TELECOM NANCY

Ingénieurs du numérique • Inspiring your digital future

TELECOM NANCY

UNIVERSITÉ DE LORRAINE

SYLLABUS

ENGLISH PROGRAM

FOR EXCHANGE STUDIES

2024-2025

UNIVERSITÉ DE LORRAINE

LORRAINE INP

École affiliée IMT

TABLE OF CONTENT

Spring semester (January to July) RESEARCH ORIENTED

COMMON CORE (MANDATORY - 18 ECTS)

Mandatory language - English	
Teaching unit SEHS 8	***ECTS credits*** 1
Goals ● Obtaining the TOEIC score requested by the school ● Deepening of the four linguistic skills (oral and written expression, oral and written comprehension) with an important part given to oral comprehension.	
Training achievements ● Understand the essential content of concrete or abstract subjects in a complex text, or during a discussion, including a technical discussion in one's specialty. ● Communicate with a certain degree of spontaneity and ease, as in a conversation with a native speaker, without tension for either party. ● Express yourself clearly and in detail on a wide range of subjects. ● Express an opinion on a current topic and explain the advantages and disadvantages of different possibilities. Advanced courses: ● Understand a wide range of long and complex texts, as well as grasp implicit meanings. ● Express yourself spontaneously and fluently without seeming to have to search for your words. ● Use the language effectively and flexibly in your social, professional or academic life. ● Express oneself on complex subjects in a clear and well-structured manner and demonstrate mastery of the tools of organization, articulation and cohesion of discourse	
Evaluation method Continuous Control	
Responsible Muriel DUVAL	***Hourly volume:*** 26 hours (26h TD)

Artificial Intelligence Project	
Teaching unit IAP	***ECTS credits*** 1
Goals ● Implement the knowledge and skills learned during the Artificial Intelligence course in the case of a project	
Training achievements ● Master basic artificial intelligence algorithms ● Know how to use existing libraries as part of a project ● Know how to solve a specific problem using artificial intelligence tools	
Evaluation method Terminal test	
Responsible Laurent BOUGRAIN	***Hourly volume:*** 30 project hours

Research Discovery Project	
Teaching unit PIDR	***ECTS credits*** 3
Goals ● Discover the general functioning of a research laboratory, ● Learn about the different research themes studied, ● Understand the functioning of a research team from the inside, ● Discover a particular research theme, ● Reflect on a very specific and limited subject within the framework of the theme studied. ● Understand how the publication and evaluation processes for research work work.	
Training achievements ● Understand the organization and processes of research: laboratory, team, scientific production, publication, presentation, etc. ● Carry out a state of the art on a specific scientific subject, ● Develop a targeted contribution and evaluate it, ● Present work in the form of a scientific article and submit it to a dedicated conference, ● Carry out a review of a scientific article, ● Present the work orally in front of peers.	
Evaluation method Terminal Test	
Responsible Jean-François SCHEID	***Hourly volume:*** 51 hours (1h CM, 50h project) + 50 hours project

Assistant Engineer Internship

Teaching unit	***ECTS credits***
STAGE 2A	10

Goals

The Assistant Engineer internship in a company aims to carry out and conclude a digital mission in a company and must involve carrying out work analyzing a problem and programming or implementing an appropriate solution.

An internship in a research laboratory is possible knowing that the cumulative duration of internships over all three years must be a minimum of 14 weeks in a company. It is part of the evaluation of your second year and must therefore be passed.

Training achievements

Business skills

- Carry out technical software development on the basis of specifications within a constrained framework,
- Program in a specific computer language,
- Apply integrated and instrumented procedures of a software production chain,
- Document, test and validate technological development,
- Carry out a state of the art on a particular method or technology developed or implemented in the internship;

Transversal skills

- Master the techniques and tools of finding an internship and put them at the service of your professional project,
- Develop your self-learning capacity to deepen your knowledge and skills in a particular field (MOOC, SPOC, tutorial, in-company training, etc.),
- Present a technical project and its implementation through a report and a defense,
- Measure, log associated resources,
- Working in a team (knowing how to present your ideas, knowing how to listen and understand others, dialogue and reporting, cooperating to achieve objectives),
- Master the tools and practices of workshops and work meetings (ensure note-taking, write reports and action plans, etc.),
- identify locations and resource people, create and develop collaboration across the project.

