Institution: Université Paul Verlaine – Metz

Specialization: Computer Science

Overview of the first semester (12 weeks of courses):

List of the courses followed by the local students in the 3rd year

- Algorithmics: 5 ECTS (60h/semester or 5h/week)
- Object Oriented Programming (C++): 5 ECTS (60h/semester or 5h/week)
- Script Programming under Linux: 5 ECTS (48h/semester or 4h/week)
- Database Systems: 5 ECTS (48h/semester or 4h/week)
- Computer Architectures: 5 ECTS (60h/semester or 5h/week)
- Foreign Languages and Communication Skills: 5 ECTS (48h/semester or 4h/week)

The ECS students that already followed some of the above courses in their home institutions can replace them with courses from the 2nd year, ISFATES 3rd year or Master 1st year. No more that 2/3 of the courses should be replaced by courses from Master 1st year.

List of some courses followed by the local students during the 2nd year (**first semester of the bachelor**):

- Algorithmics III: 5ECTS (60h/semester or 5h/week)
- Methodology and Programming: 5ECTS (60h/semester or 5h/week)
- Introduction to Databases : 5 ECTS 5ECTS (48h/semester or 5h/week)

List of some courses followed by the local students during the ISFATES 3rd year (**first semester of the bachelor**):

- Multimedia : 4 ECTS (48h/semester or 4h/week)
- Object Programming : 6ECTS (48h/semester or 5h/week)
- Java Enterprise : 5ECTS (48h/semester or 4h/week)
- Web Programming : 5ECTS (48h/semester or 4h/week)
- Human-Computer Interaction : 4 ECTS (48h/semester or 4h/week)

List of some courses followed by the local students during the Master 1st year (**choice of 3 courses maximum**):

- Software Analysis and Design : 5 ECTS (42h/semester or 4h/week)
- Combinatorial Optimisation: 5 ECTS (42h/semester or 4h/week)
- Compilation and Language Theory: 5 ECTS (48h/semester or 4h/week)
- Algorithmics and Complexity: 5 ECTS (42h/semester or 4h/week)
- .NET Development: 5 ECTS (42h/semester or 4h/week)
- Business Intelligence Tools: 5 ECTS (42h/semester or 4h/week)
- Computer Networks: 5 ECTS (42h/semester or 4h/week)

Overview of the second semester (10 weeks of courses + 8 weeks of Industrial Placement):

- Object Oriented Programming (Java): 5 ECTS (60h/semester or 6h/week)
- one choice among the two modules
    - Introduction to Computer Security: 5 ECTS (48h/semester or 5h/week)
    - Introduction to Cryptology and Data Compression: 5 ECTS (48h/semester or 5h/week)
- one choice among the two modules
    - Operations Research and Data Analysis: 5 ECTS (48h/semester or 5h/week)
    - Deterministic and Statistical Decisions: 5 ECTS (48h/semester or 5h/week)

- one choice among the two modules
  - Introduction to Mobile Development/Multimedia and Design Arts: 5 ECTS (48h/semester or 5h/week)
  - Human Factors/Multimedia and Design Arts: 5 ECTS (48h/semester or 5h/week)
- Foreign Languages and Software Engineering: 5 ECTS (48h/semester or 5h/week)
- Industrial Placement: 5 ECTS (8 weeks)

First Semester

Algorithmics (60h) L3		
The module introduces the methods designing efficient algorithms, the high-level data structures, the building and analysing algorithms. Main parts of the course are: • Execution time of an algorithm, efficient algorithms and data structures • Building methods of efficient algorithms: divide et impera, dynamic programming, greedy algorithms • Efficient data structures: balanced search binary trees, B-trees • Graph algorithms: problem of minimal cover trees (Prim, Kruskal)		
Examination: written + presentation of a project		
5 ECTS	5 hours/week	Semester 1

Object Oriented Programming (C++) (60h) L3		
The module aims to acquire the basics of object-oriented programming using the C++ language. The main parts of the module are: • Introduction to structural programming and object oriented programming • Basic C/C++ syntax (instructions, functions, control structures) • Compilation and link edition • Basic types (arrays, strings, structures, unionis, enumerations, bitvectors) • The C/C++ pre-processor • Separate compilation • Pointers and references • Exceptions in C++ • Classes and instances • Patterns/Templates • The STL • Dynamic identification of types • I/O operations and files		
Examination: written + presentation of a project		
5 ECTS	5 hours/week	Semester 1

