ESIGELEC 2020-2021
2nd Year – Semester 7
COMMON CURRICULUM REQUIREMENTS

Sciences et Techniques de l'Ingenieur

ENGINEERING & SIGNAL PROCESSING 2: 5 ECTS Credits

(ATEC C1-F) Automatic Control Engineering for energy & Signal Processing 2: 1.5 hours lecture, 17 hours class, 45 hours laboratory

Objectives

Within a given framework students should be able to use various techniques with digital filters and correctors in order to respect design specifications; and incorporating what they learned in ATS

Coursework

1) Be able to create a simplified multi-physics model for an (energy-transition) application
2) Be able to analyze given design specifications
3) Be able to choose the best corrector structure to set up (forward path, feedback path, PID)
4) To be able to set up a corrector for a given set of design instructions
5) To be able to analyse results obtained by using diverse methods of synthesis and set parameters
6) To be able to calculate parameters for IIR and FIR (Finite Impulse Response & Infinite Impulse Response) filters from given design specifications for a given application
7) To be able to analyse, compare, and interpret experiment results

ELECTRONIC ENGINEERING: 3 ECTS Credits

(EL2 C1-F) Modulation: 1 hour lecture and 16 hours laboratory

Objectives **Modulation**

- Explain the principles and importance of amplitude and frequency modulation; recognize their timing diagrams and related spectrums
- Put together a receiver (a vital step for understanding digital modulation) and choosing the best adapted components
- Put together a modulator + receiver/demodulator setup and interpret the results

Coursework **Modulation**

- Amplitude modulations and demodulations, frequency changing receiver, frequency modulation, comparing types of modulation

(EL2 C2-F) Digital Conversion: 1 hour lecture, 16 hours laboratory

Objectives **Digital Conversion**

- Master principles of conversion: ADC (Analog-to-Digital Converters) and DAC (Digital-to-Analog Converters)
- Put together the output/input relation from a converter's topology
- Put together common ADC and DAC (8 bits/1MHz)

Coursework **Digital Conversion**

- Sampling, Shannon limit, ADC / DAC

I.T.: 3 ECTS Credits

(IN2 C1-F) Cybersecurity: 11 hours class, 7 hours laboratory

Objectives:

- Cybersecurity; what is at stake. Students will be able to explain the need for cybersecurity and define the main risks and their characteristics
- To learn and put into place the basics for cybersecurity

- Describe some of the pillars of cybersecurity

Coursework

- Part 1: Fundamentals of cybersecurity
- Part 2: Guidelines for basic IT security
- Part 3: Network and applications concerns
- Part 4: Managing cybersecurity in an organization

(IN2 C2-F) I.T. Networks and Operating Systems: 10 hours class, 20 hours laboratory

Objectives: students will be able to

- Put together a network respecting given design specifications and define the network address; also be able to verify the network by using a network simulator.
- Explain the importance of networks relaying various equipment and show the importance of a network in relation to an isolated usage.
- Choose the appropriate equipment (hub, switch, bridge, router, firewall) when working with design specifications (local network, interconnected networks, etc.)
- Show the importance of layers (OSI, TCP/IP) in the context of an open system and explain the role of protocols in communication networks
- Choose the network topology most appropriate according to design specifications (size of network, equipment configuration, response time, etc.)
- Explain the concepts behind physical (MAC) and logical (IPv4 et IPv6) addressing
- Explain the function of different fields of Ethernet frames (layer 2 OSI) and interpret the importance of each type of field for a given Ethernet frame
- Explain the role of different fields for an IP packet (layer 3 OSI) and interpret the value of each of the fields for a given IP packet
- Describe the usefulness of each of the protocols used for the internet internet (HTTP, FTP, DNS, SMTP-POP3/IMAP, Telnet) and explain the necessity of a port for each
- Identify the various fields for an HTTP query given and explain how they are composed based on the client/server mechanism
- Configure network parameters for Linux and Windows
- Simulate an IT network
- Analyze IP, ICMP, ARP protocols

Coursework

- Principles of teleprocessing (network structures, communication equipment, transmission characteristics)
- OSI and TCP/IP models (why these models, concepts and protocols)
- Putting together networks with materials (physical layer)
- LAN technology (data link layer)
- Principles of IP addressing (V4 and V6)
- Network layer protocols (ARP, RARP, BOOTP, IP, ICMP)
- Signal transmission (analog, digital, modulations, etc.)

EMBEDDED SYSTEMS: 6 ECTS Credits

(SE2 C1-F) Microprocessor Architecture: 5 hours lecture, 19 hours laboratory, 26 hours tutored instruction, 20 hours project

Objectives

- To be able to extract the relevant information from technical documents written in English.
- Cite examples of applications that incorporate embedded programmable electronics
- Describe the architecture of a microprocessor and its major functions
- Establish the relationship between memory mapping and implementing a software application in a system
- Describe the purpose of a simple program (20 lines or less) written in assembler and/or C language and analyze potential calculation or operational problems
- Explain the difference between types of data handled in microprocessors
- Design, write and test a small C language program intended for a microprocessor
- Use the library of given functions to create an application respecting certain design specifications
- Create, design and put together a demonstrator depending on a given need
- Present in a succinct manner results from technical tasks
- Put together, from the technical documents of micro-controller, the following: timer, analog-digital converter, entry-exit, bang-bang control / on-off controler
- Design, write and test a C language program that respects design specifications and using the elements listed above