Evaluation method

Terminal Exam

Responsible	***Hourly volume:***
Moufida MAIMOUR	Minimum 8 weeks

1 MAJOR TO CHOOSE: ARTIFICIAL INTELLIGENCE AND DATE (12 ECTS)

Statistics and Data Analysis	
Teaching unit SFA 8	***ECTS credits*** 2
Goals ● Introduce to the most common methods of statistics and data analysis for the life of the engineer. ● Understanding data using probabilistic modeling, with a view to predictions or comparison tests	
Training achievements ● Understand the notion of statistical risk associated with a statistical decision (test, confidence interval) ● Implement the test adapted to a question asked on data and know how to interpret it ● Understand the principle of modeling and know how to apply and interpret the linear model when it is appropriate ● Know how to implement principal component analysis on large data and interpret it ● Know the principle of supervised and unsupervised classification	
Evaluation method Terminal Test	
Responsible Nassim SAHKI	***Hourly volume:*** 44 hours (4 p.m. CM, 12 p.m. TD, 4 p.m. PT)

Information Coding: application to medical data	
Teaching unit SFA 8	***ECTS credits*** 1
Goals ● Acquire a good theoretical and practical mastery of the most sophisticated techniques used for lossless and lossy digital data compression for their transfer in networks or during their archiving	
Training achievements ● Master the basic methods and tools of information coding ● Know how to understand the issues of archiving and transmission of medical data (particularly images and videos) ● Know how to implement the compression method (with or without loss) most suited to the medical context ● Understand the notion of image/video "quality" in the medical context ● Know the representation and communication format of radiological images (DICOM format) as well as the computer systems dedicated to hospitals: PACS (Picture Archiving and Communication System)	
Evaluation method Terminal Test	
Responsible Jean-Marie MOUREAUX	***Hourly volume:*** 20 hours (12h CM, 8h TD)

Evaluation de Performance	
Teaching unit SFA 8	***ECTS credits*** 1
Goals ● Raise students' awareness of the different performance indicators and basic methods for evaluating them. ● Present advanced methods for evaluating/predicting performance indicators	
Training achievements ● Describe and classify the different performance indicators (throughput, response time, occupancy rate, loss/retransmission rate, reliability, etc.) ● Understand the principles of performance evaluation ● Know how to design and analyze a simple model for evaluating the performance of a computer system ● Know how to design and analyze an advanced model for evaluating/predicting the performance of a computer system ● Raise awareness of prognostic methods for predicting performance indicators	
Evaluation method Terminal Test	
Responsible Phuc DO	***Hourly volume:*** 34 hours (12h CM, 18h TD, 4h TP) + 8 hours project

Parallel Algorithmics	
Teaching unit STIC 8	***ECTS credits*** 1
Goals ● Master the fundamental concepts of parallelism ● Know algorithm design techniques ● Know how to implement the most common tools to parallelize programs (OpenMP and MPI).	
Training achievements ● Specify a parallel algorithm ● Design a parallel application ● Evaluate a parallel algorithm and its implementation ● Identify and analyze different programming models ● Create a parallel program using OpenMP and/or MPI ● Integrate load balancing issues into parallel solutions	
Evaluation method Terminal Test	
Responsible Sylvain CONTASSOT-VIVIER	***Hourly volume:*** 22 hours (10 a.m. CM, 12 p.m. TD)

Mass Data Management	
Teaching unit STIC 8	***ECTS credits*** 3
Goals ● Be able to design and implement a system that allows the simultaneous and uniform querying of a set of heterogeneous and voluminous data sources.	
Training achievements ● Design a big data processing chain ● Identify and activate the services necessary for storing and processing large masses of data ● Implement and adapt tools for accessing heterogeneous data ● Normalize heterogeneous data ● Design and carry out processing on accessed data	
Evaluation method Terminal Test	
Responsible Say ARIDHI	***Hourly volume:*** 32 hours (10h CM, 2h TD, 20h TP) + 40 project hours

Data Visualization	
Teaching unit STIC 8	***ECTS credits*** 2
Goals ● Discover the main data visualization methods ● Implement visualization techniques using other tools	
Training achievements ● Implement various data visualization methods ● Choose a visualization method based on data types	
Evaluation method Terminal Test	
Responsible Mohammad GHONIEM	***Hourly volume:*** 19 hours (6 a.m. CM, 1 p.m. TD) + 20 project hours

Business Oriented Module 1	
Teaching unit STIC 8	***ECTS credits*** 2
Goals ● Raise students' awareness of some areas of application of Big Data: the biomedical field, smart cities, energy management.	
Training achievements ● Consider the particular complexity of certain business data ● Adapt a Knowledge Extraction process to specific data, in particular according to the requirements of an expert (for example a biologist or an urban planner)	
Evaluation method Terminal Test	
Responsible Say ARIDHI	***Hourly volume:*** 20 hours (8 p.m. CM) + 20 project hours

