic STE AMC 411D Management of documents. The objective is to be able to study the problems involved in information systems and the collaborative work which can be set up above. By a series of conferences of speakers specialized in these fields, one reviews the problems involved in the electronic management of documents and collaborative work, the tools of workflow and those of groupware. for a bibliographical dossier and/or an investigation of ground focused into one of these points is required.
- STE AMC 411E Corporate networks. The goal is to allow a good perception of large functional bricks consisting of a corporate network, and to be able to discuss (to propose, understand, to have an opinion (criticize) with professionals of the networks within the framework the development, the extension of new co-operative services in the company. Contents: infrastructure of a network on the level communication (types of networks support, interconnections of networks), architectures of the customer-server services, co-operations of applications, opening towards outside (Intranet, Internet), concepts of safety.
- STE AMC 411F Project. Practical application of knowledge and acquired skills (more particularly Analyzes and design, Data bases and Project control). Effective structuring of task forces with assignment of the roles. Resolution of a problem with follow-up by one framing, elaboration of the documents marking out the stages of the life of the project.

M STE AMC 451 Computer science

7-3 ECTS – 120 hours – M. Beigbeder

This module aims to ensure knowledge in the fundamental fields of data processing for those which are intended to conceive applications I N (software package). This knowledge relates to as well aspects material as software and is approached as well from the point of view of the concepts as methods. The fields approached are primarily: operating systems, the algorithmic one and languages. The concepts can be re-used whatever the languages or the environments of programming.

List of Courses:

- Algorithmics STE AMC 451A. The goal of the course is to present rigorous methods of design (Algorithmics paradigms etc) and analysis of algorithms (proof and calculation of complexity). This course includes: mathematical calculability, complexity, tools, sorting, methods of research, graphs, etc.
- STE AMC 451B Architecture of the computers and the operating systems. The goal of the course is to present the concept of the architecture of Von Neumann, the materials components of a computer (processor, memory, peripherals), finally the concepts fundimental rate of the operating systems (processes, files, pilot, etc).
- STE AMC 451C Theory of the languages and compilation. After a viewing a panorama of the theory of the languages which presents grammars, the automats of finished states and the pile automats, the various analyses (lexical, syntactic and sémant I that) are presented within the framework of the development of compilers or interpreters.
- STE AMC 451 D Project. The goal of the project is to implement the theoretical concepts introduced into the three other courses in a software of a scale which exceeds that of practical work. In particular the techniques and methods of development as well as the development tools under Unix are applied following an algorithmic modeling.

M STE AMC 511 Cooperation

6-3 ECTS – 90 hours – O. Boissier

This module aims to assimilate the concepts, methods, tools, allowing development of data-processing applications distributed and co-operating. After a return on the analysis and the design object (integrating formalism UML), two courses make it possible to present basic technologies for this type of applications: intermediate applicative layers (integrities or middleware), including the aspects of coordination, as well as the develop containing components. The course of algorithmic supplements this presentation while insisting on coherence, the termination, the performance of the algorithms in these applications. The effective resolution of the problems if an exact solution is not possible (heuristic) is also studied.

List of course:

- STE AMC 511A Analysis and Object Conception
- STE AMC 511B Component
- STE AMC 511C Algorithmic
- STE AMC 511D “Intergiciels”

M STE AMC 512 Information

6-3 ECTS – 90 hours – M. Roelens

This module explores information management within the data-processing applications. The course "Databases" (English course), presents the system of management of data bases Oracle, integrating language SQL, the interface out of C, the interface Web, the administration. The course "Technologies of the numerical document" presents the notions subjacent with the many systems being developed these last years with the explosion of the Internet: after an introduction to the theory of the languages, the language and methodology XML are approached, as well as the mechanisms of search for information. The course "Representation of knowledge" presents the concepts and methods making it possible to manage knowledge within a system of information, integrating the aspects of engineering of knowledge and ontologies.

List of courses :

- STE AMC 512A Databases
- STE AMC 512B Technologies of the numerical document
- STE AMC 512C Representation of knowledge

M STE AMC 513 Industrial organization and information systems

6-3 ECTS – 90 hours – X. Boucher

See M STE INS 515

M STE AMC 514 Networks

6-3 ECTS – 90 hours – M. Roelens

The goal of the module is the comprehension of the software architectures used in the software layers "low" of the data-processing networks, including the part, now fundamental, concerning the security management of these networks. This module includes/understands a significant practical part, using the possibilities of room PADICO. This room is insulated by a fire-wall from the remainder from the network

teaching, allowing all handling around the network without risks for the safety of the establishment. Work practise and the project make it possible to see all the aspects of deployment of an operational network: installation of charts networks in the computers, configuration in sub-networks, wiring, active and passive elements of network (routers, concentrators, switches), installation and configuration of services (waiters DNS, Web, ftp…), securisation of the unit (applicative filtering, relays).

List of courses :

- STE AMC 514A Introduction to the reliability of the applications and the networks
- STE AMC 514B Administration System, Networks, Internet, Web
- STE AMC 514C Security of the networks
- STE AMC 514D Technical project

M STE AMC 521 Fundamentals of computing

15-15 ECTS - 300 hours – J.F. Chambon

- STE AMC 521A Use of UNIX and its environment. Orders UNIX (Shell), files distributed (NFS), multiwindowing (X-Window, CDE-MOTIF).
- STE AMC 521B Algorithmic theoretical and practical. Structure of machine and system, structures of data, programming out of C, Java, methods of programming: *"of the algorithm to the program"*,
- STE AMC 52Ç Operating system (UNIX). Operating systems of the computers, UNIX system, UNIX Shell.

M STE AMC 522 Deepening in computer science

60 ECTS - 276 hours – J.F. Chambon

- STE AMC 522A Analysis and design of objects. Methods of analysis (UML), owners of design *(design pattern),* programing objects, software engineering, data processing department (CASE).
- STE AMC 522B Complements of programming. X11 environments, REASON, CDE, interfacing (IHM), customer-server…).
- STE AMC 522C Data bases. Information system, model relational: *Oracle*, models object, interfacing R 3rd bucket: *OracleWeb.*
- Teleprocessing STE AMC 522D and networks. Architectures of communication, Networks supports: buildings (*Ethernet family, Token Ring, FDDI);* "long distance" (*TRANSPAC, Numéris),* Interconnection of networks (bridges, routers, footbridges), Applications distributed (*"customer-server", NFS, X-Window, transport),* Internet, *"Intranet" , "extraNet").*
- Numerical STE AMC 52È Document**.** Languages and automats, Lex and Yacc, XML, XSLT, Search for information.
- STE AMC 522F Administration networks and systems – Safety. Tools for system generation, organization of an operating system UNIX with the alternatives "manufacturers", tools of administration system, tools of network administration.

M STE AMC 540 Industrial project

0-9 ECTS - 90 hours – J-J Girardot

This project carried out in partnership with industrial firms makes it possible to present to the students all the phases of the development of a data-processing product, including the economic and sociological aspects.

STE AMC 550 Graduate project

0-17 ECTS - 700 hours – J.J. Girardot

The objectives of the Graduate project are as follows:To validate the topics and the working methods acquired related to the training area (profile to follow),

- To check adequacy of his personal project to the field realities,
- To approach the functions of engineer and to share certain responsibilities for them,
- To prepare with a final integration in a firm

Evaluation through an industrial thesis and an oral presentation of the project.**M STE AMC 589 Software project**

40 ECTS – 200 hours – J.F. Chambon

Industrial team Project - time: month and half: full time.

- Schedule of conditions
- Specification
- Detailled report of programming
- Implementation, test, documentation

M STE AMC 590 : Graduate project

60 ECTS – 700 hours – J.F. Chambon

Put in situation within the framework of an industrial project in company.

The objectives of the Graduate project are:To validate the topics and the working methods acquired related to the training area (followed profile),

- To check if adequate his personal project as to the reality in the field,
- To approach the functions of research engineer or a doctorant,
- To prepare with a final integration in a company or a research laboratory

Evaluation through a research thesis and an oral presentation of the project.

M STE AMC 640 Research project

0-9 ECTS - 90 hours – O. Boissier

cf. M STE AMC 620

STE AMC 650 Graduate project

0-17 ECTS - 700 hours – O. Boissier

NANCY : TABLEAU SYNOPTIQUE DES CONCENTRATIONS EN MATH.APPLIQUEES & INFORMATIQUE

NANCY Cours de Math.appl.& Informat	Heures	Ingén.Syst. Informatiques	Maîtr.Ouvr.Syst. Informatiques	Bio Informatique	Ingén. Mathém. & Financière
Projet d'option	75	AMC 400	AMC 400	AMC 400	AMC 400
Projet individuel	45	AMC 500	AMC 500	AMC 500	AMC 500
Cours Techno GS1	45	AMC 411	AMC 412		AMC 414
	45	AMC 412	AMC 413		AMC 415
	45	AMC 421	AMC 421		AMC 452
	45	AMC 422	AMC 452		AMC 453
Cours Techno GS2	45	AMC 511	AMC 512		AMC 512
	45	AMC 512	AMC 514		AMC 516
	45	AMC 514	AMC 515		AMC 517

NAN AMC 400 Team Project

1 – 5 ECTS –75 hours- Bart Lamiroy

This project relating (preferably to an "industrial") subject is intended to apply the knowledge obtained during the first year of the GS. The project is carried out by group of 4 to 5 pupils. The evaluation is carried out by continuous assessment during the control of the project and by a defence.

NAN AMC 401 Team Project

1 – 5 ECTS –75 hours- Jean-Yves Marion

This project relating (preferably to an "industrial") subject is intended to apply the knowledge obtained during the first year of the GS. The project is carried out by group of 4 to 5 pupils. The evaluation is carried out by continuous assessment during the control of the project and by a defence.

NAN AMC 402 Team Project

1 – 5 ECTS –75 hours- Samuel Herrmann

This project relating (preferably to an "industrial") subject is intended to apply the knowledge obtained during the first year of the GS. The project is carried out by group of 4 to 5 pupils. The evaluation is carried out by continuous assessment during the control of the project and by a defence.

NAN AMC 411 Software design

4-1ECTS - 45 hours - Karl Tombre

Beyond basic programming, to learn how to conceive and to construct a software architecture, by composition, assembly,

communication and re-use of software components.

NAN AMC 412 Foundations of computing

4-1 ECTS -45hours - Jean-Yves Marion

This course treats bases of algorithmic and programming. It is centered around four questions:

- What a program,
- What does a program do,
- What can be programmed,
- How long a program needs to be carried out.

NAN AMC 421 Operating systems and networks

4-1 ECTS - 45 hours - Bart Lamiroy

To acquire a thorough comprehension of the communicating operation of an information processing system, in order to include/understand the limits and the performances of them and to be able to exploit it in a applicative context of higher level.

NAN AMC 422 Modeling of Information Systems

4-1 ECTS - 45 hours - Jacques Jaray

In software engineering, modeling is an activity which exceeds in importance the activity of programming. The purpose of it is to build a model which must make it possible to validate the specifications of the software to be built. The produced model is used as reference to the developer like for the validation.

NAN AMC 511 Ubiquitous computing

4-1ECTS-45 hours - Françoise Simonot

To learn the basic concepts of the programming via Java networks, and the technologies used recently in the field of telecommunications and Middleware.

NAN AMC 512 Control and project management in computer systems

4-1 ECTS - 45 hours - Karl Tombre

To form with the techniques necessary to ensure the control of work and the control of work of the information processing systems in the company, in particular by the means of teamwork in a project..

NAN AMC 513 Risks and quality of the information processing systems

4-1 ECTS - 45 hours - Guillaume Bonfante

To make aware of the stakes in quality of the software and make known most exhaustive possible techniques and tools available on the market for the validation and the verification of software.

NAN AMC 413 Information systems engineering

4-1 ECTS- 45 hours - Jean-Yves Marion

This course deals with whole of method and technique of engineering necessary in the installation of information systems.

NAN AMC 414 Probability for financial mathematics

4-1ECTS - 45hours - Samuel Herrmann

This course aims to present the bases of the theory of probability. It is a question, in particular, of installing the tools essential to the comprehension of the mathematical models of finance. This course will be also useful for including/understanding the stochastic methods employed well to model any phenomenon comprising a share of random. Evaluation by continuous assessment and written tests

NAN AMC 415 Partial differential equations

4-1 ECTS - 45hours - Antoine Henrot

The partial derivative equations are now present in the modeling of the majority of the physical phenomena, but also in economy, chemistry, biology… This course is intended to introduce the mathematical study of the linear partial derivative equations. The stress will be laid on the questions of existence and unicity of solution, like about the qualitative aspects. A project will be carried out using limps with tool "partial derivative equations"

of Matlab. Evaluation by continuous assessment and written tests.

NAN AMC 452 Software architecture by components assemblage

4-1 ECTS - 45 hours - Karl Tombre

The concept of software architecture, i.e. of a whole of components inter-connected to carry out a software. Its re-use is a major aspect this course.

This course deals with the manner of conceiving information systems which correspond to the strategy of the company.

NAN AMC 453 Numerical tools and modeling

4-1ECTS - 45hours - Antoine Henrot

After having seen the theoretical bases of the partial derivative equations and probabilities in first half of the year, this course has the aim of setting up a certain number of numerical tools and tools of modeling allowing the explicit resolution of the majority of the problems with which can be confronted the engineer mathematician. Concrete examples of problems will be taken, in particular, in the field of financial mathematics and the scientific calculus. Evaluation by continuous assessment and written tests.

NAN AMC 500 Scientific project

0 – 9 ECTS –90 hours- Denis Ablitzer

The purpose of this project is to initiate the student with the methods of research by a personal work on a subject suggested by a teacher-researcher of the laboratory which will frame it throughout all module. Work will give place to a report and a defense in front of a jury.

NAN AMC 501 Scientific project

0 – 9 ECTS –90 hours- Karl Tombre

The purpose of this project is to initiate the student with the methods of research by a personal work on a subject suggested by a teacher-researcher of the laboratory which will frame it throughout all module. Work will give place to a report and a defense in front of a jury.

NAN AMC 502 Scientific project

0 – 9 ECTS –90 hours- Antoine Henrot

The purpose of this project is to initiate the student with the methods of research by a personal work on a subject suggested by a teacher-researcher of the laboratory which will frame it throughout all module. Work will give place to a report and a defense in front of a jury.

NAN AMC 514 Quality and risk of information systems

4-1 ECTS- 45hours - Jean-Yves Marion

This course tackles the problems of risks and safety in the information systems, and the means of ensuring the quality of these systems.

NAN AMC 515 Information system design

4-1 ECTS -45hours - Jean-Yves Marion

NAN AMC 516 Financial mathematics

4-1ECTS – 45 hours Pierre Valois

The purpose of this course is to present the principal mathematical models used in finance. It will approach at the same time the modeling from a discrete point of view and a continuous point of view with the recent developments calling upon the stochastic differential equations. Evaluation by continuous assessment and written tests.

NAN AMC 517 Stochastic modeling

4-1 ECTS - 45hours - Nicolas Fournier

This course presents the tools and methods of modern stochastic modeling. It will approach at the same time the theoretical and numerical points of view. Applications in queuing problems, of financial mathematics or stock management will be presented. Evaluation by continuous assessment and written tests.

NAN AMC 550 Graduate project

0-17 ECTS - 700 hours – Bart Lamiroy

The objectives of the Graduate project are as follows:To validate the topics and the working methods acquired related to the training area (profile to follow),

- To check adequacy of his personal project to the field realities,
- To approach the functions of engineer and to share certain responsibilities for them,
- To prepare with a final integration in a firm

Evaluation through an industrial thesis and an oral presentation of the project.

NAN AMC 551 : Graduate project

0-17 ECTS - 700 hours – Antoine Henrot

The objectives of the Graduate project are as follows:To validate the topics and the working methods acquired related to the training area (profile to follow),

- To check adequacy of his personal project to the field realities,
- To approach the functions of engineer and to share certain responsibilities for them,
- To prepare with a final integration in a firm

Evaluation through an industrial thesis and an oral presentation of the project.

6) FACULTY AND STAFF

Abbreviations :
ING = "Diplôme d'ingénieur"
HDR = "habilité à diriger des recherches"

Last	First	Degrees	Position	School
BADEA	Anca	PhD	Associate professor	STE
BAY	Xavier	PhD	Associate professor	STE
BEAUNE	Philippe	ING, PhD	Associate professor	STE
BEIGBEDER	Michel	PhD,	Associate professor	STE
BOISSIER	Olivier	ING, PhD, HDR	Associate professor	STE
CARRARO	Laurent	PhD	Professor	STE
CHAMBON	Jean-François	ING, PhD	Associate professor	STE
CORBEL	Annie	PhD	Associate professor	STE
GIRARDOT	Jean-Jacques	ING, PhD, HDR	Professor	STE
JAILLON	Philippe	PhD	Executive researcher	STE
JEGOU	Roland	PhD	Associate professor	STE
MATHIEU	Mihaella	PhD	Associate professor	STE
PAUZE	Antoine		Executive researcher	STE
ROELENS	Marc	ING, PhD,	Professor	STE
ROUSTANT	Olivier	PhD, HDR	Associate professor	STE
SERPAGGI	Xavier	PhD	Executive researcher	STE
TOUBOUL	Eric	PhD	Executive researcher	STE
VERCOUTER	Laurent	PhD	Associate professor	STE
VINCENT	Lucien	ING, PhD,	Professor	STE
BENMOUFFEK	Dominique	PhD	Associate professor	NAN
BONFANTE	Guillaume	PhD	Associate professor	NAN
CIARLETTA	Laurent	PhD	Associate professor	NAN
FOURNIER	Nicolas	PhD	Associate professor	NAN
GNAEDIG	Isabelle	PhD, HDR	Associate professors	NAN
HENROT	Antoine	PhD, HDR	Professor	NAN
HERRMANN	Samuel	PhD	Associate professor	NAN
JARAY	Jacques	PhD, HDR	Professor	NAN
KUCHEROV	Gregory	PhD, HDR	Professor	NAN
LAMIROY	Bart	PhD	Associate professor	NAN
MARION	Jean-Yves	PhD, HDR	Professor	NAN
SIMONOT	Françoise	PhD, HDR	Professor	NAN
TISSERANT	Alain	ING, PhD	Associate professor	NAN
TOMBRE	Karl	PhD , HDR	Professor	NAN
VALOIS	Pierre	PhD, HDR	Professor	NAN

VI) Graduate Programs in Industrial and Systems Engineering

1) GRADUATE PROGRAMS LEADING TO THE "DIPLÔME D'INGÉNIEUR CIVIL DES MINES" WITH A MAJOR IN INDUSTRIAL AND SYSTEMS ENGINEERING

NANCY : MAJOR IN INDUSTRIAL ENGINEERING

This program is only available as a Major of the Joint Master in Executive Engineering & Industrial Engineering. One concentration is offered in this Major.

The competency developed in this concentration covers three great fields of the industrial engineering:

- **"Scientific production management"** terms beyond manufacturing, is applied to any production system (vast distribution, transport, banks, insurances).
- **"Decision systems engineering"** which interests in decision-making problems and that developing suitable tools.
- **"Decision-making assistance for the industrial engineering"** treats questions relating to the assembly of the various components: product, manufacturing process, computerization, automation and internal logistics.

The engineers trained in this concentration can be recruited in industrial firms, commercial sectors, or services (banks, insurances, consultation...).

A) THE TECHNOLOGICAL MAJOR (495 HOURS, 47 ECTS)

GS 1 : 4 courses (5 ECTS, 45 hrs each) & 1 project (75 h, 6 ECTS

- *Discrete & deterministic optimization* (NAN INS 411)
- *Advanced algorithmics and data base management systems* (NAN INS 412)
- *Decision-making support in the world of uncertainty (NAN INS 451)*
- *Modelling and forecasting (*NAN INS 452)

Team project (NAN INS 400)

GS2 : 3 courses (5 ECTS, 45 hrs each) & 1 project (9 ECTS, 90 hrs

- *Modeling & simulation* (NAN INS 511)
- *Data analysis and data mining* (NAN INS 512)
- *Supply chain and production management* (NAN INS 513)

Scientific project (NAN INS 500)

B) THE METHODOLOGICAL MAJOR (444 HOURS, 48 ECTS)

Program in Management - Social & Cultural Awareness (174 hours, 18 ECTS)

5 courses

- *Company management 1* (NAN GME 413) (30hrs, 3 ECTS
- *Company management 2* (NAN GME 451) (30hrs, 3 ECTS)
- **1 course** (45hrs, 5 ECTS) chosen from the following list (**List L3 M**, page xxx) : *Management supervision* (NAN GME 511), *Macro-economy and finance* (NAN GME 512), *International trade* (NAN GME 513), *Bank systems and financial products* (NAN GME 514)
- **1 course** (24 hrs, 2 ECTS) chosen from the following list (**List L3 O**, page XXX): *Design the city* (NAN GME 471), *What is Science* (NAN GME 472), *Building a modern identity*(NAN GME 473), *Ethics and society* (NAN GME 474)
- **1 course** (45hrs, 5 ECTS) chosen in the list of electives activities

Courses in Industrial Engineering (270 hours, 30 ECTS) :

5 courses (5 ECTS, 45 hrs each)

- Operations research (NAN GME 411)
- Statistics (NAN GME 412)
- **A couple of courses** from the **List 2**: *Design, Innovation, Production* (NAN GME 414 + NAN GME 454), *Risk sciences* (NAN GME 415 + NAN GME 455), *Environment, Clean and sound technology and recycling* (NAN GME 416 + NAN GME 456), *Protective engineering and social advancement* (NAN GME 41 + NAN GME 457), E-*business* (NAN GME 418 + NAN GME 458), *Aeronautics* (NAN GME 419 + NAN GME 459), *Civil engineering and society* (NAN GME 420 + NAN GME 460)
- **2 courses** chosen in the list of electives activities

Elective activities (one per semester ; 45 hours, 5 ECTS each)

- **One of the following courses** (Liste **L4 A):**

Materials working (NAN GME 421), *Digital simulation* (NAN GME 422), *Numerical analysis* (NAN GME 423), *Data-processing techniques and solutions for the company* (NAN GME 424),

- **One of the following courses** (Liste **L4 B):**

Physics for the computer (NAN GME 461),*Materials for the engineer* (NAN GME 462), *Automation, instrumentation and industrial process control* (NAN GME 463), *Tools and environment in industrial process* (NAN GME 464), *Finance analysis and diagnose* (NANGEM 465), *Energy economy* (NAN GME 468), *Optimization* (NAN GME 469).

- **One of the following courses** (Liste **L4 C**)::

Programming pearls (NAN GME 515), *Automation and digital control* (NAN GME 516), *Statistical data-processing* (NAN GME 517), *Micro-economy and game theory* (NAN GME 518), *Fracture mechanics* (NAN GME 519), *International business negotiation* (NAN GME 520), *Company communication practice* (NAN GME 521).

C) MISCELLANEOUS ACTIVITIES :

- An 8 weeks internship abroad whose goal is to get familiar with the environment and culture of foreign companies
- Graduate project (NAN ECH 550)
- Foreign languages training : 210 hours

a.

SAINT-ETIENNE : MAJOR IN INDUSTRIAL ENGINEERING

This program leads to the Joint Master in Executive Engineering & Industrial Engineering. Only certain combinations of modules are offered ; these combinations constitute the concentrations. All module combinations not listed must be approved by the advisor and the Program Head.

This program includes an ensemble of courses located at the intersection of hard sciences for engineers, with economics and management. It is intended for students who have already acquired a technical baggage, and who wish to develop scientific competencies of an organizational nature, that is, industrial management, conception of information systems, project management, management of innovation, etc. The range of businesses interested by this type of training is very large: large industrial groups, SMEs, banks, the service sector, consulting firms, etc.

The concentration in production systems management

This concentration offers training for all responsibility level jobs dealing with the implementation and running of production systems. In-depth coursework in Industrial Management trains students to conceive and set up industrial systems, as well as the planning, operational, and strategic guidance

methods of production. The managerial aspects essential to this type of job are addressed by learning to master technological innovation and run projects. This concentration leads to jobs in the organization and running of production systems, and, eventually, to jobs leading production units. It also leads to job opportunities as consultants in organization, management, and industrial strategies.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS) :

4 compulsory modules, and an industrial project
- Industrial and systems engineering (M STE INS 451)
- Industrial engineering (M STE INS 511)
- Project management 1 (M STE INS 512)
- Management of technology (M STE INS 513)
- Industrial project (STE AMC 540)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management – Social & Cultural Awareness (186 hours, 15 ECTS) :

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

One elective module chosen among the following (120 hours each) from the List L1,chapter III :
Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

One elective course chosen among the following (30 hours each) from the List L2,chapter III
Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

One elective module chosen among the following (120 hours each) from the List L3,chapter III :
Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), Natural processes (M STE GME 415).