- Be able to transpose the information learned to other microcontrollers and peripherals

Coursework

- Digital and electronic in today's world
- What constitutes and embedded system
- General overview of microprocessor architecture
- The vital signs of a microprocessor
- The varieties and organizations of electronic memory
- Handling exchanges between processors and memory
- Handling data in a microprocessor
- Language for developing applications
- Fundamentals of assembly programming
- Using an integrated development environment
- Using the basic functions of debugging
- Writing an application in C language on a MSP430
- The role of entry-exit
- The varieties of interfaces
- User protocols
- Bang-bang controller
- Front detectors

LANGUAGES & MANAGEMENT: 5 ECTS Credits

(LG2 C1-A) English: 32 hours class

Objectives

To continue improving knowledge and skills in practical and professional English; TOEIC preparation

Coursework:

- Coursework is common to all students but classes are in level groups.
- Writing an internship report in English, sales and E-tailing, marketing, recruitment and interviewing, money and finance, talking about graphs and charts, social English (telephoning, at restaurants, everyday situations), and TOEIC practice

(LG2 C2) 2nd Language: 18 hours class

Coursework: Students continue to progress in their chosen language.

(LG2 C3-F) Financial Management: 21 hours class

Objectives

- Students will acquire the basics of general accounting and financial analysis
- Understand how the financial workings and statements of a company are put together; be able to read various financial documents and interpret and critique them.
- Put together a financial diagnostic in order to assess if a business is viable and profitable
- Understand how businesses are financed
- Be able to put together functional and financial analyses

Coursework

- The importance of financial data for the ensemble of parties involved, each with their own set of needs
- How accounts work
- The organizational structures of accounting
- How financial / accounting acts are chronicled
- Putting together financial statements and result statements
- The steps in a financial diagnostic
- Activity and profit analysis: intermediary balance, ability for auto finance, economic and financial profit (leverage / negative gearing)
- Analysis of financial equilibrium: functional tests, cash flow statements, financial positions and what they mean

(LG2 C4-F) Project Management: 6 hours of lecture, 6 hours class

Objectives

- Students will acquire organizational skills and general methodology for managing projects and learn how to envision and adapt to various professional situations using real-world examples from industry.

Coursework

- Studying the methods and tools used to manage projects
- Modern and innovative professional management practices
- The study of "good practices" and commonly accepted practices
- The management of complex inter-relations between players
- Understanding the different types of projects and contracts

2020-2021
2nd Year - Semester 7
COMMON CURRICULUM - TECHNICAL REQUIREMENTS

Modules d'Ouverture[1] / Parcours Technologique[2]

ELECTRONICS MAJORS / *Parcours Électronique*

(EL 2O1-F) Connected Electronics: 4 hours lecture, 4 hours class, 44 hours laboratory (4 ECTS credits)

Objectives

- For students to learn the fundamentals of electronic systems designed with sensors and that can relay information

Primary Objectives

- To put a radio transmission chain and information relay into place using analog sensors

Secondary Objectives

- To be able to define and analyse system limitations for a wireless transmission / receiver system
- To be able to read and find key information in datasheets
- To be able to identify key characteristics of components of a transmission / receiver system so as to select the most appropriate
- To identify signal constraints to design better systems by adjusting the architecture
- To learn how to size components for efficient system functioning
- To learn how to simulate different parts of the transmission and reception chain of events
- To learn how to identify the effects of channel propagation on the quality of reception
- To learn how to simulate a complete transmission / reception chain taking into account disturbances and the channel effect
- To learn how to measure and determine characteristic parameters (tension, frequency, amplitude, etc.) of sensors and (VCO) voltage controlled oscillators
- To learn how to interface an circuit board using Arduino and a computer in order to collect, store, and monitor information
- To learn how to summarize the tasks completed for a project and present them.

(EL 2O2-F) Frequency Synthesis: 4 hours lecture, 8 hours class, 39 hours laboratory (4 ECTS credits)

Objectives

- For students to learn how to put together a Phase Locked Loop (PLL) system and synthesizers

Primary Objectives

- To set parameters for digital and analog synthesizers
- To calculate parameters for digital and analog synthesizers
- To measure functioning and locked modes of a PLL system

Secondary Objectives

- To be able to explain the loop gain of an oscillator
- To be able to explain the transfer function of a PLL
- To be able to characterize phase comparaison and the VCO (Voltage Controlled Oscillator) of a PLL
- To be able to cable and lock a PLL for a phase lock or demodulation
- To be able to cable and validate a working synthesizer

Coursework

- PLL and dynamic studies
- Analog synthesis and Dual Modulus
- DDS (Direct Digital Synthesis)
- Putting it all together with a project

(EL 203-F) Project: Airport Lighting System: 1 hour lecture, 24 hours laboratory, 28 hours

[1] Term used on the Excel spreadsheet
[2] Term used in the Word document

project (4 ECTS credits)

Objectives

- To size a complete energy conversion chain

Specific objectives

- To analyse / experiment / interpret client needs and transpose them into design specifications
- To give operating diagrams (first-order and detailed)
- To know the different varieties of solar panels and how they work
- To choose an energy storage method according to its technology, pollution characteristics, overload tolerance, and so on.
- To size a switch-mode power supply and its suitable controller
- To assess the feasibility of a solution
- To size and choose a solar inverter
- To measure system performance
- To put a test bench in place, choose measuring apparatus in order to measure the characteristics of a solar panel system
- To write a technical report and defend design and system choices satisfying client specifications