1 MAJOR TO CHOOSE: INTERNET, SYSTEMS AND SECURITY (12 ECTS)

Advanced Networks and Systems	
Teaching unit STIC 8	***ECTS credits*** 3
Goals ● Deepen and apply systems and network knowledge, describe the essential mechanisms of a system, analyze the TCP/IP protocol in detail with introduction to IPv6	
Training achievements ● State and explain the general structure of a computer system as well as the main components of an operating system ● Describe, explain and compare the different methods of designing an operating system ● Identify the main issues related to memory management ● Describe, explain and compare different methods of memory management as well as identify the advantages and disadvantages of each ● Explain the role of hardware and its impact on operating system design choices. ● Calculate physical addresses from logical addresses ● Identify some problems related to the implementation of processes and describe a possible implementation method. ● List, apply and compare the main process scheduling methods ● Explain the principles of congestion control implemented by TCP ● Mastery of the different algorithms associated with TCP ● Program a communicating application in C and master the associated advanced interfaces and paradigms ● Master IPv6 addressing and the operation of network protocols for multicast broadcasting, ● Configure network equipment and systems to achieve interconnections and basic services	
Evaluation method Continuous Control	
Responsible Rémi BADONNEL	***Hourly volume:*** 45 hours (6 p.m. CM, 4 p.m. TD, 12 p.m. PT)

Language Compilation Project 2	
Teaching unit STIC 8	***ECTS credits*** 2
Goals • Understand how a compiler works. • Write a complete compiler, including code generation	
Training achievements • Translate a high-level language into 32-bit ARM assembly code • Know code optimization techniques and know how to implement them • Master the ANTLR software	
Evaluation method Terminal Test	
Responsible Suzanne COLLIN	***Hourly volume:*** 6 hours (6h practical work) + 60 hours project

Information Theory, Data Compression and Reliability	
Teaching unit SFA 8	***ECTS credits*** 1
Goals Acquiring a theoretical and practical mastery of the most sophisticated techniques used for lossless compression of digital data and for reliability during their transfer in networks or during their archiving, is essential for a good understanding of the challenges of using these techniques.	
Training achievements ● Master the basics of information theory for the representation of data in digital form, in particular the notion of entropy ● Master the notions of lossless coding, information content and performance in terms of compression rates ● Know the most used lossless coding methods and master the corresponding algorithms (static, adaptive, arithmetic, predictive and dictionary coding) ● Know the modeling and type of transmission errors (individual or packet) ● Understand the principles of block codes, detector codes and linear, cyclic, convolutional error correctors	
Evaluation method Terminal Test	
Responsible Jean-Marie MOUREAUX	***Hourly volume:*** 26 hours (12 p.m. CM, 2 p.m. TD)

Cryptography and Authentication	
Teaching unit SFA 8	***ECTS credits*** 2
Goals Give students the foundations to understand the field of information protection and open up to certain concepts of information systems security.	
Training achievements • Mastering the challenges of cryptography in information protection • Know basic cryptographic functionalities (confidentiality, integrity, authenticity) • Understand the main symmetric and asymmetric encryption algorithms • Know the main associated cryptographic hash functions • Evaluate the limits of protection provided by cryptography	
Evaluation method Continuous Control	
Responsible Jannik THREE	***Hourly volume:*** 28 hours (2 p.m. CM, 2 p.m. TD) + 24 hours project

Security of Applications	
Teaching unit SFA 8	***ECTS credits*** 1
Goals Address security issues specific to software development	
Training achievements • Know security vulnerabilities and attacks related to programming languages and web application development • Know and know how to implement good practices related to software development • Know how to use common tools for securing computer code (static analysis, dynamic analysis)	
Evaluation method Terminal Test	
Responsible Philippe ANTOINE	***Hourly volume:*** 14 hours (CM 6h, TD 2h, 6h TP) + 12 project hours

Cyber-Security: Methods, Law and Organization	
Teaching unit STIC 8	***ECTS credits*** 1
Goals Address organizational, legal, economic and social aspects specific to the field of cyber security.	
Training achievements • Know the main standards and organizational guides in cyber security (ANSSI EBIOS, ITIL Incident Management, NIST SCAP, NSA/CCS) • Understand the law and regulations specific to cyber security (DSSI, ENISA) • Understand product certification and evaluation schemes (ISO, CSPN first level) • Know the organization and the main processes relating to cyber defense (reaction, processing, coordination, crisis management, communication), strategy and national sovereignty • Know how to assess the economic and social impacts linked to cyber security	
Evaluation method Terminal Test	
Responsible Patrick ETIENNE	***Hourly volume:*** 22 hours (12h CM, 2h TD, 8h TP)

