République Algérienne Démocratique et Populaire
الجمهورية الجزائرية الديمقراطية الشعبية
Ministère de l'Enseignement Supérieur et de la Recherche Scientifique
وزارة التعليم العالي و البحث العلمي

ESI ECOLE NATIONALE SUPÉRIEURE D'INFORMATIQUE

المدرسة الوطنية العليا للإعلام الآلي
(المعهد الوطني للتكوين في الإعلام الآلي سابقا)
Ecole nationale Supérieure d'Informatique
ex. INI (Institut National de formation en Informatique)

Second cycle

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Programs

of the 1st year of the second cycle

(May 2011)

Contents

SECOND CYCLE (1st year)

Table of course distribution: 1st year (Semester 1)

Teaching Unit EU	Semester volume (hours)					
	Lectures	Work directed	Work practices	Other	Total	Coefficients
EU Fundamental						
UEF1.1.1	**75h00**	**30h00**	**30h00**		**135h00**	**9**
Operating system 1	45h00	15h00	15h00		75h00	5
Networks 1	30h00	15h00	15h00		60h00	4
UEF1.1.2	**60h00**	**35h00**	**40h00**		**135h00**	**9**
Introduction to Software Engineering	30h00	15h00	30h00		75h00	5
Theory of programming languages and applications	30h00	20h00	10h00		60h00	4
EU Methodology						
EMU1.1	**90h00**	**60h00**			**150h00**	**10**
Numerical analysis	30h00	30h00			60h00	4
Operational research: graphs and algorithms	30h00	15h00			45h00	3
Analysis of organisations	30h00	15h00			45h00	3
Cross-cutting EU						
UET1.1		**30h00**			**30h00**	**2**
English language 1		30h00			30h00	2
Total Semester S1	**225h00**	**155h00**	**70h00**		**450h00**	**30**

Table of course distribution: 1st year (Semester 2)

Teaching Unit EU	Semester volume (hours)					
	Lectures	Work directed	Work practices	Other	Total	Coefficients
EU Fundamental						
UEF1.2.1	**75h00**	**60h00**	**30h00**		**165h00**	**11**
Operating system 2	30h00	15h00	15h00		60h00	4
Networks 2	15h00	15h00	15h00		45h00	3
Architecture	30h00	30h00			60h00	4
UEF1.2.2	**60h00**	**45h00**	**45h00**		**150h00**	**10**
IS analysis and design methodologies	30h00	30h00	**15h00**		75h00	5
Databases	30h00	15h00	**30h00**		75h00	5
EU Methodology						
EMU1.2	**30h00**	**30h00**	**45h00**		**105h00**	**7**
Introduction to computer security	15h00				15h00	1
Project management	15h00	30h00			45h00	3
Project			45h00		45h00	3
Cross-cutting EU						
UET1.2		**30h00**			**30h00**	**2**
English language 2		30h00			30h00	2
Total Semester S2	**165h00**	**165h00**	**120h00**		**455h00**	**30**

Detailed 1st year programmes

Semester 1

UEF 1.1.1- Operating System I

EU Code	Module title	Coefficient
UEF 1.1.1	Operating system I	5

Hourly volumes		
Lectures	TD / TP	TOTAL
45	30	75

Semester :	1

Prerequisites	Computer Architecture, Algorithms and Data Structures, Introduction to the Operating System.

OBJECTIVES :

The objective of this course is to enable students to understand the basic concepts of centralized operating systems, their structure and operation and to master their use through practical work.

CONTENTS:

I. Introduction to Operating Systems

1. Functions of an operating system
2. Historical development of operating systems
3. The different types of operating systems
4. Architecture of an operating system

II. Linking and loading Programmes

1. Introduction
   - Assembly, compilation and symbol tables
2. Object modules
   - Translatable object modules
   - Executable object modules
   - Shareable object modules (or shared libraries)
3. Link editors
   - Static link editors
   - Dynamic link editors and shared libraries
4. Examples of object modules
   - The ELF (Executable and linkable Format) object module
   - The Windows Portable Executable (PE) object module
5. Chargers

III. Basic mechanisms

1. Reminders and definitions
2. Interruptions

- Definitions
- Interruption levels and priority
- Mask and inhibit interruptions
- General outline of an interruption processing programme
- Unfolding
- Calls to the supervisor
- Examples of interruption systems
  - THE IBM 360/370
    - The Motorola MC68000
    - The Intel 80x86

IV. Process and scheduling

1. Introduction
2. Notion of event
3. Sequential processes (tasks)
   - Definition of a sequential process
   - States of a process
   - Transitions of a process from one state to another
   - Process control block (PCB)
   - Process operations
     - Creating a process
     - Process destruction
4. The processor allocator
   - Schedulers
     - Job scheduler (Job scheduler or long term scheduler)
     - CPU scheduler (or shortterm-scheduler)
   - Performance criteria for processor allocation algorithms
   - Different allocation strategies
   - Algorithms without recycling
     - First come first served (FIFO)
     - SJF: Shortest Job First
   - Algorithms with requisition (pre-emption)
     - Round-robin
     - Scheduling with multi-level queues
     - Scheduling with multi-level queues with recycling

V. Mutual exclusion and synchronisation

1. Relationship between processes
   - Parallel processes
   - Different types of parallel processes
2. Mutual exclusion

- Definitions
- Achieving mutual exclusion
  - Working assumptions (Dijkstra)
  - Software solutions: Using common variables
    - Hardware solutions
    - Examples

    The TAS instruction

    The 80x86 LOCK XCHG instruction
- Dijkstra's semaphores
- Implementation of P and V primitives

3. Synchronisation of processes

- Definition
- Expression of synchronisation constraints
- Specification of synchronisation
- Typical problems
- Synchronisation techniques
- Examples
  - Resource Allocator
  - The reader/writer model
    - The appointment
- Communication by common variables
  - Definition
  - General scheme of the producer-consumer
    - Buffer management

KNOWLEDGE TEST

- Continuous assessment, final test and practical work.

BIBLIOGRAPHY

- R. E. Bryant, D. R. O'Hallaron, "Computer System: A programmer's perspective", Prentice Hall, 2003.
- H. M. Deitel , P. J. Deitel, D. R. Choffness, "Operating systems", Third edition Addison-Wesley, 2004.
- S. Krakowiak, "Principes des systèmes d'exploitation des ordinateurs", Dunod, 1985
- A. Silberschatz, P. B. Galvin , G. GAGNE, "Principles of Operating Systems", 7e edition, Addison-Wesley, 2005.
- W. Stalling, "Operating Systems - Internals and Design Principles", 6th edition, Prentice Hall, 2006.
- A. S. Tanenbaum, A. S. Woodhull, "Operating Systems Design and Implementation", Third edition, Prentice Hall, 2006.

