الجمهورية الجزائرية الديمقراطية الشعبية

People's Democratic Republic of Algeria

وزارة التعليم العالي والبحث العلمي

Ministry of Higher Education and Scientific Research

اللجنة البيداغوجية الوطنية لميدان العلوم و التكنولوجيا

National Pedagogical Committee for the Field of Science and Technology

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Academic Master's Program (Harmonized)

National Program
Updated: 2022

Domain: Sciences and Technologies

Field: Telecommunications
Specialization: Networks and Telecommunications

Admission Conditions

(Indicate the bachelor's specializations that provide access to the Master's program)

Field	*Harmonized Master's*	*Specializations Providing Access to the Master's*	*Compatibility Rating*	*Coefficient Assigned to the Bachelor's Degree*
Telecommunications	Networks and Telecommunications	Telecommunications	**1**	*1.00*
		Electronics	**2**	*0.80*
		Biomedical Engineering	**3**	*0.70*
		Automation	**3**	*0.70*
		Other ST Domain Licenses (Group A)	**5**	*0.60*

Semester Organization Sheets for the Specialization

Semester 1

Teaching Unit	Subjects/ Titles	Credits	Coefficient	Weekly Hours (Course/ Tutorials /Labs)	Semester Hours (15 weeks)	Complementary Work	Evaluation Mode (Continuous/Exam)
Fundamental TU (FTU 1.1.1)	Advanced Digital Communications	6	3	3h/1h30/0h	67h30	82h30	40%/60%
	IP Routing	4	2	1h30/1h30/0h	45h00	55h00	40%/60%
Fundamental TU (FTU 1.1.2)	Propagation and Antennas	4	2	1h30/1h30/0h	45h00	55h00	40%/60%
	Advanced Signal Processing	4	2	1h30/1h30/0h	45h00	55h00	40%/60%
Methodological TU (MTU 1.1)	Lab Advanced Digital Communications	2	1	0h/0h/1h30	22h30	27h30	100%
	Lab IP Routing	2	1	0h/0h/1h30	22h30	27h30	100%
	Lab Advanced Signal Processing	2	1	0h/0h/1h30	22h30	27h30	100%
	Object-Oriented Programming in Python	3	2	1h30/0h/1h	37h30	37h30	40%/60%
Discovery TU (DTU 1.1)	Elective Subject 1	1	1	1h30/0h/0h	22h30	02h30	100%
	Elective Subject 2	1	1	1h30/0h/0h	22h30	02h30	100%
Transversal TU(TTU 1.1)	Technical English and Terminology	1	1	1h30/0h/0h	22h30	02h30	100%

Total Semester 1: 30 Credits, 17 Coefficients, 375h00

Semester 2

Teaching Unit	Subjects/ Titles	Credits	Coefficient	Weekly Hours (Course/ Tutorials/ Labs)	Semester Hours (15 weeks)	Complementary Work	Evaluation Mode (Continuous/Exam)
Fundamental UE (UEF 1.2.1)	Network Services Administration	6	3	3h/1h30/0h	67h30	82h30	40%/60%
	DSP and FPGA	4	2	1h30/1h30/0h	45h00	55h00	40%/60%
Fundamental UE (UEF 1.2.2)	Transmission Channels and Optical Components	4	2	1h30/1h30/0h	45h00	55h00	40%/60%
	Coding and Compression	4	2	1h30/1h30/0h	45h00	55h00	40%/60%
Methodological UE (UEM 1.2)	Lab Network Services Administration	2	1	0h/0h/1h30	22h30	27h30	100%
	Lab DSP and FPGA	2	1	0h/0h/1h30	22h30	27h30	100%
	Lab Coding and Compression	2	1	0h/0h/1h30	22h30	27h30	100%
	High-Speed Networks	3	2	1h30/0h/1h	37h30	37h30	40%/60%
Discovery UE (UED 1.2)	Elective Subject 1	1	1	1h30/0h/0h	22h30	02h30	100%
	Elective Subject 2	1	1	1h30/0h/0h	22h30	02h30	100%
Transversal UE (UET 1.2)	Respect for Standards and Ethical Rules	1	1	1h30/0h/0h	22h30	02h30	100%

Total Semester 2: 30 Credits, 17 Coefficients, 375h00

Semester 3

Teaching Unit	Subjects/ Titles	Credits	Coefficien	Weekly Hours (Course/ Tutorials/ Labs)	Semester Hours (15 weeks)	Complementary Work	Evaluation Mode (Continuous/Exam)
Fundamental TU (FTU 2.1.1)	Wireless and Mobile Networks	6	3	3h/1h30/0h	67h30	82h30	40%/60%
	Cryptography and Network Security	4	2	1h30/1h30/0h	45h00	55h00	40%/60%
Fundamental TU (FTU 2.1.2)	Video and Audio over IP	4	2	1h30/1h30/0h	45h00	55h00	40%/60%
	Web Technologies	4	2	1h30/1h30/0h	45h00	55h00	40%/60%
Methodological TU (MTU 2.1)	Lab Wireless and Mobile Networks	2	1	0h/0h/1h30	22h30	27h30	100%
	Lab Cryptography and Network Security	2	1	0h/0h/1h30	22h30	27h30	100%
	Lab Web Technologies and VoIP	2	1	0h/0h/1h30	22h30	27h30	100%
	Artificial Intelligence	3	2	1h30/0h/1h	37h30	37h30	40%/60%
Discovery UE (UED 2.1)	Elective Subject 1	1	1	1h30/0h/0h	22h30	02h30	100%
	Elective Subject 2	1	1	1h30/0h/0h	22h30	02h30	100%
Transversal TU (TTU 2.1)	Document Research and Thesis Design	1	1	1h30/0h/0h	22h30	02h30	100%

Total Semester 3: 30 Credits, 17 Coefficients, 375h00

Elective Subjects for Discovery Units (S1, S2, S3)

1. Linux System
2. Standards and Protocols
3. Data Representation in Images and Videos
4. Satellite Networks
5. Internet of Things (IoT)
6. Field Networks
7. Operator Networks

8. Wireless Sensor Networks
9. Electromagnetic Compatibility
10. Embedded Systems and Telecommunications
11. Radar Techniques
12. Space Telecommunications
13. Radionavigation System
14. Emerging Areas in Optical Telecommunications
15. Optical Fiber Installation and Maintenance
16. Radio Engineering
17. VSAT Technology
18. Propagation of Acoustic Microwaves in Piezoelectric Solids
19. RF and Microwave Measurements
20. Portable Micro-Antennas
21. Emerging Telecommunication Systems
22. Theoretical Physics of Optical and Microwave Analogies
23. Biological Effects of Electromagnetic Waves (Bioelectromagnetism)
24. CAD for Telecom Circuits
25. Characterization of RF Devices

Semester 4

Internship in a company or research laboratory, culminating in a thesis and defense.

Activity	Hours	Coefficient	Credits
Personal Work	550	09	18
Internship	100	04	06
Seminars	50	02	03
Other (Supervision)	50	02	03
Total Semester 4	750	17	30

Evaluation of the Master's Final Project

- Scientific Value (Jury Assessment) /6
- Thesis Writing (Jury Assessment) /4
- Presentation and Q&A (Jury Assessment) /4
- Supervisor's Assessment /3
- Internship Report Presentation (Jury Assessment) /3

Detailed Program by Subject

Semester: 1

Teaching Unit: FTU 1.1.1

Subject 1: Advanced Digital Communications

Total Hours: 67h30 (Lectures: 3h00, Tutorials: 1h30)

Credits: 6

Coefficient: 3

Teaching Objectives:

By the end of this course, the student will be able to identify the functions implemented in advanced digital communication systems. This subject covers various concepts related to non-ideal channels, multiple access techniques, and MIMO systems.

Prerequisite Knowledge:

Basic knowledge of information theory, signal processing, as well as modulation and demodulation is required to follow this subject.

Course Content:

Chapter 1. Review (1 Week)

- Principle of a global digital transmission chain
- Parameters for evaluating a transmission chain (Signal-to-Noise Ratio, Bit Error Probability, Spectral Efficiency, Bit Error Rate BER)

Chapter 2. Radio Transmission Channels (4 Weeks)

- Temporal and frequency behavior of radio channels
- Radio channel models
- Coherence bandwidth, coherence time, time spread, Doppler spread, selective channel, non-selective channel, Rayleigh fading, Ricean channel
- Channel classification

Chapter 3. Radio Channel Equalization (2 Weeks)

- Introduction to equalization
- Classical equalization structures: Zero-forcing equalizer, Minimum Mean Square Error (MMSE) equalizer, Maximum Likelihood equalization

Chapter 4. Multiplexing and Multiple Access Techniques (4 Weeks)

- Multiplexing
- Duplexing
- Time Division Multiple Access (TDMA)
- Frequency Division Multiple Access (FDMA)
- Code Division Multiple Access (CDMA)
- Orthogonal Frequency Division Multiplexing (OFDM)

Chapter 5. MIMO Systems **(4 Weeks)**

- Transmit diversity, space-time coding, spatial multiplexing
- Joint demodulation, multi-user MIMO

Assessment Method:
Continuous assessment: 40%; Exam: 60%.

Bibliographic References:

1. G. Baudouin, “Radiocommunications numériques“, Dunod, 2002.
2. J.M. Brossier,“Signal et communication numérique: égalisation et synchronisation“, Hermès Science, 97
3. P. Comon, “Communications numériques - Cours et exercices à l'usage de l'élève ingénieur“, éditions 'Harmattan, 2010.
4. A. Glavieux, M. Joindot, “ Communications numériques, introduction “, Collection pédagogique des télécommunications,Masson, 1996.
5. A. Glavieux, M. Joindot, “Introduction aux communications numériques“, Collection: Sciences Sup, Dunod, 2007.
6. H. P. Hsu, “Communications analogiques et numériques: cours et problèmes“, McGraw-Hill, 1994.
7. G. Mahé, “Systèmes de communications numériques“, Ellipses.
8. L.W. Couch, “Digital and Analog Communication Systems“, Prentice-Hall, New-Jersey, 2007.
9. S. Haykin, “Communication Systems“, John Wiley and Sons, Hoboken, New-Jersey, 2001.
10. J. Proakis, M. Salehi, “Communication Systems Engineering“, 2nd edition, Prentice-Hall, New-Jersey, 2002.
11. B. Rimoldi, “Principles of Digital Communications“, Ecole Polytechnique de Lausanne (EPFL), Switzerland.
12. J. Proakis, “Digital Communications “, McGraw-Hill, 2000.
13. B. Sklar, “Digital Communications, Fundamentals and applications“, Prentice Hall, 2001.
14. B. P. Lathi, “Modern Digital and Analog Communication Systems“, Oxford University Press, 1998.

Semester: 1

Teaching Unit: FTU 1.1.1

Subject 2: IP Routing

Total Hours: 45h00 (Lectures: 1h30, Tutorials: 1h30)

Credits: 4

Coefficient: 2

Teaching Objectives:

By the end of this course, the student will understand the functions that determine the best path in a meshed network to a destination identified by an IP network address. This subject covers static and dynamic routing.

Prerequisite Knowledge:

Information theory, network elements.