Script Programming under Linux (48h) L3		
The module aims to a better programming knowledge under Linux/Unix environments, the use of different domain-specific languages for text processing, in particular for GUI and network programming. The main parts of the module are: • Virtual and physical memory managemen • Script languages (grep, awk, sed) • Shell commands • Other script languages (Perl, Python, Tcl/Tk, Ruby)		
Examination: written		
5 ECTS	4 hours/week	Semester 1

Database Systems (48h) L3		
The module aims to understand the principles of database management systems (DBMS) and their applications, and to have a deeper knowledge of concepts and mechanisms of conceptual data modelling. The main parts of the module are: • Introduction to DBMSs • The ORACLE DBMS (database design and querying) • Programming interfaces (PL/SQL, Pro*..., JDBC, ODBC) • Physical structures for data storing and optimized data access (indexing, hashing,...) • Query processing and optimisation • Advanced conceptual modelling • Complex objects and <relational-object> databases		
Examination: written		
5 ECTS	4 hours/week	Semester 1

Computer Architectures (60h) L3		
The aim of the module is to introduce the physical organisation of conventional computers, as well as the mechanisms for executing computer programs. The main parts of the module are: • The physical machine • The machine language • The assembling process • The execution mechanisms • The memory		
Examination: written		
5 ECTS	5 hours/week	Semester 1

Foreign Languages (24h) and Communication Skills (24h) L3
This modules consists of two equivalent parts: Foreign Languages and Communication Skills.   The English part aims to introduce the general and technical English terms for the domain of Computer Science (development of communication skills, study of scientific and cultural texts)   The Communication Skills part aims to provide better communication skills between students, students and teachers, to improve the job/placement search skills. The main parts are: • Writing cover letters • Writing CVs • Preparing a job interview • Integration to the industrial environments • Other communications skills (small and big groups, observation and communication case studies, PNL, transactional analysis, interviews...)
Examination: written

5 ECTS	4 hours/week	Semester 1

Algorithmics III (60h) L2

The aim of this module is to understand the field of program evaluation and algorithmic and data structures optimization:

- Introduction of complexity
- Good practices : abstract types, numerical errors, code reasoning, ….
- Lists, stacks and files
- Trees
- Networks, sorting

Examination: project

5 ECTS	5 hours/week	Semester 1

Methodology and Programming (60h) L2

The aim of to learn more about the C language. A main point of this course is to learn the dynamic aspects of this language. The main parts of the module are:

- Pratice : transforming algorithms in C language
- Building software managing several files
- Pointers , Dynamic tables, strings, files
- Separated compilation

Examination: project

5 ECTS	5 hours/week	Semester 1

Introduction to Databases (48h) L2

The aim of this introduction of the bases of the databases The main parts of the module are:

- Entity Association model
- Relational model and relational databases
- MySQL
- Protocols: FTP, DNS, HTTP, POP, IMAP, SMTP

Examination: project

5 ECTS	4 hours/week	Semester 1

Multimedia (48h) L3 Isfates

The aim of this module is to understand the field of design, esthetics and to learn Photoshop.

- Introduction of design
- Photoshop
- Project

Examination: project

4 ECTS	4 hours/week	Semester 1

Object Programming (48h) L3 Isfates

The aim of this module is to learn the C++ Language

- OO analysis
- The C++ language
- Projects

Examination: project

6 ECTS	5 hours/week	Semester 1

Java Enterprise (48h) L3 Isfates

The aim of this module is to learn how to build complex software with the java language (It's a java advanced course). The language is JDBC. The teacher is a professional who is an expert of this language. Students will have to develop a java application.