One elective module chosen among the following (120 hours each) from the List L5,chapter III **:**
Processes (M STE ECH 411), Energetics (M STE ECH 421), Information systems Engineering (M STE AMC 411), Mechanics (M STE MAM 411), Materials (M STE MAM 412).

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** (STE GME 490), is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in industrial engineering (STE INS 550)
.
- **Foreign Languages** : 100 hours

The concentration in industrial project planning

This concentration provides competencies in the field of project management within an industrial environment. It is based on in-depth training in management and in industrial organization, and on two

project management modules which train students to deal with the different phases of a project, from conception to conclusion. This concentration leads to long term career opportunities as project heads in industrial organization.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS) :

4 compulsory modules, and an industrial project
- Industrial and systems engineering (M STE INS 451)
- Industrial engineering (M STE INS 511)
- Project management 1 (M STE INS 512)
- Project management 2 (M STE INS 514)
- Industrial project (STE AMC 540)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management – Social & Cultural Awareness (186 hours, 15 ECTS) :

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

One elective module chosen among the following (120 hours each) from the List L1,chapter III :
Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

One elective course chosen among the following (30 hours each) from the List L2,chapter III
Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

One elective module chosen among the following (120 hours each) from the List L3,chapter III :
Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), Natural processes (M STE GME 415).

One elective module chosen among the following (120 hours each) from the List L5,chapter III **:**
Processes (M STE ECH 411), Energetics (M STE ECH 421), Information systems Engineering (M STE AMC 411), Mechanics (M STE MAM 411), Materials (M STE MAM 412).

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** (STE GME 490), is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in industrial engineering (STE INS 550)
.
- **Foreign Languages** : 100 hours

The concentration in business information systems

This concentration provides a double competency: on the one hand, in management and industrial organization, and on the other hand, in information systems and associated technologies. The goal is to

train students for positions of responsibility where they will develop information systems and put them into use, while taking the technological, organizational and human dimensions into account. This concentration leads to jobs as consultants in industrial management and information systems.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS) :

4 compulsory modules, and an industrial project
- Industrial and systems engineering (M STE INS 451)
- Industrial engineering (M STE INS 511)
- Industrial organization and information systems (M STE INS 515)
- Project management 2 (M STE INS 514)
- Industrial project (STE AMC 540)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management - Social & Cultural Awareness (186 hours, 15 ECTS) :

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

One elective module chosen among the following (120 hours each) from the List L1,chapter III :
Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

One elective course chosen among the following (30 hours each) from the List L2,chapter III
Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

One elective module chosen among the following (120 hours each) from the List L3,chapter III :
Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), Natural processes (M STE GME 415).

One elective module chosen among the following (120 hours each) from the List L5,chapter III **:**
Processes (M STE ECH 411), Energetics (M STE ECH 421), Information systems Engineering (M STE AMC 411), Mechanics (M STE MAM 411), Materials (M STE MAM 412).

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** (STE GME 490), is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in industrial engineering (STE INS 550)
.
- **Foreign Languages** : 100 hours

The concentration in development of technology in companies

This concentration provides competencies in management and the organization of industrial systems, in the planning and implementation of information systems within business enterprises, and in the

implementation of technological innovation, both in context of product creation and in the creation of activities. It leads to jobs adapting new technologies to industry; these jobs are located at the interface between R&D, and production.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS) :

4 compulsory modules, and an industrial project
- Industrial and systems engineering (M STE INS 451)
- Industrial engineering (M STE INS 511)
- Industrial organization and information systems (M STE INS 515)
- Management of technology (M STE INS 513)
- Industrial project (STE AMC 540)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management – Social & Cultural Awareness (186 hours, 15 ECTS) :

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

One elective module chosen among the following (120 hours each) from the List L1,chapter III :

Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

One elective course chosen among the following (30 hours each) from the List L2,chapter III

Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

One elective module chosen among the following (120 hours each) from the List L3,chapter III :

Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), Natural processes (M STE GME 415).

One elective module chosen among the following (120 hours each) from the List L5,chapter III **:**

Processes (M STE ECH 411), Energetics (M STE ECH 421), Information systems Engineering (M STE AMC 411), Mechanics (M STE MAM 411), Materials (M STE MAM 412).

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** (STE GME 490), is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in industrial engineering (STE INS 550)
.
- **Foreign Languages** : 100 hours

SAINT-ETIENNE : MAJOR IN INDUSTRIAL ENGINEERING AND MANAGEMENT

This program leads to the Joint Master in Executive Engineering & Industrial Engineering and Management. Only certain combinations of modules are offered ; these combinations constitute the concentrations. All module combinations not listed must be approved by the advisor and the Program Head.

This program aims at training students for positions of responsibility in manufacturing units or for management positions in profit centers. It provides in-depth knowledge in the managerial fields of organization: strategy, finance, project management, management of innovation. Each of these subjects leads to a specific concentration which either combines technical and managerial modules, or contains only managerial modules.

The concentration in projects engineering

This concentration has the goal of training project heads. A first module on business engineering aims to give competencies in marketing, international business, and international logistics. It is followed by two modules on project management.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS) :

3 compulsory modules, and an industrial project
- Business engineering (M STE INS 516)
- Project management 1 (M STE INS 512)
- Project management 2 (M STE INS 514)
- Industrial project (STE AMC 540)

One elective module chosen among the following (120 hours each) from the List L1,chapter III :

Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management – Social & Cultural Awareness (66 hours, 55 ECTS) :

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

One elective course chosen among the following (30 hours each) from the List L2,chapter III

Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (360 hours, 30 ECTS) :

One elective module chosen among the following (120 hours each) from the List L3,chapter III :

Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), Natural processes (M STE GME 415).

One elective module chosen among the following (120 hours each) from the List L5,chapter III **:**

Processes (M STE ECH 411), Energetics (M STE ECH 421), Information systems Engineering (M STE AMC 411), Mechanics (M STE MAM 411), Materials (M STE MAM 412).

One elective module chosen among the following (120 hours each) from the List L4,chapter III **:**

Danger and Risk assessment (M STE GME 451), Decision making and optimization for industrial processes (M STE GME 452), Elaboration and transformation of Materials (M STE GME 453), Industrial Systems Engineering (M STE GME 454), Physical methods for the characterization of the matter (M STE GME 455).

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** (STE GME 490), is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in industrial engineering and management (STE INS 550)

.

- **Foreign Languages** : 100 hours

The concentration in territorial engineering

The evolution of organizations: fusions, new implantations, redeployment, enter into the framework of regional development, and are intimately linked with dynamics of local development. Regional and national development strategies thus have important effects on the trajectories of industrial organizations. Within this context, this concentration aims to train engineers who are also economic developers and who will put their technological competencies and their knowledge of the regional environment at the service of business or of the region.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS) :

3 compulsory modules, and an industrial project

- Territorial engineering (M STE INS 517)
- Project management 1 (M STE INS 512)
- Project management 2 (M STE INS 514)
- Industrial project (STE AMC 540)

One elective module chosen among the following (120 hours each) from the List L1,chapter III :

Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management - Social & Cultural Awareness (66 hours, 55 ECTS) :

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

One elective course chosen among the following (30 hours each) from the List L2,chapter III

Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (360 hours, 30 ECTS) :

One elective module chosen among the following (120 hours each) from the List L3,chapter III :

Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), Natural processes (M STE GME 415).

One elective module chosen among the following (120 hours each) from the List L5,chapter III **:**

Processes (M STE ECH 411), Energetics (M STE ECH 421), Information systems Engineering (M STE AMC 411), Mechanics (M STE MAM 411), Materials (M STE MAM 412).

One elective module chosen among the following (120 hours each) from the List L4,chapter III **:**

Danger and Risk assessment (M STE GME 451), Decision making and optimization for industrial processes (M STE GME 452), Elaboration and transformation of Materials (M STE GME 453), Industrial Systems Engineering (M STE GME 454), Physical methods for the characterization of the matter (M STE GME 455).

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** (STE GME 490), is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in industrial engineering and management (STE INS 550)

.

- **Foreign Languages** : 100 hours

The concentration in technical innovation

Technological innovation is an important developmental factor for an industrial organization. Within this framework, this concentration aims to provide students with competencies in the management of innovating projects based on knowledge of industrial marketing and taking into account questions related to the protection and financing of innovations.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS) :

3 compulsory modules, and an industrial project

- Business engineering (M STE INS 516)
- Industrial organization and information systems (M STE INS 515)
- Management of echnology (M STE INS 513)
- Industrial project (STE AMC 540)

One elective module chosen among the following (120 hours each) from the List L1,chapter III :

Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management – Social & Cultural Awareness (66 hours, 55 ECTS) :

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

One elective course chosen among the following (30 hours each) from the List L2,chapter III

Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (360 hours, 30 ECTS) :

One elective module chosen among the following (120 hours each) from the List L3,chapter III :

Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), Natural processes (M STE GME 415).

One elective module chosen among the following (120 hours each) from the List L5,chapter III **:**

Processes (M STE ECH 411), Energetics (M STE ECH 421), Information systems Engineering (M STE AMC 411), Mechanics (M STE MAM 411), Materials (M STE MAM 412).

One elective module chosen among the following (120 hours each) from the List L4,chapter III **:**

Danger and Risk assessment (M STE GME 451), Decision making and optimization for industrial processes (M STE GME 452), Elaboration and transformation of Materials (M STE GME 453), Industrial Systems Engineering (M STE GME 454), Physical methods for the characterization of the matter (M STE GME 455).

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** (STE GME 490), is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in industrial engineering and management (STE INS 550)

.

- **Foreign Languages** : 100 hours

The concentration in international finances

This concentration is intended for students who wish to combine their scientific and technical competencies with the economic and financial needs that organizations have, particularly as concerns financial analysis, and business evaluation.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS) :

3 compulsory modules, and an industrial project

- Business engineering (M STE INS 516)
- International finance 1 (M STE INS 518)
- International finance 2 (M STE INS 519)
- Industrial project (STE AMC 540)

One elective module chosen among the following (120 hours each) from the List L1,chapter III :

Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management – Social & Cultural Awareness (66 hours, 55 ECTS) :

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

One elective course chosen among the following (30 hours each) from the List L2,chapter III

Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (360 hours, 30 ECTS) :

One elective module chosen among the following (120 hours each) from the List L3,chapter III :

Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), Natural processes (M STE GME 415).

One elective module chosen among the following (120 hours each) from the List L5,chapter III **:**

Processes (M STE ECH 411), Energetics (M STE ECH 421), Information systems Engineering (M STE AMC 411), Mechanics (M STE MAM 411), Materials (M STE MAM 412).

One elective module chosen among the following (120 hours each) from the List L4,chapter III **:**

Danger and Risk assessment (M STE GME 451), Decision making and optimization for industrial processes (M STE GME 452), Elaboration and transformation of Materials (M STE GME 453), Industrial Systems Engineering (M STE GME 454), Physical methods for the characterization of the matter (M STE GME 455).

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** (STE GME 490), is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in industrial engineering and management (STE INS 550)

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- **Foreign Languages** : 100 hours

The concentration in financial risks

This concentration provides the theoretical and practical bases for financial risk management. It leads naturally to careers in banking and counseling (front office and trading activities), and, more globally, to financial engineering work in business or industry (for example, in gas or electricity companies or in the oil industry).

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS) :

3 compulsory modules, and an industrial project

- Business engineering (M STE INS 516)
- Quantitative finance (M STE INS 520)
- International finance 2 (M STE INS 519)
- Industrial project (STE AMC 540)

One elective module chosen among the following (120 hours each) from the List L1,chapter III :

Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management - Social & Cultural Awareness (66 hours, 55 ECTS) :

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

One elective course chosen among the following (30 hours each) from the List L2,chapter III
Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (360 hours, 30 ECTS) :

One elective module chosen among the following (120 hours each) from the List L3,chapter III :
Industrial and Systems Engineering (M STE GME 411), Finite Elements and Structures (M STE GME 412), Instrumentation (M STE GME 413), ***Statistical Methods and Actuarial Sciences*** *(M STE GME 414), Natural processes (M STE GME 415).*
The Students are advised to choose **the Statistical Methods and Actuarial Sciences (M STE GME 415) ,** but may choose another module with the agreement of the adviser.

One elective module chosen among the following (120 hours each) from the List L5,chapter III **:**
Processes (M STE ECH 411), Energetics (M STE ECH 421), Information systems Engineering (M STE AMC 411), Mechanics (M STE MAM 411), Materials (M STE MAM 412).

One elective module chosen among the following (120 hours each) from the List L4,chapter III **:**
Danger and Risk assessment (M STE GME 451), Decision making and optimization for industrial processes (M STE GME 452), Elaboration and transformation of Materials (M STE GME 453), Industrial Systems Engineering (M STE GME 454), Physical methods for the characterization of the matter (M STE GME 455).

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** (STE GME 490), is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in industrial engineering and management (STE INS 550)
.
- **Foreign Languages** : 100 hours

2) MASTER'S PROGRAMS LEADING TO A MASTER OF SCIENCE IN INDUSTRIAL AND SYSTEMS ENGINEERING

NANCY: MASTERS IN INFORMATION TECHNOLOGY

The Research Masters leading onto research in the field of industrial engineering is the Information Technology Masters in Digital and Symbolic Algorithmics.

3) POST-MASTER NON DOCTORAL PROGRAMS:

NANCY: OPERATIONAL RESEARCH AND DECISION-MAKING STRATEGIES

This program covers two major fields: the engineering of decision-making systems, information (organization, management, analysis and data mining). The first semester includes the following courses (380 hours):

a. Operational research (NAN INS)
b. Discrete and deterministic optimization (NAN INS 411)
c. Information technology for industrial engineering (NAN INS)
d. Modeling and simulation (NAN INS 511)
e. Logistics chains and production management (NAN INS 512)
f. Statistics (NAN INS)
g. Statistical data processing and data mining (NAN INS)
h. Operational project management (NAN INS)

The second semester is devoted to an industrial project, culminating in a written report to be presented before a jury.

4) DOCTORAL PROGRAMS

SAINT-ETIENNE : DECISION AID METHODS FOR INDUSTRIAL MANAGEMENT

This activity deal with modeling industrial systems for decision aid: algorithms and optimisation models, simulation tools for distributed systems (distributed artificial intelligence, distributed decision making, modeling and simulation methodology), applications of decision aid methods in industrial management.

SAINT-ETIENNE : SME NETWORKS AND VIRTUAL ENTERPRISES MODELING

This program concern of technical and economic modeling manufacturing systems, information and communication systems modeling, change and competence management for mechanical and micro-electronics industries

NANCY: INDUSTRIAL SYSTEMS MODELING

This course deals with modeling in a company, behavioral modeling and command synthesis.

NANCY: PERFORMANCE EVALUATION

This course deals with performance evaluation and the sizing of discrete stochastic event systems, analytical methods for specific systems and generic methods for the optimization of general systems.

NANCY: PRODUCTION MANAGEMENT

This course deals with production organization and management: layout, control, predictive and reactive scheduling, and production workshop maintenance policies.

5) COURSES AND MODULES IN INDUSTRIAL AND SYSTEMS ENGINEERING :

SAINT ETIENNE : TABLEAU SYNOPTIQUE DES PROFILS « GENIE INDUSTRIEL»

	ST ETIENNE Gestion et Organisation Industrielle	**Heures**	Management des Systèmes de production	Conduite de projets industriels	Syst. d'information pour l'entreprise	Déploiement technologique en Entreprise
INS 451	Génie des syst.industriels	120				
INS 511	Gestion Industrielle	90				
INS 512	Conduite de projets 1	90				
INS 513	Management de laTechnologie	90				
INS 514	Conduite de projets 2	90				
INS 515	Org.indust. et Syst.d'information	90				
L1	Electif Management	120				
L3	Electif Génie Ind.	120				
L5	Electif Génie Ind.	120				
L2	Electif Management	30				

	ST ETIENNE Pilotage stratégique des Organisation Industrielle	**H**	Projets d'ingénierie	Ingénierie territoriale	Management de l'innnovation technologique	Finances internationales	Risque financier
INS 512	Conduite de projets 1	90					
INS 513	Management de laTechnologie	90					
INS 514	Conduite de projets 2	90					
INS 515	Org.indust. et Syst.d'information	90					
INS 516	Ingénierie d'affaire	90					
INS 517	Ingénierie territoriale	90					
INS 518	Finances internationales 2	90					
INS 519	Finances internationales 1	90					
INS 520	Finance quantitative	90					
L1	Electif Management & G.Ind	30					
L3	Electif Génie Industriel	120					Statist.Meth.& Actuarial Science
L5	Electif Génie Industriel	120					
L4	Electif Génie Industriel	120					
L2	Electif Management	120					

M STE INS 451 Industrial and systems engineering

7-3 ECTS – 120 hours – M.A. Girard

This module covers industrial process analysis and modeling for the understanding and management of production organizations (in particular manufacturing). It presents the fundamental concepts of production management and develops the classic methods of stock management, procurement planning and task and production resource management. It explains the main concepts of production

system modeling and discrete-flow simulation with regard to the resolution of complex problems. It presents methods for the design of information systems, to show the issues at stake and the impact of information systems on the performance of an organization, to propose an analysis grid and a rigorous approach to modeling, and to show that the approach is consistent with the concepts and mechanisms of database management systems (DBMS). The course also includes concrete scenarios in the form of case studies and projects.

List of Courses:

- STE INS 451A Production management. The problems and architecture of production system control. Methods of stock management. MRP methods of procurement planning. MRP II methods of task and production resource management in the long and mid term. Problems and techniques of scheduling. Course assessed by written examination.
- STE INS 451B Flow modeling and discrete simulation. Introduction to the problems involved. Presentation of objectives. Principal concepts of modeling. Data modeling. Process modeling (Queues and Resources). Main concepts of simulation. Construction and validation of simulation models. Interpretation of results. Presentation of simulation environments. Presentation of SIMAN/ARENA. Construction of VBA interfaces with EXCEL and ACCESS. Optimization with OptQuest (ARENA Plug-in). Course assessed by written examination.
- STE INS 451C Design of information-systems. The place of the information system in the organization. Presentation of the modeling approach using the SADT and MERISE methods. Characteristics of existing software programs, and their links with previous models. Course assessed by written examination.
- STE INS 451D Case studies, conferences and visits. Application of STE INS 451A (Order book analysis, stock management, scheduling). Application of STE INS 451B (Simulation case). Application of STE INS 451C (Analysis and cooperative development of order control). Course assessed by written report on the work carried out.
- STE INS 451E Project. Analysis of an industrial management-system situation, carried out in pairs. Students must propose, then test, solutions to a given problem, making use of what they have learned during the INS 451 course. A report of professional quality is expected: it should detail the phases of the project, justify the options chosen and comment upon the results obtained. Course assessed by written report on the project and oral presentation.

M STE INS 511 Industrial engineering

6-3 ECTS – 90 hours – X. Boucher

This module has been designed for future engineers who wish to develop their skills in the organization and management of industrial systems, and to understand the problems of integrating these techniques into the complex realities of a company. The module covers scientific industrial management methods (production management, production system design, scheduling, maintenance, quality), and the implementation conditions for these methods (strategic approach to logistics, company simulation).

List of Courses:

- STE INS 511A Production management. Comparison of the MRP, OPT and JIT approaches. Basic rules of the OPT approach. Study of an MRP-type CAPM software package. Simulation of push and pull production workflow. Performances of a Kanban system. Course assessed by written report on CAPM practical work.
- STE INS 511B Production-system and logistics-system design. Balancing of loads (e.g. balancing of assembly lines). Sizing of storage zones (e.g. sizing of buffer stocks in transfer lines). Layout of resources (e.g. layout of machines in the workshop). Assessment by written examination.
- STE INS 511C Strategic approach to logistics (Supply Chain Management). Emergence of the supply-chain concept. Functions of the supply-chain manager. Financial approach (process, value analysis, return on investment). Links with computerized management tools (PIC/PDP, Planning, Programming, Scheduling, Execution, Control). The extended company: from subcontracting to multiple partnerships. Benchmarking, concepts of CRM and SRM. Computerized solutions (CPFR, APS and CLM), failures and best practice. Presentation of the AFNOR, ASLOG and SCOR reference systems. Susceptibility of the supply-chain approach (human beings, IS, products). Course assessed by written examinations.
- STE INS 511D Scheduling. Scheduling in production management. Typology of scheduling problems. Solution through

generation of scheduling (job shop) and application: heuristics of priority management, tree search. Minimum search time case study. Practical implementation in software programs. Presentation of a workshop-management software package (FINMATICA-ORTEMS) and its integration into an e-procurement environment. Course assessed by written report on practical work.

- STE INS 511E Maintenance and quality control. Tools for maintenance: RCM method (reliability-centered maintenance); behavior study of in-service equipment; Weibull law of failure, normal law, exponential law; censored data; renewal theory; Markov chains; choice of a maintenance policy. Quality tools: ABC, Pareto; SPC, testing by sampling; Experimental design, Taguchi (or statistical analysis). Course assessed by written examination.
- STE INS 511F SIM'2 Simulation. Handling the SIM'2 tool in the company context. Identification of a "perfect" company management method (with no unknowns). Introduction to disturbances linked to unknown quantities. Finding strategies for running a system. Implementation over a 30-simulated week timescale. Performance evaluation. Appraisal of experiments carried out. Course assessed by intermediate and final written reports.

M STE INS 512 Project management 1

6-3 ECTS – 90 hours – M. R. Boudarel

The objective of this module (completed by module M STE INS 514: Project Management 2), is to teach project management skills to be combined with scientific and/or technical knowledge. The course helps provide a global vision of project management from the design stage through to completion: needs analysis, pre-project methodology (from the original idea through to specifications), project risks, project quality control systems.

List of courses:

- STE INS 512A Needs analysis, pre-project methodology. Conditions for successful project management (applying a rigorous and effective methodology, excellent control of tools, knowledge of how to animate and motivate a multidisciplinary team). The initialization stage of the project (context, situation, challenges, objectives). The relational system of the project. The players involved, their roles and missions. Making up and managing the team, group work, the addition of intercultural expertise, team efficacy and performance. Project risk management. The information and tools necessary for the project. The needs stage. First generation tools for needs analysis; functional analysis tools. The APTE method. The risk stage (AMDEC; APR; AST). Management of project teams (motivation, behavior and conflict management, resistance to change. Completion and closure of the project (acceptance and guarantees, closure of the project and electronic storage, experience feedback (REX method). Course assessed through a case study.
- STE INS 512B Project Methodology. Process of creating a new product; Process of production of new equipment; Definitions and limits of the "pre-project" "project" and "engineering"; Invitation to Tender file; Bid (and bid preparation) file; Objective terms of the contract. Drawing up the technical response to the Invitation to Tender; Technical specifications; Preliminary outline of the project; Task analysis, WBS; Matrix of "resources", "unit costs", "unit times"; TS links – Pricing study; Summary table of pricing study; Projected resources; Risk analysis; Contractual conditions and constraints. Methods for evaluating unit costs; Calculating the price of a bid; Purchases; TS links – Pricing study, monitoring, updating. Planning preparation. Course assessed by written examination.
- STE INS 512C Quality Management. Differences between the quality approach and the certification approach (normative reference systems). Stages in the quality approach: audit, quality plan, from design through to market and experience feedback, quality indicators, quality control and the reactions of the players in the company. Course assessed by case study.

M STE INS 513 Technology management

6-3 ECTS – 90 hours – M. R. Boudarel

The aim of this module is to provide students with the tools required for implementing technological innovation to create either a product or an activity.

List of Courses:

- STE INS 513A Creativity Techniques.
- STE INS 513B Industrial Marketing.

- STE INS 513C Technological Monitoring and Innovation Protection.
- STE INS 513D Application of a Business Plan to Innovation.
- STE INS 513E Joint Innovation Project throughout the module.

M STE INS 514 Project management 2

6-3 ECTS – 90 hours – M.R. Boudarel

The objective of this module (preceded by the module Project Management 1: M STE INS 512) is to provide skills in project management, combined with scientific and/or technical knowledge. The courses in this module focus on contractual aspects, organization and planning, running a project, financial monitoring of a project, management of people working on a project.