Digital Forensics	
Teaching unit STIC 8	***ECTS credits*** 1
Goals Present a set of techniques relating to digital forensics allowing preservation, research and restitution of digital evidence.	
Training achievements • Know in what context it is necessary to apply a digital forensics procedure • Being able to secure data on any digital equipment • Know the elements that can be analyzed, with which tools • Know how to implement a methodology allowing a rigorous analysis of a media	
Evaluation method Terminal Test	
Responsible Mickael JENFT	***Hourly volume:*** 22 hours (12h CM, 2h TD, 8h TP)

Supervision, Control and Internet	
Teaching unit STIC 8	***ECTS credits*** 1
Goals ● Discover the key concepts of network and service monitoring. ● Implement these concepts with different tools (from monitoring to configuration)	
Training achievements ● Understand the challenges of monitoring networks and services, ● Know key concepts, architectures and protocols in the field, ● Know how management information is represented and carry out queries, ● Be familiar with the use and configuration of a supervision solution.	
Evaluation method Terminal Test	
Responsible Moufida MAIMOUR	***Hourly volume:*** 22 hours (4h CM, 2h TD, 16h TP)

1 MAJOR TO CHOOSE: INFORMATION SYSTEMS FOR THE INTELLIGENT ENTERPRISE (12 ECTS)

Design and Performance of the Smart Enterprise	
Teaching unit SFA 8	***ECTS credits*** 2
Goals Learn and practice essential methods and tools allowing to define needs and functional specifications (Value Analysis, Functional Analysis, etc.) but also to evaluate the proposed organizations (from CdF) before implementing them (flow analysis and evaluation, performance indicators).	
Training achievements • Contribute to the definition of functional specifications respecting the requirements of a value analysis/functional analysis • Evaluate and analyze the proposed organizations (based on ToF) before implementing them (flow analysis and evaluation, performance indicators)	
Evaluation method Terminal Test	
Responsible Phuc DO	***Hourly volume:*** 40 heures (18h CM, 12h TD, 10h TP)

Digital Twin and Artificial Intelligence for Industry	
Teaching unit SFA 8	***ECTS credits*** 2
Goals Raise engineers' awareness of the exchange of information between the business world and the production world (B2M integration), and more particularly between the planning (ERP) and management (command, scheduling and digital twin) systems of production.	
Training achievements ● Understand the principles of integration through information (Business 2 Manufacturing) ● Know how to transform planned decisions into operational actions on the ground ● Know how to specify production information flows ● Know the principles and methods of production planning, industrial automation and industrial digital twins	
Evaluation method Terminal Test	
Responsible Phuc DO	***Hourly volume:*** 34 heures (10h CM, 14h TD, 10h TP)

Information Systems Development	
Teaching unit STIC 8	***ECTS credits*** 3
Goals Put students in a real business project situation relating to the design and implementation of information systems (specifications, data/processing design, implementation on an AGL and development with internet technology). Put into practice the skills acquired in the common core and complete them (expression of constraints, reverse design).	
Training achievements • Know how to model an information system • Know how to express structural constraints concerning the company • Formalize application constraints • Retro-derive a conceptual model from a dedicated implementation • Manage a web development project in relation to a database	
Evaluation method Project	
Responsible Hervé PANETTO	***Hourly volume:*** 42 hours (10 a.m. CM, 12 p.m. TD, 8 p.m. TP) + 30 project hours

Enterprise 4.0	
Teaching unit STIC 8	***ECTS credits*** 3
Goals This module presents an introduction to business 4.0 and its characteristics, requirements as well as important digital tools.	
Training achievements • Understanding business 4.0 • Awareness of the generation, processing and application of data in business. • Basics on models and requirements for the factory of the future • Get a clear idea of the functioning and applications of a CPS in business • Have a global vision on the use of new networks in enterprise 4.0 • Awareness of different predictive technologies and tools	
Evaluation method Terminal Test	
Responsible Phuc DO	***Hourly volume:*** 42 hours (10 a.m. CM, 12 p.m. TD, 10 a.m. TP) + 10 project hours

Integrated Enterprise Management	
Teaching unit STIC 8	***ECTS credits*** 2
Goals Train engineers on methods and tools promoting integrated business management. On the method side, the analysis of business organizations will be approached through BPMN business process modeling. On the tool side, this module will address the implementation of an analysis of the configuration of an ERP based on a set of needs expressed by a given company.	
Training achievements • Model business processes to deduce information flows • Analyze the functions made available by ERP (Enterprise Resource Planning) • Analyze functional gaps against a set of business requirements • Configure an ERP Identify improvement processes for a target enterprise architecture	
Evaluation method Terminal Test	
Responsible Hervé PANETTO	***Hourly volume:*** 40 hours (6 a.m. CM, 4 p.m. TD, 6 p.m. PT)