- Introduction of the concurrence
- Threads,hreads concurrence
- Databases access
- Transactions

Examination: project

5 ECTS	4 hours/week	Semester 1

Web Programming (48h) L3 Isfates

This module aims to various aspects of web programming optimization

Dynamic web site design
Server-side web programming (with PHP)
Database interaction for web application (MySQL)
Client-side development (JavaScript and AJAX)

Examination: project and exam

Examination: project

5 ECTS	4 hours/week	Semester 1

Human-Computer Interaction (48h) L3 Isfates

The aim of this module is to learn how to design or to evaluate interfaces (web, PDA, classical interfaces,

Mobile interfaces, vocal,….) and to build products with a good usability

- Introduction of benefit of ergonomic interfaces
- Ergonomic guidelines for interfaces
- Interfaces design and evaluation
- Methods for the design : questionnaires, interviews, user tests, ….
- Specific users (seniors, disabled people, kids, other cultures) and specific interfaces (web, vocal, tactile, ….)

Examination: project

4 ECTS	4 hours/week	Semester 1

Software Analysis and Design (42h) M1

One important part of the module helps to better understand the UML notation and to integrate specific object-oriented designing techniques, in particular design patterns. Another part is dedicated to formal specifications and techniques for software validation and verification. The main parts of the module are:

- Norms for ensuring software quality
- Software extensibility and reusability
- Design patterns
- Application frameworks
- Formal modelling and refining
- Design by contract
- Modelling languages for Java: JML
- Tools for JML: ESC/Java, JMLRac

Examination: written

5 ECTS	4 hours/week	Semester 1

Combinatorial Optimisation (42h) M1

The aim of the module is to provide the general principles of linear programming (continue and on naturals) to establish fundamental algorithms for exact and approximative solving. The main parts of the module are:

- Modelling and designing with linear programming
- Fundamental theorems of linear programming
- Simplex algorithms
- Post-optimisation algorithms
- Exact and approximative resolutions (heuristics, dynamic programming, branch-and-bound)

Examination: written

5 ECTS	4 hours/week	Semester 1

Compilation and Language Theory (48h) M1

The aim of the module is to introduce the basic notions of language theory: regular expressions, grammars and syntactic analysis techniques. The main parts of the module are:

- Basic definitions: alphabet, words, concatenation, language, closure
- Regular expressions: definitions, automata, pumping lemma
- Grammars
- Bottom-up syntactic analysis
- Tools: lex, yacc

Examination: written

5 ECTS	4 hours/week	Semester 1

Algorithmics and Complexity (42h) M1

The aim the module is to build efficient algorithms to solve difficult problems. The main parts of the module are:

- Efficient algorithms : divide et impera, dynamic programming, greedy algorithms
- Algorithms for solving difficult problems: random and approximative algorithms
- Complexity: P and NP complexity classes, P=?NP, algorithmic consequences, NP-completeness, polynomial reduction

Examination: written

5 ECTS	4 hours/week	Semester 1

.NET Developement (42h) M1

The aim of the module is to introduce the .NET framework. The main parts of the module are:

- Programming C++ under the .NET framework.
- Programming in C#.
- Building graphical user interfaces under .NET framework.

Examination: written

5 ECTS	4 hours/week	Semester 1

Business Intelligence Tools (42h) M1

The aim of the module is to use graphs and operational research techniques in networks to solve difficult Business Intelligence problems (transport, telecommunications, sequencing, data mining, etc). The main parts of the module are:

- Flows: algorithms, applications
- Minimal weight spinning tree : algorithms, applications
- Minimal cost coupling: algorithms, applications
- Tools: XPRESS, CPLEX

Examination: written		
5 ECTS	4 hours/week	Semester 1

Computer Networks (48h) M1

The aim of this introduction module is to present the main principles and tools for network programming. The main parts of the module are:

- Basic notions: layer architectures, encapsulation, OSI and TCP/IP models, protocols
- Local networks: architecture, Ethernet, access policies
- Network layers and interconnections
- Internet and TCP/IP architecture
- Protocols: FTP, DNS, HTTP, POP, IMAP, SMTP

Examination: project		
5 ECTS	4 hours/week	Semester 1

Second Semester

Object Oriented Programming (Java) (60h)

The module aims to a stronger knowledge of object-oriented programming skills by the means of Java. The main parts of the module are:

- Multi-thread and concurrent programming
- Event programming
- GUI programming (AWT and Swing libraries)
- Client server applications (java.net package)
- SQL interface using the JDBC protocol.