List of Courses:

- STE INS 514A Running a project. Revision of basic concepts. The fields of project management. Analysis and processing of project risks (preliminary work: identification of the potential risks in a standard case). Contractual aspects (preliminary work: reading FIDIC documents, on-site research). Analysis of the clauses in the ABK contract. (work to provide: clarification list, clause writing). Drawing up of standard case contracts (work to provide: structure of contracts, writing of essential clauses). Project organization and planning. Budgeting. Use of Project Management Systems in planning: Case of electricity substation (work to provide: provisional planning file and optimized cost plan). Establishment of the provisional standard case (work to provide: provisional planning file and optimized cost plan). Running a project: measurement of progress and achievement. Plotting S curves. The Sotraf Case. Profit margin and accounts monitoring. Amendments and complaints. Project reviews: content and management. Experience feedback at the end of the project. Role and abilities of project leader. Specific characteristics of international projects. Course assessed by final examination.
- STE INS 514B Simulated Case. Simulates the running of a project based on a real case. Participants work in project teams and must produce the outcomes necessary for the project in accordance with fixed deadlines. Assessment by jury on the results of the case and the performance of each participant.

M STE INS 515 Industrial organization and information systems

6-3 ECTS – 90 hours – X. Boucher

This module addresses the question of how to integrate an organization and its information system. The objective is thus to help students understand and analyze all the technical, sociological and organizational problems linked to the setting up of information systems, and to train them in the methods and tools required for managing the setting up process. It is designed for future engineers who wish to develop their skills in analyzing and improving organizational structures, and implementing information systems appropriate to the organization concerned. It thus leads on to various posts, for example head of industrial engineering, information system consultant, industrial audit consultant.

List of Courses:

- STE INS 515A Integration by means of the information system. The problems of integrating processes through the information system. Expectations of top management and factors leading to an ISE project. Market offers in terms of software, typology of systems and projects (vertical, horizontal, international dimension), security. Players within the project, skills, necessary resources, methodologies, key factors for success. Course assessed by case study.
- STE INS 515B Concurrent Engineering. Industrial integration and principles of concurrent engineering. Methods and tools for concurrent engineering. Information systems for concurrent engineering. Management of life cycles: costing. Methodology for the implementation of concurrent engineering. Course assessed by oral presentation and the level of participation in the case study.
- STE INS 515C Process-oriented Modeling. Business Engineering and Business Process Management Systems as a conceptual framework. Enterprise modeling concepts. Different modeling languages for business-process, organizational and information-systems modeling. Analysis and simulation techniques for process-oriented enterprise models. Concepts of metamodeling. Practical modeling and simulation using the business process management tool ADONIS. Course assessed by active participation, and practical work during course, assessment of personal exercises.

- STE INS 515D Conducting ERP projects. The ERP object. ERP projects. Organizational dimension. Behavioral dimension of internal-external players. Strategic dimension of ERP. Internal-external environmental dimension. Course assessed together with STE INS 515E by written examination about a case study.
- STE INS 515E Industrial ERP experience. Guided tour of SAP, in the form of an interactive demonstration using the software. Experience feedback: company visit or industrial testimony. Course assessed together with STE INS 515E by written examination on a case study.
- STE INS 515F Decisional information systems. The components of a decisional information system. Functional building blocks. Elements of technical architecture. Global presentation of the stages in a decisional project. Modeling techniques. Case study: exercise derived from a real field-mission. Reconstruction of modeling results by each group. Experience feedback on the production of the decisional project. Benefits for the end user. Illustration using examples of performance indicators. Course assessed by participation in the case study, and a final report.
- STE INS 515G Total Quality Deployment. Concept of Total Quality and "client system". Notion of process. Process mapping (exercise). The TQ toolbox. Norms and certification (review). Approach to and running a project. Case studies: a manufacturer's testimony, application of the approach to a problem put forward by the manufacturer, evaluation and comprehension of the issues. Course assessed by case study.
- STE INS 515H New industrial organizational structures. Relations between prime manufacturers, groups and providers, Strategy and organization of networks. The organization of the information communication system. Methods of network management. Skills management within networks. Course assessed by case study.

M STE INS 516 Business engineering

6-3 ECTS – 90 hours – M.R. Boudarel

This module is concerned with the systemic dimension of business management. In addition to scientific and technical skills, the engineer needs to be able to situate a business affair in the international economic environment in order to understand its implications and constraints or opportunities. These skills are essential for effective dialogue with specialists.

List of Courses:

- STE INS 516A Economic feasibility, Financial engineering, international projects. Methodology of cost price calculation. Evaluation. Statement of results. Working capital – The need for working capital – Accounts. The capacity for self-financing. Economic feasibility. Company diagnosis of and the environmental elements linked to a project. Strategic and tactical choices. Cost calculations. Return on investment - choice of means of financing. Drawing up the business plan. Course assessed by case study.
- STE INS 516B Macro-economics. Major economic zones (EU, Asia, USA), GDP, GNP, and other definitions. International exchanges; Exchange of goods, financial transfers, investments, balances, zones favorable to export or investment. International institutions; Fundamental roles of the main post-45 institutions, WTO, IMF, WB. International markets; Markets: total, potential, accessible, defined accessible, supplied, penetrable, Wealthy / emerging zones / nations. Foreign purchasers; consumers, distributors, industrial purchasers, Government purchasers, the behavior and organizational structure to adopt according to type of foreign purchaser. International strategies; production concept, product concept, .business concept, market concept, client concept ("B to C"). BCG and Mc Kinsey matrices, Internal strategy; study of matrix tools for performance, growth and taking market share, strategies to draw up, actions, reactions. International cost chain; analytical study of the components of the export cost price, construction of a cost price chain. Assessment by MCQ.
- STE INS 516C International Contract Law. Negotiating a contract; cultural environment, legal environment, legal environment. International contractual freedom; free determination of international contractual regulations and international contractual law. Negotiation techniques for an international contract; choice of strategy, techniques and tactics. Mastering the pre-contractual phase; legal principles, variety of documents, draft contracts. Drawing up a contract. The layout of a contract; format, titles, sub-titles and preamble, parts and appendices. Contract content, life of the contract,

special relationship. Financial clauses; contractual remuneration, payment and guarantees. Rules for disagreements; choice of applicable law, choice of judge. Accidents during the lifetime of the contract; contractual failures/ breakdowns, contractual let-out clauses. Diverse provisions; amendments and modifications, notifications, general provisions. Course assessed by written examination.

- STE INS 516D Business Marketing and Sales. Introduction to business marketing. Specific characteristics of business marketing and consequences on marketing practice. Key concepts. A three-level approach: no sale / pre-sale / mid-sale. A strategic model for business marketing. Links with project management. Marketing: analysis and representation of market environments (networks of players), market environments, monitoring systems and relational investments to create or develop a position. Key-player and client portfolios: contents and management. Choice of priorities for business deals and project portfolio. Access to projects. The drawing-up and implementation of the winning offer: analysis of the project network and the purchase network, drawing up the content of the offer, the tactics of the offer. Course assessed by written report of a case study and oral presentation.
- STE INS 516E Logistics. Introduction to "logistics" and "supply chains". Introduction to "strategy". Developing a logistics strategy. External factors – governments, congestion, competition. Customer requirements/ customer service. Channel choice. Network planning and warehouse location planning. Mode selection. Outsourcing. New developments and new technology. Logistics in a European context. Course assessed by written examination.

M STE INS 517 Territorial Engineering

6-3 ECTS – 90 hours – M.R. Boudarel

The aim of this module is to present the concept of territorial development and possible strategies for town and country planning. It aims to describe the issues at stake for economic and industrial players so that students can understand and make use of territorial engineering to aid the strategic development of an organization.

List of courses:

- STE INS 517A Territorial development. Issues and interaction of the players involved in development and planning: Diagnosis and strategy of planning and economic development. Current organization and development of players' skills. Concepts of endogenous and exogenous development. Services, aids: technical, legal and financial. Course assessed by individual written test.
- STE INS 517B Regional planning. SRADDT (French regional sustainable planning and development plans), urban development plan, SCOT (French regional development plans), urban area contract, local area contract: Definition and content of regional planning. Private and public decisions. Original characteristics of the French model, recent developments: influences of the EU and local government. Strategies of competitiveness and solidarity; competitiveness and rivalry of territories; the question of a uniform local business tax. The tools of spatial planning at local level; presentation of SRU law, its impact on the planning and economic development of territories. Course assessed by oral presentations.
- STE INS 517C Enterprise Networks. The different types of Enterprise Networks. Territory-specific organization and actions. Strengths and weaknesses of specialized territories. Course assessed by individual questionnaire.
- STE INS 517D Territorial Strategy. Diagnosis of territorial planning. The functioning of local government and its public establishments. The strategy of "endogenous" economic development. The strategy of "exogenous" economic development. Impetus of emergence and/or support of industries. Course assessed by individual questionnaire.
- STE INS 517E Territorial Marketing. Policies and practices for the economic development of territories (outlines, changes, logics); dynamics of the economic action of local government: from economic interventionism to the territorial project; the logics of territorial development: the logic of players and networks, project logic, the logic of sustainable development, the logic of openness, the logic of citizenship. The company, a challenge for the economic development of territories; the players involved in the economic development of the territory; evolution in the place and role of companies in local development; challenges for the joint construction of strategic resources and new forms of dialogue between companies and territories. Typology of economic territorial

development initiatives. Place and role of enterprises in the new partnership dynamics; the Rhone-Alpes, an example of development contracts. Case study: the Ondaine quality operation. Course assessed according to student's choice by written work or a 30-minute presentation based on documentary work.

- STE INS 517F Territorial Marketing. Interactions between local economic development strategy and territorial marketing; from strategic analysis to territorial marketing. The marketing of the endogenous development tools of a territory; actions aimed at the development of an industry, support for enterprise creation, industrial zones. Promotion of the territory and exogenous development. Course assessed by written examination.
- STE INS 517G Supportive development. Definition of supportive finance; Mutual support, proximity finance, micro-credit and micro-finance, the various problems of developing countries, supportive finance and the creation of business activity: a means of economic and social insertion? Supportive finance: a response to the "banking gap"; the causes of the "banking gap"; the people and projects affected by the "banking gap"; the beneficiaries of supportive finance organizations. Characteristics of the supportive finance offer; diversity of the offer; the offer of financial services; the offer of non-financial services. The role of partnership in supportive finance; supportive finance and public institutions; supportive finance and banking organizations, supportive finance and companies; the question of governance: the supportive finance organizations between the public and private sphere. Social entrepreneurship. Course assessed by written examination.
- STE INS 517H Contractual policies and procedures, decentralization law. Contractual procedures Europe, State and local government. Principle of subsidiarity. Evolution of structures in the face of European harmonization and decentralization. Educational methods and means. Face to face and "transversal" "collective" interviews with questioning between students: development of current principles and reflection upon the possibilities of development, reflection upon real cases examined during a visit to various territories, documentary analysis. Oral assessment.
- STE INS 517I Evaluation of contractual policies. The expected benefits of evaluating state procedures and company assistance (framework of economic development). Control-Monitoring-Evaluation: case of the Contract of the town of St Fons (or other). Workshop: practical application of concepts acquired to a concrete case. Conference: place the evaluation in its institutional context (historical evolution of the discipline). Oral assessment.

M STE INS 518 International finance 1

6-3 ECTS – 90 hours – M. R. Boudarel

The objective of this module is to enable students to take on international financial responsibilities (whether in a company or a financial institution). Understanding different accountancy systems, making up a business plan, identifying and optimizing costs, understanding the terms of financial auditing standards.

List of Courses:

- STE INS 518A Introduction to international finance. Gain an understanding of the major aspects of the financial function in international business. An overview of the tasks and responsibilities of the financial function in an international context: the role of financial management. Financial analysis and management information. Investment appraisal. Financial planning. Share issues. Working capital management. Mergers and acquisitions.
- STE INS 518B International accounting. An outline of international accounting standards and concepts for business. The significant differences in standards and practice between major countries. Current progress towards international standards for financial statements. Overview of international reporting standards, recent problems in this area and recent legislation designed to overcome them
- STE INS 518C Introduction to international accounting standards - theory and practice. Basic accounting principles. Fundamental concepts of financial reporting. The components of financial statements. Explaining the purpose and uses of notes to financial statements. Differences between French & US or UK accounting systems (IAS, US GAAP, UK GAAP). The uses and users of financial reports.
- STE INS 518D Budgetary control and the business plan. Outline of budgets and

forward plans as essential control tools for managing a business. The purpose of information management. Budgets, business plans and objectives. Interrelationship of budgets. The budget setting process. Flexing the budget. Financial control of a project. Zero basis budgets. Non-financial measures in budgeting. Activity based budgeting (ABB). Measuring business performance

- STE INS 518E International auditing standards. Introduction to the auditing of international financial statements. Outline comparison of auditing methods between major countries. Overview of recent problems in the auditing field, particularly in the USA, and recent steps to address these problems. The uses of an audit. Outline of international auditing procedures. Outline of international auditing norms and standards. Obligatory procedures. Discretionary procedures. The users of an audit. Internal control and internal audit. Professional responsibility.
- STE INS 518F Feasibility study project. The aim of this seminar is to: provide a framework of knowledge which will help the students to understand the financial aspects of projects and companies. Provide the students on the MSc in Industrial Engineering course with technical methods for project financing and company valuation. Analyzing the environment. Examples of environmental influences. Project sensitivity analysis. Valuation of companies versus projects. Net present value analysis. Organizing capital expenditure. Performance assessment. Methods for evaluating a project.

M STE INS 519 International finance 2

6-3 ECTS – 90 hours – M. R. Boudarel

This module complements International Finance 1 (M STE INS 518). It concentrates on the banking and stock exchange aspects of managing the organization. The courses cover the methods of evaluating and selecting investments used to implement company financing strategies, in function of the requirements of the financial markets.

List of Courses:

- STE INS 519A Investments. The course covers, in a practical way, the main methods of investment evaluation and selection used in the company framework. Requirements of the financial market regarding the capital placed at the company's disposal, and the means available to the company for satisfying these requirements.
- STE INS 519B Financial Markets. The course covers, in a practical and concrete way, how the Stock Exchange operates, the economic role of the Stock Exchange and Financial Markets on a national and international level.
- STE INS 519C Banking Systems. Structure of the French banking system and its impact on the financing of the national economy, the means implemented by the financial authorities to ensure the durability of the banking system and avoid the systemic risks linked to the failure/breakdown of banks.
- STE INS 519D The European Central Bank System and the role of the National Central Bank. Monetary policy of the euro system (instruments and procedures). The roles of the National Central Bank in the ECBS. Implementation of the common currency policy. Exchange policy and international relations. Correct utilization and security of means of payment. La Banque de France at the service of the economy. The role of place and surveillance. Services to the State. Services to banks: Central Banking Risks Service, FCC, FICP, FNCV, FIBEN. Services to companies.
- STE INS 519E Options and Futures. The course covers the essentials of the financial markets in interest rate products. Different types of interest rate: simple rate, compound rate, pre and post-tax rates, equivalent rate, continuous rate. Present value. Fixed-rate instruments. Nominal rate, actuarial rate. Different types of loans and their repayment schedules. Long-term instruments: basic essential calculations. Short-term instruments. Rate curves. Explanatory theories. Fixed-rate bonds. Price, rate. Indicators of bond sensitivity. Zero-coupon bonds and yield curves. Forward rates. Futures. Definition. Uses. Options. Models for evaluating options. Different option sensitivities. Principles of option portfolio management.
- STE INS 519F Financial Management. An introduction to the major aspects of the financial function in international businesses. The role of financial management in an international/group context. financial analysis and management information. investment appraisal. Break-even and cost/volume/profit analysis. Share issues. Working capital management. Mergers and acquisitions.

M STE INS 520 Quantitative finance

6-3 ECTS – 90 hours – X. Bay

This module covers the mathematical techniques required for financial markets and institutions.

List of courses:

- STE INS 520A Asset Management. Optimal allocation in the Markowitz sense. Model for the evaluation (or balancing) of financial assets (MEDAF or CAPM). Mathematical tools required for optimization-under-constraints and multi-criterion analysis.
- STE INS 520B Risk Management. Evaluation and coverage of derivative products (options, futures, etc.) Analysis of Black & Scholes. The basic tool used is Ito's stochastic calculus.
- STE INS 520 C Risk Measurement. Economy of risks (institutions and management of risks). Econometrics of risks (probabilistic modeling), typology, quantification and aggregation of risks (Value at Risk or VaR). Risk management and company management.

M STE INS 540 Industrial project

0-9 ECTS - 90 hours – H. Marian, M.R. Boudarel

An industrial diagnosis operation carried out within a company, learning to identify and formalize a problem or set of problems using auditing methodological tools. Students work in groups of two or three and are tutored by a teacher from the School to assist, if necessary, with bibliographical research and accompany students on their first visits. The industrial project is spread over two semesters. The general approach is as follows: understanding the company's strategy and development plan, delimitation and formalization of the problems involved, choice of industrial management tools, action plans, carrying out of improvement actions, testing of the results. Project assessed by written reports and oral presentations at the end of each semester.

STE INS 550 Graduate project

0-17 ECTS - 700 hours – X. Boucher, M.R. Boudarel

The objectives of the Graduate project are as follows:To validate the topics and the working methods acquired related to the training area (profile to follow),

- To check adequacy of his personal project to the field realities,
- To approach the functions of engineer and to share certain responsibilities for them,
- To prepare with a final integration in a firm
- Evaluation through an industrial thesis and an oral presentation of the project.

NANCY :COURSES IN « INDUSTRIAL AND SYSTEMS ENGINEERING »

NAN INS 411 Discrete and deterministic optimization

4-1 ECTS - 45hours - Marie-Claude Portmann

Complementary to the operational research courses included in the common core syllabus, this course covers the essentials of combinatory optimization: concepts of complexity algorithms and problems, main polynomial problems, exact exponential methods and different methodologies for constructing approximation methods.

NAN INS 412 Advanced algorithmics and databases

4-1 ECTS - 45hours - Henri Amet

Further knowledge of algorithmics for optimal implementation of complex procedures. Main concepts of information systems and databases.

NAN INS 451 Decision-making in an uncertain world

4-1 ECTS - 45hours - Marie-Claude Portmann

This course is complementary to the operational research courses on stochastic problems included in the common core syllabus. Applications such as stock or maintenance management are seen in their industrial context. Further tools are introduced such as Petri networks and two-player game theory. Continuous assessment together with written tests.

NAN INS 452 Modeling and forecasting

4-1 ECTS - 45hours -Yves Gueniffey

This course covers both traditional mathematics-based forecasting methods and forecasting methods using "soft computing" based on neural networks. Students use professional tools and learn to interpret the results obtained. Continuous assessment together with written tests.

NAN INS 400 Team Project

1–5 ECTS –75 hours- Henri Amet

The aim of this course is to apply academic knowledge to an industrial project. It is carried out by a group of 4 to 5 students under the direction of teacher in the department. It is assessed throughout the length of the project, which ends with an oral presentation.

NAN INS 511 Modeling and simulation

4-1 ECTS - 45hours - Henri Amet

When systems are too complex, the only way of obtaining results concerning their behavior is digital simulation, enabling the performances of different scenarios to be compared. Students use a professional software program. Continuous assessment together with written tests.

NAN INS 512 Data analysis and data mining

4-1 ECTS - 45hours - Yves Gueniffey

Extraction of useful knowledge for decision-making by applying methods from mathematics and information technology to large volumes of information from diverse databases. Students use a professional software program. Continuous assessment together with written tests.

NAN INS 513 Logistics chains and production management

4-1 ECTS - 45hours - Marie-Claude Portmann

The course shows how the complexity of the problems linked to production and logistics chain management requires approaches involving hierarchical decomposition of the problems concerned. Various decision-making problems arising in such situations are presented, modeled and in some cases resolved by means of the methods taught in previous courses. Contributions from industrialists underline the problems linked to human resources and management. Continuous assessment together with written tests.

NAN INS 550: Graduate Project

0-17 ECTS - 700 hours – Henri Amet

The objectives of the Graduate project are as follows:To validate the topics and the working methods acquired related to the training area (profile to follow),

- To check adequacy of his personal project to the field realities,
- To approach the functions of engineer and to share certain responsibilities for them,
- To prepare with a final integration in a firm

Evaluation through an industrial thesis and an oral presentation of the project.

6) FACULTY AND STAFF

Abbreviations :
ING = “Diplôme d’ingénieur”
HDR = “habilité à diriger des recherches”

Last	First	Degrees	Position	School
BAY	Xavier	PhD	Associate professor	STE
BOUCHER	Xavier	ING, PhD	associate professor	STE
BOUDAREL	Marie Reine	PhD	associate professor	STE
BURLAT	Patrick	ING, PhD, HDR	Professor	STE
DOLGUI	Alexandre	ING, PhD, HDR	Professor	STE
GIRARD	Marie-Agnès	PhD	associate professor	STE
GRIMAUD	Frédéric	ING, PhD	associate professor	STE
JULLIEN	Bertrand	ING, PhD	Executive researcher	STE
MARIAN	Hélène	ING, PhD	associate professor	STE
MATHON	Albert	ING	Professor	STE
VINCENT	Lucien	ING	professor	STE
AMET	Henri	PhD	Associate professor	NAN
COUJARD	Jean-Louis	ING, PhD, HDR	Professor	NAN
GUENIFFEY	Yves	ING, PhD	Associate professor	NAN
LEROYER	Ingrid	AGREG	Associate professor	NAN
OULAMARA	Ammar	ING, PhD	Associate professor	NAN
PELISSIER	Dominique	PhD	Associate professor	NAN
PORTMANN	Marie-Claude	PhD, HDR	Professor	NAN
RAMDANE CHERIF	Wahiba	PhD	Associate professor	NAN
REBISCHUNG	Didier	ING	Executive researcher	NAN
ZIMNOWITCH	Henri	PhD,HDR	Professor	NAN

VII) Graduate Programs in Materials Science and Mechanical Engineering

1) GRADUATE PROGRAMS LEADING TO THE "DIPLÔME D'INGÉNIEUR CIVIL DES MINES" WITH A MAJOR IN "MATERIALS SCIENCE AND MECHANICAL ENGINEERING"

NANCY : MAJOR IN MATERIALS SCIENCE AND ENGINEERING

This program is only available as a Major for the Joint Master in Executive Engineering & Materials Science and Engineering. This major offers two concentrations.

The concentration in Materials sciences

This concentration treats the general properties of materials and presents certain classes of materials like dielectric and magnetic materials.

One can typically distinguish two great families of materials, the materials known for the selected structure of their mechanical characteristics, and the materials known for their efficient which ensure functions other than mechanical.

A) THE TECHNOLOGICAL MAJOR (495 HOURS, 47 ECTS)

GS 1 : 4 courses (5 ECTS, 45 hrs each) & 1 project (75 h, 6 ECTS

- *Mechanical properties of materials* (NAN MAM 411),
- *Atomic and microstructure arrangement* (NAN MAM 412),
- *Magnetic and dielectric materials* (NAN MAM 451),
- *Electronic properties of materials* NAN MAM 452),

Team project (NAN MAM 400),

GS2 : 3 courses (5 ECTS, 45 hrs each) & 1 project (9 ECTS, 90 hrs)

- *Nano sciences and nano-materials* (NAN MAM 511),
- *Functional materials applications* (NAN MAM 512)**,**
- *Selection and optimization of materials* (NAN MAM 513),

Scientific project (NAN MAM 500),

B) THE METHODOLOGICAL MAJOR (444 HOURS, 48 ECTS)

Program in Management - Social & Cultural Awareness (174 hours, 18 ECTS)

5 courses

- Company management 1 (NAN GME 413) (30hrs, 3 ECTS
- Company management 2 (NAN GME 451) (30hrs, 3 ECTS)
- **1 course** (45hrs, 5 ECTS) chosen from the following list (**List L3 M**, page xxx) : Management supervision (NAN GME 511), Macro-economy and finance (NAN GME 512), International trade (NAN GME 513), Bank systems and financial products (NAN GME 514)
- **1 course** (24 hrs, 2 ECTS) chosen from the following list (**List L3 O**, page XXX): Design the city (NAN GME 471), What is Science (NAN GME 472), Building a modern identity(NAN GME 473), Ethics and society (NAN GME 474)
- **1 course** (45hrs, 5 ECTS) chosen in the list of electives activities

Courses in Industrial Engineering (270 hours, 30 ECTS) :

5 courses (5 ECTS, 45 hrs each)

- Operations research (NAN GME 411)

- Statistics (NAN GME 412)
- **A couple of courses** from the **List 2**: Design, Innovation, Production (NAN GME 414 + NAN GME 454), Risk sciences (NAN GME 415 + NAN GME 455), Environment, Clean and sound technology and recycling (NAN GME 416 + NAN GME 456), Protective engineering and social advancement (NAN GME 41 + NAN GME 457), E-business (NAN GME 418 + NAN GME 458), Aeronautics (NAN GME 419 + NAN GME 459), Civil engineering and society (NAN GME 420 + NAN GME 460)
- **2 courses** chosen in the list of electives activities

Elective activities (45 hours, 5 ECTS each)

- **One of the following courses** (Liste **L4 A):**

Materials working (NAN GME 421), Digital simulation (NAN GME 422), Numerical analysis (NAN GME 423), Data-processing techniques and solutions for the company (NAN GME 424),

- **One of the following courses** (Liste **L4 B):**

Physics for the computer (NAN GME 461),Materials for the engineer (NAN GME 462), Automation, instrumentation and industrial process control (NAN GME 463), Tools and environment in industrial process (NAN GME 464), Finance analysis and diagnose (NANGEM 465), Energy economy (NAN GME 468), Optimization (NAN GME 469).