UEF 1.1.1- Networks I

EU Code	Module title	Coef.	Credits
UEF 1.1.1	Networks I		4

Hourly volumes		
Lectures	TD / TP	TOTAL
30	30	60

Semester :	1

Prerequisites	Electricity and Optics

OBJECTIVES :

This course is intended to provide students with a basic understanding of local area networks, their technologies, architectures and protocols. They will be able to define a local network architecture with an IP addressing plan.

CONTENTS :

I. Generalities on networks (4h)

1. Why a network, what is a network?
2. Evolution of computer networks
3. Network topologies
   - Broadcast networks
   - Multi-point networks
4. Switching techniques
   - Circuit switching
   - Message switching
   - Packet switching
5. Classification of networks by size
   - LAN
   - MAN
   - WAN
   - Example of the physical structure of the Internet
6. Classification of networks by access
   - Public network
   - Private network
7. Telecommunications or IT vision of networks
   - Public Switched Telephone Network (PSTN)
   - Packet-switched network
   - PSTN 64 network
   - Satellite network
   - Integrated Services Digital Network (ISDN)
   - Wireless network

- Internet network

8. Networks from the user's perspective
  - The modes of contact: connected or unconnected mode
  - Quality of service (speed, connection time, etc.)

9. The need for standardisation
  - ISO standardisation work
  - Main opinions of the CCITTT and the EIT
  - Definition of the concept of protocol

10. Software abstraction: Layered network architecture
  - The OSI model
  - Data transmission through the OSI model
  - Service primitives
  - The TCP/IP protocol system
  - Data transmission through the TCP/IP model
  - Example of service primitive usage scenarios

11. Summary and problems to be studied.
  - Architectural issues
  - Protocol issues (transfer rules, error handling, path selection)

Practical work (4h)
  - Know the basics of how to get a network connection
  - Become familiar with network equipment and their roles
  - File sharing in Windows

II. Data transmission (6h)

1. Definitions
2. Link modes (simplex, half duplex, full duplex)
3. Reminder: serial/parallel - synchronous/asynchronous transmission.
4. Concept of bandwidth and transmission rate
5. Transmission mode (coding/modulation)
  - Baseband transmission (Utility, NRZ coding, Manchester, 3-level coding)
  - Modulation (Usefulness, amplitude modulation, frequency modulation, phase modulation, combination of modulations)

6. Multiplexing (time, frequency) and ADSL (as a case study)
7. Characteristics of the transmission media
  - Metal brackets
  - Fibre optics
  - Radio waves
  - Reliability of transmission media

8. Characteristics of standardised modems

TP
  - DCE-ETTD junction (Null modem)
  - Case study

III. Data linkage (6h)

1. Definitions and role
2. Concept of frames
3. Communication channel allocation protocols
   - Random protocols: ALOHA, CSMA/CD
   - Deterministic protocols: Token ring, FDDI
   - Media access protocols in wireless networks
4. Error protection
   - Detection and correction by retransmission (parity, polynomial CRC check)
   - Detection with automatic correction (Hamming code)
   - The notion of acquittal
5. Some data link layer protocols (BCS, HDLC (modelling using AEFs), PPP, MAC/LLC)

TP :

- Study of collision phenomena

IV. Local network technology (8h)

1. Ethernet technology
   - Overview of Ethernet technology
   - The IEEE 802.3 standard and its variants.
   - Classification of Ethernet networks by speed (Fast and Giga Ethernet).
   - Concept of physical address
   - Structure of an Ethernet frame
   - Access method used by Ethernet
   - Interconnection techniques
     - Switches
       a. Operation
       b. Switching type (store and forward, spanning tree protocol, self-learning)
     - VLANs (Levels 1 and 2)
2. WIFI technology
   - How it works
   - The IEEE 802.11 standard
   - Frame structure
   - Equipment used in wifi technology
   - Access method used in wifi networks
   - Security problem in Wifi networks
3. Other Technologies (personal networks: bluetooth, etc.)

TP :

- Operation of the switches (PacketTracer)
- How the vlans work
- Wiring, design and configuration

V. Addressing and Routing (6h)

1. Remote access, extension of local networks to wide area networks
2. Presentation of the role of the network layer (addressing and routing)
3. IP addressing of a machine
4. Subnetwork addressing
5. Routers, gateways and bridges.
6. Static routing
7. Automatic machine configuration protocols (ARP, ICMP)
8. IPV6 addressing

TP :

- Allocation of IP addresses
- Frame capture in wireshark and study of ARP and ICMP protocols.
- Packet tracer simulator from CISCO
- Static routing under CISCO

PERSONAL WORK
- A project on the design of a local area network (case study) duration ~10 h - A project on the deployment of an addressing plan and the use of VLANs duration ~ 15h

KNOWLEDGE TEST
- A final exam (end of the semester) 40% - An intermediate examination 20% - A practical examination (end of semester) 20% - Project score 10% - Note des TP (contrôle continue) 10%

BIBLIOGRAPHY
• P. Mühlethaler, "802.11 and wireless networks", Eyrolles 2002. • "Network architecture and case studies", CampusPress 1999. • L. Toutain, "Réseaux locaux et intranet", Lavoisier 2003.

UEF 1.1.2- Introduction to Software Engineering

EU Code	Module title	Coef.	Credits
UEF 1.1.2	Introduction to Software Engineering		5

Hourly volumes		
Lectures	TD / TP	TOTAL
30	45	75

Semester :	1

Prerequisites	Algorithms and data structures and object-oriented analysis and design

OBJECTIVES :

This course aims to provide the student with a methodological approach to software design. They will learn, through a development process, to design and model software with UML. They will also know, at the end of this course, how to use support tools for the development of quality software.