 A project will be developed in common with the Software Engineering module

Examination: written + presentation of a project		
5 ECTS	6 hours/week	Semester 2

Introduction to Computer Security (48h)

The module introduces to the students the basic notions of security in networks and computer systems. The main parts of the module are:

- Human, system and network flaws
- Introduction to cryptography and its applications
- Reliability: public keys infrastructure
- Tools: IDS, IPS, VPN

- Authentication and certification

Examination: written		

5 ECTS	5 hours/week	Semester 2

Introduction to Cryptology (24h) and Data Compression (24h)

The module is split in two equal parts: Cryptology and Data Compression.

The Cryptology part aims to the comprehension of the principles, the common applications and the limits of modern cryptology. The main parts are:

- RSA cryptosystem
- Authentication
- Symmetric key cryptology
- OpenSSL

The Data Compression module is built on the following main parts:

- Bitwise operations in C++
- The String type in C++
- Data Compression: (adhoc methods, statistic methods – Shannon Fano, Huffman)

- Comparison between existing methods

Examination: written

5 ECTS	5 hours/week	Semester 2

Operations Research (24h) and Data Analysis (24h)

This module is split in two equal parts: Operations Research and Data Analysis

The Operations Research part aims to introduce the basic notions and tools of Operations Research domain, as below:

- Graphs: (optimal pathways, PERT and ROY graphs)
- Optimisation algorithms on graphs
- Linear programming and the use of XPRESS tool to find optimal solutions

The Data Analysis part deals with 'factorial' data, according to the following :

- Statistical descriptions
- Linear regression
- Analysis using main components

- Factorial analysis of correspondences

Examination: written

5 ECTS	5 hours/week	Semester 2

Deterministic (24h) and Statistical (24h) Decisions

The module is split in two main parts: Operations Research and Test Theory

The Operations Research part aims to introduce the basic notions and tools of Operations Research domain, as below:

• Graphs: (optimal pathways, PERT and ROY graphs) • Optimisation algorithms on graphs • Linear programming and the use of XPRESS tool to find optimal solutions The Test Theory part recalls basic probability and statistics notions and introduces the means and variance estimators by studying three test paradigms: • Neyman – Pearson tests: • Ficher tests • Bayes tests		
Examination: written		
5 ECTS	5 hours/week	Semester 2

Introduction to Mobile Development (24h)/Multimedia and Design Arts (24h)

This module is split in two equal parts: Mobile Development and Multimedia and Design Arts The Mobile Development part consists of : • Using a development framework in C++ to deal with mobile peripherals (Symbian) • Deploying a mobile C++ application. • Discovering the controls for creating UI and manipulating data Multimedia and Design Arts initiates to the whole multimedia creation process, the use of an appropriate tool and gives an introduction to multimedia design and common applications		
Examination: written		
5 ECTS	5 hours/week	Semester 2

Human Factors (24h) and Multimedia and Design Arts (24h)

The module is split in two parts: Human Factors and Multimedia and Design Arts The Human Factors part introduces the basic concepts of cognitive psychology and ergonomics, according to the following: • Human Factors and HCI (definition, methods, perception and representation, attention and memory, knowledge and mental models, metaphors and conceptual models, social aspects, group communication, organisational aspects, …) • Ergonomics (history, domains, approaches, methods, concepts, applications) Multimedia and Design Arts initiates to the whole multimedia creation process, the use of an appropriate tool and gives an introduction to multimedia design and common applications		
Examination: written		
5 ECTS	5 hours/week	Semester 2

Foreign Languages (24h) and Software Engineering (24h)

This module is split in two equal parts: English and Software Engineering.

The English part aims to introduce the general and technical English terms for the domain of Computer Science (development of communication skills, study of scientific and cultural texts)

The Software Engineering aims to study the UML notation. It is built on the following main parts:

- Class diagrams
- Use-case diagrams
- Interaction diagrams
- Architectural diagrams

A project will be developed in common with the Java module

Examination: written + presentation of a project

5 ECTS	5 hours/week	Semester 2

Industrial Placement (8 weeks)

The module aims at providing the practical work in a project group within an industrial environment.

Examination: presentation of a project

5 ECTS	8 weeks	Semester 2

Range of the marks

[16 – 20[:   very good
[14 – 16[:   good
[13 – 14[:   satisfactory
[10 – 12[:   sufficient
[0 - 10[:   not passed