Course Content:

Chapter 1. Switching in LANs (2 Weeks)

1. Interconnections
2. Bridge operation
3. Principle of LAN switching
4. Switching techniques

Chapter 2. VLAN (2 Weeks)

1. VLAN segmentation (Definition, advantages, types of VLAN, Ethernet frame tagging)
2. Dynamic Trunking Protocol (DTP)
3. VLAN security and design
4. Inter-VLAN routing

Chapter 3. Redundancy in Switched Links (2 Weeks)

1. Hierarchical network design: Failure domains
2. Spanning Tree Protocol (STP)
3. Convergence
4. Rapid Spanning Tree Protocol (RSTP)

Chapter 4. Link Aggregation (EtherChannel) (2 Weeks)

1. Hierarchical network design: Bandwidth increase
2. Link Aggregation Control Protocol (LACP), IEEE standards (IEEE 802.3ad, IEEE 802.1AX)
3. Port Aggregation Protocol (PAgP), Cisco proprietary
4. Configuration

Chapter 5. Static Routing **(4 Weeks)**

1. Route concept
2. Static routing
3. Routing table (route characteristics, associated metric, administrative distance)
4. Directly connected networks
5. Static routes (next-hop address, exit interface, recursive route resolution, floating static route, summarized routes, default routes)

Chapter 6. Dynamic Routing **(3 Weeks)**

1. Introduction
2. Distance-vector routing (RIPv1, RIPv2, EIGRP)
3. Link-state routing (OSPF)

Assessment Method:
Continuous assessment: 40%; Exam: 60%.

Bibliographic References:

15. A. Tanenbaum, "Computer Network".
16. Keshav, "An Engineering Approach to Computer Networking".
17. L. Toutain, "Réseaux Locaux et Internet".
18. Supportsde cours Cisco

Semester: 1

Teaching Unit: FTU 1.1.2

Subject 3: Propagation and Antennas

Total Hours: 45h00 (Lectures: 1h30, Tutorials: 1h30)

Credits: 4

Coefficient: 2

Teaching Objectives:

Study of electromagnetic wave propagation in ground-level and atmospheric environments (troposphere, stratosphere, ionosphere). This subject also covers antenna radiation.

Prerequisite Knowledge:

Knowledge of electromagnetism is required, as taught in the "Waves and Propagation" and "Transmission Lines and Antennas" subjects in the third year of the Telecommunications undergraduate program.

Course Content:

Chapter 1. Propagation of Hertzian Waves (3 Weeks)

- Spectrum of Hertzian waves
- Propagation modes of Hertzian waves (ground influence, troposphere, stratosphere, ionosphere)
- Propagation in inhomogeneous and random media (statistics of incoherent waves, etc.)

Chapter 2. Free-Space Link Study (3 Weeks)

- Definition of antenna gain and equivalent surface
- Free-space attenuation: Friis equation
- Telecommunications equation for links with and without passive relays
- Link quality (analog signal quality, analog telephony link quality)
- Satellite-ground links and applications (transmission and localization, ground stations, Artemis system between ground stations and satellites)
- Applications to some telecommunications services (fixed ground-ground links, fixed satellite service, mobile communications)

Chapter 3. Antenna Radiation (3 Weeks)

- Definition and characteristic parameters of an antenna
- Vector and scalar potential
- Radiation of an electric dipole (electromagnetic field calculation, characteristic surface, radiated power, equivalent height, radiation resistance)
- Isolated linear antenna in space

Chapter 4. Antenna Arrays (3 Weeks)

- Uniform alignment
- Non-uniform alignment
- Antenna curtain

Chapter 5. Radiation from Planar Apertures (3 Weeks)

- Radiation from a rectangular aperture
- Radiation from a circular aperture

Assessment Method:
Continuous assessment: 40%; Exam: 60%.

Bibliographic References:

1. G. Dubost,“Propagation libre et guidée des ondes électromagnétiques“, Masson, 1995.
2. M. Jouquet,“Ondes électromagnétique 1: propagation libre“, Dunod, 1973.
3. C. Garing,“Ondes électromagnétiques dans les milieux diélectriques: Exercices et problèmes corrigés“, 1998.
4. R. C. Houzé,“Les antennes,Fondamentaux“,Dunod, 2006.
5. A. Ducros,“Les antennes: Théorie et pratique“, Emission et réception, Elektor, 2008.
6. R. Aksas,“Télécommunications: Antennes Théorie et Applications“, Ellipses Marketing, 2013.

Semester: 1

Teaching Unit: FTU 1.1.2

Subject 4: Advanced Signal Processing

Total Hours: 45h00 (Lectures: 1h30, Tutorials: 1h30)

Credits: 4

Coefficient: 2

Teaching Objectives:

The student will learn the basic concepts needed to understand and apply signal processing methods related to random signals and digital filters.

Prerequisite Knowledge:

Knowledge of digital processing of deterministic signals and probabilities, as taught in the third year of the Telecommunications undergraduate program.

Course Content:

Chapter 1. Review of Digital Filters (FIR and IIR) (3 Weeks)

- Z-transform
- Structures, transfer functions, stability, and implementation of digital filters (FIR and IIR)
- Minimum-phase digital filters
- Synthesis methods for FIR and IIR filters
- Multirate digital filters

Chapter 2. Random Signals and Stochastic Processes (4 Weeks)

- Review of random processes
- Stationarity
- Power spectral density
- Matched filter, Wiener filter
- Periodogram, correlogram, averaged periodogram, smoothed periodogram
- Concepts of stochastic processes
- Wide-sense and strict-sense stationarity, ergodicity
- Examples of stochastic processes (Poisson process, Gaussian process, Markov process)
- Higher-order statistics (moments and cumulants, polyspectra, non-Gaussian processes, nonlinear processing)
- Introduction to particle filtering

Chapter 3. Parametric Spectral Analysis and Adaptive Digital Filtering (4 Weeks)

- Parametric methods
- AR model (Levinson, Yule-Walker, Burg, Pisarenko, Music, etc.)
- ARMA model

- Stochastic gradient LMS algorithm
- Recursive Least Squares (RLS) algorithm

Chapter 4. Time-Frequency and Time-Scale Analysis (4 Weeks)

- Time-frequency duality
- Short-time Fourier transform
- Continuous, discrete, and dyadic wavelets
- Multiresolution analysis and wavelet bases
- Wigner-Ville transform
- Time-scale analysis

Assessment Method:
Continuous assessment: 40%; Exam: 60%.

Bibliographic References:

1. Mori Yvon, "Signaux aléatoires et processus stochastiques", Lavoisier**,** 2014.
2. E. Robine, "Introduction à la théorie de la communication, Tome II: Signaux aléatoires", Masson 1970.
3. N. Hermann, "Probabilités de l'ingénieur : variables aléatoires et simulations Bouleau", 2002.
4. M. KUNT, "Traitement Numérique des Signaux", Dunod, Paris, 1981.
5. J. M Brossier, "Signal et Communications Numériques, Collection Traitement de Signal", Hermès, Paris, 1997.
6. M. Bellanger, "Traitement numérique du signal : Théorie et pratique", 8e édition, Dunod, 2006.

Semester: 1

Teaching Unit: MTU1.1

Subject 1: Practical Work (Lab)- Advanced Digital Communications

Total Hours: 22h30 (Practical Work: 1h30)

Credits: 2

Coefficient: 1

Teaching Objectives:

This subject describes the simulation of a digital communication chain using Matlab and Simulink: modulation of digital signals in baseband and carrier frequency, signal transmission - noisy and band-limited transmission channel - reception, and finally the implementation of new advanced communication concepts.

Prerequisite Knowledge:

Signal processing, Matlab programming.

Course Content:

Practical Work 1: Communication Blockset in Simulink (Lab 1)

- Signal terminology: frame or sample
- Source and sink libraries
- Simulation of digital communication chains using Simulink

Practical Work 2: Performance Study of Digital Modulation Techniques (Lab 2)

- Performance of a coherent digital communication system with BASK, BPSK, and BFSK modulation
- Performance of a non-coherent digital communication system with BDPSK modulation
- Performance of a coherent digital communication system with QAM modulation

Practical Work 3: Simulation of OFDM and CDMA Transmission Using Simulink (Lab 3)

- Theoretical review of OFDM and CDMA transmission
- Detailed study of the simulated OFDM system blocks
- Examples of multipath channels

Practical Work 4: Simulation of a MIMO Transmission Chain (Lab 4)

Assessment Method:
Continuous assessment: 100%.

Bibliographic References:

1. G. Baudouin, “Radiocommunications numériques“, Dunod, 2002.
2. J.M. Brossier,“Signal et communication numérique: égalisation et synchronisation“, Hermès Science, 97

3. P. Comon, “Communications numériques - Cours et exercices à l'usage de l'élève ingénieur“, éditions 'Harmattan, 2010.
4. A. Glavieux, M. Joindot, “ Communications numériques, introduction “, Collection pédagogique des télécommunications,Masson, 1996.
5. A. Glavieux, M. Joindot, “Introduction aux communications numériques“, Collection: Sciences Sup, Dunod, 2007.
6. H. P. Hsu, “Communications analogiques et numériques: cours et problèmes“, McGraw-Hill, 1994.
7. G. Mahé, “Systèmes de communications numériques“, Ellipses.
8. L.W. Couch, “Digital and Analog Communication Systems“, Prentice-Hall, New-Jersey, 2007.
9. S. Haykin, “Communication Systems“, John Wiley and Sons, Hoboken, New-Jersey, 2001.
10. J. Proakis, M. Salehi, “Communication Systems Engineering“, 2nd edition, Prentice-Hall, New-Jersey, 2002.
11. B. Rimoldi, “Principles of Digital Communications“, Ecole Polytechnique de Lausanne (EPFL), Switzerland.
12. J. Proakis, “Digital Communications “, McGraw-Hill, 2000.
13. B. Sklar, “Digital Communications, Fundamentals and applications“, Prentice Hall, 2001.
14. B. P. Lathi, “Modern Digital and Analog Communication Systems“, Oxford University Press, 1998.

Semester: 1

Teaching Unit: MTU1.1

Subject 2: Practical Work (Lab) - IP Routing

Total Hours: 22h30 (Practical Work: 1h30)

Credits: 2

Coefficient: 1

Teaching Objectives:

By the end of this practical work, the student will have hands-on experience with various routing configurations.

Prerequisite Knowledge: Information theory, network elements.

Course Content:

Practical Work 1: Basic Switch Configuration (Cisco Platform)
Simulation using Packet Tracer or practical work on real platforms

Practical Work 2: Creation and Configuration of a Segmented VLAN Network

Practical Work 3: Inter-VLAN Routing Configuration
Simulation using Packet Tracer or practical work on real platforms

Practical Work 4: Creation of a Network with Redundant Links
Simulation using Packet Tracer or practical work on real platforms

Practical Work 5: EtherChannel Protocol Configuration Between Switches
Simulation using Packet Tracer or practical work on real platforms

Practical Work 6: Implementation of Static Routing
Simulation using Packet Tracer or practical work on real platforms

Practical Work 7: Implementation of Dynamic Routing (RIPv2, EIGRP, OSPF)
Simulation using Packet Tracer or practical work on real platforms

Assessment Method:
Continuous assessment: 100%.

Bibliographic References:

1. A. Tanenbaum, "Computer Network".
2. Keshav, "An Engineering Approach to Computer Networking".
3. L. Toutain, "Réseaux Locaux et Internet".
4. Supports de cours Cisco
5. Sources diverses sur Internet.

Semester: 1

Teaching Unit: MTU1.1

Subject 3: Practical Work (Lab)- Advanced Signal Processing

Total Hours: 22h30 (Practical Work: 1h30)

Credits: 2

Coefficient: 1

Teaching Objectives:

Practical work using Matlab to give a practical aspect to complex theoretical concepts.

Prerequisite Knowledge:

Mathematics (probability theory and complex analysis), deterministic signal theory, probabilities and statistics.