CONTENTS :

I. Basic concepts (8h)

1. Issues, definitions and objectives of software engineering
2. Life cycle models (main phases, main roles)
3. Overview of ISO/IEC 12207
4. Software quality and measurement metrics (Boehm - McCall - ISO 9126)

II. Software development process (20 h)

1. LGA activities in the Unified Software Development Process
    a. Expression of needs
    b. Analysis
    c. Design
    d. Implementation
    e. Test
2. USDP phases
    a. Needs analysis
    b. Elaboration
    c. Construction
    d. Transition
3. Introduction to agile process methods

III. UML (27h)

1. Reminder of the concepts related to the object paradigms
2. Introduction to UML
3. UML diagrams
    a. Class diagram
    b. Sequence diagram

c. Collaboration diagram
d. Status diagram
e. Activity diagram
f. Component diagram
g. Deployment diagram

4. Using UML in USDP

IV. Software development support tools (20 h)

1. Editors and integrated development environments (AGL, RAD)
2. Configuration management and version control (CVS, SVN)
3. UML modelling support tools and source code generation
4. Test environments

KNOWLEDGE TEST

- Continuous assessment, final test and practical work.

BIBLIOGRAPHY

- G. Booch, J. Rumbaugh, I. Jacobson, "The Unified Software Development Process", Addison-Wesley, 1999.
- G. Booch, J. Rumbaugh, I. Jacobson, "The Unified Modeling Language (UML) Reference Guide", Addison-Wesley, 1999.
- G. Booch, J. Rumbaugh, I. Jacobson, "The Unified Modeling Language (UML) User Guide", Addison-Wesley, 1999.
- G. Booch et al, "Object-Oriented Analysis and Design, with applications", Addison-Wesley, 2007.
- P. Kruchten, "Introduction to the Rational Unifieds Process", Eyrolles, 2000.

UEF 1.1.2- Theory of programming languages and applications

EU Code	Module title	Coef.	Credits
UEF 1.1.2	Theory of programming languages and applications	4	4

Hourly volumes		
Lectures	TD / TP	TOTAL
30	30	60

Semester :	1

Prerequisites	Algorithms, programming.

OBJECTIVES :

This course presents the foundations of programming languages and develops the lexical and syntactic analysis phases of a compiler. At the end of the semester, students will know how to build a lexical and a syntactic analyser.

CONTENTS :

I. Words, Languages and Grammars

1. Definitions, derivations, language generated by a grammar
2. Chomsky's classification
3. Languages regular (grammars, automata of finite states expressions regular)
4. Algebraic languages (grammars, stack automata)

II. Lexical analysis (12h)

1. Regular expressions in lexical analysis,
2. Lexical Analyser Generator (Lex, JCC).

III. Syntactic analysis (24h)

1. Syntactic analysis methods (bottom-up, top-down),
2. Stack automata in parsing,
3. Recursive top-down analysis,
4. Syntax analyser generator (Yacc, CGC).

IV. Practical work

1. TP1: Finite State Automata
2. TP1: Implementation of a lexical analyser (Lex, JCC),
3. TP2: Implementation of a parser (JCC).

PERSONAL WORK
- Practical work (10h)

KNOWLEDGE TEST
- Continuous assessment, final test, and practical work.

BIBLIOGRAPHY

- A. Aho, J.D. Ullman, "The Theory of Parsing, Translation, and Compiling", Prentice Hall, Inc, Englewood Cliffs, New Jersey, 1972.
- P. J. Denning, J. B. Dennis, and J. E. Qualitz, "Machines, languages, and Computation", Prentice-Hall, Inc. Englewood Cliffs, New Jersey, 1978.
- R. Floyd, R., Biegel, "The Language of Machines: An Introduction to Computability and Formal Languages", Thomson Publishing, France, 1994.
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- Wolper, Pierre, "Introduction à la calculabilité", InterEditions, Paris, 1991.

EMU 1.1- Numerical Analysis

EU Code	Module title	Coef.	Credits
EMU 1.1	Numerical Analysis		4

Hourly volumes		
Lectures	TD / TP	TOTAL
30	30	60

Semester :	1

Prerequisites	Analysis and linear algebra

OBJECTIVES :

Numerical analysis is the study of methods for numerically evaluating numbers, functions .... It is an essential tool for the engineer. The modelling of the majority of real situations (the classification of web pages, image processing, optimisation of shapes, heat transfer, flows, etc.) leads to problems whose exact mathematical solution is impossible given their numerical complexity. One is therefore led to seek approximate solutions by numerical algorithms that are programmed on a computer. The purpose of numerical analysis is to construct and study these solution methods.

CONTENTS :

I. Solving linear systems by direct methods

1. Motivating example.
2. Position of the problem.
3. Reminders and additional information on matrix analysis.
4. Packaging.
5. Gaussian method.
6. LU decomposition of a matrix.
7. Cholesky method.

II. Solving linear systems by iterative methods

1. Generalities on classical iterative methods for linear systems.
2. Jacobi's method.
3. Gauss-Seidel method.
4. Relaxation method.
5. Study of the approximation error.

III. Numerical calculation of eigenvalues

1. Motivating example.
2. QR method.
   - QR decomposition :
     - By the Gram-Shmidt orthonormalisation procedure.
     - By the House-Holder method.
   - QR method for the calculation of eigenvalues.

3. Jacobi's method.
4. Iterated power method.

IV. Solving non-linear equations of the form f(x)=0

1. Motivating example.
2. Dichotomy method.
3. Fixed point methods.
4. Newton's method.

V. Polynomial interpolation

1. Motivating example.
2. Lagrange interpolation.
3. Estimation of the Lagrangian interpolation error.

VI. Digital integration

1. Motivating example.
2. General method (quadrature formulas).
3. Newton-Cotes quadrature formulas:
   - Simple.
   - Composites.
4. Study of the error.

VII. Numerical solution ofEDO with initial conditions

1. Motivating example.
2. General and definitions.
3. Numerical stepwise methods :
   - Euler's method.
   - Taylor method of order *p*.
   - Range-Kutta method of order 2.
   - Range-Kutta method of order 4.
4. Study of the error.

PERSONAL WORK
- Programming algorithms in Matlab

KNOWLEDGE TEST
- Continuous assessment and final test and practical work.

BIBLIOGRAPHY

- Course handout.
- P.G. Ciarlet, "Introduction à l'analyse numérique matricielle et à l'optimisation- Cours et exercices corrigés", Dunod, 2006
- M. Schatzman, "Numerical analysis - a mathematical approach - courses and exercises", Dunod, 2001
- M. Sibony, J. Mardon, "Linear and non-linear systems, numerical analysis T1", Hermann, 1984

EMU 1.1- RO- Graphs and algorithms

EU Code	Module title	Coefficient
EMU 1.1	RO- Graphs and Algorithms	3

Hourly volumes		
Lectures	TD / TP	TOTAL
30	15	45

Semester :	1

Prerequisites	• Linear Algebra, Matrix Analysis

OBJECTIVES :

This course aims to introduce graph theory. Graph theory is at the crossroads of three disciplines: problem solving, discrete mathematics and algorithmics. Graphs are a powerful tool for modelling many combinatorial problems. Graph theory offers very efficient algorithms for solving many well-known problems, such as shortest path algorithms or the scheduling problem.

