Networks and Telecommunications
ENSEA - RT 3rd Year Academic Track

RT_1 Digital communications principles (6 ECTS)

RT_3500 Digital Telecommunications (Lectures: 18h / Tutorial classes: 16h / Lab: 20h)
This course is designed to introduce the concepts of modern digital communications, which are the basis for impressive increases in the information transmission and in the quality of transmissions on wireless networks (WiFi, 4G, 5G, BlueTooth, etc.). This course is based on the knowledge acquired in the second year in Digital Communications (Minor Signal).
The practical labs, which use the Matlab software for matrix calculation, will allow to deepen the theoretical concepts and to apply them in a system of concrete communication. After reminding the benefits of digital communications in relation to analogue communications, we will study in detail the aspects that have contributed to the development of new information and communication technologies.
The following points will be explored:
- very high-speed communications, high spectral efficiency, constellation diagrams;
- wireless channel modeling (mobile radio), levelling techniques;
- OFDM multi-carrier communications;
- error-correcting coding: convolutional codes and decoders, introduction to Turbo-codes and associated LDPC codes.

RT_3510 Transmission Mediums (Lectures: 12h / Tutorial classes: 12h / Lab: 16h)
This module is dedicated to the study of transmission channels in a broad definition: radio channel, twisted pair, optical fiber. The study of the supports will be based on the following standards and on the notion of sizing the canal.
Metal supports:
- Coaxial line
- Mismatching
- Losses and weakening
- Two-wire line
- Linear distortions
- Twisted pairs
- Diaphonies
Optical fiber communications:
- Multimode fibers, single mode fibers, bandwidth.
- Technology: manufacturing, cables, connections, reflectometry.
- Optical components: couplers, multiplexers in wavelength, switches.
- LEDs, laser diodes, photodiodes, optical amplifiers, fields of use.
- Optic fiber transmission systems and networks, design of a link.
Radiocommunications:
- Real propagation channel
- Index gradient
- Multipath and Fresnel ellipsoid
- Hydrometeores
- Critical elements: intermodulation and noise

- Notion of availability
- Satellite communications

RT_2 Wireless communications (4 ECTS)

RT_3535 Wireless communications (Lectures: 22h / Tutorial classes: 18h / Lab: 20h)
In this course the high-speed transmission techniques and multiple access used in the current standards are presented. The first part is focused on the parameterization of the physical layer of these systems (useful flow rates, symbolic flow rate, code output…). In the second part, several techniques are presented in order to improve the performance of
layer-level access of wireless telecommunications. Practical work in Matlab allows to study the performance of multi-antenna systems, power allocation techniques and retransmissions.
- Wireless channels (Rayleigh model). Capacity of wireless channels and cut-off probability.
- Power allocation: waterfilling
- ML detection, design of ML detection systems for wireless communication
- Spectrum widening techniques, frequency gaps, CDMA
- MIMO systems: diversity techniques at reception and emission, Alamouti code, techniques of spatial multiplexing.
- MIMO-OFDM systems. Ex: DVB-T and ADSL. Analysis of WiFi (802.11.a/g/n) and 4G (LTE) systems.
- Multiple access in OFDM.
- Acknowledgement and retransmissions (ACK/NACK, ARQ, Hybrid-ARQ). Application: HSDPA
- Medium access and collision (ALOHA, CSMA).
Application: Wifi
- Frequency reuse in cellular systems.
Application: GSM, LTE.

RT_3 Networks (5 ECTS)

RT_3536 Network Protocoles (Lectures: 8h / Tutorial classes: 10h / Lab: 12h)
The objective of this course is to train engineering students to design applications based on a data transmission network. Although mainly based on TCP IP protocols, other protocols will also be studied. The content of this course covers the analysis of the different protocols. Finally, an introduction to the architecture of network services will conclude the course.
- General concepts and main characteristics of communication protocols.
- OSI reference model. Protocols standardization.
- Local networks. Access methods, static/dynamic allocation, centralized/decentralized management.
- CSMA/CD, token techniques.
- TCP/IP-Internet protocol stack.
- Architecture definition and dimensioning. Model of Erlang for circuit-switched networks, model of queues for packet-switched networks.
- Real-time protocols. Application to voice over IP (RTP).
- Client/server architectures. 3-tier architecture,
N-tier architecture.
Laboratory analysis of network protocol under IP.