Course Content:

Practical Work 1: Synthesis and Application of a Low-Pass FIR Filter Using the Window Method (Hanning, Hamming, Bessel, and/or Blackman)

Practical Work 2: Synthesis and Application of a Low-Pass IIR Filter Using Bilinear Transformation

Practical Work 3: Parametric AR and/or ARMA Spectral Analysis of Sound Signals (Example of Non-Stationary Signals)

Practical Work 4: Elimination of 50Hz Interference Using the LMS Gradient Algorithm

Practical Work 5: Signal Denoising Using Discrete Wavelet Transform (DWT)

Assessment Method:
Continuous assessment: 100%.

Bibliographic References:

1. Mori Yvon, "Signaux aléatoires et processus stochastiques", Lavoisier**,** 2014.
2. E. Robine, "Introduction à la théorie de la communication, Tome II: Signaux aléatoires", Masson 1970.
3. N. Hermann, "Probabilités de l'ingénieur : variables aléatoires et simulations Bouleau", 2002.
4. M. KUNT, "Traitement Numérique des Signaux", Dunod, Paris, 1981.
5. J. M Brossier, "Signal et Communications Numériques, Collection Traitement de Signal", Hermès, Paris, 1997.
6. M. Bellanger, "Traitement numérique du signal : Théorie et pratique", 8e édition, Dunod, 2006.

Semester: 1

Teaching Unit: MTU 1.1

Subject 4: Object-Oriented Programming in Python

Total Hours: 37h30 (Lectures: 1h30, Practical Work (Lab): 1h00)

Credits: 3

Coefficient: 2

Teaching Objectives:

The student will learn the fundamentals of object-oriented programming and master advanced programming techniques in Python.

Prerequisite Knowledge:

- Basic programming (Pascal/Matlab)
- Computer Science 1, Computer Science 2, Computer Science 3

Course Content:

Chapter 1. Introduction to Object-Oriented Programming (OOP) (2 Weeks)

- OOP principles, encapsulation, and abstraction
- Introduction to Python, Python libraries
- Program execution in Python
- Development environments (IDLE, PyCharm, Jupyter, Spyder)

Chapter 2. Basic Concepts (3 Weeks)

- Python object types, operators, lists, dictionaries, tuples, sets, strings
- Control flow, loops, numpy arrays, recursion
- Modules, creating modules, functions, Python packages

Chapter 3. Classes and Objects (3 Weeks)

- Class declaration, instance variables and methods
- Method definition, access rights, encapsulation of attributes and methods
- Constructor, destructor, interacting objects
- Object equality and cloning in Python, message passing
- Class association, dependency, friend classes, nested classes

Chapter 4. Inheritance and Polymorphism (3 Weeks)

- Object aggregation and composition, inheritance
- Inheritance rules, constructor chaining, base classes
- Protected attributes and methods, multiple inheritance
- Method and attribute overloading, polymorphism

- Method redefinition, virtual methods, abstract classes

Chapter 5. Advanced Concepts: Design Patterns (2 Weeks)

- Function objects, design patterns (creational, structural)
- Structural patterns (composites, decorators)
- Function decorators, class decorators

Chapter 6. Containers, Iterators, and Object Collections (2 Weeks)

- Containers, iterators, function generators, coroutines
- Collections (queues, stacks, filters, map, reduce)

Practical Work - Object-Oriented Programming in Python

- Practical Work 1: Introduction to Python (Modules: NumPy, matplotlib, Pandas, CSV files, etc.)
- Practical Work 2: Python Programming (Loops, Control Statements, Functions)
- Practical Work 3: Classes and Objects
- Practical Work 4: Inheritance and Polymorphism
- Practical Work 5: Design Patterns and Decorators
- Practical Work 6: Containers, Iterators, Standard Library Modules (Itertools, Pickle, Socket, Urllib2, ftplib, etc.)

Assessment Method:
Continuous assessment: 40%; Exam: 60%.

Bibliographic References:

1. Anaconda : Anaconda Environments (AEN 4.0) — Anaconda documentation
2. T. Ziadé., 2009. Programmation python conception et optimisation, Edition Eyrolles. Programmation PYTHON (zenk-security.com)
3. J.Chan, 2014. Learn python in one day and learn it well, Edition Eyrolles.
4. J. Hunt, 2020. A beginners guide for python 3 programming, Edition Springer
5. H. Bersini, 2013. La programmation orientée objet cours et exercices, Edition Eyrolles. La programmation orientée objet: Cours et exercices en UML2, Python, PHP, C#,C++ et Java (y compris Android) (Noire) (French Edition) (livre21.com)
6. M. Lutz., 2009. Learning python : Powerful object-oriented programming, Learning Python (ehu.es)
7. D. Phillips, 2015. Python 3 object oriented programming, 2ème edition, PACKT publishing, livre.pdf
8. V. Boucheny, 2020. Apprendre la programmation orientée objet avec le langage python, 2ème édition, Eyrolles.
9. H. P. Langtangen, 2014. A primer on scientific programming with python, 4ème édition, Springer.
10. G. Swinnen, 2012. Apprendre a programmer avec Python3, apprendre_python3_5.pdf (inforef.be)

Semester: 1

Teaching Unit: DTU 1.1

Subject 1: Elective Subject

Total Hours: 22h30 (Lectures: 1h30)

Credits: 1

Coefficient: 1

Semester: 1

Teaching Unit: DTU 1.1

Subject 2: Elective Subject

Total Hours: 22h30 (Lectures: 1h30)

Credits: 1

Coefficient: 1

Semester: 1

Teaching Unit: TTU 1.1

Subject: Technical English and Terminology

Total Hours: 22h30 (Lectures: 1h30)

Credits: 1

Coefficient: 1

Teaching Objectives:

Introduce the student to technical vocabulary. Strengthen their language skills. Help them understand and summarize technical documents. Enable them to follow conversations in English in a scientific context.

Prerequisite Knowledge:

Basic English vocabulary and grammar.

Course Content:

- Written comprehension: Reading and analyzing texts related to the specialization.
- Oral comprehension: Note-taking, summarizing, and presenting authentic scientific videos.
- Oral expression: Presenting a scientific or technical topic, exchanging oral messages, telephone communication, gestures.
- Written expression: Extracting ideas from scientific documents, writing scientific messages, exchanging written information, CV writing, internship or job application letters.

Recommendation: It is strongly recommended that the instructor presents and explains, at the end of each session, a list of technical terms in three languages (English, French, and Arabic if possible).

Assessment Method:
Exam: 100%.

Bibliographic References:

1. P.T. Danison, Guide pratique pour rédiger en anglais: usages et règles, conseils pratiques, Editions d'Organisation 2007.
2. A. Chamberlain, R. Steele, Guide pratique de la communication: anglais, Didier 1992.
3. R. Ernst, Dictionnaire des techniques et sciences appliquées: français-anglais, Dunod 2002.
4. J. Comfort, S. Hick, and A. Savage, Basic Technical English, Oxford University Press, 1980.
5. E. H. Glendinning and N. Glendinning, Oxford English for Electrical and Mechanical Engineering, Oxford University Press 1995.
6. T. N. Huckin, and A. L. Olsen, Technical writing and professional communication for nonnative speakers of English, Mc Graw-Hill 1991.
7. J. Orasanu, Reading Comprehension from Research to Practice, Erlbaum Associates 1986.

Proposed Elective Subjects (S1)

Semester: 1

Teaching Unit: DTU1.1

Subject 1: Linux System

Total Hours: 22h30 (Lectures: 1h30)

Credits: 1

Coefficient: 1

Teaching Objectives:

This subject will give the student an idea of the use and customization of a GNU/Linux system.

Prerequisite Knowledge:

Knowledge of the Windows operating system and programming.

Course Content:

Chapter 1. Installation of the GNU/Linux System (3 Weeks)

- History of Linux
- Linux as free software (GNU/Linux)
- Linux distributions
- Where to find help on Linux

Chapter 2. Disk and Peripheral Management (2 Weeks)

- Hard disk structure
- Disk partitioning
- Naming conventions for disks and partitions in GNU/Linux
- File systems / Ext2fs (Second Extended File System)
- Boot process and login to the Linux system

Chapter 3. Basic Administration (2 Weeks)

- User management in Linux
- Users and groups in Linux
- File access rights

Chapter 4. Introduction to the Command Line (2 Weeks)

- Command interpreter
- Directory and file manipulation commands
- User and group manipulation commands
- Accessing other disks (Mounting a file system)

Chapter 5. Kernel, Performance, and Tuning (3 Weeks)

- Kernel modules
- Kernel module manipulation
- Module configuration
- Kernel compilation and installation

Chapter 6. Presentation of Network Services in GNU/Linux (3 Weeks)

- Network configuration in GNU/Linux
- Networks in GNU/Linux: file sharing
- Presentation of file systems (NFS, NIS)
- Presentation of file sharing systems with Windows (Samba)

Assessment Method:
Exam: 100%.

Bibliographic References:

1. Richard Stallman et la révolution du logiciel libre.
2. Linus Torvalds et David Diamond, "*Il était une fois Linux : L'extraordinaire histoire d'une révolution accidentelle*", Osman Eyrolles Multimédia, 2001.
3. Chris DiBona (dir.), "*Tribune libre : Ténors de l'informatique libre*", O'Reilly, 1999.

Semester: 1

Teaching Unit: DTU1.1

Subject 2: Standards and Protocols

Total Hours: 22h30 (Lectures: 1h30)

Credits: 1

Coefficient: 1

Teaching Objectives:

Introduce the student to the most common communication protocols. Teach the student how to specify protocols and standards. Distinguish networks and protocols related to each layer of the OSI and TCP/IP models, acquire good knowledge of concepts related to different types of networks and protocols.

Prerequisite Knowledge:

Information theory, network elements.

Course Content:

Chapter 1. Fundamental Concepts (2 Weeks)

- Standardization institutions in telecommunications (ITU, IEC, OSI, IEEE, etc.)
- History and evolution
- Standards, recommendations, norms, and protocols (definitions and differences)
- Role of a protocol

Chapter 2. Standards Associated with Analog and Digital Broadcasting (2 Weeks)

- Analog audio and video standards (CCIR, NTSC, etc.)
- Digital audio and video standards (DVB, ATSC, ISDB, NICAM, etc.)

Chapter 3. Standards Associated with Digital Communication Networks (4 Weeks)

- Classification of communication networks
- Networks and standardization
- History and evolution of networks
- Integrated Services Digital Network (ISDN)
- Review of OSI and TCP/IP models
- Different frame and packet-level protocols
- Different segment and message-level protocols
- ADSL protocols

Chapter 4. Protocols for Wireless and Mobile Networks (4 Weeks)

- 802.11 protocols
- 802.15 protocols

- 802.16 protocols
- GSM protocols
- 3G protocols (UMTS)
- 4G protocols (LTE)
- 5G technologies and protocols

Chapter 5. Internet Protocols (3 Weeks)

- Internet (history and evolution)
- Classification of Internet protocols
- Messaging service protocols (SMTP, POP, IMAP)
- Information service protocols (HTTP, FTP, application protocols)

Assessment Method:
Exam: 100%.

Bibliographic References:

1. Michel Kadoch, " Protocoles et réseaux locaux", Presses de l'université du Québec, 2012.
2. José Dordoigne," Réseaux locaux et étendus: notions fondamentales", Editions ENI, 2005.
3. Guy Pujolle," Réseaux", Eyrolles, 2008.
4. Claude Rigault, " Les réseaux télécoms basés IP et leurs interconnexions", Hermes –Lavoisier, 2015.