Fall semester (September to February) INDUSTRY ORIENTED

COMMON CORE (MANDATORY - 15 ECTS)

Mandatory Language - English	
Teaching unit SEHS 9	***ECTS credits*** 1
Goals ● Obtaining the TOEIC score requested by the school ● Deepening of the four linguistic skills (oral and written expression, oral and written comprehension) with an important part given to oral comprehension.	
Training achievements ● Understand the essential content of concrete or abstract subjects in a complex text, or during a discussion, including a technical discussion in one's specialty. ● Communicate with a certain degree of spontaneity and ease, as in a conversation with a native speaker, without tension for either party. ● Express yourself clearly and in detail on a wide range of subjects. ● Express an opinion on a current topic and explain the advantages and disadvantages of different possibilities. Advanced courses: ● Understand a wide range of long and complex texts, as well as grasp implicit meanings. ● Express yourself spontaneously and fluently without seeming to have to search for your words. ● Use the language effectively and flexibly in your social, professional or academic life. ● Express oneself on complex subjects in a clear and well-structured manner and demonstrate mastery of the tools of organization, articulation and cohesion of discourse	
Evaluation method Continuous Control	
Responsible Muriel DUVAL	***Hourly volume:*** 28 hours (28h TD)

Seminar 3A	
Teaching unit SEMINAIRE3A	***ECTS credits*** 1
Goals ● Enable the acquisition of essential skills, in the areas of management and management, for the exercise of the engineering profession.	
Training achievements ● Develop your professional project ● Analyze and structure your knowledge, know-how and interpersonal skills and present them ● Build your argument during the job interview	
Evaluation method Continuous Control	
Responsible Zahra RONDEAU	***Hourly volume:*** 35 hours

Enterprise serious game	
Teaching unit GAMEBUSINESS	***ECTS credits*** 2
Goals Enable the acquisition of essential skills, in the areas of management and management, for the exercise of the engineering profession.	
Training achievements ● Understand how a business works and the decision-making process. : team management of a fictitious company in a competitive market ● Understand the process by which leaders ensure that the resources that are obtained and used are used effectively and efficiently to achieve the organization's objectives. ● Make relevant decisions in a business management situation (organize, anticipate, choose, calculate, budget, control, correct, etc.)	
Evaluation method Continuous Control	
Responsible Zahra RONDEAU	***Hourly volume:*** 35 hours

Industrial project

Teaching unit	***ECTS credits***
PI	8

Goals

Raise students' awareness of the concrete problems of companies by carrying out a needs analysis, feasibility study, development of a demonstrator, validation, etc., based on a problem submitted by a company.

Training achievements

- Business skills
  - Write a framework note,
  - Define technical specifications and/or models,
  - Know how to apply an agile method
  - Determine technical choices (software and hardware architecture) and select technologies,
  - Create a functional and/or technical solution,
  - Apply “southbound” validation methods (technical tests, functional tests, proofs, metrology) and “northbound” (compliance of the solution with specifications and user expectations).
- Transversal skills
  - Master project management (plan, identify, define and prioritize the activities to be accomplished, carry out actions, adapt to constraints and changes, evaluate the results),
  - Respect deadlines and procedures,
  - Report to stakeholders,
  - Mastery of organizing and leading meetings,
  - Manage a multi-actor configuration (academic supervision, industrial supervision, members of the project group),
  - Knowing how to work in a team (getting involved, knowing how to motivate and involve others, managing conflicts and different points of view, negotiating compromises),
  - Master professional communication (present a successful product orally and in writing in French, lead training, etc.).

Evaluation method

Continuous Control

Responsible	***Hourly volume:***
Anne-Laure CRUGNOLA / Gérald OSTER	250 project hours

1 MAJOR TO CHOOSE: ARTIFICIAL INTELLIGENCE AND DATE (15 ECTS)

NoSQL databases	
Teaching unit STIC 9	***ECTS credits*** 3
Goals Give students the basis for understanding the NoSQL ecosystem and the characteristics of market solutions (ElasticSearch, Cassandra, MongoDB, Redis, Neo4j, etc.).	
Training achievements ● Know how the main NoSQL solutions work ● Design and develop an application that manipulates a NoSQL database ● Understand some distributed systems concepts such as consistency and the CAP theorem	
Evaluation method Terminal Test	
Responsible Say ARIDHI	***Hourly volume:*** 44 hours (10h CM, 2h TD, 32h TP)