CONTENTS :

I. Introduction to Operations Research and Modelling

1. Introduction to Operations Research
2. Methodology for solving an OR problem
3. System analysis
4. Modelling and model validation
5. Implementation
6. Case study

II. Fundamentals of graph theory

1. Graphs, isomorphisms, adjacencies
2. Simple graphs
3. Undirected graphs
4. Chains, cycles and connectedness
5. Subgraphs and partial graphs

III. Trees and Arborescence

1. Tree properties
2. Trees
3. Minimum weight tree problem -Kruskal algorithm

IV. Shortest path problem

1. Position of the problem, basic theory
2. Shortest path tree - properties
3. Shortest path algorithms: Djikstra, Danzig and Ford.

V. Maximum flow problem

1. Position of the problem
2. Ford and Fulkerson algorithm
3. The minimum cut theorem
4. Compatible streams

VI. Scheduling problem

1. Position of the problem
2. Project-related network
3. PERT method: deterministic and random cases
4. Optimisation of scheduling: the CPM method

VII. TP: Transport problem

1. Position of the Transport problem
2. Properties of the Transport problem
3. Solving the Transport Problem :
4. BALAS-HAMER and STEPPING STONE algorithm
5. The problem of assignment

PERSONAL WORK

- 1 TP

KNOWLEDGE TEST

- Continuous assessment and final test and practical work.

BIBLIOGRAPHY

- L. R. Ford and D. R. Fulkerson, **"**Flows and networks**",** Princeton University Press.
- M. Gondron and M. Minoux, **"**Graphs and Algorithms**"** Wiley Interscience, 1984.
- R. Bronson, **"**Operations Research**"** Shaum Series, 1982.

UET 1.1- Analysis of organisations

EU Code	Module title	Coefficient
UET 1.1	**Analysis of Organisations**	**3**

Hourly volumes		
Lectures	**TD / TP**	**TOTAL**
30	**15**	**45**

Semester :	**1**

Prerequisites	Business Economics, Introduction to Information Systems

OBJECTIVES :

Through this course, we aim to

- to broaden the students' knowledge of the theory of organisations as socio-technical systems and hence of the dynamics that govern them.
- to study the influence of the decision in organisations
- to develop the student's analytical and intervention skills within organisations and understanding of major business functions.

At the end of this course, students will be able to:

- analyse and understand the major currents of organisational thought
- to step back from a single, simplistic view of the complexity of life in business and organisation and sharpen their critical eye.
- understand how a business process works

CONTENTS :

I. Introduction to organisational theories (7h)

1. Organisational concept: definitions
2. Comparison of concepts: organisation, management, system
3. Some organisational metaphors (after G. Morgan):
   - Organisation seen as a living organism
   - Organisation seen as a machine
   - Organisation as a political system
   - Organisation seen as a brain that processes information
   - No goals: No organisation (importance of reconciling conflicting objectives)
4. History of the main currents or schools of thought in organisation
   - Classical rationalist school (Taylor, Weber, Fayol)
   - School of human relations (Mayo, Maslow, Herzberg, ..)
   - Socio-technical school (Woodward)
   - Systemic school
   - Managerial and strategic school (Drucker, Ansoff, Porter, Mintzberg, ..)
   - School of Organisation and Culture (Hofstede)
5. Summary

II. Organisational structures (10h)

1. Coordination mechanisms as the essence of any organisation
   - Mutual Adjustment
   - Direct supervision
   - Standardisation of work
2. Basic elements of an organisation
3. Typology of formal organisational structures
   - By authority: linear, functional, staff & line, matrix
   - According to contingency (Mintzberg H.)
4. Evolution of organisational structures (extended organisations, virtual organisations)

III. The organisation: a place for decision-making (3h)

1. Decision concept: IDC model
2. Notion of Rationality of Decision: (H. Simon)
3. Centralization & decentralization of decisions

IV. Overview of the main functions of the company (10 hours)

1. Responsibility, tasks, organisation
2. Flow of a business process

RECOMMENDATIONS

T.D.

- Exercises on TSO, motivation, strategy,
- The organisation as a system of flows (authority, information, decision, …): presentation of cases.
- Case studies : Organisational structures (workstations, organisation charts, etc.)

PERSONAL WORK

- Reading articles

KNOWLEDGE TEST

-2 Tests (intermediate and final) and TD mark.

BIBLIOGRAPHY

- Y. Ansoff, "From strategic planning to strategic management", Wiley, 1976
- A. Bartoli, "Communication et organisation: pour une politique générale cohérente", Editions d'Organisation, 1991
- G. Biolley, "Mutation du management", Les Editions d'Organisation, 1986
- L. Boyer, Poiree M., Salin E., "Précis d'organisation et de gestion de la production", Les Editions d'Organisation, 1986
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- B. Lussato, "Introduction critiques aux théories d'organisation", Dunod, 1988
- Y. F. Lyvian, "Introduction à l'analyse des organisations", Economica, 2000
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- H. Mintzberg, "Structure et dynamique des organisations", Editions d'organisation, 1982
- H. Mintzberg, "Management des organisations", Editions d'organisation, 1986
- G. Morgan, "Images of Organizations", Second edition, 2006
- J.C. Scheid, "Les grands auteurs en organisation", Dunod, 1989
- H.A Simon, "The New Science of Management Decision", Harper and Row, 1960
- L. Von Bertalanffy, "General Systems Theory", Dunod, 1993

UET 1.1 - English

EU Code	Module title	Coefficient
UET1.1	English 1	2

Hourly volumes		
Lectures	TD / TP	TOTAL
	30	30

Semester :	1

Prerequisites	• No

OBJECTIVES :

This course aims to teach the student to :

- Better communication of personal data (Profile).
- Researching information and processing it in order to synthesise the data collected on the Net.
- Avoid the dangers of literal translation (cross-referencing information).

CONTENTS :

I. Activity One: Curriculum Vitae (18h)

1. How to make a Curriculum Vitae (containing personal data)
2. How to present (communicate) a Curriculum Vitae in public.
3. Taking care of your presentation (Ergonomics of the presentation)

II. Activity Two (12 hours)

1. Written comprehension & production in a personal work situation
2. Ability to search for relevant information and avoid "infobesity

PERSONAL WORK

- Preparation of the CV in "PowerPoint", "Prezi", or any other presentation tool.
- Search for information on certain Semantic Web concepts.