II - Detailed Program by Subject for Semester S2

Semester: 2

Teaching Unit: FTU 1.2.1

Subject 1: Network Services Administration

Total Hours: 67h30 (Lectures: 3h00, Tutorials: 1h30)

Credits: 6

Coefficient: 3

Teaching Objectives:

Acquire the knowledge and skills necessary for the operation, administration, maintenance, and monitoring of computer networks. The student will become familiar with functions and protocols that enable them to manage access rights, data traffic, data backup, and the proper functioning of services such as directory services, email services, and application services.

Prerequisite Knowledge:

Communication protocols, OSI model, network elements.

Course Content:

Chapter 1. Introduction to Network Administration (2 Weeks)

- Objectives and role of administration
- Network administration model
- Client-server networks
- Administration protocols
- Application layer services
- Service port concepts

Chapter 2. SNMP Service (Simple Network Management Protocol) (2 Weeks)

- Syslog service
- SNMP service: Presentation and history
- Principles, configuration, advantages, and disadvantages

Chapter 3. Directory Services (3 Weeks)

- Different directory services
- Domain Name System (DNS)
- Dynamic Host Configuration Protocol (DHCP) and IP address management with DHCP
- Lightweight Directory Access Protocol (LDAP). Configuration.
- Other directory services

Chapter 4. User Management and NFS Service (2 Weeks)

- Introduction, generalities on NIS (Network Information System) and NFS (Network File System)

- Operation, NIS server and client configuration
- NFS operation, characteristics, commands

Chapter 5. Email and Application Services (3 Weeks)

- Basic principles of email
- Message format
- SMTP protocol. Installation, configuration, and operation
- FTP (File Transfer Protocol) and Web services. Definition, operation, configuration

Chapter 6. Domain Controller (3 Weeks)

- Introduction, presentation, architecture (domains, trees, forests)
- User, group, and permission management
- Security
- Domain management
- Trust concepts between domains
- Example of a domain controller (Active Directory AD)

Assessment Method:
Continuous assessment: 40%; Exam: 60%.

Bibliographic References:

1. Pierre-Yves Cloux et Rafael Corvalan, "Les annuaires LDAP, méta-annaires et e-provinionning", Édition Dunod - 334 pages , 2eédition, 1er juin 2004.
2. de Julien Rouxel, " Intégrez un serveur de fichiers Open Source à votre réseau d'entreprise", Edition: ENI- 400 pages, 1re édition, 1er avril 2011.
3. François Pignet, " Supervision et Administration", ENI 10/12/2007.
4. Douglas R. MAURO, Kevin J. SCHMIDT, "Essential SNMP". Editeur O'REILLY. 23/09.2005.
5. Jean-François, Apréa : "Configuration d'une infrastructure Active Directory avec Windows Server", 2008. Editions ENI ,2008.
6. Gilles Chamillard, Sébastien Rohaut. Ubuntu, "Administration d'un système Linux", Editions ENI, 2013.

Semester: 2

Teaching Unit: FTU 1.2.1

Subject 2: DSP and FPGA

Total Hours: 45h00 (Lectures: 1h30, Tutorials: 1h30)

Credits: 4

Coefficient: 2

Teaching Objectives:

By the end of this unit, the student should master the design flow. They should also be able to perform algorithm-architecture matching for the implementation of algorithms on DSP-based platforms.

Prerequisite Knowledge:

Digital electronics (combinatorial and sequential), microprocessor system architecture.

Course Content:

Chapter 1. Architecture and Peripherals of DSPs (4 Weeks)

- Presentation of different DSP families
- Classification of DSPs
- Introduction to the MAC (Multiply and Accumulate) unit
- Internal memories (Harvard architecture)
- Presentation of the instruction set for each computing unit (RISC architecture)
- Different internal peripherals for interfacing with the external world: (HPI, GPIO, McBSP, Timers, PLL, etc.)

Chapter 2. Memory Management (3 Weeks)

- Presentation and interest of the Harvard architecture
- Internal memories (L1 and L2 levels)
- External memories (SRAM, Flash, DDRAM, etc.)
- Memory addressing plan
- *.cmd file (section organization)
- Addressing modes
- Block transfer technique
- Data organization for EDMA
- Parameters and options for EDMA
- Example of data transfer

Chapter 3. Input/Output Management (2 Weeks)

- Polling and interrupt techniques
- Interrupts (interrupt sources, hardware and software interrupts, interrupt vector, interrupt handling)
- Interrupt programming (examples)

Chapter 4. Implementation of Algorithms on DSPs (3 Weeks)

- Data representation in digital (Fixed-point representation, floating-point representation)
- Algorithm-architecture matching
- Implementation of digital filtering (IIR or FIR) on DSP (circular addressing)
- Implementation of FFT on DSP (bit-reversed addressing)

Chapter 5. Introduction to FPGA Architecture (3 Weeks)

- Programmable logic networks (PLA, PLD, CPLD, FPGA)
- General FPGA architecture
- Configurable logic blocks (CLB)
- Input/output cells
- Routing channels
- Integrated memory blocks
- Examples of manufacturers (Altera and Xilinx)
- Applications

Assessment Method:
Continuous assessment: 40%; Exam: 60%.

Bibliographic References:

1. Zanella, "Architecture et technologie des ordinateurs", Dunod.
2. N.Dahnoun, "Digital Signal Processing Implementation using the TMS320 C6000 DSP platform", Prentice Hall, 2000.
3. N. Kehtarnaz, N. Kim, "Real Time Digital Signal Processing Based on TMS320C6000" Newnes, 2004.
4. N. Kehtarnaz, M. Keramat, " DSP système design using TMS320C6000", Prentice Hall, 2006.
5. Volnei A. Pedroni, “Circuit Design with VHDL”, MIT Press, 2004.
6. Jacques Weber , Sébastien Moutault, Maurice Meaudre, “Le langage VHDL : du langage au circuit, du circuit au langage“, Dunod, 2007.
7. Christian Tavernier, “Circuits logiques programmables“, Dunod 1992.

Semester: 2

Teaching Unit: FTU 1.2.2

Subject 3: Transmission Channels and Optical Components

Total Hours: 45h00 (Lectures: 1h30, Tutorials: 1h30)

Credits: 4

Coefficient: 2

Teaching Objectives:

Study wave propagation in guided media such as transmission lines and optical fibers, with particular attention to passive and active optical components and their applications in telecommunication networks.

Prerequisite Knowledge:

Basic knowledge of electromagnetics and optoelectronics, as taught in the "Transmission Media", "Antennas and Transmission Lines", and "Optoelectronics" subjects in the third year of the Telecommunications undergraduate program.

Course Content:

Chapter 1. Transmission Lines (3 Weeks)

- General study of lines in sinusoidal regime (line diagram, line equations, line impedance - telegraph equations)
- Standing waves (reflection coefficient, voltage standing wave ratio VSWR)
- Impedance matching in transmission lines (matching by impedance transformer, using reactive LC circuits, using a stub)
- Smith chart (description, use for solving various line-related problems)

Chapter 2. Waveguides (4 Weeks)

- Rectangular waveguides: TM and TE modes, dispersion equation, propagation constant, cutoff frequency, impedance, etc.
- Cylindrical waveguides: TM and TE modes, dispersion equation, propagation constant, cutoff frequency, impedance, etc.
- Optical waveguides (Optical fibers: Light propagation, polarization, attenuation, chromatic dispersion, PMD, nonlinear effects, types of optical fibers)

Chapter 3. Passive and Active Optical Components (4 Weeks)

- **Passive components:**
  - Fixed attenuators, manual variable attenuators
  - Circulators, polarization controllers, couplers, isolators, Faraday mirrors
  - Multiplexers/Demultiplexers, polarizers, Faraday rotators
- **Active components:**
  - Optical amplifiers, EDFA and semiconductor (SOA) modules

- Variable attenuators
- Tunable dispersion compensators
- Polarization controllers, media converters, DPSK demodulators
- Pump diodes, laser diodes, LEDs, electro-optic modulators, photodiodes, SLED, switches, transceivers

Chapter 4. Optical Fiber Transmission Systems (4 Weeks)

- Block diagram of an optical transmission chain
- Optical cable and connectors
- Structures and families of digital links: point-to-point, with optical amplifiers EDFA, multiplexed links (WDM)
- Optical fiber networks (Passive and active networks, different FTTX architectures, Bragg networks for optical encoding and decoding, CDMA)

Assessment Method:
Continuous assessment: 40%; Exam: 60%.

Bibliographic References:

1. G. DUBOST, " Propagation libre et guidée des ondes électromagnétiques / Rayonnement -Exercices avec solutions et rappels de cours".
2. J. Quinet, "Théorie et pratique des circuits de l'électronique et des amplificateur, Propagation du courant H.F. le long des lignes ; Abaque de Smith- Antenne. Equations de Maxwell et Applications".
3. Yariv & Yeh , "Photonics. Optical electronics in modern communications".
4. Kaminow,"Optical Fiber telecommunications, A: Components and Subsystems", 2008.
5. G. Keiser, "Optical fiber communications", 3rd edition, Mc Graw Hill, 2000.
6. Agrawal, "Fiber−Optic communication systems", U.G.P. Wiley, Interscience 1992.
7. J. A. Buck, "Fundamentals of optical fibers", Wiley Interscience.
8. J. M. Senior, "Optical fiber communications: Principles and practice", Prentice−Hall International Series in Optoelectronics, 2nd edition Englewood Cliffs, USA.
9. M. Joindot, "Les télécommunications par fibres optiques", Collection technique et scientifique du CNET, Dunod, 1996.

Semester: 2

Teaching Unit: FTU 1.2.2

Subject 4: Coding and Compression

Total Hours: 45h00 (Lecture: 1h30, Tutorial: 1h30)

Credits: 4

Coefficient: 2

Teaching Objectives:

Familiarize students with data coding and compression techniques such as channel coding, source coding, and image compression. Students will learn the foundational principles for evaluating the advantages and disadvantages of different compression techniques, as well as the criteria for selecting a data compression method.

Recommended Prerequisites:

Probability and statistics, information theory, signal processing.

Course Content

Chapter 1. Fundamental Concepts of Source Coding and Channel Coding (3 Weeks)

- Review of fundamental results from information theory
- Sources and source coding
- Definition, differences, and benefits of source coding
- Properties of a code
- Kraft-McMillan inequality
- Shannon's first theorem
- Channel and channel coding
- Notions of joint coding

Chapter 2. Entropy Coding (4 Weeks)

- Huffman coding - adaptive versions of Huffman and Shannon-Fano
- Arithmetic coding
- LZW coding
- Evaluation criteria (calculation of entropy, average length, redundancy, and efficiency for each method)
- Application to images.

Chapter 3: Channel Coding (4 Weeks)

- Main concepts and definitions
- General communication scheme and transmission channel
- Types of channels
- Efficiency, redundancy, and channel capacity
- Channel coding and Shannon's second theorem. Channel coding strategies
- Error-correcting codes (Hamming codes, linear codes, cyclic codes, Reed-Solomon codes, etc.)

- Convolutional codes: State diagram, trellis coding, decoding (Viterbi algorithm)
- Turbo codes and LDPC codes
- Encoder performance
- Application examples

Chapter 4. Lossy Compression Methods (4 Weeks)

- General notions and definitions
- General scheme of transform-based compression methods
- Evaluation criteria (MSE, PSNR, CR, SSIM, etc.)
- Description of different components (Transformation, Quantization, and entropy coding)
- Effects of transformation on compression methods
- Effects of quantization and different types of quantization
- Standards and standardization bodies for image compression

Assessment Method:
Continuous assessment: 40%; Exam: 60%.