ELECTRICAL ENGINEERING MAJORS / *Parcours Génie Électrique*

(GE 201-F) Energy Production and Conversion: 11 hours lecture, 7 hours class, 11 hours laboratory

(2 ECTS)

Objectives

- For students to learn about and analyse various energy sources;
- Be able to explain and design an energy production conversion schema for wind power

Coursework

- The different forms of primary energy: solar, wind, biomass, heat pumps, nuclear, and so on.
- Their use, impact on the environment,
- Calculate the cost of the various forms of energy
- Understand energy storage problems
- Understand how alternators function (stator, rotor, etc.)
- Understand magnetoelectric conversion with synchronous machines functioning as generators
- Mathmatical modelling for three-phase alternators
- Understand how modelling works for alternators in no-load and load trials
- Understand the necessary precautions to take when coupling an alternator with an energy supply
- Calculate active and reactive power either produced or absorbed in a synchronous machine during a load trial
- Learn about the various types of wind turbines
- Analyze how the various forms function
- Understand the necessary steps for wind turbine installation
- Calculate the power generated by a wind turbine in a wind farm
- Learn how power is fed into energy networks from wind farms
- Modelling and simulation of power generation from wind energy supply chains

(GE 202-F)[3] Automation: 6 hours class, 20 hours laboratory

Objectives

- This course will allow students to conduct analyses of simple industrial systems using Grafcet.
- Students will program automated logic controllers using their Grafcet analyses.

Coursework

- Analyses methods and design methodology using Grafcet
- Structure and language of a Siemens controller
- Analysing, programming and testing simple industrial systems

[3] No ECTS credits attributed in the Excel file

I.T. ENGINEERING MAJORS / *Parcours Informatique*

IN 201-F + IN 202-F = 4 ECTS credits

(IN 201-F) Website Design and Construction: 4 hours lecture, 4 hours class, 14.25 hours laboratory

Objectives

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

- Explain:
  - How the internet and Web function together
  - What HTTP is
  - What a client and web server is
  - The role PHP, HTML, CSS and Javascript languages play
  - The principal steps of a web-based project
  - The importance of validation for web site security
- Design and rollout a web site
  - That is dynamic
  - That respects the principles of contents separation and presentation
  - Respects HTML5, CSS and w3c norms
  - Secured against SQL injections and defacement
  - Using Git (a version control system)

Coursework

This course develops the following notions:

- Relation between the Internet and the Web, HTTP, clients and servers, Web languages
- Designing and structuring a website
- Using PHP to work with formulas
- Dynamic websites: preprocessors, sessions, data bases

Labwork involves:

- HTML: creating hypertext links and inserting photos
- CSS / Javascript: putting together a document and animating it
- Coding a webpage from a given model

Project work will have 3 phases

- Putting together and planning the design and structure
- Creating the website and rolling it out
- Presentation of the site and its hosting service

(IN 202– F) TCP/IP Network Interconnection: 8 hours lecture, 2 hours class, 16 hours laboratory

Coursework

- Fundamental protocols for networks: the IP protocol
- Basics: network architecture and norms: characteristics, OSI reference model, TCP/IP model
- IP addressing: address classes, private/public addresses, NAT/PAT address translation and subnets
- IP routing: static and dynamic, distance vector, link state, hybrid
- Layer 2 switches: basic functions, transmission, STP (Spanning Tree Protocol), VLANs (Virtual Local Area Network)
- Fundamental principles of configuring Cisco routers and switches: presentation of components, starting processes, configuration files, HyperTerminal configuration, IOS (Internet Operating System) and various configuration modes.
- Basic router configuration: host name, passwords, interfaces, test commands
- Configuring and IP router: configuring static and default routing, dynamic routing (RIP, OSPF, EIGRP)
- Configuring a switch: basic commands, configuring an administrator IP address, managing VLANs (creating, modifying, deleting), creating a trunk, putting a STP into place.

EMBEDDED SYSTEMS MAJORS / *Parcours Systemes Embarqués*

SE 201-F = 4 ECTS credits

(SE 201-F) LabVIEW / Instrumentation and Systems: 4 hours lecture, 19 hours class, 30 hours laboratory

Objectives

- Identify the various elements that make up data acquisition

- From design specifications (doing simple physics measurements incorporating sensors, conditioning electronics and a converter) to be able to identify the essential parameters for data acquisition (resolution, measurements, precision and frequency)
- Select a sensor according to design specifications
- Explain the phenomenon of aliasing from a sinusoid example and define the cut-off frequency for the aliasing filter
- Define the elements that make up a LabVIEW program and the user tools to create one
- Describe the types of data that users can control in LabVIEW and their codifications
- Explain the notions of command/control, indicator, constant, function, VI (virtual instruments) and Express VIs
- Using and explaining loops in LabVIEW
- Create a program in LabVIEW made up of loops and with fewer than ten programming elements
- Explain the steps involved in creating a subVI in LabVIEW
- Describe the Measurement and Automation Explorer (MAX) and what it does
- Use MAX to verify and generate analog and digital signals
- Configure a Data Acquisition (DAQ) depending on the application
- Develop a program in LabVIEW for the acquisition or generating data. The program must adhere to design specifications and incorporate feedback and property nodes