KNOWLEDGE TEST

- The presentation itself is a test of the knowledge acquired during the preparation of the activities.

BIBLIOGRAPHY

- https://segue.middlebury.edu/view/html/site/fren6696a-l08/node/2827590
- http://www.restode.cfwb.be/francais/profs4/04Reflexions/Download/JPH-Fondements-Didactic.pdf

Detailed programme of the 3rd year
Semester 2

UEF 1.2.1- Operating System II

EU Code	Module title	Coefficient
UEF1.2.1	Operating System II	4

Hourly volumes		
Lectures	TD / TP	TOTAL
30	30	60

Semester :	2

Prerequisites	Operating system I

OBJECTIVES :

The objective of this course is to enable students to understand the basic concepts of centralized operating systems, their structure and operation and to master their use through practical work.

CONTENTS :

I. Interlocking

1. Introduction
- The problem of interlocking
- Definition

2. Characterisation of interlocking
- Necessary conditions
- Resource allocation graph

3. Methods of dealing with interlocking
- Static prevention methods
- Avoidance: a dynamic prevention method
- Methods of detection and cure

II. Memory management

1. Introduction
- Memory Manager
- Reminders (memory hierarchy, link editing and loading)

2. Contiguous allocation of main memory
- Memory management in single-programmed systems
- Swapping technique
- Multi-programmed systems

Memory management with the fixed partition technique Memory management with the variable partition technique

3. Virtual memory management
- Introduction

Logical and physical addresses

Logical address space and physical address space The objectives of the virtual memory concept

- Pagination
  - Definition
  - Single level pagination
  - The translation of virtual addresses into real addresses The implementation of the page table
  - Multi-level pagination The reverse page table
  - The choice of page size The associative memory
  - Paged memory protection
  - Code and data sharing (page sharing)
- Segmentation
  - Definition
  - The translation of virtual addresses into real addresses
  - Implementation of the segment table
  - Protection and sharing of segments Fragmentation
- Segmentation with pagination
  - Translation of a virtual address into a real address
- Examples
  - Intel 80x86 machines Linux system
  - MULTICS system (GE645)

4. Pagination on demand

- Representation of virtual and physical process spaces Representation of virtual process spaces Representation of physical space
- Page fault detection and processing Page fault detection Page fault processing
- Replacement algorithms The
  - FIFO algorithm
  - The optimal algorithm (OPT or MIN) The LRU (Least Recently Used) algorithm
  - The second chance algorithm and the clock algorithm The LFU (or NFU) algorithm: Least frequently used
  - The Aging Algorithm
  - The NRU (Not recently used) algorithm
- Loading programs into main memory
- Allocation of slots (actual pages)

Global replacement and local replacement
Allocation algorithms
- The thrashing of a multi-programmed system
Locality property and workspace (Working Set)
Collapse prevention using the working set
Implementation of the working set model
Page fault frequency (PFF)

III. Secondary memory management

1. Introduction
   - Disc structure
   - Formatting disks
2. Management of disk transfers (secondary memory)
   - Optimising the movement of moving arm disc heads
   - FCFS(First Come First Served)
   - SSTF (Shortest Seek Time First)
   - Scan (lift technique) and C-Scan (Circular Scan)
   - Look and C-Look
   - N-Step-SCAN and FSCAN
   - Optimisation of the turnaround time (latency) A
     single queue: FCFS
     One queue per sector: SATF (Shortest Access Time Frist) or Sector Queueing
3. Disk caches
4. RAID (Redundant Arrays of Independent Disks)
   - RAID level 0 (RAID 0) or stripping
   - RAID level 1 (RAID 1) or mirroring
     - RAID level 2 (RAID 2)
     - RAID level 3 (RAID 3)
     - RAID level 4 (RAID 4)
     - RAID level 5 (RAID 5)
5. Logical Inputs and Outputs
6. Reminders
   - Input/output devices
   - Device controllers
   - Channel (or exchange unit) and DMA Controller
   - The main device driver modes
7. Virtual devices (or I/O streams)
8. Problems with processing speeds
   - Buffers in main memory
   - Buffers on secondary memory: or SPOOL (Simultaneous Peripheral Operation On Line)
9. File Management Systems

- Introduction
  Definition: file, item, block, block factor, logical block and physical block (physical record) Functions of a file management system (FMS)
- File operations
  Creating, opening, closing and deleting a file

10. Organisation of files
- Logical organisation, physical organisation and access mode
- Sequential organisation
- Direct organisation
- Single key indexed sequential organisation
- Indexed sequential organisation with multiple keys

11. File systems
- File descriptor
- Directory structure
  One-level directory
  Hierarchical or multi-level directory
  Examples: FAT, NTFS and UNIX/LINUX file systems

12. Disk space allocation
- The contiguous allowance
- The non-contiguous allowance
  Block size Representation of free blocks
  Non-contiguous allocation methods Chained blocks
  Allocation index tables
  Allocation file
- Examples: FAT, NTFS and UNIX/LINUX file systems

13. Security and protection of files
- Security
- Protection
  Name protection
  Passwords
  Access control matrices Access control by user class
- Examples:
  Protection in the NTFS file system Protection in Unix and Linux file systems

KNOWLEDGE TEST
- Continuous assessment, final test and practical work.

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- H. M. Deitel, P. J. Deitel, D. R. Choffness, "Operating systems", Third edition, Addison-Wesley, 2004
- S. Krakowiak, "Principes des systèmes d'exploitation des ordinateurs", Dunod, 1985
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UEF 1.2.1- Network II

EU Code	Module title	Coefficient
UEF 1.2.1	**Network II**	**3**

Hourly volumes		
Lectures	**TD / TP**	**TOTAL**
20	**25**	**45**

Semester :	**1**

Prerequisites	Networks I

OBJECTIVES :

This course aims to introduce students to wide area networks and their associated technologies. The student will learn how to configure, design and analyse the architecture of a computer network. The course focuses on the transport layer and some application layer protocols such as DNS.