Bibliography:

1. M. Cover and J. A. Thomas, “Elements of information theory“, 2nd edition, Wiley Series in telecommunications and signal Processing, 2006.
2. M. Barlaud, C. Labit, “Compression et codage des images et des vidéos“, traité Collection IC2, Ed. Hermés, 319p, 2002.
3. K. Sayood, "Introduction to Data Compression, Third Edition", Elsevier Inc. 2006.
4. Olivier Rioul, "Théorie de l'information et du codage", Edit. Lavoisier, 2007.
5. N. Moreau, "Outils pour la compression des signaux: applications aux signaux audio", Collection
6. Télécom, Edition Lavoisier, Octobre 2009.
7. J. C., Moreira, P. G., Farrell, "Essentials of Error-Control Coding", John Wiley and Sons, Ltd, 2006.
8. C. Berrou, "Codes et turbocodes", Springer-verlag France, 2007.

Semester: 2

Teaching Unit: MTU1.2

Subject 1: Practical Work (Lab) on Network Service Administration

Total Hours: 22h30 (Practical Work: 1h30)

Credits: 2

Coefficient: 1

Teaching Objectives

By the end of this course, students will have the tools and skills to administer a network. They will be able to install and configure servers for a given network service (under Linux and/or Windows Server).

[Recommended Prerequisites]{.underline}:

Communication protocols, OSI model, network components.

Course Content

Practical Work 1: Administration Environment (Lab 1)

- Setting up a network administration environment
- Setting up a DNS service

Practical Work 2: DHCP Service (Lab 2)

- Setting up a DHCP service (DHCP configuration, interaction with Bind, managing limited leases in a heterogeneous environment, address reservation (@mac), configuring a DHCP server)

Practical Work 3: DNS Service (Lab 3)

- Advanced DNS installation and configuration (Notions of root-server, TLD, zone, records, configuration file formats, dynamic DNS, interaction with DHCP (RDNC))

Practical Work 4: FTP and Web Services (Lab 4)

- Installing and configuring a web server and an FTP server
- Presentation of client-side and server-side technologies
- Making a web application and an FTP application available

Practical Work 5: Remote Administration (Lab 5)

- Remote administration with Webmin: integrated tools for remote administration SSH and Telnet

Practical Work 6: Installing an Active Directory Domain Controller (Lab 6)

- Installing and configuring the domain controller

- Testing session opening
- Integrating workstations into the domain
- Creating group restrictions
- Configuring print services
- Creating trusts

Practical Work 7: Mail Service (Lab 7)

- Installing and configuring Postfix
- Setting up SMTP servers

Assessment Method:
Continuous assessment: 100%

Bibliography:

1. Pierre-Yves Cloux et Rafael Corvalan, " Les annuaires LDAP, méta-annaires et e-provinionning", Édition Dunod - 334 pages , 2eédition, 1er juin 2004.
2. de Julien Rouxel, " Intégrez un serveur de fichiers Open Source à votre réseau d'entreprise", Edition: ENI - 400 pages, 1re édition, 1er avril 2011.
3. François Pignet, " Supervision et Administration", ENI 10/12/2007
4. Douglas R. MAURO, Kevin J. SCHMIDT, " Essential SNMP". Editeur O'REILLY. 23/09.2005
5. Jean-François, Apréa : "Configuration d'une infrastructure Active Directory avec Windows Server", 2008. Editions ENI ,2008.
6. Gilles Chamillard, Sébastien Rohaut. Ubuntu, "Administration d'un système Linux", Editions ENI, 2013.

Semester: 2

Teaching Unit: MTU1.2

Subject 2: Practical Work (Lab) on DSP and FPGA

Total Hours: 22h30 (Practical Work: 1h30)

Credits: 2

Coefficient: 1

Teaching Objectives:

In this unit, students will master the CCS (Code Composer Studio) tool for developing applications on DSP-based platforms. They will apply theoretical knowledge acquired during lectures and tutorials to port application programs to DSP platforms, ensuring algorithm-architecture compatibility.

Recommended Prerequisites:
Digital electronics (combinatorial and sequential), microprocessor system architectures.

Course Content:

Practical Work 1: Getting Started with the CCS Environment (Lab 1)
(Code Composer Studio version 4.0 or later). Configuring the CCS environment for DSP board use (BSL, CSL, and RTL libraries).

Practical Work 2: Configuring and Using the CODEC (Lab 2)
(Supported sampling frequencies, use in polling and interrupt modes).

Practical Work 3: Techniques for Configuring the Environment for DSP Use in Deferred or Real-Time Mode **(Lab 3)**

Practical Work 4: Programming Interrupts (Lab 4)
(Writing the ISR (Interrupt Service Routine)).

Practical Work 5: Programming an Application Involving MCBSP (Multi-Channel Buffered Serial Port) and the CODEC **(Lab 5)**

Practical Work 6: Programming Digital Filtering Operations **(Lab 6)**

Practical Work 7: Programming the Fast Fourier Transform **(FFT) (Lab 7)**

Practical Work 8: Introduction to VHDL Language **(Lab 8)**

- Presentation of the development tool: development board and simulation software.
- Using the VHDL simulator.
- Developing an example circuit: (decimal counter, multiplexer, and/or shift register).

Assessment Method:
Continuous assessment: 100%

Bibliography:

1. Zanella, "Architecture et technologie des ordinateurs", Dunod.
2. N.Dahnoun, "Digital Signal Processing Implementation using the TMS320 C6000 DSP platform", Prentice Hall, 2000.
3. N. Kehtarnaz, N. Kim, "Real Time Digital Signal Processing Based on TMS320C6000" Newnes, 2004.
4. N. Kehtarnaz, M. Keramat, " DSP système design using TMS320C6000", Prentice Hall, 2006.
5. Volnei A. Pedroni, “Circuit Design with VHDL”, MIT Press, 2004.
6. Jacques Weber , Sébastien Moutault, Maurice Meaudre, “Le langage VHDL : du langage au circuit, du circuit au langage“, Dunod, 2007.
7. Christian Tavernier, “Circuits logiques programmables“, Dunod 1992.

Semester: 2

Teaching Unit: MTU1.2

Subject 3: Practical Work (Lab) on Coding and Compression

Total Hours: 22h30 (Practical Work: 1h30)

Credits: 2

Coefficient: 1

Teaching Objectives:

Familiarize students with data coding and compression techniques such as channel coding, source coding, and image compression.

Recommended Prerequisites: Probability and statistics, information theory, signal processing.

Course Content:

Practical Work 1: Study and Simulation of Shannon-Fano and Huffman Coding

(Calculation of entropy, average length, and efficiency; determination of the alphabet, probabilities, and frequencies). Application to image compression.

Practical Work 2: Study and Simulation of Arithmetic Coding

Practical Work 3: Study and Simulation of LZW Coding

Practical Work 4: Study and Simulation of Channel Coding (Block Coding and Convolutional Coding)

Practical Work 5: Modeling a Chain with Source Coding and Channel Coding on Binary and Gaussian Channels

Practical Work 6: Example Implementation of Low-Complexity Fast DCT

Assessment Method: Continuous assessment: 100%

Bibliography:

1. M. Cover and J. A. Thomas, “Elements of information theory“, 2nd edition, Wiley Series in telecommunications and signal Processing, 2006.
2. M. Barlaud, C. Labit, “Compression et codage des images et des vidéos“, traité Collection IC2, Ed. Hermés, 319p, 2002.
3. K. Sayood, "Introduction to Data Compression, Third Edition", Elsevier Inc. 2006.
4. Olivier Rioul, "Théorie de l'information et du codage", Edit. Lavoisier, 2007.
5. N. Moreau, "Outils pour la compression des signaux: applications aux signaux audio", Collection
6. Télécom, Edition Lavoisier, Octobre 2009.
7. J. C., Moreira, P. G., Farrell, "Essentials of Error-Control Coding", John Wiley and Sons, Ltd, 2006.
8. C. Berrou, "Codes et turbocodes", Springer-verlag France, 20

Semester: 2

Teaching Unit: MTU1.2

Subject 4: High-Speed Networks

Total Hours: 37h30 (Lecture: 1h30, Practical Work: 1h00)

Credits: 3

Coefficient: 2

Teaching Objectives:

The aim of this course is to present networks using PDH, SDH/SONET, and DWDM technologies. The evolution of these technologies now allows for record-breaking speeds. The objective is to provide a comprehensive overview of very high-speed transport techniques, describe different WAN techniques and their advantages, and highlight the benefits of tunneling methods.

Recommended Prerequisites:
Communication protocols, OSI model, network components.

Course Content:

Chapter 1. Hierarchical Network Modeling (2 Weeks)

- Designing a switched architecture
- Multi-layer architecture (Core Layer, Distribution Layer, and Access Layer)
- Modular architecture
- Internet service providers
- WAN services

Chapter 2. Metropolitan Networks (2 Weeks)

- Gigabit Ethernet and 10Gigabit Ethernet (IEEE802.3z, IEEE802.3ae)
- Token-Ring architecture (IEEE802.5) and FDDI architecture (Fiber Distributed Data Interface-IEEE802.8-)
- DQDB (Distributed Queue Dual Bus DQDB -IEEE 802.6-)

Chapter 3. Transport Networks (4 Weeks)

- Transmission plan (Network synchronization, Plesiochronous Digital Hierarchy (PDH), Synchronous Optical Networking (SONET), Synchronous Digital Hierarchy (SDH), Dense Wavelength Division Multiplexing (DWDM))
- Local loop
- Switching techniques (circuit, packet)
- Private WAN infrastructure and Public WAN infrastructure
- Switched WAN access
- Leased lines (T1/E1, T3/E3)
- X.25
- Frame Relay

- ATM (Asynchronous Transfer Mode)
- MPLS (MultiProtocol Label Switching) and GMPLS (Generalized MPLS)

Chapter 4. Tunneling Protocols (3 Weeks)

- HDLC protocol (High-Level Data Link Control)
- PPP protocol (Point-to-point Protocol)
- PPPoE protocol (PPP over Ethernet)
- L2TP protocol (Layer 2 Tunneling Protocol)
- Virtual Private Networks VPN/Dynamic VPN and IPsec (Internet Protocol Security)

Chapter 5. High-Speed Solutions (4 Weeks)

- DSL technologies (ADSL, SDSL, VDSL)
- Fiber optics, optical network topologies, PON, GPON, FTTx, FTTH, FTTB
- Wifi mesh (Municipal Wifi)
- WIMAX (Worldwide Interoperability for Microwave Access) IEEE 802.16
- Cellular/mobile implementations (2G/3G/4G, LTE)
- Satellite implementations (VSAT)

High-Speed Networks Practical Work (Labs)

Practical Work 1: Simulating a WAN Network
Configuring a router-to-router link using a "Serial DCE" connection.

Practical Work 2: Simulating Internet Access
Configuring LAN interface, WAN interface (ATM), Dialer Interface, default routing, NAT configuration.

Practical Work 3: Configuring Extended MPLS and Static MPLS

Practical Work 4: Configuring a "Frame Relay Cloud" on a Router via Simulation

Practical Work 5: Creating an IP Sec VPN Tunnel Between Routers

Practical Work 6: Simulating an Inter-Site Connection via Cloud-PT

Assessment Method:
Continuous assessment: 40%; Exam: 60%.