Coursework

- Introduction to instrumentation: data acquisition in a measurement and control system, fundamental constituents of data acquisition, instrumentation vocabulary, methodology for studying problems in instrumentation
- Characteristics of data acquisition processes: extent of measurement, precision, resolution, speed, sampling and aliasing
- Sensor technologies and the associated physics: position encoder, binary position encoder, load cells
- LabVIEW software: discovering the environment, creating and developing programs, functions, VIs, and Express VIs, tools, debugging, programming with data flow, types of data, help, creating with a VI, loops, nodes, graphs, data acquisition, case and sequence structures, tables and documents, personalizing, clusters

2020-2021
Semester 8
2nd Year COMMON CURRICULUM

Enseignements Transversaux

English, 2nd Language, Electives, and Human Resources
ET 201, 202, 203, and 204 = 3 ECTS credits

(ET 201-A) English: 18 hours of class

Objectives: To continue improving knowledge and skills in practical and professional English; TOEIC preparation
Coursework:

- Common coursework / classes are in level groups. Themes this semester are money and finance, talking about graphs and charts, social English (telephoning, at restaurants, everyday situations), and TOEIC practice

(ET 202) 2nd Language: 18 hours of class

Coursework: Students continue to progress in their chosen language.

(ET 204-F) Human Resources Workshop: 2 hours lecture / class

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

- Optimize their search for an internship or employment
- Recognize the advantages and dangers of their e-reputation
- Putting together a marketable CV

Coursework

- A conference on how to make the most of today's research tools for finding a job or employment
- A CV workshop led by company Human Resource professionals.

(ET 203-F) Electives: 18 hours class: *Students choose one of the following electives*

* *Marketing*

Objectives
Introduce students to the fundamental notions and principle constituents of a marketing culture; to define essential steps of marketing attitudes and work methods; to develop personal ideas as relating to current marketing evolutions
Coursework
Market studies, buyer behaviour, strategic analysis, marketing decisions, marketing mix variables, direct marketing

**Business Building*

Objectives
To provide the necessary technical and economic elements needed to create a business
Coursework
Market studies, choosing a market, how to advertise and network, client-supplier relations

**Management Control / Accounting*

Objectives

- Familiarize students with management control, its place in companies, the fundamentals, tools, role and its principle tasks
- Be able to calculate and interpret production costs (using a specific method), partial costs, benefits, and the break-even point
- Be able to analyze business changes from the point of view of the break-even point, and understand the limits of these types of analyses
- Understand what a budget and variance are in management control
- Be able to put together - while considering sales predictions and a planning budget - a cash budget, income statements, and financial statements
- Have an idea about how variance is calculated by studying some real-world figures
- Bring together the notions of financial development and investment; calculating investment flow, return rates, net present values, interpreting the aforementioned figures and understanding their limits
- Understand what a balanced scorecard is and understand how, and of what it's put together

Coursework
1) Management control and its missions

The need for management, its place in companies, organizational concerns

2) Calculating costs

What's at stake, total cost, a specific method for calculating, partial costs, the break-even point, other methods for calculating costs

3) Managing budgets – a first approach

Planning and managing a budget, the general budget, the investment budget and its links to finance, variance and business figures, fundamental notions of and analyzing variance, fundamentals of balanced scorecards and a first approach

∗*Company Strategies* - *Course description currently unavailable*

∗*Problem Analysis and Resolution Methodology*

Objectives

- Students will be able to assess the quality of information, distinguish between facts and opinions, and be able to define a problem
- Students will be able to use problem-solving methodology, and use it wisely
- Students will learn about decision-making tools
- Students will learn how to assess, measure, generalize and standardize a solution to a given problem

Coursework

- Definition of a problem / Problem-solving methodology / Problem-solving tools (ABC-analysis, fishbone diagrams, fault-tree analysis, the 80-20 rule and so on) / Decision making tools / Applying solutions

∗*Promoting process change in companies impacted by IT projects*

Objectives

- The professor will explain the fundamentals of change management and steps for business transformations
- Students will interpret the behind the scenes ideas
- Non-verbal communication analysis to be a more effective communicator
- Extrapolation techniques to recognize tentatives for manipulation
- Real-world examples to see how methodology can be applied
- Comparing two methods of change management (by profession or by I.T.)
- Role plays to learn the art of persuasion
- Explain the major steps of a transformative project

(ST 201-F) 2nd Year Internship: 10 ECTS Credits

(P 201–F) Engineering Projet & (P202-A) English: 5 ECTS Credits

Objectives

This project is an opportunity for students to

- exercise their initiative and independence,
- improve their organizational skills (within a team, respecting deadlines and budgets) manage their time,
- improve their communication skills,
- as well as providing a real-world situation close to their future professional environments

Coursework

Project stages include:

- putting together groups and researching possible projects
- technical and economic feasibility studies
- putting together functional specifications and success strategies

ENGLISH: 10 hours

- This Engineering project incorporates English language work targeting projects & presentations (adapted to a student's English skill-level)

2020-2021
ESIGELEC
2ND YEAR / Semester 8
CORE COURSEWORK - *Les Dominants*

Coursework for the following majors:

ARI - *Industrial Automation and Robotics*

BDTN – *Big Data*

CERT – *Networks and IOT Cybersecurity*

EDD – *Energy and Sustainable Development*

ESAA – *Electronic Systems for Auto and Aerospace Engineering*

GET – *Electrical Engineering and Transport*

IA DES – *Business Engineering: Energy & Signals*

IA IR – *Business Engineering: I.T. & Networks*

ICOM – *Telecommunications Engineering*

IF – *Financial Engineering*

ISE-OC – *Embedded Systems Engineering: Communicating Objects*

ISE-VA – *Embedded Systems Engineering: Autonomous Vehicles*

ISN – *I.T. Services Engineering*

ISYMED – *Medical Systems Engineering*

MCTGE – *Mechatronic & Electrical Engineering*

MAJOR: ARI
INDUSTRIAL AUTOMATION AND ROBOTICS

ELECTRIC ACTUATORS - 4 ECTS Credits

(ARI 201-F) Electric Actuators: 28 hours lecture, 12 hours class, 20 hours laboratory

Objectives

For students to understand and be able to size an electric actuator such as inverters, dimmers, four-quadrant choppers, etc.

Coursework

- To understand and analyze how a single-phase dimmer works
- To understand and analyse how flyback and forward switching mode power supply (SMPS) works
- To understand and analyse how circuits work with commutation
- To understand and analyse how 1, 2 and 4-quadrant choppers work and how they function with DC (direct current) motors
- To understand and analyse how single and three-phase inverters work and how they function with alternating current motors
- To understand and analyse harmonic problems incurred by aforementioned setups

INDUSTRIAL SYSTEM CONTROL - 4 ECTS Credits

(ARI 202-F) Industrial System Control: 18 hours lecture, 6 hours class, 36 hours laboratory

Objectives

For industrial systems with supervision and communication systems, students will study how to use complex functions and structure data exchange.

Coursework

- To be able to configure and structure automated systems
- To be able to set up digital functions for industrial systems
- To be able to analyse and design a program to be used by a controller
- To be able to implement digital and analog conversions
- To exchange data by industrial networks
- To be able to configure a supervision system with a tactile screen with functions

DIGITAL CONTROL - 4 ECTS Credits

(ARI 203-F) Digital Control: 26 hours lecture, 6 hours class, 28 hours laboratory

Objectives

To learn how to choose and calculate a digital controller by using the mathematical model of a transfer function or state model

Coursework

- Describing sampling and render a continuous system discrete
- Using modified and inverted Z transforms
- Modelling discrete systems (impulse response, transfer functions, equations and state representations)
- Analyzing discrete systems according to stability, speed and precision
- Design a digital controller (when system performance is insufficient) using various methods
- Design a direct-current motor and its control system in a laboratory setting
- Analyse controllability and observability of discreet systems
- Design a real-time digital controller
- Complete a laboratory model of digital control

MAJOR: BDTN

BIG DATA for DIGITAL TRANSFORMATION

BUSINESS INTELLIGENCE = 4 ECTS credits

(BDTN 201-A[4]) Business Intelligence: 16 hours lecture, 18 hours class, 24 hours laboratory (course in English)

Objective – Taking a BI project from design to implementation

- Recognize and use the language of I.T. systems architecture
- List and describe various types of architectures
- Analyse and comment on a type of architecture
- Describe the importance of decision architecture
- Define some decision architectures
- Understand the constraints related to information quality and quantity
- Design and work with a multidimensional models
- Design a star schema adapted to a company's BI needs
- Explain the roles of various players for IT projects and most notably that of the architect
- Explain the various life cycle phases for a BI project

With the help of SAP Business Objects and BDD Oracle, the student will be able to

- Put in place a data warehouse (DW) meeting specific needs
- Define various tables (aggregate, detail, dimension, fact)
- Write SQL queries to contribute to the warehouse
- Define queries
- Complete a BI project

CLOUD COMPUTING ARCHITECTURE = 4 ECTS credits

(BDTN 202-F) Cloud Computing Architecture: 22 hours lecture, 36 hours laboratory

Objectives – Implementing Cloud services

- Explain the various types of Cloud architectures
- Chose an architecture based on client needs
- Using DevOps computing for Cloud
- Create and use an ASP.NET solution with Visual Studio
- Make data available via a web service
- Use a BI solution with Saa S (Software as a Service)
- Bringing information together with SharePoint

Pre-requisites

- Object oriented programming with Java
- Website design
- Network services

GEOGRAPHIC DATA SCIENCE = 4 ECTS credits

(BDTN 203-F) Geographic Data Science: 22 hours lecture, 36 hours laboratory

Using raw data, be able to document the process for obtaining data ready to be integrated into a Geographical Information System (GIS). Produce an analysis responding to specific constraints requiring a GIS, then putting one into place.