CONTENT OF THE MODULE :

I. Operator networks (4h)

1. Introduction
2. Some WAN technologies
   - Specialised lines
   - The PSTN network
   - The X.25 network (PPP)
   - Frame Relay
3. Internet: the public WAN
   - Definition and background
   - Internet architecture
   - Internet access (ISP concept)
   - Means of interconnection (LS, PSTN, ADSL,)
   - NAT (Network Address Translation)
   - VPN (just a short presentation)
4. Additional services (convergence)

Practical work (4h): Tracroute on the Internet (Discovery of the Internet architecture as well as NAT, private/public addressing)

II. Transport protocols (8h)

1. Role and position in the OSI model - TCP/IP
2. Concept of flow control and error recovery
   - Utopian protocol
   - Send/Wait Protocol
   - Protocol using anticipation window
3. Notion of port
4. TCP protocol (connected mode) :
   - Features
   - How it works

- Header structure
- Establishing the connection
- Data exchange
  - Acknowledgement
  - Sequence number
  - Time out
  - Flow control and anticipation window concepts
- Closing a connection
- Congestion control

5. UDP protocol (unconnected mode)
   - Features
   - Header structure
6. Network programming interface: Sockets

TP (6h):

- Use of Telnet, FTP
- Use of WireShark for the analysis of protocols: FTP, Telnet in *client* mode.

III. Introduction to computer network administration (8h)

1. Introduction to administration
2. Use of passwords and access control mechanisms
3. Automatic configuration: BOOTP, DHCP
4. Name resolution protocol: DNS
5. E-mail protocols: SMTP, POP and IMAP
6. HTTP (Web) protocol

Practical work (10h): Administration and configuration under LINUX

PERSONAL WORK
- A project on the design of a local area network (case study) duration ~10 h
- A project on the deployment of an addressing plan and the use of VLANs duration ~ 15h

KNOWLEDGE TEST
- A final exam (end of semester) 40%
- An intermediate examination 20%
- A practical examination (end of the semester) 20%
- Project score 10%
- Note des TP (contrôle continue) 10%

BIBLIOGRAPHY
• P. Mühlethaler, "802.11 and wireless networks", Eyrolles 2002. • "Network architecture and case studies", CampusPress 1999. • L. Toutain, "Réseaux locaux et intranet", Lavoisier 2003.

UEF 1.2.1- Advanced computer architectures

EU Code	Module title	Coefficient
UEF 1.2.1	**Advanced Computer Architecture**	**4**

Hourly volumes		
Lectures	**TD / TP**	**TOTAL**
30	**30**	**60**

Semester :	**2**

Prerequisites	Computer Architecture I, Computer Architecture II.

OBJECTIVES :

The objective of this course is to provide the student with knowledge of the performance and interaction between the different functional components of a computer system.

At the end of this course, he should acquire the skills to structure his programs correctly so that they run more efficiently on a real machine. When choosing a system to use, they should be able to understand the trade-offs between different components, such as CPU clock rate, memory size, cache memory, etc.

CONTENTS :

I. Software architecture and processor microarchitecture (6h)

1. Examples of processor families (Intel and Motorola)
2. Internal architecture of a microprocessor
3. I/O interfaces, buses, controllers
4. Interrupt and interrupt controllers.
5. Microcontrollers and DSPs.

II. Performance measurement of an instruction set architecture (3h)

1. Introduction
2. CPU performance equations
3. Units of performance measurement
4. Test programmes
5. Acceleration of calculations, Amdahl's law

III. Memory hierarchy (3h)

1. Moore's Law, access time and memory cycle time,
2. Principles of locality
3. Notion of memory hierarchy
4. Principle of cache memories
5. Cache defects
6. Cache organizations
7. Replacement of a cached line
8. Write to cache
9. Cache levels
10. Cache size
11. Virtual memory

IV. Pipelined microarchitectures (3h)

1. Motivation
2. Principle of the pipeline
3. Pipeline constraints
4. Structural hazards and their resolution
5. Data hazards and their resolution
6. Control contingencies and their resolution
7. Performance of pipelined systems

V. Superscalar architectures and VLIW (3h)

1. Motivation
2. Principle of superscalar microarchitectures
3. Launch constraints
4. Structural hazards and their resolution
5. Data hazards and their resolution
6. Control contingencies and their resolution
7. Tidying up
8. Examples of superscalar processors
9. Principle of VLIW architectures
10. Flow of instructions
11. Instruction format
12. Comparison between VLIW and superscalar processors

VI. CISC and RISC architectures (3h)

1. History and background of CISC processors
2. CISC characteristics and instruction sets (examples and characteristics)
3. Disadvantages of CISC processors
4. Examples of CISC machines
5. Rationale for the introduction of RISC processors
6. Characteristics of RISC processors
7. RISC processor instruction set
8. Management of local variables in RISC processors (use of registers and register windows)
9. Management of global variables
10. Role of the compiler
11. RISC processor acceleration techniques
12. Examples of RISC processors
13. CISC/RISC comparison
14. Current processor trends

VII. Multicore processors (2h)

1. History of multicore processors
2. Definition of a multicore processor
3. Advantages of multicore processors
4. Manufacturers and the multicore market
5. Applications of multicore processors
6. Operation of a multicore processor
7. Manufacturing techniques for multicore processors
8. Implementation of multicore technology
9. Comparison of multicore processors
10. The future of multicore processors

VIII. Multiprocessor architectures (3h)

1. Justification of parallelism
2. Flynn's classification,

3. SISD architectures,
4. SIMD architectures
5. MISD architectures
6. MIMD architectures
7. Classification criteria for MIMD architectures
8. Shared memory MIMDs (SMPs)
9. Distributed memory MIMDs (PC clusters)
10. Cluster/SMP comparison
11. UMA and NUMA systems
12. Interconnection networks
13. Examples of MIMD processors

IX. Trends in new computers (4h)

PRACTICAL WORK

TP1: Initiation on t h e Simplescalar architecture simulator.

Contents :

- General presentation
- Functional simulation (sim-fast, sim-safe).
- Profile (sim-profile).
- Simulated cache (sim-cache).
- Out-of-order simulation.
- The different pipeline stages in the out-of-order simulator.
- Installation.
- Example application (**sim-fast, sim-safe, sim-profile**).

TP2: Acceleration of calculations :
Objective: The effect of cache size on computation speed-up. Tool:
Simplescalar, simulators: sim-cache, sim-profile.

Contents :

- Simulation of cache memory with several sizes.
- Performance measurement (IPC, CPI, cache misses, etc).

TP3: Pipeline and Superscalar Architecture (3 parts) :
Objectives:

- Simulation and testing of several configurations.
- Monitor and control the execution of instructions in different pipeline stages.
- Comparison between pipeline and superscalar architecture.
- Dependencies.