Cloud Computing: Opportunities and Risks	
Teaching unit STIC 9	***ECTS credits*** 1
Goals This course aims to convey the basics of Cloud Computing, to describe the major concepts and to allow future engineers to implement them on a reference platform.	
Training achievements ● Understand the challenges of Cloud Computing and its consequences for the company ● Know the main deployment models and service models ● Understanding the design patterns associated with Cloud Computing ● Be able to deploy and configure services using a Cloud Computing platform ● Understanding security risks (threats, attacks, protection) ● Deploy and administer an OpenStack platform	
Evaluation method Terminal Test	
Responsible Rémi BADONNEL	***Hourly volume:*** 18 hours (6 a.m. CM, 2 a.m. TD, 10 a.m. TP)

Business Oriented Module 2 + Big Data Seminar	
Teaching unit STIC 9	***ECTS credits*** 2
Goals Allow students to acquire knowledge and skills in a particular application area	
Training achievements ● Issues specific to a field (biomedical data, smart cities) ● Specific data formats ● Development project aimed at solving problems specific to the chosen field	
Evaluation method Terminal Test	
Responsible Laurent DUPONT / Nicolas JAY	***Hourly volume:*** 20 hours (8 p.m. CM) + 10 project hours

Statistical Learning	
Teaching unit STIC 9	***ECTS credits*** 2
Goals ● Introduce to the most common methods of statistics and data analysis for the life of the engineer. ● Studying classification problems, dimension reduction, prediction and data comparison are essential when handling complex or large objects.	
Training achievements ● Understand the challenges of statistical learning and be able to characterize both the problems posed and the methods implemented according to different criteria ● Implement the method adapted to a problem posed ● Understand the added value of a probabilistic model but also its limits ● Compare different methods and choose the best algorithm for a given problem	
Evaluation method Terminal Test	
Responsible Efoevi Angelo KOUDOU	***Hourly volume:*** 20 hours (8h CM, 12h TD)

Advanced Artificial Intelligence	
Teaching unit STIC 9	***ECTS credits*** 2
Goals The aim of this course is to see the practice of modern artificial intelligence algorithms based on neural architecture and to implement them in a programming project. Classes are taught by professional speakers	
Training achievements ● Know the main artificial intelligence algorithms (neural network, deep learning, convolutional network, recurrent neural network) ● Know the advantages and disadvantages of each algorithm as well as the implementation conditions ● Implement one of these algorithms in a project to solve a specific problem	
Evaluation method Terminal Test	
Responsible Say ARIDHI	***Hourly volume:*** 32 hours (10h CM, 2h TD, 20h TP)

Hackathon Big Data	
Teaching unit STIC 9	***ECTS credits*** 2
Goals Offer students a project allowing them to manipulate real data with an objective imposed by a partner. This project should allow them to apply what they have learned and acquire new skills.	
Training achievements ● The student will be able to face a real problem involving masses of data, participate in a group project, and present a prototype.	
Evaluation method Terminal Test	
Responsible Say ARIDHI	***Hourly volume:*** 32 hours (4 p.m. TD, 4 p.m. TP)

Data Mining and Knowledge Extraction	
Teaching unit STIC 9	***ECTS credits*** 2
Goals Allow the future engineer to manage a process of extracting knowledge from data.	
Training achievements ● Design and carry out data preparation for a knowledge extraction process, ● Choose excavation programs adapted to your needs ● Evaluate and interpret the results of the data extraction process	
Evaluation method Terminal Test	
Responsible Say ARIDHI	***Hourly volume:*** 48 hours (8 p.m. CM, 28 p.m. TD) + 10 project hours

Distributed Algorithmics	
Teaching unit STIC 9	***ECTS credits*** 1
Goals ● Master distributed algorithms used in processing large masses of data.	
Training achievements ● Design an advanced distributed Map-Reduce algorithm and implement it on Hadoop ● Configure and program advanced Hadoop mechanisms to optimize information flows between components ● Design and implement algorithms for analyzing large masses of data with Hadoop and Spark ● Write Pig queries ● Use mining tools on a "Big Data" platform such as Hadoop	
Evaluation method Terminal Test	
Responsible Jérôme FRANÇOIS	***Hourly volume:*** 16 hours (6am CM, 10am TD) + 15 hours project