Objectives

- Explain the steps in data cleaning, analysis, and exploratory data analyses
- Complete a massive data analysis using data collected with R and Python
- Produce a document with R markdown and Python Jupyter
- Integrate and project data cleaned in a GIS
- Complete an analysis corresponding to a real-world need
- Automate analyses with ModelBuilder and API Python
- Apply acquired knowledge in cross-data to work with Open Data

[4] Same course as IAIR 201

MAJOR: CERT
NETWORKS AND IOT CYBERSECURITY

DIGITAL SECURITY
ASR 203, 205 & 206 = 4 ECTS credits

(ASR 205-F) Cryptography: 20 hours lecture

Objectives

- To explain where problems in I.T. security or telecommunications systems come from
- Explain how cryptographic systems work and how they are used to provide security services
- To apply various security techniques incorporating cryptography for a local company network

Coursework

- The origin of network weaknesses which lead to hacker attacks
- The role and characteristics of communication protocols
- An example: *Data Link* Control (*HDLC*) *Protocol*
- The various types of encryption and their limits
- Identification methods in a network
- Network security IPsec protocol and TLS *(Transport Layer Security)*
- Access control for services

(ASR 203-A) Information Systems Security: 20 hours lecture (course in English)

Objectives

- To set up a secure architecture for a company's IT system; work with standard architectures and incorporating new technologies (IOT 4.0 and Big Data) while assuring continuity of service to clients

Coursework

- Typical security architectures used in companies
- Organizational security – standards and good practices
- The players assuring security in a company
- Threats and risks linked with information systems
- Preventive countermeasures and plans
- Detection and reaction to IT attacks

(ASR 206-F) Systems Access & Authentication: 12 hours lecture, 8 hours laboratory

Objectives

- Design a program (PHP, C or Java) to interact (search, add, modify, delete) with an Open LDAP server
- Explain the interest of a directory in a company
- Install and configure an Open LDAP server with Windows and Linux
- Explain an access rights configuration file that has never been seen before
- Explain the schema of a class that has never been seen before
- List some attributes and explain them
- Correctly use the basic commands (administrator and client) for Open LDAP
- Produce an LDIF file for an organization
- Accurately describe how a twenty-line program works

Coursework

- Directories and Identity Management
- Background of directories and introduction to LDAP (X500 and LDAP standards)
- LDAP directories and their applications: information systems security and e-commerce
- The LDAP standard: LDAP models (information, designation, service, security)
- Directory access interfaces
- Designing a directory (content, access rights, tree structure)
- Introduction to LDAP server topology (distribution, replication)
- Password management tools, identification / single sign-on and access control tools
- LDAP APIs

ETHICAL HACKING & FORENSIC ANALYSIS
ASR 202 & 207 = 4 ECTS credits

(ASR 202-F) Ethical Hacking: 20 hours lecture, 20 hours laboratory

Objectives

- To explain and implement various attack techniques used by hackers and deploy solutions to protect against them

Coursework

- Introduction to Ethical Hacking / Footprinting and Recognition / Network scans / Enumeration technique / Pirating systems / Malware threats / Sniffing / Social Engineering / Denial of Service / Session hijacking / Web Server Hacking / Web Application Hacking / SQL Injection / Hacking into wireless networks / Hacking mobile platforms / IDS, Firewalls and Honeypots / Cloud computing / Cryptography

(ASR 207-A) Forensic Analysis: 20 hours lecture (course in English)

Objectives

- To understand the field of computer forensics
- Explain computer structure and operating systems
- Explain network, cloud, and mobile device investigation
- To master the tools of investigative methodology

Coursework

- Introduction to forensic analysis
- Scientific principles specific to computer forensics
- The structure of computers and operating systems
- Network investigation, cloud and mobile devices and investigation
- Investigation tools and methodologies
- Examining, acquiring, and preserving electronic evidence

NETWORK SERVICES & QUALITY OF SERVICE
ASR 201 & 204 = 4 ECTS credits

(ASR 201-F) Quality of Service in TCP/IP Networks: 6 hours class, 24 hours laboratory

Objectives

This course aims to:

- Explain the concepts involving TCP/IP networks, for example address translation, filtering and routing
- Enable students to configure routers and Cisco switches when the network has multiple segments
- Explain and assess QoS models, and show configuration schemas for the DiffServ model

Coursework

- Fundamentals of TCP/IP network connections
- Access control lists
- Marking and classifying
- Organizing and managing
- Traffic management (FIFO, PQ, CQ, WFQ, CBWFQ, LLQ)
- Congestion management (WRED)

(ASR 204-F) Network Services: 2 hours lecture, 7 hours class, 21 hours laboratory

Objectives

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

- explain the role that the main internet services play
- install, set-up and use services such as Web servers, FTP, DNS, mail, Active Directory, Firewall, Proxy, etc.
- secure access to a network via a firewall and proxy set up with Linux

Coursework

- Configuring a network using Linux and Windows
- Installing a web server with Windows
- Installing a mail service with Windows
- Installing a firewall with Linux
- Installing a DNS (Domain Name Server) with Linux and Windows / Active Directory
- Configuring an internet proxy with an antivirus with Linux

MAJOR: EDD

ENERGY AND SUSTAINABLE DEVELOPMENT

RENEWABLE ENERGIES

EDD 201, 202, 203, 204 = 7 ECTS credits

(EDD 201-F) Wind Turbines: 14 hours lecture, 4 hours class, 12 hours laboratory

Objectives

- For students to be able to size a large wind farm, including being able to complete a study on its impacts
- The goal of this course is to equip students with the pertinent knowledge of the technical aspects of wind turbines (how they work, principles, technologies, energy production) and the installation of wind farms for small or large energy production needs

Coursework

- Aerodynamics and limitations for wind turbines
- Wind turbine architecture (blades, hydraulic circuits, brakes, energy conversion chain, generators, etc.)
- Sizing
- Regulations for wind parks (small and large)
  - Installing and operating
  - Urban legislation and regulations
  - Researching sites and studying potential
- Connecting wind turbines / parks to national electricity grid
- Profitability of wind turbines
- Complete study of a wind park installation (sizing, calculating energy production, environmental impact, site design, etc.)