- **One of the following courses** (Liste **L4 C**)::

Programming pearls (NAN GME 515), Automation and digital control (NAN GME 516), Statistical data-processing (NAN GME 517), Micro-economy and game theory (NAN GME 518), Fracture mechanics (NAN GME 519), International business negotiation (NAN GME 520), Company communication practice (NAN GME 521).

C) MISCELLANEOUS ACTIVITIES :

- An 8 weeks internship abroad whose goal is to get familiar with the environment and culture of foreign companies
- Graduate project (NAN ECH 550)
- Foreign languages training : 210 hours

The concentration in Materials engineering

The subject of this concentration is to present explanation of various processes which will make it possible to obtain a semi-finished product having a aimed microstructure (with properties), starting from the liquid phase, or by thermo mechanical transformations.

The concentration initially presents a broad outline of explanation of materials. The physicochemical differences observed between certain families of materials imposed in the second part treated separately of crystallized materials (mainly metal) and amorphous materials (mainly glass and polymers).

A) THE TECHNOLOGICAL MAJOR (495 HOURS, 47 ECTS)

GS 1 : 4 courses (5 ECTS, 45 hrs each) & 1 project (75 h, 6 ECTS

- Mechanical properties of materials (NAN MAM 411),
- Atomic and microstructure arrangement (NAN MAM 412),
- Development and treatment of crystalline materials (NAN MAM 453),
- Transformation of amorphous materials (NAN MAM 454),

Team project (NAN MAM 400),

GS2 : 3 courses (5 ECTS, 45 hrs each) & 1 project (9 ECTS, 90 hrs)

- Composite materials and semi-crystalline polymers (NAN MAM 514),
- Ceramics and sintered materials engineering (NAN MAM 515),
- Selection and optimization of materials (NAN MAM 513),

Scientific project (NAN MAM 500)

B) THE METHODOLOGICAL MAJOR (444 HOURS, 48 ECTS)

Program in Management - Social & Cultural Awareness (174 hours, 18 ECTS)

5 courses

- *Company management 1* (NAN GME 413) (30hrs, 3 ECTS

- *Company management 2* (NAN GME 451) (30hrs, 3 ECTS)
- **1 course** (45hrs, 5 ECTS) chosen from the following list (**List L3 M**, page xxx) : *Management supervision* (NAN GME 511), *Macro-economy and finance* (NAN GME 512), *International trade* (NAN GME 513), *Bank systems and financial products* (NAN GME 514)
- **1 course** (24 hrs, 2 ECTS) chosen from the following list (**List L3 O**, page XXX): *Design the city* (NAN GME 471), *What is Science* (NAN GME 472), *Building a modern identity*(NAN GME 473), *Ethics and society* (NAN GME 474)
- **1 course** (45hrs, 5 ECTS) chosen in the list of electives activities

Courses in Industrial Engineering (270 hours, 30 ECTS) :

5 courses (5 ECTS, 45 hrs each)

- Operations research (NAN GME 411)
- Statistics (NAN GME 412)
- **A couple of courses** from the **List 2**: *Design, Innovation, Production* (NAN GME 414 + NAN GME 454), *Risk sciences* (NAN GME 415 + NAN GME 455), *Environment, Clean and sound technology and recycling* (NAN GME 416 + NAN GME 456), *Protective engineering and social advancement* (NAN GME 41 + NAN GME 457), E-*business* (NAN GME 418 + NAN GME 458), *Aeronautics* (NAN GME 419 + NAN GME 459), *Civil engineering and society* (NAN GME 420 + NAN GME 460)
- **2 courses** chosen in the list of electives activities

Elective activities (one per semester ; 45 hours, 5 ECTS each)

- **One of the following courses** (Liste **L4 A):**

Materials working (NAN GME 421), *Digital simulation* (NAN GME 422), *Numerical analysis* (NAN GME 423), *Data-processing techniques and solutions for the company* (NAN GME 424),

- **One of the following courses** (Liste **L4 B):**

Physics for the computer (NAN GME 461),*Materials for the engineer* (NAN GME 462), *Automation, instrumentation and industrial process control* (NAN GME 463), *Tools and environment in industrial process* (NAN GME 464), *Finance analysis and diagnose* (NANGEM 465), *Energy economy* (NAN GME 468), *Optimization* (NAN GME 469).

- **One of the following courses** (Liste **L4 C**)::

Programming pearls (NAN GME 515), *Automation and digital control* (NAN GME 516), *Statistical data-processing* (NAN GME 517), *Micro-economy and game theory* (NAN GME 518), *Fracture mechanics* (NAN GME 519), *International business negotiation* (NAN GME 520), *Company communication practice* (NAN GME 521).

C) MISCELLANEOUS ACTIVITIES :

- An 8 weeks internship abroad whose goal is to get familiar with the environment and culture of foreign companies
- Graduate project (NAN ECH 550)
- Foreign languages training : 210 hours

SAINT-ETIENNE : MAJOR IN MATERIALS SCIENCE AND MECHANICAL ENGINEERING

This program leads to the Joint Master in Executive Engineering & Materials Science and Mechanical Engineering. Only certain combinations of modules are offered ; these combinations constitute the concentrations. All module combinations not listed must be approved by the advisor and the Program Head.

The objective of this Major is to provide a multidisciplinary training in Physics and the Mechanics of materials. The need for diverse competencies coupled with the need for open-mindedness in the engineer justify the introduction of teaching modules in Conception-Choice of Materials and in and Management of Techniques and Competencies. And The Technical Major is oriented by projects which are largely proposed by industrial actors. Each student-engineer is placed in the situation of having a project to complete within a business enterprise, using appropriate structuring, training and management methods. This gives students a chance to develop their creativity, sense of initiative, and sense of responsibility.

The concentration in Design et conception

The concentration in design and conception is adapted to students whose personal project is oriented towards careers in project management in the field of scaling and/or structure testing. This concentration leads to job opportunities in diverse sectors, from consulting firms to large equipment building companies.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS) :

4 compulsory modules, and an industrial project
- Mechanics (M STE MAM 411) **or** Materials (M STE MAM 412)
- Structure computations (M STE MAM 511)
- Management of technics and skills (M STE MAM 512)
- Design and selection of materials (M STE MAM 513)
- Industrial project (STE AMC 540)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management - Social & Cultural Awareness (186 hours, 15 ECTS) :

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

One elective module chosen among the following (120 hours each) from the List L1,chapter III :

Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

One elective course chosen among the following (30 hours each) from the List L2,chapter III

Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

One elective module chosen among the following (120 hours each) from the List L3,chapter III :

*Industrial and Systems Engineering (M STE GME 411), **Finite Elements and Structures** (M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), Natural processes (M STE GME 415).*

The Students are advised to choose **the Finite Elements and Structures module (M STE GME 412) ,** but may choose another module with the agreement of the adviser.

One elective module chosen among the following (120 hours each) from the List L4,chapter III **:**

Danger and Risk assessment (M STE GME 451), Decision making and optimization for industrial processes (M STE GME 452), Elaboration and transformation of Materials (M STE GME 453), Industrial Systems Engineering (M STE GME 454), Physical methods for the characterization of the matter (M STE GME 455).

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** (STE GME 490), is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in materials science and mechanical engineering (STE MAM 550)

.

- **Foreign Languages** : 100 hours

- **Sports activities** : 114 hours

The concentration in Materials

This concentration in materials is adapted to students whose personal project is oriented towards careers in the field of implementation, utilization, verification of materials and any other step of the materials life cycle. Career opportunities range from production management, through quality control, expertise, consulting, etc.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS) :

4 compulsory modules, and an industrial project
- Mechanics (M STE MAM 411) **or** Materials (M STE MAM 412)
- Materials engineering (M STE MAM 514)
- Management of technics and skills (M STE MAM 512)
- Design and selection of materials (M STE MAM 513)
- Industrial project (STE MAM 540)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management - Social & Cultural Awareness (186 hours, 15 ECTS) :

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

One elective module chosen among the following (120 hours each) from the List L1,chapter III :

Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

One elective course chosen among the following (30 hours each) from the List L2,chapter III

Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

One elective module chosen among the following (120 hours each) from the List L3,chapter III :

Industrial and Systems Engineering (M STE GME 411), ***Finite Elements and Structures*** *(M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), Natural processes (M STE GME 415).*

The Students are advised to choose **the Finite Elements and Structures module (M STE GME 412) ,** but may choose another module with the agreement of the adviser.

One elective module chosen among the following (120 hours each) from the List L4,chapter III **:**

Danger and Risk assessment (M STE GME 451), Decision making and optimization for industrial processes (M STE GME 452), ***Elaboration and transformation of Materials*** *(M STE GME 453), Industrial Systems Engineering (M STE GME 454), Physical methods for the characterization of the matter (M STE GME 455).*

The Students are advised to choose **the Elaboration and transformation of Materials module (M STE GME 453) ,** but may choose another module with the agreement of the adviser.

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** (STE GME 490), is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in materials science and mechanical engineering (STE MAM 550)

.

- **Foreign Languages** : 100 hours

- **Sports activities** : 114 hours

The concentration in Mechanical engineering R&D

The concentration in mechanical engineering R&D is specifically intended for students who wish to work in the field of research in Mechanics of materials and structures. Students will find career opportunities as research engineers in this field. This concentration allows students to simultaneously obtain a Master of Science ("Master Recherche") in "Mechanics and Engineering" (see below), and thus directly pursue a doctoral degree.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS) :

4 compulsory modules, and a research project

- Mechanics (M STE MAM 411)
- Structure computations (M STE MAM 511)
- Mechanics and engineering (M STE MAM 612)
- Design and selection of materials (M STE MAM 513)
- Research project (STE MAM 640)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management - Social & Cultural Awareness (186 hours, 15 ECTS) :

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

One elective module chosen among the following (120 hours each) from the List L1,chapter III :

Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

One elective course chosen among the following (30 hours each) from the List L2,chapter III

Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

One elective module chosen among the following (120 hours each) from the List L3,chapter III :

Industrial and Systems Engineering (M STE GME 411), ***Finite Elements and Structures*** *(M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), Natural processes (M STE GME 415).*

The Students are advised to choose **the Finite Elements and Structures module (M STE GME 412) ,** but may choose another module with the agreement of the adviser.

One elective module chosen among the following (120 hours each) from the List L4,chapter III **:**

Danger and Risk assessment (M STE GME 451), Decision making and optimization for industrial processes (M STE GME 452), Elaboration and transformation of Materials (M STE GME 453), Industrial Systems Engineering (M STE GME 454), Physical methods for the characterization of the matter (M STE GME 455).

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** (STE GME 490), is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in materials science and mechanical engineering (STE MAM 650 obtaining simultaneously a Master of Science)

.

- **Foreign Languages** : 100 hours

- **Sports activities** : 114 hours

The concentration in Materials R&D

The concentration in materials R&D is specifically intended for students who wish to work in the field of research in materials engineering and science. Students will find career opportunities as research engineers in this field. This concentration allows students to simultaneously obtain a Master of Science ("Master Recherche") in "Materials engineering and science", and thus directly pursue a doctoral degree.

A) THE TECHNOLOGICAL MAJOR (480 HOURS, 46 ECTS) :

4 compulsory modules, and an industrial project

- Materials (M STE MAM 412)
- Materials engineering (M STE MAM 514)
- Management of technics and skills (M STE MAM 512)
- Materials science and engineering (M STE MAM 611)
- Industrial project (STE MAM 540)

B) THE METHODOLOGICAL MAJOR (426 HOURS, 35 ECTS) :

Program in Management - Social & Cultural Awareness (186 hours, 15 ECTS) :

- *Audit (STE GME 416)*
- *Research of Information and Interview Techniques (STE GME 417)*

One elective module chosen among the following (120 hours each) from the List L1,chapter III :

Principles of accounting and of financial systems (M STE GME 461), Entrepreneurship & business ownership (M STE GME 462), Industrial Economy (M STE GME 463), Management of human resources and evolution of structures (M STE GME 464), Industrial Ecology (M STE GME 465).

One elective course chosen among the following (30 hours each) from the List L2,chapter III

Intercultural Management (STE GME 511), Conflict Management and Negotiation (STE GME 512), Industrial Marketing (STE GME 513)

Courses in Industrial Engineering (240 hours, 20 ECTS) :

One elective module chosen among the following (120 hours each) from the List L3,chapter III :

Industrial and Systems Engineering (M STE GME 411), ***Finite Elements and Structures*** *(M STE GME 412), Instrumentation (M STE GME 413), Statistical Methods and Actuarial Sciences (M STE GME 414), Natural processes (M STE GME 415).*

The Students are advised to choose **the Finite Elements and Structures module (M STE GME 412) ,** but may choose another module with the agreement of the adviser.

One elective module chosen among the following (120 hours each) from the List L4,chapter III **:**

Danger and Risk assessment (M STE GME 451), Decision making and optimization for industrial processes (M STE GME 452), ***Elaboration and transformation of Materials*** *(M STE GME 453), Industrial Systems Engineering (M STE GME 454), Physical methods for the characterization of the matter (M STE GME 455).*

The Students are advised to choose **the Elaboration and transformation of Materials module (M STE GME 453) ,** but may choose another module with the agreement of the adviser.

C) OTHER ACTIVITIES :

- **A Graduate project within the methodological major** (STE GME 490), is carried out at the end of the first year of GS. The project is generally undertaken in a business enterprise under the guidance of a GS advisor. It is a group project and concludes with a report and an oral defense.

- The program ends with a **Graduate project** in materials science and mechanical engineering (STE MAM 650 obtaining simultaneously a Master of Science)

.

- **Foreign Languages** : 100 hours

- **Sports activities** : 114 hours

2) MASTER'S PROGRAMS LEADING TO A MASTER OF SCIENCE

NANCY: PHYSICS AND CHEMISTRY OF MATTER AND MATERIALS

This course is concerned primarily with physics (electronic properties, phase transitions and critical phenomena, radiation-matter interaction, physics of surfaces and interfaces, crystallography).

NANCY: MATERIALS SCIENCE AND ENGINEERING

The research Masters (MS) "Materials Science and Engineering" is research training for students - with or without an engineering diploma - intending to work as engineers in materials science. It involves placing students attracted by technical and scientific activities involving materials in the industrial sector into a situation where they can apply their interest and aptitudes for materials through a year of personal documentary research, experimentation and work experience in a university laboratory or industrial research centre. This is a new and original method of personal training (compared with their academic career so far) to complement more traditional methods and a useful complement to an engineering diploma.

The fields covered are Materials Science, Materials Engineering and the Procedural Engineering of Materials Production.

SAINT-ETIENNE : SCIENCE AND ENGINEERING OF MATERIALS

CONTACT : Julian Driver (driver@emse.fr)

PARTNERSHIP AND INSTITUTIONAL FRAMEWORK

This Master of Science involves the following institutions and laboratories:

- the "Université de Grenoble I"
- the "Institut National Polytechnique de Grenoble" ("INPG")

Such a partnership provides all students with a top-notch scientific environment where they will find the best expertise and counselling support to define and manage their master curriculum.

OBJECTIVE

The MS ("Master Recherche") in Materials Science and Engineering has the goal of providing students with the basic scientific knowledge useful in understanding the phenomena which govern the transformation of materials in all their diversity (from their elaboration to their behavior under operating conditions). The notion of elaboration must here be understood in its broadest sense, that is, including

the synthesis leading to a structure or microstructure with the desired properties. The program is composed of two parts, which are equally weighted:

- theoretical coursework, which is comprised of “common core” classes, “concepts and modeling” type classes, and specialized classes.

Introduction to research which includes a research internship in a laboratory.

SCOPE OF ACTIVITY and RESEARCH DOMAINS

- Improving the properties of metallic alloys through microstructure control by means of thermo-mechanical treatments in association with numerical modeling of the physics and mechanics of plastic deformation, damage and recrystallization and the quantitative characterization of microstructure evolution during alloy processing.
- Microstructure based analysis, understanding and modeling of the mechanical properties of materials, particularly metallic alloys and intermetallics in their chemical environment.
- Control of technical ceramic component production parameters by powder metallurgy in order to master their microstructure evolution and the correlation with the mechanical (fracture, wear), electrical (dielectric breakdown) and thermal (shock) properties.
- Surface treatments: the production and characterization of surface treatments and coatings essentially by electrolysis.

SAINT-ETIENNE : MECHANICS AND ENGINEERING

CONTACT : Alain Vautrin (vautrin@emse.fr)

PARTNERSHIP AND INSTITUTIONAL FRAMEWORK

This Master of Science involves the following institutions and laboratories:

- the “Ecole Nationale Supérieure de Saint-Etienne" ("ENISE")
- the "Université Jean Monnet" at Saint-Etienne

Such a partnership provides all students with a top-notch scientific environment where they will find the best expertise and counselling support to define and manage their master curriculum.

OBJECTIVE

The MS (“Master Recherche”) in Mechanics and Engineering aims to provide students with:

- knowledge in modeling, identification, and reliability of mechanical and thermomechanical systems
- a methodology that is well adapted to conducting research projects

Students will be able to acquire more in-depth knowledge of a particular subject in mechanics by choosing specific course units to individualize a learning itinerary. These subjects and itineraries come out of scientific competencies of the teaching and research teams involved:

- The “modeling and numerical simulation” theme covers methods for numerical simulation applied to the mechanical behavior of components, and technologies for implementation at high temperatures. This theme allows for specific itineraries in calculations of structures, processing, and transfers.

The objective of the “Composite structures and their identification” theme is mastering the complete chain of identification of mechanical behavior, from the choice to the implementation of experimental techniques to the methods for obtaining the parameters of the model. It allows student to develop notions of conception and manufacturing , of durability and maintenance

SCOPE OF ACTIVITY and RESEARCH DOMAINS

- Process modeling and optimization to improve our understanding of the fabrication processes of materials such as organic based composites and specifying and optimizing the pertinent parameters
- Computer-aided design ; the development of software tools and design methods for composite structures
- Composites and fabrics : improving our understanding and modeling of the mechanical properties and durability of composite materials and fabrics
- Physics and mechanics of microsystems and their assembly : modeling the microstructures and residual stresses in microsystems including their in-service behaviour with the aim of improving the design tools used by this branch of industry.

3) DOCTORAL PROGRAMS

NANCY: SCIENCE AND ENGINEERING OF MATERIALS PRODUCTION

- Metallurgy of production by gas-solid, gas-liquid, solid-solid; casting and solidification methods
- Original methods producing metastable structures: mechanosynthesis, production of modulated structures, amorphous alloys (metallic or semi-conductors), quasicrystal, metallic powders and compaction, ceramics
- Process Engineering of Materials Production

NANCY: MICROSTRUCTURES AND PROPERTIES

- Structural phase transformation: crystallization, crystal-to-crystal transition, amorphous or quasi-crystals, design of thermal and thermomechanical alloy processing procedures, modeling of phase transformation and thermomechanical processing.
- Mechanical properties of metallic alloys, semi-conductors, ceramics and polymers; mechanical properties of metastable systems (amorphous alloys, quasicrystals, materials obtained by mechanosynthesis or powder metallurgy); fundamental study of dislocation movements; modeling of polycrystalline structures and seed growth.
- Mechanics of the rupture of metallic alloys, semi-conductors, ceramics and polymers.
- Relationships between local order and physical properties in amorphous alloys, metallic glasses, modulated structures; role of local order in thermodynamic, mechanical, magnetic and transport properties.

NANCY: SURFACES AND INTERFACES

- Mechanics of surfaces and interfaces: elastic constants, laws of behavior, fragility, adhesion, mechanics of contacts and coated surfaces.
- Physical and chemical properties of surfaces and interfaces: influence of coatings on tribological properties and corrosion resistance; synthesis of superficial alloys and associated microscopic mechanisms (epitaxia, diffusion, segregation).

NANCY: TREATMENTS AND TREATMENT PROCESSES

- Methodology of thermal and thermomechanical treatments: modeling and simulation; role of internal constraints.
- Treatment processes: mass (heating and refrigeration); surface (plasma-assisted treatment processes, laser treatments, thermochemical treatments, rapid-cycle treatments).

Engineering of surface treatment processes.

SAINT-ETIENNE : MATERIALS SCIENCE AND ENGINEERING

Most of the research topics in Materials Science and Engineering are regrouped within the CNRS laboratory UMR 5146 as follows :

- Microstructures and Processing Department: Improving the properties of metallic alloys through microstructure control by means of thermo-mechanical treatments in association with numerical modeling of the physics and mechanics of plastic deformation, damage and recrystallization and the quantitative characterization of microstructure evolution during alloy processing.

- Physical Mechanics and Interfaces: Microstructure based analysis, understanding and modeling of the mechanical properties of materials, particularly metallic alloys and intermetallics in their chemical environment.
- Special Ceramics: control of technical ceramic component production parameters by powder metallurgy in order to master their microstructure evolution and the correlation with the mechanical (fracture, wear), electrical (dielectric breakdown) and thermal (shock) properties.
- Surface treatments: the production and characterization of surface treatments and coatings essentially by electrolysis.

SAINT-ETIENNE : MECHANICS AND ENGINEERING

In this program the research topics are:

- Process modeling and optimization to improve our understanding of the fabrication processes of materials such as organic based composites and specifying and optimizing the pertinent parameters
- Computer-aided design ; the development of software tools and design methods for composite structures
- Composites and fabrics : improving our understanding and modeling of the mechanical properties and durability of composite materials and fabrics
- Physics and mechanics of microsystems and their assembly : modeling the microstructures and residual stresses in microsystems including their in-service behaviour with the aim of improving the design tools used by this branch of industry.

4) COURSES AND MODULES IN MATERIALS SCIENCE & ENGINEERING

SAINT ETIENNE : TABLEAU SYNOPTIQUE DES PROFILS « MATERIAUX MECANIQUE»

	SAINT ETIENNE Matériaux Mécanique	Design et Conception	Matériaux	R&D Mécanique	R&D en matériaux
MAM 411	Mécanique	ou	ou		
MAM 451	Matériaux	ou	ou		
MAM 511	Calcul de structures				
MAM 512	Manag. des Techn.&Compéten.				
MAM 513	Conception et Choix des Mat.				
MAM 514	Ingénierie des matériaux				
MAM 611	Science et Génie des matériaux				
MAM 612	Mécanique et Ingénierie				
Liste L1	Electif Management				
Liste L3	Electif Génie Ind.	Eléments finis	Eléments finis	Eléments finis	Eléments finis
Liste L4	Electif Génie Ind.		Elab.Transf. Matériaux		Elab.Transf. Matériaux
Liste L5	Electif Génie Ind.				
Liste L2	Electif Management				
	Légende		**Cours de 1ère année**		**Cours de 2ème année**

M STE MAM 411 Mechanics

6-4 ECTS – 120 hours – S. Drapier

This module aims to teach the skills required for understanding the mechanical behavior of materials and structures. The course concentrates on the material and geometric

approximations required for modeling, and thus understanding, real problems. Application of the theory covered in class, by means of supplementary practical work, to reinforce students' ability to use these simplifications in a well controlled framework, without losing sight of the difficulties of identifying mechanical properties. This combination of theory, practical and project work will enable future engineers to contextualize the results of simulations and trials with respect to underlying models.