1 MAJOR TO CHOOSE: INTERNET, SYSTEMS AND SECURITY (15 ECTS)

Mobile Applications and Internet of Things	
Teaching unit STIC 9	***ECTS credits*** 2
Goals Acquire both knowledge and skills related to mobile application development and the Internet of Things.	
Training achievements ● Design a service based on the Internet of Things: from data collection to presentation to the user on a mobile terminal ● Know how the main Internet of Things protocols work ● Deploy and monitor a wireless sensor network ● Design and develop an Android application ● Control the risks linked to these environments	
Evaluation method Terminal Test	
Responsible Thibault CHOLEZ	***Hourly volume:*** 20 hours (6h CM, 8h TD, 6h TP) + 10 hours project

Ethical Hacking	
Teaching unit STIC 9	***ECTS credits*** 2
Goals The best defense being attack, it is very useful, when you want to be sure of your security, to have this security tested by teams specialized in attack. These “white hats” carry out ethical hacking, that is to say attack tests at the request of the site maintainer.	
Training achievements ● Know the best practices of ethical hacking ● Know and implement penetration techniques into a system ● Know how to develop a test plan and vulnerability analysis coverage ● Know how to write a report presenting the flaws in a system and the countermeasures to adopt	
Evaluation method Terminal Test	
Responsible Jérôme FRANÇOIS	***Hourly volume:*** 16 hours (16h TP) + 20 hours project

Big Data for Cyber Security	
Teaching unit STIC 9	***ECTS credits*** 1
Goals Asee an overview of the different principles at work in collecting, processing and analyzing large, changing, structured and unstructured data to determine situations and trends among volumes of data.	
Training achievements ● Understand the concept of logs and associated technologies (SIEM, Big Data, etc.) ● Identify processing principles (correlation, standardization, etc.) ● Acquire the principles of defining and managing use cases ● Define reports and indicators within dashboards ● Data processing techniques (behavioral analysis, machine learning, statistical models, etc.) applied to cybersecurity ● Security and privacy regulatory environment	
Evaluation method Terminal Test	
Responsible Christophe BIANCO	***Hourly volume:*** 22 hours (4h CM, 2h TD, 16h TP)

Malware and Reverse Engineering	
Teaching unit STIC 9	***ECTS credits*** 2
Goals Present to students the methods and tools related to computer virology and reverse engineering of code	
Training achievements • Know how to assess the vulnerabilities of a system with regard to the threat induced by malware • Know how to assess the dangerousness of a program, describe its anomalies • Know how to analyze malware protections (obfuscation) and bypass them • Be able to search for the payload of malware by static analysis (IDA) or dynamic (Pintool), and return the functionalities • Describe the damage caused by malware on a system	
Evaluation method Terminal Test	
Responsible Guillaume BONFANTE	***Hourly volume:*** 31 hours (28h CM, 3h TD)

Advanced Cryptography	
Teaching unit STIC 9	***ECTS credits*** 1
Goals Present advanced methods and tools based on cryptographic techniques.	
Training achievements • Understand the operation of advanced methods and tools based on cryptographic techniques: blockchain and smart contracts, electronic voting protocol, zero-disclosure proof, homomorphic encryption • Be able to anticipate attacks	
Evaluation method Terminal Test	
Responsible Jannik THREE	***Hourly volume:*** 20 hours (12h CM, 8h TD)

Security and Verification Protocols	
Teaching unit STIC 9	***ECTS credits*** 2
Goals Introduce students to methods and tools related to security protocols and their verification	
Training achievements ● Be able to anticipate attacks ● Understand attacker models, evaluate their practical consequences ● Know protocol verification software, evaluate the feasibility of network attack scenarios	
Evaluation method Terminal Test	
Responsible Jannik THREE	***Hourly volume:*** 28 hours (2 p.m. CM, 2 p.m. TD)

Security of Networks and Services	
Teaching unit STIC 9	***ECTS credits*** 2
Goals Study and deepen security issues specific to networks and computer software based on knowledge of Unix, Windows systems and Internet protocols.	
Training achievements • Know the main categories of software and network attacks • Know how to use audit tools to assess the security of an infrastructure and its services • Know best practices related to the development of secure web applications • Be able to configure common protection tools (firewalls, secure VPNs, IDS)	
Evaluation method Terminal Test	
Responsible Jérôme FRANÇOIS	***Hourly volume:*** 36 hours (12h CM, 2h TD, 22h TP)

Cyber Security Management	
Teaching unit STIC 9	***ECTS credits*** 2
Goals Present to students the methods and tools related to security management through concrete cases, while also addressing issues related to physical and material security in this context.	
Training achievements ● Understand how a SOC (Security Operating Center) works and the different stages related to security incident management. ● Design and implement an information system security policy (PSSI) ● Master the methods and tools allowing its supervision and control (ISMS integrated into a SIEM) ● Understand the elements of the policy relating to the physical and material security of the information system ● Implement the concepts linked to this management through practical work (Blue team versus Red team)	
Evaluation method Terminal Test	
Responsible Christophe BIANCO	***Hourly volume:*** 30 hours (12h CM, 2h TD, 16h TP)