Tool: Simplescalar, simulator: **sim-ouorder.**

Contents :

- Presentation of the pipeline stages of the Simplescalar simulator.
- Relationship between the different pipeline stages.
- Test several configurations (architectures) according to several parameters (number of resources, pipeline stages, in-order, out-of-order, fetch, decode, issue, etc).
- Simulation of the solution by sending (solution for the resolution of data hazards).
- Comparison between pipeline and superscalar architecture.

KNOWLEDGE TEST

- Continuous assessment, final test and practical work

BIBLIOGRAPHY

- Parallel computer architecture, A Hardware/Software approach, David E. Culler, Jaswinder Pal Singh and Anoop Gupta, Morgan Kaufmann Publishers, ISBN: 1-55860-343-3, 1999
- Introduction to Digital Systems, Miloš Ercegovac, University of California at Los Angeles, Tomás Lang, University of California at Irvine, Jaime Moreno, ISBN: 0-471-52799-8, Wiley Publishers, 1999.
- The Architecture of Computer Hardware and System Software: An Information Technology Approach, Third Edition, Irv Englander, Bentley College, ISBN: 0-471-07325-3, Wiley Publishers, 2003.
- Understanding Parallel Supercomputing, R. Michael Hord, ISBN: 0-7803-1120-5, Wiley-IEEE Press, March 2001.
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- Fundamentals of Computer Architecture, by Mark Burrell, Publisher: Palgrave Macmillan, ISBN: 0333998669, 26 September 2003.
- Computer Systems Design and Architecture (International Edition), by Vincent P. Heuring, Harry F. Jordan, Publisher: Prentice-Hall, 2nd Ed edition, ISBN: 0131911562 ISBN: 0131911562, 30 November 2003.

UEF 1.2.2- Methodologies of Analysis and Design of Information Systems

EU Code	Title of the module	Coefficient
UEF 1.2.2	Methods of analysis and design of Information Systems	5

Hourly volumes		
Lectures	TD / TP	TOTAL
30	45	75

Semester :	2

Prerequisites	Introduction to GL, Introduction to I.S.

OBJECTIVES :

The objective of this course is to provide the methodological bases necessary for the analysis and the design of information systems of company. This course presents a systemic method in cascade (MERISE 2, SADT,..). At the end of this course, the student will master the tools necessary for the analysis of a system.

CONTENTS :

I. Basic concepts (3h)

1. Information system, Typologies
2. I.S. project (success factors, failure factors) I.S.
3. planning
4. Why a method?

II. MERISE 2 method (24 h)

1. Overview of the project process (master plan, preliminary study, detailed study, etc.)
2. Levels of abstraction
3. Conceptual level
   - Communication model
   - Conceptual processing model
   - Conceptual data model (covered in the BDD course)
4. Organisational level
5. Technical level

III. TD: I.S. analysis tools (3h)

RECOMMENDATIONS

TD/TP

- Information flow diagram
- Document analysis and design
- Analysis and design of workstations
- Diagnostic tools

PERSONAL WORK
– Exercises

KNOWLEDGE TEST
2 written examinations – 3 TD/TP notes

BIBLIOGRAPHY

- M. Diviné, Merise 2, Editions du Phénomène, 1994
- N. B. Espinasse, "Ingénierie des systèmes d'information MERISE", Vuibert, 2001
- J. Gabay, "Merise et UML pour la modélisation des SI", Dunod, 2002
- J. Gabay, "Apprendre et Pratiquer MERISE", Masson Milan Barcelona, Mexico 1989
- J. A. Kowal, "Analysing systems", Prentice Hall, 1988
- J. L. Lemoigne, "La théorie du système général", PUF, 1977
- P. T. Quang, C. Chartrier-Kastler, "MERISE APPLIQUEE Conception des systèmes d'information: de la pratique à la théorie : Méthode et outils", Eyrolles, 1989
- H. Tardieu, A. Rochfeld, R. Colleti, "La Méthode MERISE tome 1 & 2", Les Editions d'Organisations, Paris, 1983

UEF 1.2.2- Databases

EU Code	Title of the module	Coefficient
UEF1.2.2	Databases	5

Hourly volumes		
Lectures	TD / TP	TOTAL
30	45	75

Semester :	2

Prerequisites	Algorithms and structures for data, structures for files, Logic and Mathematics.

OBJECTIVES :

The Database course provides an introduction to the field of data design and manipulation and the use of database technologies. At the end of the course, the student will be able to :

- design a database starting from a given reality with the entity/association model and the UML class diagram;
- translate an entity/association model into a relational schema, normalise it and manipulate it with relational algebra;
- create the database corresponding to the relational schema, manipulate the structure of the database with the DDL and query data with the DML.

CONTENTS :

I. Concepts Data modelling

1. Basic modelling concepts (UML and Entity Association)
2. Integrity Constraint Modelling

II. The Relational Model

1. Basic concepts of the model
2. Moving from the entity-association to the relational model
3. Standardization theory
4. Relational algebra
5. Algebraic language

III. Handling of databases

1. SQL language components
2. Data Definition Language
3. Data Manipulation Language

IV. Database programming and administration

1. Index management and manipulation
2. Transaction management and handling
3. Database security management

PERSONAL WORK
TP, project.

KNOWLEDGE TEST
- Continuous assessment, final test, practical work

BIBLIOGRAPHY

- N. B. Giles Roys, "Database Design with UML", Presses Université Quebec, 2007.
- G. Gardarin, "Bases de données", Eyrolles, 1987.
- A. Meires, "Introduction pratique aux bases de données", Eyrolles, 2005.
- C. Soutou, "de UML à SQL, Conception des bases de données", Eyrolles, 2002.
- C. Soutou, "UML 2 for databases", Eyrolles, 2007.
- G. Simsions, G.Witt, "DATA Modeling Essentials", Morgan Kaufmann, 2004.
- C. Churcher, "Beginning Database Design, from novice to professional", Apress, 2007.
- T. Teorey, "Database modeling and design", Morgan Kaufmann, 1998.

UEM1.2- Introduction to computer security

EU Code	Module title	Coefficient
EMU1.2	**Introduction to computer security**	**1**

Hourly volumes		
Lectures	**TD / TP**	**TOTAL**
20		**20**

Semester :	**1**

Prerequisites	

OBJECTIVES :

This course aims to :

- To raise the student's awareness of computer security issues.
- To present the fundamental aspects of computer security.
- Know how to carry out risk analysis.
- To familiarise the student with aspects of cryptography.
- Know how to use some cryptographic tools to perform a security service.
- Identify and correct possible flaws in both the use o f an operating system and the construction of software.