(EDD 202-F) Smart Grid: 20 hours lecture

Objective

- The objective of this course is to introduce the concept of Smart Grid which is a bi-directional electric and communication network that improves the reliability, security, and efficiency of the electric system for small to large-scale generation, transmission, distribution, and storage. It included software and hardware applications for dynamic, integrated, and interoperable optimization of electric system operations, maintenance, and planning; distributed generation interconnection integration; feedback and controls at the consumer level".

Coursework

- Introduction and Definitions
- Conceptual Mode
- Stakeholders & Drivers
- Applications & Technologies
  - Advanced Metering Infrastructure
  - Smart Meter
  - Distribution Grid Management
  - Advanced Control systems
  - Renewables Integration
  - Energy Storage
  - Electric Vehicle integration

(EDD 203-F) Solar Energy: 21 hours lecture, 9 hours laboratory

Objective

- For students to know how to use solar energy as a source of heat and electricity

Coursework

- Estimations of power production, principles, sizing, cell properties, technologies, inverters, recycling, protections, lightning protections, economic concerns, investments, administrative concerns, players in the field, and so on.

(EDD 204-F) Solar Energy Projects: 20 hours lecture

Objective

- For students to learn how to deal with a call for tender for a photovoltaic power station

Coursework

- Using PVSOL software to estimate electricity production of a solar park / calculating shade and solar access (Solmetric Suneye tool)
- Using PVSOL software to choose and define elements of a solar park
- Using SolarCalc to calculate electric safety parameters and connection to electricity grid

ELECTRICAL ENGINEERING
EDD 205, 206, 207 = 5 ECTS credits

(EDD 205-F) Converters and Electric Machines: 17 hours lecture, 4 hours class, 9 hours laboratory

Objectives

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

- describe the various systems used to convert electrical current (direct and alternating)
- manipulate the speed of electric motors (direct or alternating) while considering they electrical parameters (U, I) and functions (speed and torque)
- calculate the loss of power by switching and propose solutions to inhibit power loss

Coursework

- Direct-current machines, alternating-current machines, control law, direct-direct current converters, pulse wave modulated undulators, alternative converters, and so on.

(EDD206-F) Electric Vehicles: 30 hours lecture

Objectives

For students to understand the limitations of electric vehicle projects in industry

Coursework

- The history of electric vehicles
- The various types of electric vehicles and their components (battery, electronic systems, etc.)
  - Micro Hybrids, Mild Hybrids, Full Hybrids and Electric vehicles
- The current market
- How the different systems of electric vehicles function
  - DCDC, Inverters, Power Modules

(EDD207-F) Electric Networks: 14 hours lecture, 6 hours laboratory

Coursework

Transport and energy distribution, electrical protection, grounding, design and construction of an electrical installation, and so on.

MAJOR: ESAA

ELECTRONIC SYSTEMS FOR AUTO AND AEROSPACE ENGINEERING

SYSTEM DESIGN = 2 ECTS credits

(ESA 201-F) System Design: 16 hours lecture, 3 hours class

Objectives

For students to learn the various steps involved in the development of electronic systems and be able to apply what they have learned to a simple example scenario.

Coursework

- To work using the V-model methodology for developing electronic products for the fields of auto and aerospace engineering. Students will see the importance of the various steps of this process. There will be examples and illustrations of situations.

TESTING & MEASURING 1

ESA 202 & 203 = 5 ECTS credits

(ESA 202-F) Electronic Measuring Devices 1: 16 hours lecture, 8 hours class, 16 hours laboratory

Objectives

For students to learn the functions and operating modes of standard electronic measuring devices; students will learn how to use them in order to characterize electronic setups.

Coursework

- Vector Network Analyser
- Spectrum Analyser
- Impedance Analyser
- C-V measurements and I-V measurements
- Advances oscilloscope functions
- Generating complex signals
- Functions, uses and design of measuring devices

(ESA 203-F) Automated Testing with LabView: 12 hours lecture, 8 hours class, 20 hours laboratory

Objectives

For students to configure a measuring apparatus developed from a LabVIEW HMI (Human-Machine Interface) and be able to deal with the generated data and present it in a specific manner.

Coursework

- Introduction to LabVIEW and VI (Virtual Instrument) programming
- Communication buses and measuring devices (GPIB, LAN, USB)
- Instrument drivers
- Exercise: Designing a HMI for an electronic measuring device used in the ESA 202 course

ELECTRONICS

ESA 204 & 205 = 2 ECTS Credits

(ESA 204-A) Digital Electronics: 8 hours lecture, 4 hours class, 8 hours laboratory *(Course in English)*

Objectives

For students to put together and test a logical function in programmable logic

- Using a schema editor to describe a function
- Using VHDL to describe an asynchronous function
- Using VHDL to describe a synchronous function
- Using a simulator to validate the workings of a function by using a digital timing diagram

Coursework

- Introduction to various programmable logics (PAL, GAL, PLD, FGPA)
- VHDL (concurrent and sequential statements)

Laboratory work

- Use a schema editor to validate the function of a clock
- Code and validate a Binary Code Decimal (BCD) 7-segment decoder
- Code and validate a data recovery function on a data stream

(ESA 205-F) CAD: 4 hours lecture, 16 hours laboratory

Objectives

For students to use simulation tools to make predictions about electronic systems or functions, interpret results and make necessary modifications to attain pre-set objectives.