List of Courses:

- STE MAM 411A Mechanics of materials. Behavioral laws required for the representation, and thus the simplification, of frequently complex behaviors.
- STE MAM 411B Mechanics of structures. Geometric simplifications enabling the mechanics of continuous media to be transformed "simplified" problems, producing lower cost usable solutions, for example in the context of sizing (beams, girders, sheets).
- STE MAM 411C Measurements and identification. Implementation of experimental work to identify the parameters of behavioral models with regard to materials and structures.
- STE MAM 411D Project of analytical or experimental nature, perhaps combined with the "Finite elements" module (M STE GME 413). The personal project offers the possibility of comparing complementary experimental and/or theoretical approaches.

M STE MAM 412 Materials

7-3 ECTS – 120 hours – A. Fraczkiewicz

The aim of this module is to help students acquire real skills in materials science. In particular, it involves understanding and predicting the physical and mechanical behavior of materials, on both the macroscopic and microscopic scale (i.e. from the nanometer to the millimeter). From a practical point of view, the module focuses on the ability to:

- discuss the materials and treatment required for a given utilization;
- dialogue effectively with a client, a service provider or materials specialist;
- read and make use of the technical or scientific literature relating to the field.

List of Courses:

- STE MAM 412A Crystalline defects. Recognition of characteristics and main properties of atomic crystalline defects, for interpretation, on a microscopic scale, of the physical and mechanical properties of materials.
- STE MAM 412B Diffusion and phase transformations. Recognition of the classic phase transformations in materials science, understanding the mechanisms governing the nature and evolution of microstructures, and analyzing the relations between phase diagrams, composition and thermal treatments, in order to achieve a practical improvement in the final properties of the material.
- STE MAM 412C Phenomenology of mechanical behavior. Recognition of the various categories of mechanical behavior of materials and the various methods for determining these behaviors, through a global (or macroscopic) approach, not taking into consideration the microstructure of the materials, and how to use the concepts acquired to evaluate the maximum admissible stress or service life, in simple cases.
- STE MAM 412D Microstructure and mechanical behavior. Introduction to the microscopic modeling of the mechanical behavior of materials. How the knowledge and control of microstructures enables selection of materials for a given application, optimized by their composition and treatment.
- STE MAM 412E Physical properties of materials. Explanation of electrical, thermal, magnetic and optical properties of materials from the behavior of electrons, and applications exploiting the electronic properties of materials in fields such as microelectronics, optoelectronics and transducer technology.
- STE MAM 413F Laboratory Projects. Study a phenomenon or type of material, from the point of view of the relationship between microstructure and properties. This is the opportunity for students to improve their understanding of the concepts developed in class, and to learn about materials characterization methods.

M STE MAM 511 Structure computation

5-4 ECTS – 90 hours – W.S. Han

This module enables students to increase their knowledge of the mechanics of materials and structures, from their behavior, whether static or dynamic, isotropic or not, linear or non-linear, to their rupture. There is one final, oral, examination for the whole course. Students are given the opportunity to develop a particular subject in parallel with the classes, then to present it to the tutors and other students. A discussion then ensues covering any of the concepts dealt with in the module. This method

of examination is designed to prepare the student for scientific presentations in an industrial context.

List of Courses:

- STE MAM 511A Rupture. Understanding the mechanical causes of the rupture of structural components.
- STE MAM 511B Modeling of the behavior of structures. Consolidates the basic concepts of the mechanics of continuous media, introduces non-linear behaviors and gives the basic theory of models of non-linear finite-element calculation.
- STE MAM 511C Dynamics of solids and structures. Provides the basic principles concerning the problems of structural vibration.
- STE MAM 511D Mechanics of polymers and composites. Introduces solid polymer materials by emphasizing the relationship between microstructure and utilization for the design of components, presents the basics of the analysis and dimensioning of stratified composite structures, analysis of the effects due to anisotropy.

M STE MAM 512 Management of techniques and skills

6-3 ECTS – 90 hours – R. Blondeau

This module is an introduction to the management of an industrial company. It consists of three parts: a course on the methodology of design and innovation, a series of presentations and company visits, which are then the basis for a project used for the overall assessment of the module.

List of Courses:

- STE MAM 512A Design methodology. Considering the design methods for the creation of engineering objects and the monitoring of their life cycle. The purpose of this course is more to initiate a certain mental approach than to provide knowledge.
- STE MAM 512B Talks. Series of presentations given by materials manufacturers (Usinor, Pechiney) and heads of SMEs. These presentations deal with various fields: technical innovation - strategy - marketing - investments - yield – economic intelligence – industrial property - management of human skills.
- STE MAM 512C Project. Visits to technical and managerial companies. Oral “surprise” report on aspects of management.

M STE MAM 513 Design and selection of materials

6-3 ECTS – 90 hours – D. Delafosse

This module aims to open up new approaches to product design. These approaches, characteristic of engineering sciences, make use of specific methods of materials selection and production processes. The course is organized in four parts: seminars on families of materials; a course on the tools and methods of design; a course on the methods of selection of materials and procedures, and a final design project presented in English.

List of Courses:

- STE MAM 513A Seminars on the various families of materials and their uses in different industrial sectors. Presentations of metallic materials, polymers, composites and ceramics given by industrial producers or users of these materials. Some of these presentations are given in English.
- STE MAM 513B Methods of selection of materials and processes. This course aims to introduce a rational methodology for the selection of materials and production processes in function of the applications required. The methodology is based on the concept of performance indices, as implemented in the “Cambridge Engineering Selector” program aiding the selection of materials and procedures. Practical work is carried out using this software. The limits of this method and of alternative approaches are presented by means of case studies.
- STE MAM 513C Selection-aiding tools. Digital optimization plays an important role in the identification of mechanical models and their use for the purposes of design. We present the principles underlying the methods of digital optimization through the problems of the mechanics of structures: the identification of laws of behavior and the design of structures in composite materials. Design and production of computerized technical information management systems.
- STE MAM 513D Project. Design project making use of the techniques of selection of materials and processes covered in class, carried out in groups of 3 to 4 students. Presented in English.

M STE MAM 514 Materials engineering

5-4 ECTS – 90 hours – D. Goeuriot

This module is closely linked to the industrial project (M STE MAM 540). This project makes use of various scientific and technical skills, which is why a wide choice of courses is offered, covering various "materials" professions: production, control and expertise, R and D, consultancy; and also covering all families of materials: metals, ceramics, polymers and composites. Students must choose four courses from among those mentioned below, bearing in mind that the “Rupture” course (STE MAM 514A) is compulsory.

Assessment of the module is by oral examination on a question (worked on in personal time) covering several courses, together with more specific questions.

List of Courses:

- STE MAM 514A Rupture. The mechanical causes of the rupture of structural components.
- STE MAM 514B Forming of metals by plastic deformation. The fundamental concepts required for the analysis and understanding of the industrial procedures for forming metals, in the fields of both continuous media mechanics and physical metallurgy.
- STE MAM 514C Corrosion – Surfaces. Physical-chemical mechanical and micro-structural industrial problems linked to corrosion, methods of prevention and repair. Fundamental mechanisms involved in degradation phenomena, which need to be understood by designers, manufacturers and users.
- STE MAM 514D Ceramics. Sensitization to the relationship between the production, microstructure and utilization of ceramic materials.
- STE MAM 514E Relationship between microstructures and properties. Reinforces the understanding of the relationship between the microstructure and properties of materials.
- STE MAM 514F Fatigue, creep. Explains the main causes of the failure of materials and structures. Provides an introduction to the methods of calculation of the service life of components.
- STE MAM 514G Implementation of polymers. Illustrates the important aspects of the production and transformation of polymers.

M STE MAM 540 Industrial project

0-9 ECTS - 90 hours – D. Goeuriot

The two main objectives of these projects are to:

- Give students the opportunity to apply their knowledge and skills in the context of a project carried out in relation with a prime manufacturer;
- Enable students to build up a working environment in function of the project in hand (tutorials, seeking outside skills etc.).

STE MAM 550: Graduate project

0-17 ECTS - 700 hours – D. Goeuriot

The objectives of the Graduate project are as follows:

- To validate the topics and the working methods acquired related to the training area (profile to follow),
- To check adequacy of his personal project to the field realities,
- To approach the functions of engineer and to share certain responsibilities for them,
- To prepare with a final integration in a firm

Evaluation through an industrial thesis and an oral presentation of the project.

M STE MAM 611 Materials science and engineering

4-5 ECTS – 90 hours – J. Driver

This aim of this module is to provide students with the background knowledge and basic concepts of materials sciences and engineering. It contains a general teaching component, then three courses introducing particular concepts and models.

List of courses:

- STE MAM 611A Concepts and basic models. This course introduces the governing forces behind the origin and evolution of microstructures, interfaces within materials, and particular defects and dislocations.
- STE MAM 611B Phase transformations and microstructures. Definition and characterization of microstructures, relationship between microstructures and properties (examples), phase transitions and transformations, microstructures generated by solid-solid phase transformations.
- STE MAM 611C Physics of deformation. The mechanisms of the hardening of metal alloys, creep, localization of plastic deformation (fatigue), monocrystal, micro-macro transition.
- STE MAM 611D Surfaces and interfaces. Electronic structure of surfaces, chemical analysis of surfaces, solid-liquid adhesion.

M STE MAM 612 Mechanics and engineering

5-4 ECTS – 90 hours – R. Fortunier

This module provides further study of mechanics, and is designed for students whose personal project contains a research component, or who intend pursuing doctorate studies in the field. It consists of three courses.

List of Courses:

- STE MAM 612A Mechanics of composites. The main concepts covered are the molecular structure of solid polymers, their mechanical properties and modeling, the constitution of composite materials (reinforcements, matrices, forming processes), the anisotropic elastic behavior of the ply, identification of constants, laminated plate theory and associated rupture criteria.

- STE MAM 612B Identification of the behavior of materials. Modeling the mechanical behavior of materials and the strategy of experimental identification of the parameters of behavioral laws for both static and dynamic behaviors.
- STE MAM 612C Photomechanics. Field methods are applied to the identification of the behavior of materials and structures. Concepts of calibration, out-of-plane displacements, signal derivation and stereo-correlation.

M STE MAM 640 Research project

0-9 ECTS - 90 hours – D. Goeuriot

The aim of this module is to introduce students to research tools and methods via personal work on a subject proposed by a lecturer-researcher who, within the context of his/her activities, supervises the project throughout the module. Students must adopt a rigorous approach, carrying out bibliographical research, experiments and/or simulations, and interpreting them by means of models. Students thus acquire the working methodology required for conducting a research project.

STE MAM 650: Graduate project

0-17 ECTS - 700 hours – D. Goeuriot

The objectives of the Graduate project are:To validate the topics and the working methods acquired related to the training area (followed profile),

- To check if adequate his personal project as to the reality in the field,
- To approach the functions of research engineer or a doctorant,
- To prepare with a final integration in a company or a research laboratory

Evaluation through a research thesis and an oral presentation of the project.

NANCY :COURSES IN "MATERIALS – MECHANICS"

NAN MAM 400 Team project

1-5 ECTS – 60 hours – Gerard Michot

This project, preferably on an "industrial" subject, is designed to apply the knowledge acquired during the first year of the GS. The project is carried out by groups of 4 or 5 students. Assessment is by continuous assessment during the project together with a presentation.

NAN MAM 411 Mechanical properties of materials

4-1 ECTS – 45 hours – Thomas Kruml

Mechanical properties and behavior. Phenomenological laws and microscopic mechanisms. Methods of measurement. This module presents the concepts of mechanical properties and behavior (elasticity, plasticity, rupture), the phenomenological laws and microscopic mechanisms involved, together with methods used to measure them. Examples are taken from all classes of materials, though mainly metals. Course assessed by continuous assessment and written examinations.

NAN MAM 412 Atomic arrangements and microstructures

4-1 ECTS – 45 hours - Elisabeth Bauer-Grosse

Through a fundamental approach based on crystallography, thermodynamics and kinetics and an experimental approach based on the various materials characterization techniques, this course enables the constitution of a material to be discovered and described at scales ranging from atomic architecture to microstructure and gives the basic elements for conceiving or predicting the constitution that will best respond to the conditions of use of a material. Course assessed by continuous assessment and written examination.

NAN MAM 451 Mechanical and dielectrical materials

4-1 ECTS – 45 hours - Jean-Pierre Michel

Electronic properties of metals and semi-conductors. Microelectronic Components. Course assessed by continuous assessment and written examinations.

NAN MAM 452 Electronic properties of materials

4-1 ECTS – 45 hours - Marie-Odile Selme

The objective of the course is to understand the electronic properties of materials from their microscopic structure. Course assessed by continuous assessment and written examinations.

NAN MAM 453 Production and treatment – crystalline materials

4-1 ECTS – 45 hours - Gerard Lesoult

Production, transformation and forming of materials for specific functions: the case of metals and ceramics. Course assessed by continuous assessment and written examinations

NAN MAM 454 Transformation of amorphous materials

4-1 ECTS – 45 hours - Christian G'Sell

Production, transformation and forming of materials for specific function: the case of polymers. Course assessed by continuous assessment and written examinations.

NAN MAM 500 Research project

0-7 ECTS – 70 hours - Gerard Michot

Project on a research subject. It has a dual objective: to familiarize future engineers with the world of research so they can make instinctive use of laboratories for the creation of new products during their careers, and also to provide an introduction to research for students who go on to work in that sector. Project assessed by continuous assessment and written examinations.

NAN MAM 511 Nanosciences and nanomaterials

4-1 ECTS – 45 hours - Marie-Odile Selme

Surface properties of materials. Characterization, growth, manufacturing technologies. Characterization of nanodevices. Course assessed by continuous assessment and written examinations.

NAN MAM 512 Implementation of functional materials: semi-conductors and electronics materials

4-1 ECTS – 45 hours - Philippe Mangin

This module deals with the production processes of functional materials and their implementation in the field of optronics, i.e. optics for electronics and communication. Course assessed by continuous assessment and written examinations.

NAN MAM 513 Selection and optimization of materials

4-1 ECTS – 45 hours - Elisabeth Bauer-Grosse

This course covers every field of use of materials, in the form of presentations and case studies, detailing in each case the approach enabling "material" specifications to be drawn up in function of i) the possibilities of optimizing the desired property by appropriate treatment, ii) the means of forming or assembly leading to the best property / cost ratio, iii) working conditions (ageing, safety) and recycling. Course assessed by continuous assessment and written examination.

NAN MAM 514 Composite materials and semi-crystalline polymers

4-1 ECTS – 45 hours - Christian G'Sell

Formation, structure and mechanical properties of heterogeneous and / or anisotropic materials (composite materials reinforced with fibers or particles, polymer alloys, micro-heterogeneous polymers). Course assessed by continuous assessment and written examination.

NAN MAM 515 Engineering of ceramics and vitreous materials

4-1 ECTS – 45 hours - Alain Mocellin

Engineering of ceramics and vitreous materials. Major stages in the production system of a material from powder. ¨Physico-chemical mechanisms of the system at each stage. Influence of process control parameters, at successive stages, upon the progressive formation of the microstructure and resulting properties. Some significant concrete cases discussed and illustrated in detail. Course assessed by continuous assessment and written examination.

M NAN MAT 610 Physics and chemistry of matter and materials

15 – 0 ECTS – 150 Hours – Daniel Malterre

List of courses:

- NAN MAT 610A Electronic Properties of solids
- NAN MAT 610B Critical Phenomena
- NAN MAT 610C Radiation-matter interaction
- NAN MAT 610D Physico-chemistry of Surfaces
- NAN MAT 610E Magnetism
- NAN MAT 610F Structure and electrical properties of materials
- NAN MAT 610G Magnetochemistry
- NAN MAT 610H Carbon materials and adsorption
- NAN MAT 610I Electronic transmission phenomena in materials
- NAN MAT 610J Low dimensionality solids and polymer materials

M NAN MAM 611 Materials Sciences and engineering

15-0 ECTS – 150 hours - Gerard Lesoult

List of Courses:

- NAN MAT 611A Engineering of materials production and treatment processes
- NAN MAT 611B Origin of microstructures
- NAN MAT 611C Analysis and modeling of materials production and treatment processes
- NAN MAT 611D Advanced thermally activated and/or plasma assisted procedures of surface processing in gaseous phase
- NAN MAT 611E Formation and control of vitreous microstructures
- NAN MAT 611F Crystalline growth and solidification

5) FACULTY AND STAFF

Abbreviations :
ING = "Diplôme d'ingénieur"
HDR = "habilité à diriger des recherches"

Last	First	Degrees	Position	School
BARRAT	Sylvère	PhD	associate professor	NAN
BAUER-GROSSE	Elisabeth	PhD, HDR	professor	NAN
CLEYMAND	Franck	PhD	associate professor	NAN
G'SELL	Christian	PhD, HDR	professor	NAN
LENOIR	Bertrand	PhD, HDR	professor	NAN
LESOULT	Gérard	Ing, PhD, HDR	professor	NAN
MANGIN	Philippe	PhD, HDR	professor	NAN
MICHEL	Jean-Pierre	PhD, HDR	professor	NAN
MICHOT	Gérard	PhD, HDR	professor	NAN
MOCELLIN	Alain	Ing, PhD, HDR	professor	NAN
SELME	Marie-Odile	PhD, HDR	professor	NAN
BENABEN	Patrick	ING, PhD, HDR	Associate professor	STE
BISCONDI	Michel	ING, PhD, HDR	Professor	STE
BLONDEAU	Régis	ING	Professor	STE
BOSCH	Cédric	PhD	Executive researcher	STE
DARRIEULAT	Michel	ING, PhD	Professor	STE
DELAFOSSE	David	ING, PhD, HDR	Associate professor	STE
DESRAYAUD	Christophe	ING, PhD	Associate professor	STE
DRAPIER	Sylvain	PhD, HDR	Associate professor	STE
DRIVER	Julian	ING, PhD, HDR	Professor	STE
FILLIT	René	ING	Executive researcher	STE
FRACZKIEWICZ	Anna	ING, PhD, HDR	Professor	STE
FOREST	Bernard	ING, PhD, HDR	Professor	STE
FORTUNIER	Roland	ING, PhD, HDR	Professor	STE
GIRINON	Dominique	ING, PhD, HDR	Professor	STE
GOEURIOT	Dominique	ING, PhD, HDR	Professor	STE
GOEURIOT	Patrice	ING, PhD, HDR	Professor	STE
HAN	Woo-Suck	ING, PhD	Associate professor	STE
KLOCKER	Helmut	ING, PhD, HDR	Associate professor	STE
LE COZE	Jean	ING, PhD, HDR	Professor	STE
LE RICHE	Rodolphe	ING, PhD	Associate professor – CNRS	STE
MAURICE	Claire	ING, PhD	Associate professor – CNRS	STE
MOLIMARD	Jérôme	ING, PhD	Associate professor	STE
MONTHEILLET	Frank	ING, PhD, HDR	Professor – CNRS	STE
PIOT	David	ING, PhD	Executive researcher	STE

STOLARZ	Jacques	PhD, HDR	Associate professor	STE
TANGUY	Döme	PhD	Associate professor – CNRS	STE
VALDIVIESO	François	ING, PhD	Associate professor	STE
VAUTRIN	Alain	ING, PhD, HDR	Professor	STE
WOLSKI	Krzysztof	ING, PhD, HDR	Associate professor	STE

CHAPTER III: PROGRAMS IN GENERAL METHODS FOR ENGINEERS (GME)

1) INFORMATION ON THE GENERAL METHODS FOR ENGINEERS

A) « L'INGÉNIEUR GÉNÉRALISTE » : CAPACITIES AND TRAINING

The goal of MINES Engineering Schools is to produce "general" engineers. At the end of the program of study, the engineer will have been trained to react to a significant variety of engineering problems including, but not limited to those specific to his or her field of specialization.

An engineer must be able to set up problem-solving options, define strategies, organize new structures, innovate, design and elaborate complex systems, resolve operational difficulties, all within an information-intensive and technology based economy. The engineer must therefore have at his or her disposal all the skills necessary to the formulation of new ideas and to decision-making.

The French Ecoles des Mines are ideally placed to reach the goals elaborated above because they have focused on a systemic approach for many years. Their approach (the Formation in General Methods for Engineers – GME) consists of general methodological training complemented by technological specialization in a specific field of studies. This combination provides the future engineer with the variety of tools, skills, and methods most useful to an engineering career.
The three pillars of the GME approach are the following: 1) scientific and technological groundwork specific to Industrial and Systems Engineering; 2) management techniques 3) an outward dimension which includes exposure to the humanities, business culture, international studies, and notions of durable development, etc.
Faced with the demand by business for the type of general engineer described above, numerous teaching initiatives have been developed by Engineering Schools (often in partnership with Business Schools). Unlike the well-defined training given by Technological Departments, these initiatives vary greatly from one School to another and are dependant on the engineering profile of the School (mechanical, civil etc.) However, three common criteria emerge:

B) THE THREE POLES OF THE GENERAL METHODS FOR ENGINEERS PROGRAM

1) The scientific and technological bases of Industrial and Systems engineering.

These are the mathematics or physics-based methods and tools of Industrial and Systems Engineering. This type of engineering is well established by now, and teaches methods that are highly valued by professionals, ranging from "soft science" approaches (ergonomics, sociology of the workplace, etc.) to the "hard science" methods derived from mathematics, physics and chemistry. Some keywords: statistics (stochastic methods, regressions, etc.); modeling (optimization, simulation); different types of programming (linear, dynamic, etc.) numerical engineering and other techniques that are helpful for idea-conception.
All these approaches can only be mastered by professionals with a solid mathematical background; it is precisely this characteristic that makes the difference between the engineer and the other managers in the enterprise.

Taken as a whole, the methods and techniques outlined above constitute a powerful tool to innovate and to assist in decision-making.

2) The basis of management

Although the MINES Engineering Schools do not teach as in-depth management methods as Business Schools, they nonetheless have developed a program designed to teach future engineers the management and organizational skills useful for their professional responsibilities. Some key words here are: management and organization, the economy, market forces, etc.

3) Outward orientation; exposure to social and cultural issues

The goal is acquiring an awareness of the social contexts within which an engineer operates and expanding engineering training to include the human and cultural dimensions which lead to a better understanding of different types of business cultures (big companies, small businesses, start-ups, the service sector, the financial sector, manufacturing, etc.); a better understanding of environmental and ecological issues, and finally, at an international level, a better understanding of how differences in culture, behavior, and reasoning function.

2) SAINT-ETIENNE : COURSES AND MODULES IN GENERAL METHODS FOR ENGINEERS (GME)

STE GME 416 Audit

0.5-0.5 ECTS – 15 hours – M.R. Boudarel

This course aims to prepare students to afford concrete situations which can be lived during training period into company. It concerns to give them methodologies and analytical tools as well as diagnoses, and more specifically those adapted to the quality standard and approach, which allow them to understand the organization functioning in which they are immerged. Pedagogy makes large place to working group and interactivity.

STE GME 417 Information research and interview techniques

1-1 ECTS – 21 hours – M.R. Boudarel

This course supplements the preceding course STE GME 416. The observation and the diagnosis of professional situations rest on the information analysis obtained by investigations and talks.

The course presents a whole of tools making it possible to obtain and exploit this information: structuring of the questioning, interview techniques and negotiation, analyses answers.

STE GME 490 Graduate project

0-12 ECTS – 500 hours – M.R. Boudarel

This Graduate project is carried out like a work into a company. This is the time to validate competencies acquired into the de GME training on three aspects : scientific tools of industrial engineering, management and opening. A first draft, a oral defense, a writing report and an exploitation into groups allow to validate this project.

LIST L1 SAINT-ETIENNE

Module		hours
Principles of accounting and of financial systems	M STE GME 461	120
Entrepreneurship & business ownership	M STE GME 461	120
Industrial economy	M STE GME 461	120
Management of human resources ; evolution of structures	M STE GME 461	120
Industrial ecology	M STE GME 461	120

STE GME 461 Principles of accounting and of financial systems

7-3 ECTS - 120 hours - M.R. Boudarel

This module aims to give to a future finacial manager the bases necessary to include and use financial flows related to the production:to know to read and analyze a countable assessment, to simulate the management of a company, to know the practices and the banking tools related to the activity of the company.