CONTENTS :

I. Basic concepts (6h)

1. Motivation
- Raising students' awareness of security issues through numbers
- Raising students' awareness of security issues through examples: virus, worm, Trojan horse, spyware, spam, etc.

2. General
- Definition of IT security
- IT security objectives
- Threats/ Levels of vulnerability

3. Risk analysis

TD: make risk analysis tables according to given scenarios.

II. Introduction to cryptography (14h)

1. Objectives of cryptography (confidentiality, integrity, authentication, etc.)
2. Definition of cryptography/cryptanalysis
3. Encryption/Decryption/Cryption key and the notion of entropy
4. Symmetric encryption (DES, AES, RC4)
5. Asymmetric encryption (RSA, ElGamal, EC)
6. Other cryptographic primitives
- Cryptographic hashing and integrity
- MAC/HMAC and authentication
- Electronic signature

7. Key management principle
- Presentation of the problem

- Key exchange by Diffie-Hallman
- Public Key Infrastructure
  - Decentralised model
  - Hierarchy model and certificates

8. Basic cryptanalysis methods and key protection
- Some cryptographic protocols
- Possible types of attacks
- Origin authentication protocols
- Strong challenge/response authentication protocols

Chapter II TD/TP: OpenSSL workshop to use cryptography for data and exchange security.

PERSONAL WORK
- Implementation of the HTTPS protocol (secure web server) - Duration ~ 10 hours

KNOWLEDGE TEST
- A final exam (50%) - One TP exam (35%) - TP mark (continuous assessment) 15%.

BIBLIOGRAPHY

- W. Talligs, "Sécurité des réseaux: Applications et Standards", Vuibert, 2002.
- B. Schneier, "Cryptographie appliquée : Algorithmes, protocoles et codes source en C", Vuibert, 2002.
- G. Dubertret, "Initiation à la cryptographie", Vuibert 1998.
- "Les principes de la sécurité informatique : Guide d'audit", IFACI, PARIS.

UEM1.2- Project Management

EMU Code	Title of the module	Coefficient
EMU1.2	**Project Management**	3

Hourly volumes		
Lectures	**TD / TP**	**TOTAL**
15	**30**	**45**

Semester :	**2**

Prerequisites	Introduction to organisations, Introduction GL

OBJECTIVES :

Whatever the field, the activities to be carried out are increasingly organised in projects. In order to effectively manage these projects, companies are changing their organisation by adopting the project mode, where the job of Project Manager becomes essential.

The objectives are :

- Introduce students to the different notions and concepts associated with project management, the key success factors, in order to facilitate their integration into project teams.
- Develop communication and relational skills in a project situation by experimenting with management techniques usually used: meetings, written communication, negotiation, etc.

CONTENTS :

I. Project concept (5 h)

1. Definitions and terminology
2. Evolving in project mode
3. Type of projects
4. Real-life examples of projects
5. Project failures, especially IT projects
6. Key success factors
7. General approach to project management

II. Project actors and organisation (4 h)

1. Main actors: users, contracting authority, project management
2. Committees? Why and how?

III. Communication and group dynamics: Leading a project team (6 h)

1. Importance of communication
2. Leading a project team: roles played by members
3. Case studies :
   - Role-playing (simulation) as part of a project e.g. Launching an Intranet
   - Conflict negotiation techniques

RECOMMENDATIONS

TD/TP (30h) :

- "Organised action": Work in sub-groups to build a common project.
- Simulations of certain phases of project management:
  - Role-playing (simulation) as part of a project e.g. launching an intranet
  - Conflict negotiation techniques

PERSONAL WORK

- Reading articles
- Preparation of the roles to be played

KNOWLEDGE TEST

- 1 written exam
- 2 marks in TD/TP

BIBLIOGRAPHY & WEBOGRAPHY

- J.C. Corbel, "Management de projet : Fondamentaux, Méthodes et outils", Ed. d'Organisations, 2005
- A. Fernandez, "Le chef de projet efficace" Edition d'organisation, Paris, 2005
- PMI, "A Guide to the Project Management Body of Knowledge", published by PMI http://www.pmi.org/
- L'Association Francophone de Management de Projet http://www.afitep.fr/
- Project managers' community portal: http://www.managementprojet.com/
- The French project management website: http://www.gestiondeprojet.com/
- Web project management: http://universite.online.fr/supports/projet/index.htm
- Project Management Forum: http://www.pmforum.org/

UET 1.2- English

ETU code	Module title	Coefficient
TEU 1.2	English 2	2

Hourly volumes		
Lectures	TD / TP	TOTAL
	30	30

Semester :	2

Prerequisites	• No pre-requisites

OBJECTIVES :

- Written and oral papers on topics in the field of computer science to be delivered in the form of presentations.
- Preparation of a (English) lesson on an aspect of English grammar to be delivered

CONTENTS :

I. Activity One (18:00)

1. How to make a presentation (based on information gathered from the web)
2. How to present (communicate) a Curriculum Vitae in public.
3. Taking care of your presentation (Ergonomics of the presentation)

II. Activity two (12 hours)

1. Written comprehension & production in a personal work situation
2. Ability to search for information in order to construct a grammar lesson.

PERSONAL WORK

- Preparation of a presentation in "PowerPoint", "Prezi", or any other presentation tool.
- Researching information for the construction of a course.

KNOWLEDGE TEST

- The presentation will be used as an EMD (Medium Duration Test)
- The presentation itself is a test of the knowledge acquired during the preparation of the activities.

BIBLIOGRAPHY

- https://segue.middlebury.edu/view/html/site/fren6696a-l08/node/2827590
- http://www.restode.cfwb.be/francais/profs4/04Reflexions/Download/JPH-Fondements-Didactique.pdf

EMU 1.2- Project

UEF code	Module title	Coefficient
EMU 1.2	**Project**	**3**

Hourly volumes	**45h**

Semester :	**2**

OBJECTIVES :

The project is proposed to a group of 6 students. It is supervised by two internal teachers. Its objectives are to combine different disciplines to provide solutions to a concrete problem and to help the student to better understand the practical interest of certain modules.

The project also aims to train students to :

- read a specification,
- organise their work within the constraints imposed by the specifications and the tasks assigned to each member of the project,
- search for and use the documentation they may need and link different modules,
- use their knowledge of different disciplines and be creative,
- synthesise the results of their work, write a report and make an oral presentation of the work.