Bibliography:

1. Jean-Yves Didier ,’’Introduction aux réseaux’’ ,LSC – Université d'Evry.
2. L. Sassatelli,"Réseaux étendus et réseaux d’opérateurs’’, université Sophia-Antipolis 2012-2013.
3. G. Pujolle, ’’Les réseaux’’, Edition Eyrolles, 2014.

Semester: 2

Teaching Unit: UED 2.1

Subject 1:

Total Hours: 22h30 (Lecture: 1h30)

Credits: 1

Coefficient: 1

Semester: 2

Teaching Unit: UED 1.2

Subject 2: Elective Subject

Total Hours: 22h30 (Lecture: 1h30)

Credits: 1

Coefficient: 1

Semester: 2

Teaching Unit: TTU 1.2

Subject: Respect for Standards and Ethical and Integrity Rules

Total Hours: 22h30 (Lecture: 1h30)

Credits: 1

Coefficient: 1

Teaching Objectives:

Develop students' awareness of respecting ethical principles and rules governing university life and the professional world. Sensitize them to the importance of valuing intellectual property. Explain the risks of moral issues such as corruption and how to combat them, and alert them to the ethical challenges posed by new technologies and sustainable development.

Recommended Prerequisites:
Ethics and professional conduct (fundamentals).

Course Content:

A. Respect for Ethical and Integrity Rules

1. **Review of the MESRS Ethics and Professional Conduct Charter:** Integrity and honesty. Academic freedom. Mutual respect. Scientific truth, objectivity, and critical thinking. Equity. Rights and obligations of students, teachers, and administrative and technical staff.
2. **Integrity in Research**

- Respect for ethical principles in teaching and research.
- Responsibilities in teamwork: Professional equality. Combating discrimination. Pursuit of the common good. Inappropriate conduct in collective work.
- Adopting responsible behavior and combating misconduct: Responsible conduct in research. Scientific fraud. Combating fraud. Plagiarism (definition, forms, procedures to avoid unintentional plagiarism, detection, sanctions, etc.). Data falsification and fabrication.

3. **Ethics and Professional Conduct in the Workplace**

- Legal confidentiality in companies. Loyalty to the company. Responsibility within the company. Conflicts of interest. Integrity (corruption in the workplace, its forms, consequences, methods of combating it, and sanctions).

B. Intellectual Property
I. Fundamentals of Intellectual Property

1. Industrial property. Literary and artistic property.
2. Rules for citing references (books, scientific articles, conference papers, theses, dissertations, etc.).

II. Copyright

1. **Copyright in the Digital Environment**
   Introduction. Copyright for databases, software. Special case of open-source software.
2. **Copyright on the Internet and E-Commerce**
   Domain name rights. Intellectual property on the internet. E-commerce site rights. Intellectual property and social networks.
3. **Patents**
   Definition. Rights in a patent. Utility of a patent. Patentability. Patent applications in Algeria and worldwide.

III. Protection and Valorization of Intellectual Property
How to protect intellectual property. Violations and legal tools. Valorization of intellectual property. Protection of intellectual property in Algeria.

C. Ethics, Sustainable Development, and New Technologies
Link between ethics and sustainable development, energy savings, bioethics, and new technologies (artificial intelligence, scientific progress, humanoids, robots, drones).

Assessment Method:
Exam: 100%.

Bibliography:

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16. http://www.app.asso.fr/
17. http://ressources.univ-rennes2.fr/propriete-intellectuelle/cours-2-54.html
18. Fanny Rinck et léda Mansour "littératie à l'ère du numérique : le copier-coller chez les étudiants" Université grenoble 3 et Université paris ouest Nanterre la défense Nanterre, france
19. L'abc du droit d'auteur, organisation des nations unies pour l'éducation, la science et la culture (UNESCO)
20. Alain bensoussan livre blanc – une science ouverte dans une république numérique direction de l'information scientifique et technique CNRS
21. Copyright in the cultural industries. - Cheltenham: E. Elgar, 2002. - XXII-263 p.
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23. Emanuela Chiriac, Monique Filiatrault et André Régimbald. "guide de l'étudiant: l'intégrité intellectuelle plagiat, tricherie et fraude… les éviter et, surtout, comment bien citer ses sources" 2014
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25. Pierrick Malissard "La propriété intellectuelle "origine et évolution" 2010
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Proposal for Some Discovery Subjects (S2)

Semester: 2

Teaching Unit: DTU 1.2

Subject 1: Representation of Image and Video Data

Total Hours: 22h30 (Lecture: 1h30)

Credits: 1

Coefficient: 1

Teaching Objectives:

The objective of this course is to introduce students to the basics of representing and processing image and video data.

Recommended Prerequisites:
Notions of signal processing.

Course Content:

Chapter 1. Introduction to Image and Video Representation (3 Weeks)

- Image acquisition and formation, image digitization.
- Color spaces and color transformations (RGB, HSV, YCrCb).
- Notions of resolution and quantization of a digital image (Size, dpi, ppi, bpp, etc.).
- Different types of images (Thermal, radar echoes, satellite images, wireless sensor images, etc.).
- Digital image formats (BMP, TIFF, JPG, GIF, and PNG).
- Notions of digital video, video formats.
- Video format conversion and frame extraction.

Chapter 2. Image and Video Processing (4 Weeks)

- Image and video processing chain.
- Preprocessing methods: Quality enhancement (histogram manipulation, restoration, noise reduction, edge detection).
- Notions of post-processing.

Chapter 3. Image and Video Representation for Analysis (4 Weeks)

- Representation of still images: color, texture, and shape.
- Descriptors: color, shape, and textures.
- Transform-based descriptors (DCT and wavelets).
- Motion descriptors.
- Applications to image and video analysis.

Chapter 4. Workshop on Image and Video Processing Tools (4 Weeks)

- Getting started with image and video processing tools in C++ and OpenCV.
- Reading and writing image and video files.

- Capturing a video sequence.
- RGB, HSV, binary, and grayscale representation of an image.
- Applying image filtering techniques.

Assessment Method:
Exam: 100%.

Bibliography:

1. Jean-Yves Dufour., Outils d'analyse vidéo pour une pleine exploitation des données de vidéoprotection. Edition Lavoisier, 2012.
2. Laurant Berger., Traitement d'images et de vidéos avec OpenCV 3 C++ (Windows, Linux, Rapsberry. Edition Eyrolles, 2017.
3. Rachid Belaroussi., Traitement de l'image et de la vidéo avec exercices pratiques en matlab et C++. Edition Eyrolles, 2010.
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5. Rafael C. Gonzalez., et Richard E Woods., Digital Image Processing. Prentice Hall, 2008.
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Semester: 2

Teaching Unit: UED1.2

Subject 2: Satellite Networks

Total Hours: 22h30 (Lecture: 1h30)

Credits: 1

Coefficient: 1

Teaching Objectives:

The objective of this course is to present the main characteristics of satellite networks, their architectures, and configurations in a general manner.

Recommended Prerequisites:
Transmission media, propagation and antennas, digital communication.

Course Content:

Chapter 1. Satellite Communication (4 Weeks)

- Satellite positioning (movement of an artificial satellite: Kepler's laws, orbital plane).
- Satellite trajectory. Different types of orbits (Geostationary orbit, polar circular orbit, inclined circular orbit, elliptical orbits).
- Frequency bands.
- Calculation of geostationary orbit altitude.
- Calculation of satellite speed.
- Link budget (Main parameters of a link, attenuations, noise notion, power budget, global budget, examples of link budgets).
- Constraints of satellite solutions (Coverage, bandwidth management, Handover, delay).

Chapter 2. Attenuations in Radio Wave Propagation (2 Weeks)

- Introduction.
- Atmospheric losses.
- Ionospheric effects.
- Rain attenuation.

Chapter 3. Satellite Networks (5 Weeks)

- Introduction.
- Operating principles.
- Satellite network architectures (Mesh architecture, Star architecture).
- Configuration of a Vsat Star Network (Current model, ATM over Satellite model).
- Geostationary Satellite Constellation (GEO).
- LEO/MEO Satellite Constellations (Iridium, Globalstar, Teledesic).

Chapter 4. Satellite Radionavigation Systems (4 Weeks)

- Terrestrial radionavigation systems (VOR, TACAN, DME, ILS, MLS, LORAN).
- Presentation of the GPS system and GPS signals (Functional architecture of a receiver).
- GPS measurement principle: pseudo-distances, pseudo-speeds, calculation of GPS position and speed.
- Specificities of military GPS receivers: cryptographic modules, direct Y-code acquisition, jamming resistance.

Assessment Method:
Exam: 100%.

Bibliography:

1. B. R. Elbert, “The Satellite Communication Applications Handbook”, Artech House, 2004.
2. E. Altman, A. Ferreira, J. Galtier, “Les réseaux satellitaires de telecommunication”, Dunod, 1999.
3. J. Pelton, ”Satellite Communications”, Springer, 2011.

III - Detailed Program by Subject for Semester S3

Semester: 3

Teaching Unit: FTU 2.1.1

Subject 2: Wireless and Mobile Networks

Total Hours: 67h30 (Lecture: 3h00, Tutorial: 1h30)

Credits: 6

Coefficient: 3

Teaching Objectives

This course is dedicated to wireless networks (WiFi and WiMAX) and 3G and 4G mobile networks. By the end of the course, students will have a comprehensive understanding of these networks (architecture, radio interface, radio channel, dimensioning and planning, services offered, security management, roaming, etc.).

Recommended Prerequisites:
TCP networks, digital communications, telephony.

Course Content:

Chapter 1. Review of Basic Concepts (2 Weeks)

Review and definitions, types of wireless communications, modern wireless communication systems, wireless and mobile networks, the concept of cellular networks, architectures. Base stations, frequency bands.

Chapter 2. Wireless Personal Area Networks (WPAN) (2 Weeks)
Standards and characteristics, Ultra-Wide Band (UWB), Standard 802.15, Bluetooth, Zigbee, access techniques, implementation, security. Some examples: WBAN (Wireless Body Area Networks), WSN (Wireless Sensor Networks), etc.

Chapter 3. Wireless Local Area Networks: IEEE 802.11 (WiFi) (3 Weeks)
Standard 802.11, architecture and layers, 802.11a, 802.11b, 802.11g, 802.11n, and 802.11ac or high-speed WiFi, etc. Routing and transmission techniques: Architecture of 802.11 mode with infrastructure, conditions for installing access points. Architecture of 802.11 mode without infrastructure, ad-hoc, security.

Chapter 4. Wireless Metropolitan Area Networks (2 Weeks)
WMAN, architecture and evolution, Local Multipoint Distribution Service (LMDS), Multichannel Multipoint Distribution System (MMDS), main characteristics of IEEE 802.16 standard, WiMAX, spectral options, WiMAX Subscriber Stations, WiMAX Base Stations, WiMAX technical solutions.

Chapter 5. 3G, 4G, and 5G Mobile Networks (4 Weeks)
Structure of a mobile radio system, mobile radio coverage (pico cellular, micro cellular, satellite), review of previous generations (EDGE, GSM, GPRS, services offered: SMS, etc.), different 3G standards, technologies and characteristics, UMTS, WCDMA, CDMA2000, TD-SCDMA. LTE architecture, LTE Advanced, characteristics and performance, standardization, evolution of cellular technologies, futuristic view of the 5th generation (frequency plan, speed, latency, etc.).

Chapter 6. Introduction to Cognitive Radio (2 Weeks)
Problem (Saturated and poorly used frequency spectrum), history of cognitive radio (CR), architecture, cognition cycle, components, functions (Spectrum sensing, Spectrum management, Spectrum mobility).

Assessment Method:
Continuous assessment: 40%; Exam: 60%.