List of Courses :

- STE GME 461A General ledger and taxation. To know to read and interpret the accounts of a company.
- STE GME 461B Business Gaming. To understand the interactions between the various functions of the company and to learn the fundamental elements from the financial strategy through the piloting of a small company in a competitive market.
- STE GME 461C Cost accounting and control of management. To know to evaluate the committed costs and the profitability released by a decision of management.To envisage the budgets and to control the follow-up of their realization.
- STE GME 461D Financial Management. To know to work out the estimated budgets, to dialogue with the financial partners, to include/understand the logic of formation of profitability.
- STE GME 461E Finance and banks. To know the financial environment of the company and the principal means of financing, to know to use the tools of decision-making aid as regards investment or financing.

STE GME 462 Enterpreneurship & businees ownership

7-3 ECTS - 120 hours - M.R. Boudarel

The finality of this module is to initiate the pupils with the creation of firm, either within an existing structure or in a structure (undertaken, subsidiary, establishment) new.A project of creation enables them to put pursuant to an interactive manner the acquired concepts in progress.

List of Courses :

- STE GME 462A Economics and planning Feasibility of business. To present the concept of the business stake, its utility, the difficulties of implementation.
- STE GME 462B Undertaken and territory. From an approach practises problems of the local development and durable development, to highlight the objectives, the methods, the sets of actors and the current evolutions of the policies of development of the territories.
- STE GME 462C Project control. To know the various phases of a project and to know the principal methods of planning and follow-up.
- Economic STE GME 462D Intelligence. To initiate the pupils with the patent rights and the protection of works.
- STE GME 462E Management of technology. To highlight the various situation marketing with which the industrial companies are confronted and their consequences on the management of technology.
- STE GME 462F Personal Projects. To simulate or precede the creation of a company, idea of the project until the plan of businesses.

STE GME 463 Industrial economy

7-3 ECTS - 120 hours - M.R. Boudarel

The purpose of this module is to make it possible to the pupils to better include/understand the economic strategies, to analyze the problems of development of the industrial sectors through the sectoral analysis and to lead an economic analysis.

List of Courses :

- STE 463A. Industrial Statistics. Presentation and analyzes principal French and international industrial statistics.
- STE 463B Theory of the industrial economy. To study the behaviors of the companies in different configuration from markets for which the conditions of the pure and perfect competition are not observed.
- STE 464C Econometrics. To include/understand the principles of the econometric methods based on the linear models as their articulation with the economic analysis.
- STE 464D Personal Projects. Sectoral study or analyzes strategic of group, tutoré by a specialist in the sector.

STE GME 464 Management of human resources; Evolution of structures

7-3 ECTS - 120 hours - M.R. Boudarel

This module makes it possible to take into account the personal elements in the evolution of the organization.The changes of the company induce changes in the organization and thus a new way of approaching the management of the men.Piloting by competences becomes a strategic asset and

requires a social coordination inside the company.

List of Courses :

- STE GME 464A Social Audit. To familiarize the pupils with the tools and steps of the social diagnosis of the company: to evaluate the social performance of the company, the relevance and the effectiveness of its policy of human capital management.
- STE GME 464B Management of human ressources. To locate the human phenomena emerging in the organization when it evolves/moves.
- STE GME 464C Total performances and stakes of the change. To include/understand the bond between the total performance and the global solution of fascinating work of account human, social and organisational dimensions.To identify the implication of the actors like an essential factor of success of the changes.
- STE GME 464D Social right. To know the legal provisions as regards human stock management.
- STE GME 464E Knowledge management and competences. To control the concept of competence, to include/understand the interest of the human stock management by competence, to know the management of knowledge in an organization.
- STE GME 464F Management and play Go. To understand management through its analogies with the play of Go.

M STE GME 465 Industrial ecology

7-3 ECTS - 120 hours - H. Vaillant

See STE EGC 451

LIST L2 SAINT-ETIENNE

Module		hours
Intercultural Management	STE GME 511	30
Conflict Management & Negotiation	STE GME 512	30
Industrial Marketing	STE GME 513	30

STE GME 511 Intercultural management

1-1 ECTS - 30 hours - M.R. Boudarel

Manage farming differences compared to the international context gold into french organizations.It concerns to learn to avoid dysfunctioning whitebait to stop projects into the framework both of missions to foreign countries gold into the management of pluricultural teams, to optimizes the enrichments generated by the assimilation of the disparities, to develop the capacity to be adapted to an environment multiculturel.

STE GME 512 Conflict management and negotiation

1-1 ECTS - 30 hours - M.R. Boudarel

This course stresses two skills required of the engineer of today:negotiator and mediator.Many exercises of settings in situation, individual and collective, make it possible to the pupils to distinguish the situations of implementation of these competences, to include/understand the relational aspects, to identify the methodological and behavioral reference marks of them to develop them.

STE GME 513 Industrial marketing

1-1 ECTS - 30 hours - M.R. Boudarel

This course is centered on marketing in the companies industrialist (B to B).It presents the basic concepts and the various fields of marketing, makes it possible to include/understand the operation of the market and clarifies the strategy of segmentation of this market and choice of wallets customers.It largely calls upon active pedagogy through discussion-debates and case studies.

LIST L3 SAINT-ETIENNE

Module		hours
Industrial and systems engineering	M STE GME 411	120
Finite elements and structures	M STE GME 412	120
Instrumentation	M STE GME 413	120
Statistical methods and actuarial science	M STE GME 414	120
Natural processes	M STE GME 415	120

M STE GME 411 Industrial and systems engineering.

7-3 ECTS – 120 hours – J.M. Herri

This module presents a whole of methods and software dedicated to the modeling, simulation, optimisation and managing of industrial and continuous processes. 2/3 of this module are practical works using applied mathematics or industrial softwares such as Matlab, Simulink or Aspen.

List of courses :

- STE 411A Complements of signal processing. Deterministic theory of signals and systems, mathematics tools, digital filtering, random signals.

- STE 411B Process control. Laplace transform, identification of dynamic systems, regulation using PID, modeling with Simulink.
- STE 411C Flowsheeting , simulation and optimisation using ASPEN. Case studies belonging to process separation and energetic management.
- STE 411D Diagnosis and reliability of industrial system. Basic concepts for the diagnosis and the relibility of the industrial systems, including quantitative and qualitative methods. Exercises and industrial examples.
- STE 411E Real-time modeling and Supervision of industrial processes. To try out the supervision of the dynamic industrial processes using real-time modeling and/or knowledge-based systems
- STE 411F Dynamical systems. Main aspects of modeling of dynamical systems and their asymptotic behaviour. Application to mechanics, fluid dynamics, chemistry, engineering, biology, population behaviours,..

M STE GME 412 : Finite elements and structures

7-3 ECTS - 120 hours - H. Klöcker

The purpose of this module is to give the bases of modeling by finite elements, which are then applied in all the fields of engineering: mechanics of constructions, fluid mechanics , electrical , chemical, materials engineering.

The students can choose one of the three axes to study more deeply a subject. An option in which they will have to solve concrete problems using industrial computer codes and to carry out a project.

Conferences animated by professionals make it possible to give a progress report on the current problems posed by numerical modeling.

List of courses :

- STE GME 412A Introduction to the finite element methods. To locate the finite element method among the other methods of resolution and to control its use in the simple cases.
- STE GME 412B Structure calculation. To use finite element methods to model and analyze the complex structures using code ANSYS (axis of deepening n°1).
- STE GME 412C Plasticity. To understand the physical phenomena brought into play in the plasticization of materials and the techniques used to model them complex; to know to use code ABAQUS (axis of deepening n°2).
- STE GME 412D Phenomena of transfer. To know the techniques of finite elements used to model the problems of thermics, mechanics of the fluids, complexe thermodynamics; to know to use the FLOWING code (axis of deepening n°3).
- STE GME 412E Design of structures. To treat a case of design of structures met in the industrial life with a CAD software (axis of deepening n°1).
- STE GME 412F Working. To study the setting forms some by plastic deformation of the metal parts, the management of the contact between tool and part, the uniform of structures. To simulate the industrial processes of working ANSYS (axis of deepening n°2).
- STE GME 412G Phenomena of transfer. To model problems of transfer by numerical methods of resolution and analysis (axis of deepening n°3).

M STE GME 413 : Instrumentation

7-3 ECTS – 120 hours – P. Breuil

This module aims to acquire knowledge required to design and setting up of an analogic and numeric electronic device dedicated to signal processing and regulation.

Problems of analogical- numerical interface are more particularly approached. The practical part, which calls upon numerical models and the Labview software represents two thirds of the module.

List of courses :

- STE GME 413A Complements of Signal Processing. See M. STE 411A.
- STE GME 413B Automatic and regulation. See M. STE 411B.
- STE GME 413C Practicals of Electronics: Training to the basic notions of analog and digital electronic, preparation to the project.
- STE GME 413D Practicals of digital instrumentation: Implementation of the concepts used in digital instrumentation (Signal Processing, Regulation, Measurement Analysis). Learning of a powerful graphical development environment for digital instrumentation: Labview.
- STE GME 413E Project “design of digital instrumentation with microcontroler”: Preliminary draft (theory, conception, search of components and sensors, objectives of performances), realisation of “hard” (electronic and sensors) and “soft” (Microchip “PIC” microcontroler,

programmed with C langage), evaluation and writing of specifications.

M STE GME 414 : Statistical methods and actuarial science

7-3 ECTS - 120 hours - O. Roustant

The module courses present the resolution methods of the statistical problems appearing specifically in the fields of finance and insurance, and in a very general way as a whole of the industrial activities.
Many practise cases are solved using specialized software such as Matlab or SPAD.

List of courses :

- STE GME 414A Probabilities and conditioning. To know the theoretical tools necessary to the comprehension of the probabilistic models used in dynamic management of the random phenomena.
- STE GME 414B Data analysis. To know to approach the multivariable data processing, to analyze and interpret their results.
- STE GME 414C Regression. To know the statistical tools which make it possible to explain a variable by a whole of others. Linear regression, nonparametric regression.
- STE GME 414D Time series. To analyse the random phenomena depending on time, to understand them, to envisage them.
- STE GME 414E Random processes and stochastic calculation. To know the great classes of random or stochastic processes useful from the engineerings point of view, to initiate with conditioning in probabilities or the dependence calculation like to stochastic calculation for the applications.
- STE GME 414F Financial mathematics. Financial transactions of the private individual or the small company unquestionable future. The course insists more especially on the actualization of flows and the annual percentage rates through undivided and bond loans.
- STE GME 414G Theoretical bases of the insurance. These bases relate to “life insurance” as well as property and causualty: survival durations, capital insurance, mathematical provisions, model with several causes of death...

M STE GME 415 Natural processes

7-3 ECTS - 120 hours -J.L. Bouchardon

See M. STE EGC 411

LIST L4 SAINT-ETIENNE

Module		hours
Danger and risks assessment	M STE GME 451	120
Decision making and optimization for industrial processes	M STE GME 452	120
Materials elaboration and transformation	M STE GME 453	120
Industrial systems engineering	M STE GME 454	120
Physical methods for the characterization of the matter	M STE GME 455	120

M STE GME 451 : Danger and risks assessment

7-3 ECTS - 120 hours - H. Londiche

Acquaints students with a sense danger as well as the idea of an acceptable risk notion in order to integrate this dimension into their projects

- Habituate future engineers to a scientific approach of risk analysis with the help of a systemic view which takes into account the point of view of a large number of factors.
- To familiarize the students with the use of various and complementary methods to identify, evaluate, and manage the risks of any nature met in an industrial project or regional planning schemes.
- To offer of decision-making aids for the determination of measurements which result from this.
- In forseeable problems integrate : technical aspects, economic considerations, standards aspects as well as human factors, psychological aspects, social and cultural constraints.

List of Courses :

- STE GME 451A Risk Assesment Methodology**.** Familiarize the students with concepts allied to saftey functions and furnish them with the has scientific approach of risks to ensures their mastery of rational management thanks to double dose of prevention and protection.Written exam.
- STE GME 451B Risk Problems and Risk Management**.** Accustom the engineering students to has systematic approach to risk management which permits control of the risks in order to allow a rational management ensuring their control.Various methods to

forsee hazards and limit to their effect are presented.In particular the objectifies of the future race is to demostrate to our engineers the necessity, the complexity, and the advantage of financial coverageof risks with insurance have well have the role of managing risk.
Put studies, oral exam and multiply choice test.

- STE GME 451C Natural Hazards and Land use planning. Show to the engineer the importance of natural risks and the need to ensure their management by setting up adapted instruments:technical systems,ground occupation plans, plantations, earthworks, natural observations, historical experience feedback, etc Examination written with documents.
- STE GME 451D Systems reliability. To sensitize the engineer with the analysis reliability engineer of the reliability and to present several models implemented to him to guarantee a good availability of the technical equipment.Written examination.
- STE GME 451E Case study with MOSAR methodology (systemic approach). To implement methodology "Mads-mosar" to analyze the risks of an industrial facility starting from a systemic approach.Total evaluation of the report submitted at the end of the module.
- STE GME 451F Hazards cross study Project. To apply the concepts, methodologies and reasoning developed in the other modules in order to acquire a knowledge to make and a sufficient qualification level to lead a safety study. To be able to propose solutions of type the technical, human or organisational to reduce risks by managing the constraints induced by the regulation and the urgent economic requirements. Oral defence and written report.

M STE GME 452 Decision making and optimization for industrial processes

7-3 ECTS - 120 hours - K Szafnicki

This module presents a panorama of the various methods and techniques used in industry to optimize the processes, which they are exact or especially approximate.They are illustrated by many case studies which are modelled and solved using specialized software.

List of Courses:

- STE GME 452A Traditional Optimization. To provide the basic methods of nonlinear optimization by identifying the various classes of usually encountered problems;to give a sufficient practice of the application of these methods while insisting on the aspects modeling and choice of the algorithm of optimization.
- STE GME 452B Total evolutionary Methods.Algorithms (of which genetic), reheated simulated, methods of regrouping, coupling between local methods and total methods.
- STE GME 452C Identification. To present and try out theoretical and practical knowledge necessary to construction and the optimization of models of simulation of the behavior of the processes.
- STE GME 452D Experimental design. To know and know to use the experimental designs to work out a strategy of search for an optimum dependent on multiple factors.
- STE GME 452E Multicriterion analysis.To provide the concepts and notions necessary to the control of the tools of decision-making aid multicriterion;the American and European approaches are presented, as well as the Electra method.
- STE GME 453F personal Projects.Implementation on a real case of one of the methods presented in the module.

M STE GME 453 Materials elaboration and transformation

7-3 ECTS - 120 hours - M.Darrieulat

This module constitutes an initiation with the technical difficulties which arise in the companies which produce or transform materials.It includes/understands conferences carried out by engineers of industry as well as a visit in a great iron and steel site.

List of Courses :

- STE GME 453A Development of metal alloys by liquid way. Manufacture of steel starting from the ore, starting from

scrap;manufacture of aluminium by electrochemical way.
- STE GME 453B Ceramic and metal powders. Physicochemical principles of the compaction and sintering;methods practise obtaining ceramics and composites metal.
- STE GME 453C Composite and polymeric. To show the characteristics of working of the composites and polymers;to envisage the properties of materials from those of its components.
- STE GME 453D Transformation of materials. To know the industrial processes of transformation of metal:forging, spinning, rolling.
- STE GME 453E Project. A project carried out in binomial makes it possible to the pupils to be familiarized with the industrial applications and to perceive the economic incidences of them.

M STE GME 454 Engineering industrial systems

7-3 ECTS - 120 hours - M.A. Girard

See M STE INS 451

M STE GME 455 Solid-state characterization

7-3 ECTS - 120 hours - C Pijolat

The purpose of this module is to present the physical bases for a good comprehension and the use of the principal techniques of characterization:to control the basic concepts such as the interactions radiation-matter, to know the principal techniques, to deepen them by a work practises on project, to analyze way criticizes the needs for characterization and the possibilities of the techniques.More half of the module is devoted to practical work.

List of Courses :

- STE GME 455A Physical basis. To understand the concepts necessary to comprehension of the interactions between matter and radiation, to know and apply the principles of the principal methods of characterization.
- STE GME 455B Methods for characterization. Use of the techniques available to the laboratory:diffraction x-rays, infra-red spectrometry, microscopy, analyzes surfaces… These techniques are implemented within the framework of practical work in bearing laboratory on a case study requiring the use of several of them.
- STE GME 455C Bibliographic project. Bibliographical work completed in groups of 2 or 3 pupils and concerning the study of techniques or fields requiring the use of methods of characterization:use of the Doppler effect, chromatography, nuclear magnetic resonance…
- STE GME 455D Laboratory project.

LIST L5 SAINT-ETIENNE

Module		hours
Processes	M STE ECH 411	120
Energetics	M STE ECH 421	120
Information systems engineering	M STE AMC 411	120
Mechanics	M STE MAM 411	120
Materials	M STE MAM 412	120

3) NANCY : COURSES AND MODULES IN GENERAL METHODS FOR ENGINEERS (GME)

LIST 1 (OBLIGATORY COURSES GME)

NAN GME 411 Operations research

4-1 ECTS - 45 hours- Henri Amet

The purpose of this course is to provide bases in required operational, discipline which provides a means of modeling as well as practical and effective methods to solve a very broad class of industrial problems.It calls upon disciplines such data processing and mathematics.The programme treats the graph theory and the algorithms associated, the linear programming, stochastic operations research.The evaluation is carried out by continuous assessment and two written tests.

NAN GME 412 Statistics

4-1 ECTS - 45 hours- Mr. Thierry Verdel

This course introduces the concepts of probabilities and random variables, the normal

law, statistical control, the linear regression and the statistical experimentation.

NAN GME 413 Management of company 1

3-0 ECTS - 30 hours-.Jean-Louis Couard

The objective of this course is to apprehend the nature and the principal characteristics of the function managériale at various levels (team, organization, company), to acquire methods of design, organization and project control.The management of quality, safety, the risks and the environment are approached in this course.The evaluation is carried out by continuous assessment and a report/ratio.

NAN GME 451 Management of company 2

3-0 ECTS - 30 hours-.Jean-Louis Coujard

This course introduces the concepts of marketing, the analysis and financial management, human stock management:need assessment, management of the careers, formation and of management of teams.A business game makes it possible to apprehend the taught concepts in a concrete way.It is also used as tool for evaluation.

LIST 2 (COURSE OF TRANSVERSE AXES)

NAN GME 414 Design, innovation, production 1

4-1 ECTS - 45 hours- Christian G'Sell

It is about a course (spread out over two six-month periods) in which aims to stimulate the creative spirit of the pupils and to encourage them to invent a product, a service.The project of the pupils who work in team is evaluated by a jury.The first part covers the part of the cycle of life which goes from the idea to the prototype.

NAN GME 454 Design, innovation, production 2

4-1 ECTS - 45 hours- Christian G' Sell

This second part covers the part of the cycle of life which goes from the prototype to the market and which treats marketing, of intellectual property, of risk…The evaluation was described above.

NAN GME 415 »Cindyniques » or sciences of danger 1

4-1 ECTS - 45 hours- Thierry Verdel

It is about a course being spread out over two six-month periods which aims to familiarize the pupils with the culture of the risk and the principal methods evaluation used in industry, in particular probabilistic calculations.The evaluation of knowledge is founded on the continuous assessment with tests written thus that on the realization of a project giving place to a report/ratio and a defence in front of a jury.

NAN GME 455 "Cindyniques" or sciences of danger 2

4-1 ECTS - 45 hours- Thierry Verdel

This second part covers the evaluation of the generated risks a realization likely to generate damage on the goods and the people.The evaluation was described above.

NAN GME 416 Environment, cleaner industries and promoting recycling 1

4-1 ECTS - 45 hours- Denis Ablitzer

It is about a course being spread out over two six-month periods which aims to train engineers "citizens" ready to take into account the environment in their occupation.The first milked part of the industry of the environment in France, policy of regulation and environmental stakes. The evaluation is based primarily on a project in group being spread out over the two six-month periods.

NAN GME 456 Environment, cleaner industries and promoting recycling 2

4-1 ECTS - 45 hours- Denis Ablitzer

This second part deals more particularly of waste and effluents, the operations of treatment and the industrial obligations.The evaluation was described above.

NAN GME 417 Territorial engineering and social innovation 1

4-1 ECTS - 45 hours- Frederic Koeut

It is about a course being spread out over two six-month periods which aims to familiarize the pupils with the project management within the framework of the regional planning or urban.It is also of the interest to make it possible to the future engineers to better locate their company compared to the actors who

intervene in his vicinity.The first milked part of regional planning and urban development, analysis project management of risk but also of the local authorities and of their operating mode.
The control of knowledge is based on the principle of the evaluation continues as well as on the annual project which gives place to the drafting of a report/ratio and a defence in front of a jury.

NAN GME 457 Territorial engineering and social innovation 2

4-1 ECTS - 45 hours- Frederic Koeut

This second part deals more particularly of projects, public markets and financial arrangement and administrative but also of conversion of industry and refitting of the suburbs.
The mode of evaluation was described previously.

NAN GME 418 E-business 1

4-1 ECTS - 45 hours- Alain Tisserant

It is about a course being spread out over two six-month periods whose objective is to give a training on the changes operated by the development of data processing in the organization of the companies and the transactions between companies.The first part deals more particularly with the information system of the company, of the tools put at device to allow the communication, co-operative work.The evaluation is done on the basis of project led in group which gives place to a report/ratio and a defence.

NAN GME 458 E-business 2

4-1 ECTS - 45 hours- Alain Tisserant

This part more particularly of electronic trade B2B and B2C, the problems of safety, encoding and confidentiality.
The evaluation was described in the first part.

NAN GME 419 Aeronautics 1

4-1 ECTS - 45 hours- Jean-Charles Chevrier

It is about a course being spread out over two six-month periods to make known technical and multi-field in the field of aviation, air transport and the industry regulation.The first milked part of the regulation, meteorology and navigation.
The evaluation is based on the realization of technical projects like by an external examination.

NAN GME 459 Aeronautics 2

4-1 ECTS - 45 hours- Mr. Jean-Charles Chevrier

This milked part of technique:propellers… but also of regulation and certification and economic impacts.
Its evaluation was described above.

NAN GME 420 Civil engineering and company 1

4-1 ECTS - 45 hours- Olivier Deck

It is about a course being spread out over two six-month periods whose objective is to make known extended on the world of construction, to know the actors of them:architects, economists, engineering and design departments, administrations, contractors… but also to apprehend the complexity of the interactions which bind a construction and its environment.The evaluation is carried out on the basis of project in group giving place to report/ratio and defence.

NAN GME 460 Civil engineering and company 2

4-1 ECTS - 45 hours- Mr. Olivier DECK

The description of this part and its evaluation is contained in the description of the first course.

LIST 3 (A MANAGERIAL WITH THE CHOICE)

NAN GME 511 Control management

4-1 ECTS - 45 hours- Henri Zimnovitch

This course is intended to transmit to the pupils the principles and techniques of the control of management with an aim of making them able to work out or take part in the installation of a system of control of management within a company.The evaluation is carried out by continuous assessment and written tests.

NAN GME 512:Macro-economy and finance

4-1 ECTS - 45 hours- Domenica Pelissier

This course supplements the concepts of general economy acquired before.The standard model of macro-economic balance is approached in a complete and rigorous way

with applications to the financial markets.The concept of efficient market, power station in finance of market is discussed for its impact on the possibilities of forecast.This course calls upon testimonys of professionals of the bank and markets financial.The evaluation is carried out by continuous assessment on framed exercises using the Excel software.

NAN GME 513 International trading

4-1 ECTS - 45hours - Claude Lavicka

The objective of this course is to familiarize the pupils with the structure of the international trade.It treats commercial environment of the company, techniques of the trade, marketing and negotiation international.
The evaluation is done on the basis of continuous assessment.

NAN GME 514 Banking structure and financial products

4-1 ECTS - 45hours - Umberto Pitis

The objective of this course is to render comprehensible the banking structure and the financial products in the current circuit. It treats in particular introduction out of purse, COB, tender offers.
The evaluation is done on the basis of continuous assessment.

LISTE4 (ELECTIVE)

NAN GME 421 Working

4-1 ECTS – 45 hours - Jean-Philippe Castle

The objective of this course is to give to the future engineer the guiding principles for the analysis of the difficulties which arise as regards making of materials in complex physical systems subjected to constraints.
The evaluation is carried out by continuous assessment and written tests.