RT_3534 Network Interconnection (Lectures: 14h / Tutorial classes: 6h / Lab: 24h)
- The notions of IP addressing and sub-addressing

- The creation of an IP addressing plan
- Definition of architecture
- Routing protocols: RIP, OSPF, BGP, MPLS
- Congestion control, TCP Tahoe, TCP Reno
- Quality of service
- Software defined networking

RT_4 Network architecture and security (5 ECTS)

RT_3529 Architecture of Information Systems (Lectures: 6h / Tutorial classes: -h / Lab: 2h)
The aim of the course is to understand the key elements of a telecommunication information system, its architecture and its implementation model:
- Role of the information system (IS)
- The interfaces of the telecommunication network with the IS and the data exchanged,
- Steps in defining an IS architecture, stages of implementation (TOGAF method). Model Publisher/Integrator
- Operational processes and concepts (ITU M.3050, eTOM)
- SOA Applications and Architecture
- Cases of functional treatment of information: activation, maintenance and invoicing of service. Application for corporate VPN networks, FTTH and Mobile.

RT_3521 Java for Networks (Lectures: 4h / Tutorial classes: -h / Lab: 20h)
This training is designed as an extension of Second-year Java course. More specifically, it deals with the creation of network services in Java using specific packages for networks. The creation and use of sockets is fundamental in this course.
- Recap on Java: operators, operator overloading and functions, classes, builders and destroyers, inheritance and interfaces.
- Client-server applications on UDP
- Client-server applications over multi-threaded TCP

RT_3532 Network Security (Lectures: 16h / Tutorial classes: 2h / Lab: 12h)
- Economic vulnerabilities and challenges.
- Communications security, encryption.
- Flow control: firewall.
- Detection of network attacks.
- Implementing and testing a firewall on a network platform.

RT_5 Project (5 ECTS)

RT_3549 Networks and Telecommunications Lab (Lectures: -h / Tutorial classes: -h / Lab: 40h)
Each student will deal with a theme of his or her choice, either on the field of "telecommunications", or in the field of "networks" (high-speed coding techniques, distributed storage, Massive MIMO, network virtualization, VPN solutions, streaming applications, sensor networks, IoT platforms, software radio...) The objective is to obtain a functional demonstrator.

RT_3550 Conferences (Lectures: 10h / Tutorial classes: -h / Lab: -h)
The lectures are delivered by professionals working in this specialty field and are focused on current issues. The topics may vary from one year to the next depending on the evolution of the techniques.
- Free Internet, dematerialization of environments and connected objects, what impact on telecommunication companies? (PSA Group)
- Corporate network architectures (data, voice and data services, security) and their developments (PSA Group)
- The challenges of 5G (National Frequency Agency)

SH_3EME Humanities (5 ECTS)

DSH_3000 Human Resources Management and International Management (Lectures: 16h / Tutorial classes: 6h / Lab: -h)
This transversal training offers:
- an awareness of labor law specifically for the engineer: employment contract, expatriation, working environment in the company
- managerial aspects dealt within a multicultural context such as team management, corporate culture, professional projects…
- accounting aspects: employee cost versus human capital.

DSH_3060 English (Lectures: -h / Tutorial classes: 24h / Lab: -h)
The objective of the third-year courses is to make the students able to work in English and have a good command of the language.
The goal is achieving a professional use and to reach, at least, a B2 level requested do obtain the degree.
Two third-year options are grouped together for English courses. Level groups can be formed. The students will be able to work on different aspects of life professional (communication in different settings, in the office, abroad, in seminars, through writing, orally, case studies...), by carrying out work groups and putting in practice the knowledge they have acquired throughout their training.

DSH_3061 FLE (French for foreigners) (Lectures: -h / Tutorial classes: 24h / Lab: -h)
The main goal of this class is training the foreign students through communication fundamentals for everyday life, proposing them an introduction to French culture and civilization and more advanced knowledge in order to work in a French company during the final internship period.