Bibliography:

1. Lin, Y. B., & Chlamtac, I. (2008). Wireless and mobile network architectures. John Wiley & Sons.2, 2008.
2. Gast, M. (2005). 802.11 wireless networks: the definitive guide. " O'Reilly Media, Inc.", 2005.
3. K. Al Agha, (2016) Wireless and Mobile Networks, Wiley, 2006.
4. A.K.Nayak, S.C.Rai, R.Mall , (2016), Computer Network Simulators Using NS2, Productivity Press, 2016.
5. R.Mutha, (2013), Performance Evaluation of AdHoc Routing Protocols By NS2 Simulation, LAP Lambert Academic Publishing, 2013.
6. G. Baudoin, «Radiocommunications Numériques T1: Principes, Modélisation et Simulation,» Dunod, Paris, 2007
7. S. TABBANE, Réseaux Mobiles, Hermès science publications, 1997.
8. Stéphane Lohier, Dominique Présent. Réseaux et transmissions - 6e édition. Protocoles, infrastructures et services. NFO SUP, Dunod janvier 2016.
9. **Aurélien Géron.** WiFi professionnel. La norme 802.11, le déploiement, la sécurité. Dunod**23/09/2009**
10. Pujolle, " Les Réseaux ", Ed Eyrolle, 8ème édition, 2014.

Semester: 3

Teaching Unit: UEF 2.1.1

Subject 1: Cryptography and Network Security

Total Hours: 45h00 (Lecture: 1h30, Tutorial: 1h30)

Credits: 4

Coefficient:2

Teaching Objectives:

Presentation and study of network security mechanisms.

Recommended Prerequisites:
TCP networks, applied mathematics.

Course Content:

Chapter 1. Private Key (Secret), Stream and Block Cipher (4 Weeks)
Review of basic cryptographic concepts (Notations, Kerckhoff's principle, the two categories of systems), block cipher: Feistel structures, D.E.S. - Data Encryption Standard, weaknesses of D.E.S. and evolutions, A.E.S. - Advanced Encryption Standard, symmetric cipher modes.

Stream cipher: Classical LFSRs, modern use of LFSRs, RC4, comparisons between block and stream ciphers.

Chapter 2. Public Key Cipher (4 Weeks)
Concepts and arithmetic review, prime numbers (GCD), congruence (Euclidean division), Euclid's algorithm, Merkle-Hellman, RSA: Rivest - Shamir - Adleman, El Gamal, use of elliptic curves, comparisons between private and public key ciphers.

Chapter 3. Cryptanalysis (3 Weeks)
Unconditional security - Computational security - Proven security, perfect confidentiality, cryptanalytic attacks, correlation attacks and resilient functions, linear and non-linear approximation attacks and non-linearity of Boolean functions. Hash function attacks, side-channel attacks.

Chapter 4. Network Security (4 Weeks)
Risks, attacks, services and security mechanisms, security policy and architecture, firewalls, proxy servers, VPNs, intrusion detection systems, DMZ, IPSEC (Architecture, IPSec modes, SPD and SA, Authentication Header, Encapsulation Security Payload, key management).

Assessment Method:
Continuous assessment: 40%; Exam: 60%.

Bibliography:

1. O. Paul, “Prévention des dénis de service dans les réseaux publics“,Sécurité des systèmes d’information, 2003.
2. F. Raynal, “Canaux cachés“, Sécurité des systèmes d’information, 2003.

3. T. Noel, “IP Mobile“, Sécurité des systèmes d’information,2002.
4. D. Trezentos, “Standard pour réseaux sans fil: IEEE 802.11“, Sécurité des systèmes d’Informations, 2002.
5. C. Chiaramonti, “Échange de données informatisées“, Sécurité des systèmes d’information, 2001.
6. **Gilles Dubertret.** Univers secret de la cryptographie. **Vuibert 20/11/2015**
7. Damien Vergnaud**.** Exercices et problèmes de cryptographie. Licence 3, master, écoles d'ingénieurs. Editeur(s): Dunod**. 07/01/2015**

Semester: 3

Teaching Unit: FTU 2.1.2

Subject 3: Video and Audio over IP

Total Hours: 45h00 (Lectures: 1h30, Tutorials: 1h30)

Credits: 4

Coeffecient: 2

Teaching Objectives:

This subject focuses on the tools and information sources necessary for students to understand the protocols governing the operation of video and audio over IP.

Recommended Prerequisites:

Different types of networks. Coding and compression, Digital Communications.

Course Content:

Chapter 1: Fundamentals and Basics (2 Weeks)

- Basics and foundations of multimedia.
- Principles of voice and video over IP.
- Advantages and constraints of voice and video communication over IP (QoS: latency, jitter, packet loss).

Chapter 2: Multimedia Protocols (3 Weeks)

- Real-time transport protocols for voice and video (RTP), QoS control protocols (RTCP), signaling and communication protocols (RTSP, SDP, SIP, etc.).
- Hardware and software components managing voice and video flows in unicast and multicast multimedia sessions.
- Detailed architecture of the H.323 protocol. Detailed architecture of the SIP protocol.

Chapter 3: Voice and Video over IP (3 Weeks)

- Principle of voice over IP. Voice transport and coding, audio compression standards (G.711, G.723, G.729, etc.). Principle of video over IP.
- Overview of video compression standards.

Chapter 4: Video Streaming (4 Weeks)

- Types of streaming (stored, live). Video over the internet: history, mechanisms.
- Error correction techniques at the application level. Review of error-correcting codes applied in streaming (XOR-based, Reed-Solomon, erasure codes, etc.).
- Delay-quality trade-offs. Adaptive HTTP, MPEG-DASH streaming. Future perspectives.

Chapter 5: IPTV (3 Weeks)

- History. IPTV, Web TV, VoD, Catch-Up TV, and adaptive multi-device streaming.
- Unicast and multicast. Network architecture, head-end, rights management, transport and distribution networks, ADSL access, Residential Gateway (RGW), STB, etc.

Assessment Method:
Continuous assessment: 40%; Exam: 60%.

Bibliography:

1. C. Servin, Réseaux et télécoms, Dunod, Paris, 2003.
2. S. Déon, La téléphonie sur IP, Eyrolles, 2010.
3. G. Pujolle, Les réseaux, Eyrolles, 2000.
4. O. Hersent, La voix sur IP : Déploiement des architectures, Eyrolles, 2006.
5. Amal Punchihewa, Bhim Dulal.IPTV-Internet Protocol Television: Understanding Basics to Next Generation IPTV Services and Technologies Paperback – May 11, 2013
6. Howard Greenfield, Wes Simpson. IPTV and Internet Video. Focal Press March 2007

Semester: 3

Teaching Unit: FTU 2.1.2

Subject 4: Web Technologies

Total Hours: 45h00 (Lectures: 1h30, Tutorials: 1h30)

Credits: 4

Coefficient: 2

Teaching Objectives:

Discover the content and structure of a web page that presents information on the internet. Learn the basics of the client-server model. Write and modify web pages using a standardized content description language.

Recommended Prerequisites:

Different types of networks.

Course Content:

Chapter 1: Introduction (2 Weeks)

- Introduction to the web: history of the internet and the web.
- The client-server model.

Chapter 2: Structure of an HTML Document (4 Weeks)

- Basics. Markup principles. XML and DTD.
- Key HTML tags (text formatting, layout, tables).
- Concepts of URLs and links. Frames. CSS.

Chapter 3: Client-Side Scripting Languages (3 Weeks)

- Introduction. JavaScript. VB Script. jQuery.

Chapter 4: Server-Side Scripting Languages (3 Weeks)

- Introduction. PHP. ASP. JSP.
- Database connection and manipulation.

Chapter 5: Advanced Web Technologies (3 Weeks)

- AJAX. JEE Framework: Struts.
- Web design.

Assessment Method:
Continuous assessment: 40%; Exam: 60%.

Bibliography:

1. Programmation Web avec PHP – C. Lacroix, N. Leprince, C. Boggero, C. Lauer – éditions Eyrolles
2. Vos premiers pas avec PHP 4 – J. Engels – éditions Eyrolles
3. Grand livre PHP4 & MySQL – G. Leierer, R. Stoll – éditions Eyrolles

Semester: 3

Teaching Unit: MTU 2.1

Subject 2: Practical Work on Wireless and Mobile Networks

Total Hours: 22h30 (Practical Work: 1h30)

Credits: 2

Coefficient: 1

Teaching Objectives:

Master the different techniques of wireless and mobile transmissions, as well as testing the corresponding networks.

Recommended Prerequisites:

Fixed and mobile communication systems.

Course Content:

- **Lab 1:** Installation and analysis of a Bluetooth network (WPAN).
- **Lab 2:** Installation and analysis of a Wi-Fi network (WLAN) with and without infrastructure (ad-hoc).
- **Lab 3:** Simulation of a WiMAX network, WiMAX station configuration: user and QoS management.
- **Lab 4:** Spectral analysis of wireless networks and electromagnetic field measurement (using, where possible, a spectrum analyzer, RF wattmeter, electromagnetic field detector, etc.).
- **Lab 5:** Monitoring and QoS evaluation of 2G, 3G, and, if possible, 4G radio networks.
- **Lab 6:** Simulation and planning of mobile radio networks using software (e.g., ATTOL).

Assessment Method:
Continuous assessment: 100%.

Bibliography:

1. Lin, Y. B., & Chlamtac, I. (2008). Wireless and mobile network architectures. John Wiley & Sons.2, 2008.
2. Gast, M. (2005). 802.11 wireless networks: the definitive guide. " O'Reilly Media, Inc.", 2005.
3. K. Al Agha, (2016) Wireless and Mobile Networks, Wiley, 2006.
4. A.K.Nayak, S.C.Rai, R.Mall , (2016), Computer Network Simulators Using NS2, Productivity Press, 2016.
5. R.Mutha, (2013), Performance Evaluation of AdHoc Routing Protocols By NS2 Simulation, LAP Lambert Academic Publishing, 2013.
6. G. Baudoin, «Radiocommunications Numériques T1: Principes, Modélisation et Simulation,» Dunod, Paris, 2007.
7. S. TABBANE, Réseaux Mobiles, Hermès science publications, 1997.
8. Stéphane Lohier, Dominique Présent. Réseaux et transmissions - 6e édition. Protocoles, infrastructures et services. NFO SUP, Dunod janvier 2016.
9. **Aurélien Géron.** WiFi professionnel. La norme 802.11, le déploiement, la sécurité. Dunod**23/09/2009**
10. Pujolle, “ Les Réseaux ”, Ed Eyrolle, 8ème édition, 2014.

Semester: 3

Teaching Unit: MTU 2.1

Subject 1: Practical Work (Lab) on Cryptography and Network Security

Total Hours: 22h30 (Practical Work: 1h30)

Credits: 2

Coefficient: 1

Teaching Objectives:

Present, study, and program network security mechanisms.

Recommended Prerequisites:

TCP networks, Applied Mathematics.

Course Content:

- **Lab 1:** Programming a Feistel round cipher system in Matlab.
- **Lab 2:** Image encryption in Matlab using encryption modes.
- **Lab 3:** Generation of DES encryption keys.
- **Lab 4:** Programming in Matlab to perform polynomial addition and multiplication (binary chain) in the AES field.
- **Lab 5:** Configuration and setup of a DMZ firewall (simulated or real).
- **Lab 6:** Configuration of an IPsec VPN between routers (simulated or real).

Assessment Method:
Continuous assessment: 100%.