NAN GME 422 Digital simulation

4-1 ECTS – 45 hours – Hervé Combeau

The objective of this course is to bring to the student techniques to help it to include/understand physical phenomena.Simulation makes it possible "to make numerical experiments".If the basic applications touch with physics (resolution of the conservation equations in mechanics of the continuous mediums, nonlinear dynamic systems), the course will approach simulation in other fields.
The evaluation is carried out by continuous assessment and written tests.

NAN GME 423 Numerical analysis

4-1 ECTS - 45hours - Antoine Henrot

In this course, one considers all the numerical problems with which scientists or engineers in the exercise of their trade can be confronted.The exercises are carried out using the Matlab software very much used in the industry or the laboratories research.
The evaluation is carried out by continuous assessment and written tests.

NAN GME 424 Data-processing techniques and solutions for the company

4-1 ECTS - 45hours - Alain Tisserant

This course aims at giving a general culture in data processing in complement of basic knowledge in programming.One approaches there the basic concepts of data, software genius, networks but also of ERP, telecommunications.
The evaluation is carried out by continuous assessment and written tests.

NAN GME 461 The physics of the computer

4-1 ECTS - 45hours - Marie-Odile Selme

The objective of this course is to approach the electronic components of a computer as well as the industrial aspects of its manufacture.
The evaluation is carried out by continuous assessment and written tests.

NAN GME 462 Materials for the engineer

4-1 ECTS - 45hours - Elisabeth Gautier

The objective of the course is to give the pupils who will not choose one of the options of the department materials, the minimum of knowledge to apprehend the "fact materials", of the essential data to choose and implement materials and a vision of the development brought by the innovation in the field of materials.
The evaluation is carried out by continuous assessment and written tests.

NAN GME 463 Automatic, instrumentation and base industrial control

4-1 ECTS - 45hours - Didier Maquin

The objective of this course is to give to the pupils concepts of sensors, commandability, observability and regulation of function.
The evaluation is carried out by continuous assessment and written tests.

NAN GME 464 Tools and environment for production control

4-1 ECTS - 45hours - Marie-Claude Portmann

This course is intended to the pupils who did not choose the major production control.It aims at bringing basic knowledge as regards production control to them and overall internal and external logistics (supply chain management).It treats also simulation of the systems with discrete events.
The evaluation is carried out by continuous assessment and written tests.

NAN GME 465 Analyze and financial diagnosis

4-1 ECTS - 45hours - Henri Zimnovitch

The objective of this course is to transmit to the pupils the techniques of analysis and financial management with an aim of forming them with the diagnosis and the evaluation of the company.The participants in this course must be able to measure the financial incidences their last and future decisions as regards management so much on the plans commercial, technical and administrative.
The evaluation is carried out by continuous assessment and written tests.

NAN GME 468 Economic energetics

4-1 ECTS - 45hours - Pierre Casadesus

This course which treats financial aspects of energy saving extends to economic aspects relating to the diversified development of renewable energies but also to the environmental protection.
The evaluation is carried out by continuous assessment and written tests.

NAN GME 469 Optimization

4-1 ECTS - 45hours - Francis Conrad

This course is addressed to future engineers being able to be confronted in their professional practice with problems of optimization.One approaches various mathematical aspects of optimization there:existence and unicity, taken into account of convexity, conditions necessary and sufficient of optimality.
The evaluation is carried out by continuous assessment and written tests.

NAN GME 515 Algorithmic nuggets

4-1 ECTS - 45hours - Karl Tombre

The objective of this course is to illustrate diversity diversity and the "beauty" of algorithmic by the study of some representative problems.
The evaluation is carried out by continuous assessment and written tests.

NAN GME 516 Automatic, numerical control

4-1 ECTS - 45hours - Didier Maquin

This course is addressed to pupils having basic knowledge automatically and more particularly in regulation.It aims at learning how to design an algorithm of regulation.It introduces techniques of numerical control.
The evaluation is carried out by continuous assessment and written tests.

NAN GME 517 Statistical data processing

4-1 ECTS - 45hours - Yves Gueniffey

The course treats methods of analysis of data and excavation of data (mining dated).
The evaluation is carried out by continuous assessment and written tests.

NAN GME 518 Micro-economics and game theory

4-1 ECTS - 45hours - Domenica Pelissier

The course aims to present at the pupils the principal models of the microeconomic theory.The discovery of the game theory can also help the future engineer to conceive economic and financial strategies in dubious future with incomplete information.
The evaluation is carried out by continuous assessment and written tests.

NAN GME 519 Breaking process

4-1 ECTS - 45hours - Gerard Michot

The objective of the course is to sensitize future the engineers interested by the design of parts of structures in the problems of mechanical reliability.
The evaluation is carried out by continuous assessment and written tests.

NAN GME 520 International negotiation business

4-1 ECTS - 45hours - Guy Deloffre

This course presents a theoretical and practical approach for the negotiation in the businesses.Part of the course treats international legislation.
The evaluation is carried out by continuous assessment and written tests.

NAN GME 521 Practical of the communication in the organizations

4-1 ECTS - 45hours - Bernard Druesne

It is a question of an appreciation course to the various actions of communicating and the various tools which the communication uses.
The evaluation is carried out by continuous assessment.

LIST 5 (GENERAL CULTURE)

NAN GME 471 To think the city (after September 11, 2001)

2-0 ECTS - 24 hours - Jean-Pierre Commercial

On the basis of the assumption that we are living one decisive period requiring the thought of a true world urban civilization, the course combines the analysis of philosophical positions to that of urbanistic doctrines with vocation to reflect on waited of such a civilization.
The evaluation is carried out starting from a personal work.

NAN GME 472 What is science?

2-0 ECTS - 24 hours - Léna Soler

The objective of the course is to involve the pupils to be reflected on science and with this intention acquire some elementary conceptual tools.The relationship between truth and effectiveness of theoretical sciences will be approached, the determinants of the scientific evolution, the question of scientific progress.

The evaluation will relate to a personal work.

NAN GME 473 Formation of the modern identity

2-0 ECTS - 24 hours - Tanguy Wuilleme

This course aims to question the thirst for authenticity and sincerity which work the consciences of the modern man.It is a question of escaping the air partly of time, by operating a turning by the history of the subjectivism or the way in which the modern ones became gifted beings of interiority.
The evaluation is carried out by continuous assessment.

NAN GME 474 Ethics and company

2-0 ECTS - 24 hours - Yves Gueniffey

The objectifies of this module is to give few tools for thinking responsability today.Which questions stated into this race:of what responsible are we?With company could Be citizen?Evaluation is done by has personal work.

4) FACULTY AND STAFF

All the faculty and staff members of the different departments of the GS take share into the GEM training.

CHAPTER 4 : RESEARCH IN THE MINES GROUP

Research at Nancy Site

The Nancy site has developed privileged relations with research laboratories in three specific areas : materials science, earth sciences and computer science.

Materials sciences has a long-standing tradition in the School and comprises three UMR (Mixed Research Units) : the Laboratory of Materials Science and Engineering , the Laboratory of Surface Science and Engineering, and the Laboratory of Materials Physics . Earth Sciences are located in the Laboratory of Environmental Science, Geomechanics and Public Works (LAEGO) and the Centre for Petrographic and Geological Research.
Research in Computer Science is located at the Lorraine Laboratory for Computer Science and its Applications (LORIA).

MATERIALS SCIENCE

THE LABORATORY FOR MATERIALS SCIENCE , MATERIALS ENGINEERING AND METALLURGY (LSG2M)

This laboratory was founded 50 years ago. It has inherited from a long tradition of metallurgists who developed metallurgy in France as a specialized branch of solid state chemistry and thermodynamics . The idea was to apprehend the whole range of phenomena taking place during the elaboration, transformation, and treatment of materials and to improve the production of metallurgical products .
The LSG2M first started by focussing on in depth knowledge of phase diagrams and resulting microstructures in metallic alloys and their oxides and integrated concepts coming from mechanics and thermal science in order to establish a rigorous basis for the control and prediction of phase transformations and their effects over structural materials mechanical performance by numerical simulation.
Current research focuses on lighter metallic materials (aluminium alloys, titanium bases, intermetallic compounds) , composites such as cermets or the writing of numerical codes for the control and simulation of the complete range of cast aluminium products. The whole range of research in this area is labelled ~~as~~ “Thermomechanical Treatments and Microstructure” and caters for companies producing metallic materials as well as for those who use these materials for ground, sea, or air transportation and those who, more generally, need structured materials because of their improved mechanical properties and long duration.
The LSG2M sees upstream processes in materials elaboration, as well as the shaping of metallic parts through solidification, as subjects of primary importance. The lab thus includes specialists in process engineering and the thermocinetics of metals and alloys solidification.
Hands-on experience is equally important, with applications on industrial sites and numerical simulation.
Applications in “Metals Processing” and “Solidification” are numerous, and range from civil nuclear applications to purity control of liquid metals, through homogeneity of very large parts formed by solidification or molding of thin walls. New research themes have been introduced, such as experimental and numerical studies of crystal growth in gravity in the presence of convection currents or application of the methods of metallurgical processes engineering to the treatment of metallic waste or to a better control of environmental cleanliness.
Finally, another subject of expertise was added to the department: design, synthesis, physical and mechanical characterization as well as research in the technological applications of new materials.
The list of these materials known as “Divided Materials”, comprises carbides and transition metals nitrides, metallic glasses, quasicrystals and similar metallic compounds, powders and nanograins of

metals or oxides obtained through mechanical synthesis or soft chemistry and particularly, mixtures of metals and oxides prepared by mechano-synthesis-compaction called cermets.
The fundamental topics addressed by this group are understanding the elementary mechanisms of mechanosynthesis, particularly on the coupling between grain size, compared effects of surface and volume and phase transformation, as well as resulting properties and more specific aspects such as catalytical activity, optical properties or behavior of surfaces in wetting, or wearing (which generally includes some of the technological sectors we aim at).
The LSG2M laboratory is situated at the crossroad of different areas which are currently particularly active in materials science:

- solid chemistry and thermodynamics
- process engineering
- mechanics of materials

THE LABORATORY OF SURFACE SCIENCE AND ENGINEERING (LSGS)

This laboratory offers a pluridisciplinary approach to the optimization of materials surface, with the objective of their adaptation to the various mechanical constraints in their chemical and thermal environment.
The specific scientific objectives associated with this approach are developed along the following topics :

- surface treatment processes engineering

- study of the thermochemical treatment processes and of the chemical and physical deposition processes in gaseous phase
- modeling and numerical simulation or reactors behavior

- optimization of materials before surface treatment. Physicochemical and structural characterization of transformed surfaces

- local and fine characterization of the composition and microstructure of transformed surfaces (size and orientation of coating crystallites, level of crystallinity, quality of interfaces, physico-chemistry, concentration profiles).
- development of the theoretical models of crystal growth or of diffusion-precipitation
- design of local correlations between the processes and the structures of transformed surfaces (development of an efficient engineering process of surface treatment)
- study of the first stages in surface reactions

- mechanical characterization of transformed structures

- behavior laws of multilayers, internal constrains, brittleness.
- contact mechanics and tribology
- mechanical modeling correlations between structures and mechanical properties of transformed surfaces (development of structures and architectures of optimized coatings for specific contact conditions).

THE LABORATORY OF MATERIALS PHYSICS (LMP)

Research in this laboratory aims at understanding the link between materials properties and their microstructure in general (phase nature and morphology, defects…). Activities range from the preparation and design of synthesized materials (metallic multilayers for example) to the characterization of existing materials in view of specific industrial applications (e.g. behavior of ceramics under heat).
Multilayer activity is currently focused on the search for materials with original magnetic properties (giant mangeto-resistance, new permanent magnets…), prepared by evaporation, cathodic pulverization or epitaxy by molecular jets and characterized both from a structural point of view (X rays, electronic microscopy) as well as from functional point of view (magnetic dichrosm, neutrons…).
Ionic microanalysis is used to study the diffusion between compounds. Current studies address segregations in oxide ceramics and ceramics/metals interfaces. Through fine control of the stoechiometry of compounds and doping elements, the preparation of thermoelements with high merit factor is achieved, under microcrystallic form or through mecanosynthesis.
As far as polymers are concerned, behavior laws are established in view of modeling and optimizing manufacturing processes and in- service behavior. We determine the respective contributions of phases in semicrystalline polymers and study the major deformations taking place in networks (elastomeres, ultimate behavior of amorphic polymers).

Work on ceramics is based on expertise in mechanical trials (compression, flexion, traction) at temperatures above 1500°C, with aluminium nitride and silicium carbide as the materials studied.
Silicium on the other hand is used as the model materials for the study of the behavioral transition between fragile and ductile.
After studying microcrystalline metallic alloys (Al and Mg basis) obtained through centrifugal pulverization, the laboratory now addresses the preparation of ceramic/metal nanocompounds starting from ultrafine powders.
Theoretical studies are most often linked to experimental work performed in the laboratory, be it two-dimension inhomogeneous critical systems or the calculation of electronic structures of compounds, or multilayers.

EARTH SCIENCES

THE LABORATORY OF ENVIRONMENT, GEOMECHANICS AND GREAT WORKS (LAEGO)

This laboratory is shared between MINES of Nancy and the Nancy School of Geology and associated to INERIS (National Institute for Industrial Environment and Risks), which is a state-run organization governed by the Ministry of Territorial Infrastructure and Environment).
LAEGO's research area lies in the broad sector which addresses man's use and development of the above-ground and underground environment.
LAEGO operates around three main areas :

- soil mechanics
- rock mechanics
- porous media transformations and hydrogeology,

whose the aim is to create new scientific knowledge to be applied to the problem of waste storage, optimization of mining works and foundation type works, heaps, quarries, civil engineering materials, water resources and their protection (pollutant transfer) and more generally the problems of risks for the environment and constructions.
It also deals with the interaction between surface structures and ground and underground behavior, as well as with the consequences of closing down underground structures.
Two transversal themes correspond to a deliberate project to develop new methods: solicitations and dynamic effects on the control of natural risks in geoengineering.

THE CENTER FOR PETROGRAPHIC AND GEOLOGICAL RESEARCH

This is a CNRS unit which is located on the School's premises.
The topics addressed at the Ecole des Mines of Nancy revolve around the geology of the earth's deep crust :

- tranfer of matter and heat by liquids (magmas) and fluids in the continental crust with implications for the genesis of metallic ore sites.
- tectonic , metamorphic and magmatic evolution, of segments of Western Europe hercynian chain

The practical applications of the research are seen in the numerous contributions toward preservation of the geological heritage in natural reserves.

COMPUTER SCIENCE

LORIA, THE LORRAINE LABORATORY FOR RESEARCH AND APPLICATIONS IN COMPUTER SCIENCE

This is a joint laboratory with the INPL, the University of Nancy UHP and Nancy 2, ~~to~~ the CNRS and INRIA.
LORIA has centered its scientific policy around the topic of software intelligence . Software intelligence for the sciences and technologies of information and communication is an essential component of technological, economic and cultural development.

Software programs are everywhere in our society. The mastery of their design, production, and use is therefore an essential challenge for sustainable development.
In this context, LORIA has developed activities in five research areas :

- calculations, networks and high performance graphics
- Tele operations and intelligent assistants
- languages engineering, engineering of scientific, technical and cultural data and information
- quality and reliability of software and information systems.
- bio-informatics and applications to geonomics.

Research carried out at LORIA is both fundamental and applied, which implies numerous industrial partnerships in a large economic sector. LORIA is also involved in long-standing relations with numerous French and foreign laboratories, in Europe and in the USA, Japan, China, North Africa etc…

Research at the Saint-Etienne Site

Research activities are carried out in the four divisions for teaching and research, are closely connected to industrial needs, and are based on numerous national and international collaborations.

DIVISION FOR MATERIALS AND STRUCTURE SCIENCES (SMS)

114 people work in the Division, including 48 PhD students and 16 full professors . The Division includes UMR 5146 which is associated to the CNRS (National Centre for Scientific Research) and whose specialty is plasticity, damage, and corrosion of materials.
Research sub-departments are as follow :

1 The High purity metals and alloys department (MHP department, PECM CNRS UMR)

The goal of the production of single and bi-crystals and pure metals is to obtain significant quantities (a few kg) of well-identified samples for studies of in-service properties. The study of the effects of impurities on processing and use properties requires the preparation of alloys with controlled purity, doped with selected impurities.
Melting is carried out in a cold crucible, by induction. The ingots (from 300g to 4kg) are solidified in the cold crucible and heat and cold forged into bars.
Purity is characterized by chemical analysis. Together with a network of Japanese, German, and US laboratories, the MHP laboratory contributes to a comparative round robin on pure iron.
The metals and alloys produced are base iron, base nickel and stainless steels prepared from purified iron, nickel and chromium. The single and bi-crystals are aluminium, copper, nickel, stainless steel and intermetallic FeAl alloys.
Research supported by the European Community, on corrosion resistance of Fe-20Cr-5Al refractory alloys above 1000°C is in progress in collaboration with Clausthal, Liverpool, Cranfield, Birmingham and Grenoble Universities, several industrial partners, and Jülich (D) and Petten (NL) EEC research centres.
A CNRS program entitled “Multi-scale approach of macroscopic properties of structures materials “ is in progress in co-operation with CNRS laboratories at the Ecole Centrale de Paris, the Ecole Polytechnique, and ONERA.

2 The Microstructures and processing department (MMF, CNRS URA PECM)

The microstructure and processing department pursues its research within the framework of significant projects concerning metal alloy work-up :

- A European project "Through process modeling of Al rolling and extrusion" (VIRFAB) is carried out in collaboration with four aluminium industrial companies, four academic partners (Aachen,Trondheim, Sheffield and Delft) and two research centres (Stockholm and Sintef).

- The project "Friction Stir Welding" on an AA2024 alloy for applications in aeronautics.
- Thermo-mechanical treatments of ferritic steels with Cr, of Ni 718-based super-alloys and of Zircaloy.
- Grain boundary mobility in aluminium (a project supported by the Rhone-Alpes region in collaboration with the Materials Department, Riso, Denmark).
- Cutting 6xxx aluminium alloy sheets for car bodies.
- Heterogeneities of deformation when forging TA6V parts.
- Textures and mechanical anisotropy of extruded AA 7xxx sections for aeronautics.
- EBSD measurement of local deformations in springs made from 718 for nuclear power plants.
- Characterization of materials for micro-electronics, and in particular X-ray characterization of the surface quality of single-crystal aspheric lenses.
- Controlled metal alloy cross forging to obtain materials with ultrafine microstructures.
- Calculations of 3D deformations in thin rolled sheets (VAI/CLECIM)

3. The Mechanical physics and interface department (MPI, URA CNRS PECM)

The research activities of the mechanical physics and interface department address the damage mechanisms of materials in service. The five areas of investigation are as follows : corrosion-deformation interaction, damage at interfaces, intermetallics, fatigue and microstructure, biomaterials.
Studies are made on low temperature creep of titanium and new developments are in progress to define a testing method for the selection of materials which resist corrosion under stress.
Work on damage at interfaces, particularly at high temperatures and aggressive environments (molten metals, , oxidizing or reducing atmospheres), made it possible to highlight nanometre-thick intergranular films which are responsible for extreme brittleness (the cracking phenomenon due to embrittlement by molten metals, ruptures at the elastic limit) and to develop quantitative assay methods of surface (Auger/XPS spectrometries), in relation with the University of Surrey, UK.
Activities currently centered on Embrittlement by Molten Metals (EMM) will evolve to studies relating to high temperature reactors (HTR).
In the field of intermetallics, a plastic anomaly model was developed for FeAl .
Work on the fourth area of investigation concerned oligocyclic fatigue in metastable austenitic stainless steels with study of the influence of the test temperature and microstructure parameters and fatigue in hyper-hardened and aged superduplex stainless steels with research into damage mechanisms and microstructural anisotropy.
As far as biomaterials are concerned, recent research addressed the characterization and comprehension of fretting-corrosion of metal biomaterials used in joint protheses . In addition, the last year was devoted to the design and set-up of an original machine to generate shocks on hip protheses. This ~~will~~ aims at improving the performance of implants.

4 The Surface treatment department (TDS, CNRS UMR PECM)

The surface treatment department (TDS) currently pursues its research in the development of model nano-materials obtained electrolytically (composite materials by inclusion of particles or alternated microstructures) as well as in research to determine the microstructural characteristics of chromium deposits. In addition, the TDS department is in charge of various industrial and European contracts.
In the field of model materials and nano-materials, Cr-Ni multilayers for application in mechanics and microelectronics (giant magneto-resistance effect GMR) and electroplated composite materials are being studied to refine preparation methods by an electrochemical approach and to develop characterization methods for the physicochemical properties.
European or international contracts can be cited, such as :

- The "ECOCROM" program : an industrialization study of a hard chromium plating process starting from trivalent chromium solutions (20 partners in 10 different countries).
- The "ILE" program which addresses the synthesis of effluent recycling processes in industrial activities
- The European Collective Research Pilot Action program called "CHROMATEX" addressing the substitution of hexavalent chromium in automobile and aeronautical industry manufacturing processes using zinc or aluminium alloys substrates (4 professional organisations, 5 research centres and 80 small and medium-sized companies in 4 different countries).

Additionally several direct industrial contracts are in progress :

- on steel sheets electrolytically plated with zinc, a program aimed at studying and developing less polluting, alternative anti-corrosion processes for hexavalent chromium
- on laser systems, a study of the influence of Laser irradiation (Nd/YAG) on the microstructure of target materials.
- on a pilot study of a purification and recycling process for used chromic and acid solutions. This study should lead to industrial use of the process in 2003.

5 The Special Ceramics Department (CES, CNRS UMR PECM)

The main research program of the Special Ceramics Department (CES) is the modeling of the existing links between the preparation and properties of ceramic materials. The objective is to acquire a strong scientific position on the control of microstructures in various ceramic materials, from both an experimental and a simulation point of view, and to progress in the understanding of links between microstructures and certain properties so as to determine their durability.
This approach can be explained in two different stages :

- the control of ceramic materials microstructures by the control of the preparation parameters, supplemented by simulation of the evolution of microstructures during the sintering cycle.
- the modeling of the links between microstructural parameters and dielectric, mechanical and optical properties leading to the control of materials durability, i-e modeling of environmental influences.

The Department is now positioned on three scientific topics. The following subjects are currently being investigated :

- control of ceramic microstructures
- composite ceramics materials structures
- control of high voltage electrical insulation materials
- high voltage

A transverse topic "modeling and sintering" relates to thickening simulation. It facilitates interconnections and communication between the different PhD students.

6 The Mechanical Engineering and Materials Department (MEM)

The main research and technology transfer objective of the Mechanical Engineering and Materials Department (MEM) is to contribute to the analysis, modeling and design of new materials and structures for, in particular, the transportation, civil and mechanical engineering sectors. This objective is reached through a mechanical engineering approach which closely associates good control of the theoretical, digital and experimental tools of mechanics and in-depth knowledge of the structure of materials.
Departmental activities are structured around four topics :

- processes : modeling and optimization
- implementation: design assistance
- behavior of composites and fabrics
- the mechanics of MEMS

These topics are all part of broader problems, pooling similar approaches carried out on different families of materials and structures by the other SMS teams.

DIVISION FOR INDUSTRIAL AND NATURAL SCIENCES (SPIN)

The Division totals 89 persons including 39 PhD students and 17 full professors. It includes 2 CNRS associated departments , UMR 5148 , LPMG (Laboratory of Processes in Granular Media) and part of UMR 6524 (Laboratory of Lithospheric Transport Phenomena), which is jointly operated with the University Jean Monnet of Saint-Etienne and the University Blaise Pascal of Clermont-Ferrand.