1 MAJOR TO CHOOSE: INFORMATION SYSTEMS FOR THE INTELLIGENT ENTERPRISE (15 ECTS)

Model-based systems engineering

Teaching unit	***ECTS credits***
STIC 9	3

Objectives

- To present the basic concepts of business modelling, model-driven systems engineering and the different approaches to the problem (systemic approach, object approach, requirements, etc.).
- Introduce the problem of integrating business processes through reference architectures.
- Master and apply business modelling models, languages and tools in order to derive a relevant information system enabling the integration of the various business processes.

Training achievements

- Apply a systems approach to the engineering of a complex information system
- Apply systems engineering standards and best practices
- Use a standard modelling framework to study generic business processes
- Model business processes relating to a defined objective
- Analyse the functional and technical requirements for modelling a system

Evaluation method
Terminal test

Responsible	***Hourly volume:***
Hervé PANETTO	46 hours (14h CM, 8h TD, 24h TP) + 20 hours project

Distributed systems	
Teaching unit STIC 9	***ECTS credits*** 3
Objectives Study the different types of distributed architecture	
Training achievements ● Differentiate between a network error and another type of error ● Write a program that allows communication between two computers ● Explain why it is not possible to have both consistency, availability and partition tolerance in a distributed system ● Implement a simple server ● Explain the difference between a stateful and stateless service ● Understand the problems of scaling up ● Know the principles of a service-oriented architecture	
Evaluation method Continuous monitoring	
Responsible François CHAROY	***Hourly volume:*** 30 hours (14h CM, 16h TD) + 15 hours project

NoSQL database	
Teaching unit STIC 9	***ECTS credits*** 3
Objectives Giving students a basic understanding of the NoSQL ecosystem and the characteristics of the solutions on the market (ElasticSearch, Cassandra, MongoDB, Redis, Neo4j, etc.).	
Training achievements ● Understand how the main NoSQL solutions work ● Design and develop an application that manipulates a NoSQL database ● Understand some distributed systems concepts such as consistency and the CAP theorem.	
Evaluation method Terminal test	
Responsible Sabeur ARIDHI	***Hourly volume:*** 44 hours (10h CM, 2h TD, 32h TP)

SAP Enterprise Resource Planning system	
Teaching unit STIC 9	***ECTS credits*** 2
Objectives Discover SAP's ERP (Enterprise Resource Planning), its functions, and how to implement it in a company, which requires business-specific configuration and specific developments to ensure integration and interoperability with the company's pre-existing information system.	
Training achievements ● Understanding the SAP ERP architecture ● Parametrise a set of business processes ● Develop specific functionalities in conjunction with the metadata defined by SAP ERP ● Integrate an ERP into a target company ● Study the relationships between SAP ERP and other business applications	
Evaluation method Terminal test	
Responsible Hervé PANETTO	***Hourly volume:*** 24 hours (24h TD)

Business Intelligence	
Teaching unit STIC 9	***ECTS credits*** 2
Objectives To present the techniques used to design business intelligence databases, the sole aim of which is to render information while prioritising response times and data accessibility.	
Training achievements ● Understanding the principles of BI (Business Intelligence) ● Developing generic interfaces for data collection ● Implementing a data warehouse ● Develop decision support tools from a mass of heterogeneous data ● Apply algorithms to implement data mining processes	
Evaluation metod Terminal test	
Responsible Hervé PANETTO	***Hourly volume:*** 38 hours (8h CM, 10h TD, 20h TP) + 10 hours project

Enterprise applications interoperability

Teaching unit	***ECTS credits***
STIC 9	2

Objectives

- Train students to manage a project to implement integrated management and production control software packages covering the analysis and development phases enabling business applications to interface with all the information from the various production processes in a B2M (Business to Manufacturing) context.
- Study EAI, SOAP, B2MML integration technologies and model-based architectures (MDE, OMG MDA, IS) and their implementation to ensure model and data interoperability between enterprise applications.

Training achievements

- Meta-modelling a modelling language to understand its foundations
- Express functional constraints and analyse their intrinsic consistency
- Analyse the semantics of data models
- Define semantic correspondences relating to the exchange of data between several information systems
- Apply an MBSE (Model-Based Systems Engineering) approach to identify multi-model, multi-trade relationships in the specification of a complex system to be developed

Evaluation method
Terminal test

Responsible	***Hourly volume:***
Hervé PANETTO	42 hours (10h CM, 12h TD, 20h TP) + 20 hours project