Bibliography:

1. O. Paul, “Prévention des dénis de service dans les réseaux publics“,Sécurité des systèmes d’information, 2003.
2. F. Raynal, “Canaux cachés“, Sécurité des systèmes d’information, 2003.
3. T. Noel, “IP Mobile“, Sécurité des systèmes d’information,2002.
4. D. Trezentos, “Standard pour réseaux sans fil: IEEE 802.11“, Sécurité des systèmes d’Informations, 2002.
5. C. Chiaramonti, “Échange de données informatisées“, Sécurité des systèmes d’information, 2001.
6. **Gilles Dubertret.** Univers secret de la cryptographie. **Vuibert 20/11/2015**
7. Damien Vergnaud**.** Exercices et problèmes de cryptographie. Licence 3, master, écoles d'ingénieurs. Editeur(s): Dunod**. 07/01/2015**

Semester: 3

Teaching Unit: MTU 2.1

Subject 3: Practical Work (Lab) on Web Technologies and VoIP

Total Hours: 22h30 (Practical Work: 1h30)

Credits: 2

Coefficient: 1

Teaching Objectives:

Write and modify web pages using a standardized content description language. Introduce students to the components and mechanisms of multimedia, and analyze and monitor the elements of multimedia data chains.

Recommended Prerequisites:

Different types of networks. Coding and compression, Digital Communications.

Course Content:

- **Lab 1:** Review of IP, UDP, RTP, TCP/IP, RTSP, HTTP, etc.
- **Lab 2:** Configuration and setup of a web server.
- **Lab 3:** Generation of HTML pages, adding CSS and JavaScript.
- **Lab 4:** VoIP and QoS: SIP server and client configuration, codec evaluation.
- **Lab 5:** VoIP frame analysis with Wireshark: SIP session analysis, VoIP frame capture.
- **Lab 6:** Video streaming in unicast, multicast, and broadcast (wired and wireless networks): using VLC, FFMPEG, etc.

Assessment Method:
Continuous assessment: 100%.

Bibliography:

1. Programmation Web avec PHP – C. Lacroix, N. Leprince, C. Boggero, C. Lauer – éditions Eyrolles
2. Vos premiers pas avec PHP 4 – J. Engels – éditions Eyrolles
3. Grand livre PHP4 & MySQL – G. Leierer, R. Stoll – éditions Eyrolles
4. C. Servin, Réseaux et télécoms, Dunod, Paris, 2003.
5. S. Déon, La téléphonie sur IP, Eyrolles, 2010.
6. G. Pujolle, Les réseaux, Eyrolles, 2000.
7. O. Hersent, La voix sur IP : Déploiement des architectures, Eyrolles, 2006.
8. Y. Amal Punchihewa, Bhim Dulal.IPTV-Internet Protocol Television: Understanding Basics to Next Generation IPTV Services and Technologies Paperback – May 11, 2013
9. Howard Greenfield, Wes Simpson. IPTV and Internet Video. Focal Press March 2007

Semester: 3

Teaching Unit: MTU 2.1

Subject 4: Artificial Intelligence

Total Hours: 37h30 (Lectures: 1h30, Practical Work: 1h00)

Credits: 3

Coefficient: 2

Teaching Objectives:

Master the use of machine learning techniques for data classification and prediction in telecommunications networks.

Recommended Prerequisites:

Optimization theory, signal and image processing, statistical models, development environment (Python).

Course Content:

Chapter 1: Concepts of Artificial Intelligence (AI) (2 weeks)

- Definition of AI: Imitation of human intelligence
- Components of intelligence
- Designing an AI system: Objectives, system elements, machine learning
- Steps in designing an AI system: Problem formulation, problem decomposition, learning, system evaluation, system deployment
- Learning approaches: Unsupervised, supervised, semi-supervised, transfer learning, reinforcement learning
- Examples of AI applications: Natural language processing, expert systems, pattern recognition, robotics

Chapter 2: Unsupervised Learning (2 weeks)

- Introduction
- Taxonomy of unsupervised learning algorithms
- K-Means algorithm
- Applications

Chapter 3: Supervised Learning via Regression (2 weeks)

- Introduction
- Linear regression
- Polynomial regression
- Logistic regression
- Applications

Chapter 4: Supervised Learning via Neural Networks (3 weeks)

- Introduction
- Neural representation: The Perceptron
- Neural network architectures (Single-layer and multi-layer perceptrons)
- Optimization criteria for multi-layer neural networks
- Learning algorithm for multi-layer neural networks
- Applications

Chapter 5: Deep Learning via Convolutional Networks (3 weeks)

- Introduction
- Convolutional Neural Networks (CNN): Principles
- CNN architectures: Convolution, Rectification, Batch normalization, Pooling, Flattening, Fully connected layers, Softmax
- Optimization criteria: Cross-entropy loss, least squares criterion
- Hyperparameter tuning
- Example architectures (VGG, ResNet, AlexNet, GoogleNet, etc.)

Chapter 6: Reinforcement Learning (3 weeks)

- Introduction
- Principles of reinforcement learning
- Q-Learning algorithm
- Applications

Practical Work in Artificial Intelligence

- **PW1**: Data understanding and preparation: Familiarization with AI libraries (Keras, TensorFlow, scikit-learn, PyTorch), preparing data for learning applications.
- **PW2**: Unsupervised learning: K-Means algorithm for data classification.
- **PW3**: Supervised learning via logistic regression: Designing a data prediction model (e.g., churn prediction, received signal strength prediction).
- **PW4**: Supervised learning via artificial neural classification (Multi-layer perceptron model): Signal classification, image classification, digital modulation classification, radio interference signal detection.
- **PW5**: Deep learning via convolutional networks: Applications in object recognition, spectrum detection for LTE signal identification, radio coverage overrun detection.
- **PW6**: Reinforcement learning: Using the Q-Learning algorithm for resource allocation in telecommunications networks.

Assessment Method: Continuous assessment: 100%

Bibliographic References:

1. D.Sarkar, R. Bali, T. Sharma., Practical machine learning with python : A Problem-Solver's Guide to Building Real-World Intelligent Systems. practical-machine-learning-python-problem-solvers.pdf (kre.dp.ua)
2. Machine learning with python : tutorials point, Machine Learning with Python (tutorialspoint.com)
3. F. Chollet, 2018. Deep learning with python, Deep Learning with Python (wordpress.com)
4. R.S.Sutton., A .J. Barto, 2018. Reinforcement learning : an introduction, Reinforcement Learning: An Introduction, 2nd Edition - PDF Drive
5. F. Richard Yu, Y. He, 2019. Deep Reinforcement learning for wirless networks, Edition Springer.
6. F.L. Luo, 2020. Machine learning for future wireless communications, Edition Wiley.

Semester: 3

Teaching Unit: DTU 2.1

Subject 1: Elective Subject

Total Hours: 22h30 (Lectures: 1h30)

Credits: 1

Coefficient: 1

Semester: 3

Teaching Unit: DTU 2.1

Subject 2: Elective Subject

Total Hours: 22h30 (Lectures: 1h30)

Credits: 1

Coefficient: 1

Semester: 3

Teaching Unit: TTU 2.1

Subject 1: Document Research and Thesis Design

Total Hours: 22h30 (Lectures: 1h30)

Credits: 1

Coefficient: 1

Teaching Objectives:

Provide students with the necessary tools to search for and utilize information effectively for their final year projects. Guide them through the steps of writing a scientific document and emphasize the importance of clear, rigorous, and pedagogical communication.

Recommended Prerequisites: Methodology of writing and presentation.

Course Content:

Part I: Document Research

- **Chapter I-1**: Topic definition (2 weeks)
- **Chapter I-2**: Selecting information sources (2 weeks)
- **Chapter I-3**: Locating documents (1 week)
- **Chapter I-4**: Processing information (2 weeks)
- **Chapter I-5**: Bibliography presentation (1 week)

Part II: Thesis Design

- **Chapter II-1**: Thesis structure and steps (2 weeks)
- **Chapter II-2**: Writing techniques and standards (2 weeks)
- **Chapter II-3**: Workshop: Critical study of a manuscript (1 week)
- **Chapter II-4**: Oral presentations and defenses (1 week)
- **Chapter II-5**: Avoiding plagiarism (1 week)

Assessment Method: Exam: 100%

Bibliographic References:

1. M. Griselin et al., Guide de la communication écrite, 2e édition, Dunod, 1999.
2. J.L. Lebrun, Guide pratique de rédaction scientifique : comment écrire pour le lecteur scientifique international, Les Ulis, EDP Sciences, 2007.
3. A. Mallender Tanner, ABC de la rédaction technique : modes d'emploi, notices d'utilisation, aides en ligne, Dunod, 2002.
4. M. Greuter, Bien rédiger son mémoire ou son rapport de stage, L'Etudiant, 2007.
5. M. Boeglin, lire et rédiger à la fac. Du chaos des idées au texte structuré. L'Etudiant, 2005.
6. M. Beaud, l'art de la thèse, Editions Casbah, 1999.
7. M. Beaud, l'art de la thèse, La découverte, 2003.
8. M. Kalika, Le mémoire de Master, Dunod, 2005.

Semester: 3

Teaching Unit: DTU 2.1

Subject 1: Internet of Things

Total Hours: 22h30 (Lectures: 1h30)

Credits: 1

Coefficient: 1

Teaching Objectives:
Provide students with foundational knowledge of IoT architecture, equipment, protocols, and platforms, as well as data collection, storage, and processing. Students will also learn to identify security risks in IoT applications.

Recommended Prerequisites:
Basic networking concepts, IP routing, advanced digital communications.

Course Content:

- **Chapter 1**: Introduction to IoT (1 week)
- **Chapter 2**: Physical architecture and IoT equipment (4 weeks)
- **Chapter 3**: Communication in IoT systems (4 weeks)
- **Chapter 4**: IoT systems connected to the Cloud (5 weeks)
- **Chapter 5**: Applications and security in IoT systems (2 weeks)

Assessment Method:
Exam: 100%

Bibliographic References:

1. Jim Cooke, “Cloud Computing: The New Economics of IT”. CISCO,2011.
2. Imad Saleh, “ Les enjeux et les défis de l'Internet des Objets (IdO) ”. Internet des objets1,2017.
3. Polepaka, Sanjeeva & Das, M. & Kumar, R., “Internet of Things and Its Applications: An Overview”. In book: Advances in Cybernetics, Cognition, and Machine Learning for Communication Technologies,2020.

Semester: 3

Teaching Unit: DTU 2.1

Subject 1: Field Networks

Total Hours: 22h30 (Lectures: 1h30)

Credits: 1

Coefficient: 1

Teaching Objectives:

Introduce field networks or fieldbuses, which connect multiple entities of a system within a limited geographical area (e.g., factories, workshops, automotive, embedded electronics), considering real-time network reduction or extension.

Recommended Prerequisites:
Knowledge of different network types.

Course Content:

- **Chapter 1**: Overview of fieldbuses (3 weeks)
- **Chapter 2**: Different field networks (3 weeks)
- **Chapter 3**: RS485 Modbus (3 weeks)
- **Chapter 4**: CAN (Computer Area Network) (3 weeks)
- **Chapter 5**: Profibus (Process Field Bus) (3 weeks)

Assessment Method:
Exam: 100%

Bibliographic References:

1. Authors : groupe de travail Ciam. ‘’ Réseaux de terrain. Critères de sûreté de fonctionnement’’. Editeur : Hermès. Année d’édition 2009.
2. Jean-François Hérold, Olivier Guillotin, Patrick Anaya. ‘’ Informatique industrielle et réseaux’’. Editeur Dunod. Année d’édition 2010.