Program 1 Thermal transformation of solid

The transformation reactions of solid compounds such as reduction, oxidation and dehydration are studied experimentally in order to determine the reaction mechanisms, the transformation kinetic laws, and to model industrial heterogeneous reactors for better mastery of the process and of product quality.
During thermal processing, solids can undergo various transformations: grain size change in a divided solid, crystal structure modification, chemical transformation, chemical reactions through germination and new phase nucleation and growth. The purpose is to design a study methodology which involves the fundamental concepts of heterogeneous kinetics and the thermodynamics of point defects. Experimental results are interpreted within the framework of models and help validate them.
Current subjects of investigation are as follows:

- oxidation of zirconium alloys (nuclear fuel cracking) by water vapor
- modeling of non-isothermal or non-isobaric reactions
- kaolinite dehydroxylation
- uranium oxide reduction by ammonia (for nuclear fuel manufacturing)
- preparation and characterization of thick film cathodes for SOFC fuel cells

Program 2 Powder technologies

As opposed to program 1 where the transformation of solids is considered at the local scale, program 2 addresses the whole grain population of the sample, whether pure, in the form of a mixture, reactive or not.
The physicochemical and mechanical properties of granular packing are studied experimentally and modelled in the framework of different applications :

- compression of pharmaceutical powders (improvement of the usage properties of starch tablets
- dry granulation of organic powders using roll-compaction

improvement of doped-alumina sintering for the development of sensors for ionising radiations

Mastering powder morphology is now studied through 3 new PhD topics :

- study of the effects of organic additives on clinker grinding
- preparation of phosphor powders with controlled morphology.
- influence of sand packing on the properties of granular media

Program 3 : electrical properties of solids and device design
This area of investigation benefits from previous expertise in two areas :
physicochemistry of semi-conductor oxides and use of their electrical properties for gas detection with different devices
instrumentation for on-line analysis of liquid and gaseous wastes
Topics currently in progress address :

- improvement of the selectivity of SnO2 type gases by deposit of a superficial membrane
- development of SOFC-type fuel cells (Semiconductor Oxide Fuel Cell) using thick films technology
- study of compatibility between thick films and silicon-based microelectronic technology
- study of the developing and testing conditions of a silicon-based microsensor for chemistry

Program 4 : adsorption and adsorbents

This research area deals with adsorption as an important step in industrial processes. The use and texture properties of adsorbent solid compounds largely depend on their synthesis mode. Adsorption studies are also carried out with focus on the manufacturing processes of these materials and on the procedures which confer new properties to them. Current topics address :

- study of active carbons for gas filtration : use of impregnated active carbon cloth in order to fix smelly gases
- nitrogen oxides adsorption on tin dioxide and DeNOx catalysis (nitrogen dioxides reduction)
- activation of paper mill sludge : European "COPCAS" program whose objective is to recover industrial waste through active carbon manufacturing.

Program 5 : industrial crystallization

The general objective is to study the crystallization and precipitation of solid compounds under conditions close to industrial scale.
Better understanding of the processes requires good knowledge of the following basic steps : mixture of the reactants, stirring, germination, dissolution-growth, aggregation, agglomeration , fragmentation and sedimentation.
These phenomena are studied both experimentally and theoretically. The following topics were addressed in 2002 :

- study of aggregation of metal oxide suspensions (hydrophobic silicia in aqueous medium)
- study of the behavior of a flowing suspension of gas hydrates in an instrumental loop, an important problematic for off-shore oil and gas production. Study of the formation of a hydrates clot in the loop.
- cold transportation under ice or hydrates state.
- modeling of methane production from sedimentary hydrates : possible gas resources

Program 6: organic-inorganic multi-component materials

This program addresses the interaction of organic compounds in the preparation or synthesis of inorganic materials, particularly hydraulic binders. The topics studied take advantage of the synergy between two areas of investigation : the first one considers the physico-chemistry of ligno-cellulosic derivatives, the other one the physicochemistry of inorganic compounds for construction and ceramics.
Current research deals with :

- study of interaction between wood and gypsum (synthesis of a composite material with gypsum matrix reinforced with processed wood fibers)
- study of interactions of polysaccharides from natural origin in cement coatings
- effects of temperature, time, atmosphere parameters on the thermal treatment of wood.

Program 7 : interactions between fluids, materials and minerals

The general objective is the modeling of the transformations induced by fluid circulation in rocks and porous materials . These transformations have an effect on soils or monuments (deterioration), on oil reservoirs and their long-term use and on minerals and waste and their use and recycling.
Current research addresses :

- theoretical and experimental study of the natural deterioration of materials exposed to weathering (preservation of concrete buildings and of cultural heritage) and of soil pollution by metals.
- development of a computer code (DIAPHORE) adapted to the problem of reactive transport in porous media and its application to the transformations induced by fluid circulation in natural oil reservoirs, in the long term (quality of the reservoirs) and short term (acid gas storage).
- recycling of inorganic industrial wastes, particularly phosphogypsum and wastes from the fertilizer industry.

Program 8 : thermohydraulics and industrial safety

Protection of the public against hazardous industrial sites requires calculation of safety distances adapted to each potential accident scenario.
Pressurized liquid gas accidental releases after the loss of containment of a reservoir and atmospheric expansion in the form of a flashing jet are the object of thermohydraulics models which are validated with pilot-scale experiments.
Current topics address :

- validation and improvement of liquid-vapor two-phase flow models
- experimental study and modeling of rain-out (I-e deposition of part of the liquid jet on the ground)

Program 9 : biotransformations and biomedical engineering

This research area is definitely oriented towards biomedical engineering :

- biomaterials for bone substitutes : a close collaboration between the laboratory of Biology and Biochemistry of Bone Tissues (LBBTO) of the Faculty of Medicine of Saint-Etienne (INSERM unit) and the SPIN Division has enabled the characterization of the constituants (carbonate ions) and mechanisms at work in bone-rebuilding with a biomaterial (hydroxyapatite).
- biomodeling (in collaboration with the Faculty of Medicine and General Hospital of Saint-Etienne) : the diagnosis and the development of cancers and allergies require a better understanding of the immune response of a human organism with respect to its environment. The latter lies essentially on the interaction between T lymphocytes and bearing presenting-antigen cells. The objective is to determine the memory of our immune system regarding this interaction by means of appropriate mathematical models.
- biosensors : study of miniaturized biosensors for medical applications (dosage of glucose by means of conducting polymers) and design of biosensors using whole cells (micro algae) for on-line measurement of global toxicity and dosage of pesticides.

DIVISION FOR SCIENCES, INFORMATION AND TECHNOLOGIES FOR ENVIRONMENT (SITE)

The division totals 46 persons including 22 PhD students and 7 full professors.
The division research activities are centered around four main areas : environmental information systems, sustainable development, control and supervision of eco-industrial processes, technological and natural hazards.

Program 1 : Environmental Information Systems

This research topic is mainly devoted to water resources and air quality. The SITE Division has developed a research program in collaboration with the University of Minnesota on the predetermination of hydrological models (analytical vs discrete) starting from data specifications based on Geographical Information Systems.
The fields of application of this research program are the subject of industrial collaborations for the rehabilitation of gravel pits located in alluvial zones.
Within the framework of Rhône-Alpes projects and in collaboration with the University of Saint-Etienne and the pollution control network, a short-term analysis of ozone peaks in an urban environment has been undertaken on behalf of the city of Saint-Etienne.

Program 2 : Information Systems and Sustainable Development

The “Industrial Companies and Sustainable Development” Department addresses the internal processes within companies and their relationship with the outside world from a sustainable development point of view.
In this context, the problems of management are extended to governance and the study of the different actors, and analyzed in view of the design of methods, tools and systems of reference. Information and assessment problems are designed both from a substantive and procedural perspective.
Current research addresses :

- development of criteria and indicators for the Greater Lyon area, starting from negotiation theory, ecological imprint and human development indicators. Prepared in collaboration with Rhône-Alpes Energie-Environnement, the program aims at designing methods and decision making tools to be used by local actors of development who take part in territorial projects (global development contracts, territorial charters, SAGE, river contracts etc…)
- governance processes for water management based on the analysis of different actors on a given territory
- sustainable development teaching methods (in collaboration with UQAM Montreal) : review of different approaches in the teaching of sustainable development and assessment of required knowledge and expertise for the multiple aspects of this broad concept.

Program 3 : Control and Supervision of Eco-Industrial Processes

This research topic lied within the framework of clean technologies and waste recycling. A project called "Water and Environmental Technologies" is currently being studied in collaboration with universities and industrial partners. The idea is to develop a decision-making tool for the reduction of polluting flows in oil refineries.
Another project addresses the precipitation of heavy metals with a new precipitant and is undertaken in partnership with a small company to lower the metal content in waste.
The IPEN department is also developing a study of the anodic oxidation of industrial waste in the context of the European project ENVIREDOX.
In the framework of a project financed by a company specialized in waste treatment, initial collaboration has begun to design a supervision method for the exploitation and recycling of biogas. The aim of this project is to ensure the profitability of biogas recycling units and to reduce the costs of long-term follow-up by optimizing waste degradation and hence biogas production.
A second program continues the air quality spatial analysis initiated in collaboration with EPF Lausanne.

Program 4 : Technological and Natural Hazards

The European ARAMIS (Accidental Risk Assessment Methodology for Industries) research program was recently initiated. The SITE division intervenes in the development of generic methods for the analysis of major hazards (failure tree), on installation methodology of safety fences ensuring in-depth protection, on the definition of safety management efficiency indicators and the characterization of potential targets around industrial sites (vulnerability).

Program 5 : Long-Distance learning of engineering tools

All four departments are involved in developing engineering teaching methods and are committed to the transmission of state-of-the-art research to the different students. Priority is given to highlighting the pedagogical tools developed by the SITE Division (a dozen pedagogical modules in environmental engineering and project management) and to identify long-distance learning possibilities in this area.
All faculty and research members are involved in this activity which revolves around a multi-media pedagogical platform.
The platform is used in the engineering courses and continuous education as well.

DIVISION FOR COMPUTER SCIENCE, MATHEMATICS, INFORMATION AND MANAGEMENT (SIMMO)

The Division totals 57 persons including 23 PhD students and 5 full professors.

Program 1 : Applied Mathematics, Statistical Data Processing, Inverse Problems

This program covers several research projects:

- modeling of germination-growth process : this project is carried out in collaboration with the SPIN Division and MINES Nancy and involves several industrial partners (Pechiney, Comhurex, CEA).

It addresses probabilistic and deterministic modeling of germination-growth reactions in non-isobaric, non-isothermal conditions, reduction of variance by Monte-Carlo methods (reverse calculations and uncertainties) and the elaboration of a heterogeneous kinetics computation software for laboratories (in collaboration with the data processing development unit).

- post-processing for a neutron criticality code

This project is carried out in collaboration with the IRSN Criticality Studies Service in Fontenay aux Roses, France. Its main objective is to use statistical techniques to improve estimates of the effective

neutron multiplication coefficient or KEFF, the physical coefficient which measures the degree of criticality of a given neutron configuration.

- automatic analysis of electrophoresis on proteins

This project is run with the BioMérieux Institute, Saint-Etienne Teaching Hospital, and the School's Signal, Image and Pattern unit. The concept aims at applying image analysis followed by statistical techniques to photographs of protein migrations on gel plates (electrophoresis). This process is used to differentiate the proteins which are characteristic of the presence of cancer.

- evaluation of weather derivatives

weather derivatives are insurance products which provide compensation for loss or lack of earnings due to climatic risks. Research currently addresses the evaluation of the estimation error in the temperature model developed and the study of stocks of companies with climate-sensitive businesses.

- digitized experimental designs for petroleum production

This project is run in collaboration with Total and concerns production prediction and calculations of uncertainties, on the basis of incomplete knowledge about the content of oil fields, a history of production and results obtained by a petroleum production simulator. Design of computer experiments are developed to optimize/replace the use of the simulator by response surfaces.

Program 2 : Image, Signals and Pattern

This topic is addressed by the SIF team (Image, Signal, Pattern) and concerns signal processing and images and pattern and shape recognition .. This topic is a multi-disciplinary field of STIC (Sciences and Technologies of Information and Communication). Application fields are numerous and include materials engineering, process engineering, information engineering, industrial engineering, bio-medical engineering, etc.
This basic research deals with several non-linear approaches (including the modeling, treatment, analytical and simulation aspects), mainly applied to images.
Research in progress is logarithmic treatment founded on logarithmic image processing theory, mixed logarithmic and morphological processing, locally adaptive multi-scalar processing and homotopic processing.
The idea is to complete this research program by proceeding from theory to practice.
Applied research is carried out in partnership with other Divisions at ENSMSE, industrial companies or institutions, industrial or academic teams. One research contract with an industrial company deals, in particular, with the characterization of crystals by analysis of images formed from Xrays.
A particular effort will be made in the near future to extend to "bio" applications including bio-imagery, bio-computer science and bio-modeling (in collaboration with the School's SMS and SPIN divisions) and external partners such as the INSERM Laboratory in Biology and Bone Biochemistry of Saint-Etienne, Saint-Etienne teaching hospital and industrial companies in this sector.

Program 3 : Multi-Agent Systems

The multi-agent systems department (SMA) develops new models and tools to build computer systems in which several autonomous agents interact within a common environment . Multi-agent technologies are particularly useful to turn each physical or virtual object into devices capable of interacting and cooperating with other objects, other agents as well as with the users.
Research carried out in the SMA department develops theoretical studies, computer tools and practical implementations in the area of multi-agent system to analyze, design and implement decentralized , heterogeneous, open and dynamic applications. The research conducted in the SMA group primarily addresses four themes dedicated to each of the above-mentioned characteristics :

- decentralization and autonomy : study of the coordination and control of MAS by developing models of organizations and interactions, organizing interaction sessions and defining agents architectures with adjustable autonomy.
- adaptation and learning : automatic learning techniques enabling the system and the agents to adapt dynamically to changes in the environment.
- openness and trust : the problematic of openness has led to the development of research on trust and safety.
- multi-agent oriented programming : this topic addresses the development of a multi-agent developing environment.

Program 4 : Information Processing and Internet

The activities of the Department are focused on "Communication and Information Technologies", and more particularly on the treatment of information on the Internet. The issues at stake are multiple and complex.
Three main axes are being developed :
* Information, Creation, Organization, Classification and Retrieval (COCRI). The COCRI project consists in implementing and testing a cooperative architecture for information retrieval systems. The field of application is the WWW and in this is different from conventional data retrieval research because of its unprecedented heterogeneity and size. In order to classify documents by themes, we assumed we possessed meta-information concerning the documents, of the type of meta-information that can be inserted in HTML pages with a META flag.
* Information Evaluation and Validation
In our new "Information Society", the development of the Internet exposes individuals to abuses and risks of many kinds. Our objective is to study different automatic and manual reliability assessment mechanisms, as well as means to pool the results and return them to users in the most effective way (validation and certification service for data and use of grammatical inference to improve web sites).
* Information, Interaction, Internet
This topic addresses browser assistance and the use of information on the Internet. One important aspect of its present activity concerns the development and the introduction of open tools destined for collaborative work using open and innovative technologies such as Java and XML which underlie several research and development projects (COSI, CESIFS and SCALE).
The SCALE project (Internet-based intelligent tool to support Collaborative Argumentation-based Learning in secondary Schools) aims at designing and implementing a computer tool to develop students ability to argue and thus to acquire knowledge more easily through argumentation.

Program 5 : Industrial Engineering

Six major themes have been developed in this group.
All six are approached with a double point of view : on the one hand, an academic scientific approach which consists in particular in designing new concepts and new theoretical models, and on the other hand, a contractual approach which consists in developing industrial and pedagogical applications through the design of models or operational patterns, which provide assistance in decision making.

- Technical and economic modeling of manufacturing processes

This program aims at including the complexity and upgradeability of the systems used to assess industrial performance. These systems must be studied in a dynamic and global perspective which includes, in addition to simple technological performance, the economic dimension, the control decision mechanisms, project management and the characterization of performance.

- modeling of information/communication systems

Work developed in this program addresses the adaptation of conventional methods and tools to the constraints of new types of organizations, in particular via a process approach.

- study of change in organizations

Organizations often change their structure, which is a major problem in terms of change management. Our research addresses more particularly the mechanisms by which skills are managed.

- modeling, assessment and implementation of cyclic production systems

The objective of this research is to propose means to construct production cycles with finite capacities and a management instrumentation allowing implementation in companies.
This research relies on the study of labor flexibility levers to adjust production capacities to work loads. Research currently in progress deals with the assessment and implementation of cyclic production systems, as well as on adjustment in workload capacity through the management of labor flexibility in cyclic production systems.

- multi-agent environment modeling : the simulation of industrial systems

This research programs aims at providing a methodological approach for the modeling and simulation of complex and distributed industrial systems. It is backed by multi-agent concepts that make it possible to include not only logical distribution (modeling) of the models, but also physical distribution (distributed simulation).

- flow management in the micro-electronic industry

This research program was recently initiated within the context of the CMP development. The objective is to apply the division's skills in flow management to the specific context of microelectronics, i.e. numerous operations, non-deterministic procedures and production automation (collaboration is in progress with STMicrolectronics on the topic of "modeling and optimization through simulation of the transportation system of a wafers production unit.

APPENDIX : THE UNDERGRADUATE SCHOOL

Undergraduate courses leading to the “Diplôme d’Ingénieur Civil des Mines” of Nancy

The courses are organized in races said joint basis, and are obligatory for all the students.They concern essentially the generic methods.They are taught all along the year.During this period seminars take place butt the trade of engineer which aim is to allowed the student to build has professional project and to facilitate the choice of the major.

Mathematics

5-1 ECTS - 60 hours - M.A Henrot

The objectifies is to give another sight of mathematics have well have year additional training.Teaching extends one two races.
The first race contains two shares, the first treating of the holomorphic theory of the functions for to their application in fluids mechanic, elasticity, automatic, for example.
The other race propose five choices:

- Discrete mathematics
- Functional analyzes
- Stabilization and controllability of the dynamic systems of finished size
- Mathematics for physics
- Derivative introduction to the partial equations

Computer Science

5-1 ECTS - 60 hours - M.K Tombre

Teaching extends one two races.The aim of the first is learning the basis from computer science and the programming.The second race treats structure of program by the objects have well ace dated bases.

Mechanics

2-1 ECTS - 30 hours - M.M Fourar

This race presents the basis principles of the solids and fluid mechanics with industrial applications.It treats concept of continuous media, tensors of constraints and deformations, traditional law of elasticity, laws of behaviour of Newtonian fluids.

Physics

5-1 ECTS - 60 hours - M.Ph Mangin

This teaching aims to bring additional training in modern physics.It extends one two races of which one is year introduction to quantum physics and the other one statistical physics.

Statistics

2-1 ECTS - 30 hours - M.Th Verdel

The purpose of this teaching is to initiate the students with stochastic modeling.It introduces in particular the variable concepts of probability and random, normal law, control, estimate and statistical let us comparisons ace well have linear regression.

Thermodynamics

2-1 ECTS - 30 hours - M.G Lesoult

The purpose of this teaching, which report to the study of the matter and energy transformation, is to prepare the study of subjects have varied have: heat engines, the genesis of the rock'n'rolls, the operation of the chemical engines, and finally the control of the microstructure of materials.

Undergraduate courses leading to the “Diplôme d’Ingénieur Civil des Mines” of Saint-Etienne

The courses are organised in obligatory modules for all of the students, which concern the generic methods have well have the technological training, and are taught during has complete school year.
while deepening to their fundamental knowledge, the students gradually learn to integrate to their knowledge in the concrete resolution of the problems which are proposed to them.All the occasions are seized to favour this integration:contribution of teachers of various fields to the same race to highlight the contributions of has discipline to the other, common lab work in several modules, box studies synthesizing all the knowledge, confrontation with complex situations through teaching simulators experimental gold unknown situations.The second priority of this year of training is the acquisition of has field of competences which enables to the students to find to their place in A group and to contribute to has collective work:the accent is more particularly focused one the interpersonal communication and the training of the project control in its relational aspects.

Module in Mathematics

0-8 ECTS - 120 hours - E Touboul
It is At the same time has question of increasing the mathematical assets of the students in the fields which are unknown for them and of making them become aware of the utility of mathematics in their future trade of engineer.For that, they will cuts to learn how to model has concrete problem in terms mathematics, to develop to their knowledge of the methods available to solve it in the field of the numerical methods, the probabilities and statistics, and operations research, and finally to implement concretely these methods using software specialized such have Matlab.

List of Courses :

- **Numerical methods**.Knowing and uses the BASIC numerical methods, the methods of derivative solution of linear systems and partial equations.
- **Operations research**.Knowing the basis of discrete mathematics:theory of the graphs, linear systems, research out of tree (branch and bound) and dynamic programming
- **Probabilities and Statistics**.Acquiring the vocabulary and the concepts necessary to the comprehension and the treatment of the random phenomena.
- **Introduction to signals processing**.Understanding the mathematics vocabulary and tools used in the deterministic theory of the signals and the systems.

Module in Computer Science

2-6 ECTS - 120 hours - J.J. Girardot
This modulates aims to give to any student the user' S knowledge of the dated processing which it will need necessarily.They have well concern the material, the software and the programming that the environments networks and Internet.The puts studies suggested to the students edge Be common to other modules, in particular mathematical and management of the company.

List of Courses :

- **Introduction to Computer Science**.Knowing the dated-processing networks of the school environment.To know to uses the tools of communication of Internet.To understand the essential concepts of the programming through the training of language.
- **Office automation applications**.Knowing to uses the office automation tools of the engineer, text processing, spreadsheet, BASIC manager of dated.
- **Programming and concept languages**. Introduction to algorithmic and the structures of dated.

- **Information systems design**.Control the concepts related one the information systems and the dated bases.
- **Integrated applications**.Knowing to uses and make communicate, within the framework of has general puts study, various methods and tools presented in the module.

Module in Physics

2-9 ECTS - 150 hours - K Wolski

The objectifies of this double module is:to give to all the students the knowledge in physics in the field of materials and the process essential to any engineer, and to prepare the elective modules of deepening of the Graduate School.It also allows the student, through has project of experimental physics, to develop its physical direction, to learn how to seek and to uses information and abilities which miss to him to conclude it, and to take share in the life of has research laboratory.

List of Courses :

- **Complex systems and thermodynamics**.Showing how one edge deduce the macroscopic properties from has system starting from has model of has whole of element in interaction.Applications to various fields, social sciences includes.
- **Mechanics of continuous media and elasticity**.Knowing the concepts of strain and stress.To understand the theory of elasticity.Knowing to solve the equations and to uses the methods of resolution.
- **Physical and mechanical properties of solid materials**.Explaining the origin of the physical and mechanical properties of solid materials and principal Knowing the models which are used to represent and to considers them.
- **Personal project in experimental physics**.Learning how to solve has complex experimental problem.

Module in Company management

4-7 ECTS - 150 hours - M.R. Boudarel

The aim of this module is to show the company like has environment system evolving in year economic and competitive and to present how and with which organisational, informational and decisional tools it adapts to the constraints and opportunities.The second objectifies of the module is to prepare the students with year essential component managerial of the trade of engineer.While living room the control of has real project groups some, they learn how to uses the quantitative methods of management from time and the budgets, and to identify the socio-dynamic phenomena which occur there.

List of Courses :

- **Introduction to project management**.Learning the BASIC techniques of the control of has project of design and industrialization of has product.
- **Business simulation game**.Making discover the countable and financial mechanisms company and highlight the role of management in the construction of great balances.
- **Project management**.Training of the project control by the action focused one work in group and the phenomena of communication and relation.
- **Macro-economics**.Providing essential knowledge to the comprehension of has national economy in its world environment.
- **Market**.Understanding the relation between the company and the market, through the approach marketing and strategy of company.
- **Environmental engineering and sustainable development**.Becoming aware of the natural and human environmental impact of the decisions taken by the engineers.
- **Evolution of the organizations**.Understand the relations of power and to their effects one the organizations.
- **Information and strategy of company**.Identifying information like has strategic resource of the company and to know the methods and tools of representation and management of this information.

Module in Development of the communication and professional competence

6-6 ECTS - 230 hours - M.R. Boudarel
The purpose of this module is has first acquisition of necessary relational competence of one engineer intended to lead projects of scale in A mondialized context.The methods and technical presented are tested within the framework of the module and of those which give place to activities of communication, to that the and maintenance.

List of Courses :

- **Communication Techniques**.Discovering and knowing to uses the resources of the inter-professional effective communication in order to Be in the relation At the head with head gold group.
- **Company visits**.Identifying the company like has whole of process in interaction by means of year investigation carried out starting from has grid of observation.
- **Industrial placement operator**.The industrial placement is prepared by has training of the drafting of CV and technical of oral carryforward.During the industrial placement, the accent is ugly one the observation of the production process under the angle of quality, safety, and its environmental impacts.It gives places to the drafting of has carryforward and has public defence.

Module in Foreign languages

0-10 ECTS - 130 hours - L Bois-Simon
For the French-speaking students, the training of English and has second foreign language At choice is has need for to their future trade of engineer.Teaching is characterized by has communicative and pragmatic approach resolutely towards the linguistic needs for the professional life.
For the non-French-speaking students, it is has question of making known sufficient French to them to enable them to understand the lesson suggested by Graduate School, to Be integrated into the everyday life of the students, and to improve in the mastery of the language.