Coursework

- RF simulation with ADS
- BF simulation with PSPICE
- System simulations with SystemView

COMMUNICATION SYSTEMS
ESA 206 & 207 = 3 ECTS Credits

(ESA 206-F) Signal Integrity: 7 hours lecture, 4 hours class, 8 hours laboratory

Objectives

For students to be able to predict and interpret wave forms coming from exchanges between a transmitter and receiver on a line; for students to be able to choose a method of calculation or measurement to obtain specified wave shapes.

Coursework

- Transmission lines and digital signals and propagation phenomena; reflection coefficient; tools for analysing an impulse response; TDR (Time Domain Reflectometer); eye diagrams

(ESA 207-A) Wireless Communication: 16 hours lecture, 2 hours class *(Course in English)*

Objectives

For students to be able to describe the main elements of wireless communication and how they work; for students to be able to size a wireless communication link while considering potential limitations.

Coursework

- Fundamentals of wireless communication; transceiver architecture; digital modulation; link budget; antennae; examples of models of propagation; noise; calculating bit error rate (BER); examples of systems used in the automobile and aerospace fields (Bluetooth, 66GHz collision avoidance Radar, GPS, and so on.)

MAJOR: GET
ELECTRICAL ENGINEERING AND TRANSPORT

ELECTROMECHANICAL CONVERSION
GET 201, 202, 203 & 204 = 6 ECTS Credits

(GET 201-F) Static Converters: 14 hours lecture, 4 hours class, 12 hours laboratory

Coursework

- Fundamentals and introduction to AC / DC converters
- DC / DC converters: Buck, Boost, Buck-Boost, multi quadrant choppers
- DC / AC converters: power converters (single phase, three phase), Fourier analysis and transforms of harmonics, loss of power
- Electronic speed controllers and their use

(GET 202-F) Power Conversion and Control: 10 hours lecture, 4 hours class, 8 hours laboratory

Objectives

- For students to learn about the various types of power converters
- Students will be able to design control for a power converter

Coursework

- PWM (Pulse Width Modulation) control for single-phase and three-phase power converters
- Digital control for converters

(GET 203-F) Electrical Machines and Control: 16 hours lecture, 4 hours class, 6 hours laboratory

Objectives

- For students to study and learn about alternating-current machines and control

Coursework

- Introduction and fundamentals of alternating-current machines
- 3-phase asynchronous motor
- 3-phase synchronous machine
- Permanent magnet synchronous motor
- Vector control

(GET 204-F) Vehicles and Communication Networks: 12 hours lecture, 6 hours laboratory

Objectives

- To develop and design embedded electronics systems using CAN and LIN
- To analyze existing structures and architectures

Coursework

- Economic aspects of the automobile industry
- Mechanical / electronic interfaces
- Electronics and their functions in automobiles
- Embedded systems architecture
- Examples of making functions electronic
- Bringing multiple functions together (ABS, airbags, fuel injection, etc)
- New types of sensors
- TOR, PWM (Pulse Width Modulation), LIN (Local Interconnect Network), CAN (Controller Area Network)
- Innovation (multimedia, 42V)
- Computers, microprocessors, DSP (Digital Signal Processing), multiplexing, software
- Design specifications and limitations
- Examples of development
- CAN protocol: formatting a CAN bus data frame
- Description and characteristics of exchanges: encoding
- CAN physical layer
- Modes for management
- External characteristics
- Tools and components

- Examples of applications
- Exchange principles
- Error detection and processing
- Labwork (information exchange, CAN buse multiplexing)

ENERGY AND APPLICATIONS
GET 205, 206, & 207 = 6 ECTS Credits

(GET 205-F) Energy: 10 hours lecture, 2 hours class, 16 hours laboratory

Objectives

- To learn about the various types of energy, study the resources and consumption, and size an energy production unit
- To handle the various types of electrical energy conversion
- To analyse the effects of conventional energies
- To analyse the effects of renewable energies
- To learn about energy storage and transfer
- To handle the tools used for sizing (PV Sol, Windpro, etc.)

Coursework

- Introduction: Quick review of physics (force, strength, kinetics)
- Producing electric energy
- Converting electric energy
- Renewable energies: wind turbines, solar, hydraulic (waves and tides)

(GET 206-F) Energy in Transport Systems: 26 hours lecture, 2 hours class, 6 hours laboratory

Objectives: To study railway electrification, hybrid and electric vehicles

Coursework

- Traction control systems
- Electromagnetic compatibility in railway transport
- Electric vehicles
- Hybrid vehicles
- Batteries
- Electric motorization
- Characteristics of electric machines

(GET 207-F) Energy Management: 11 hours lecture, 2 hours class, 9 hours laboratory

Objectives

- Students will be expected to understand the various infrastructures allowing electricity to be brought to consumers
- To study disturbance in three-phase electric networks
- To learn how three-phase transformers are grouped
- To master the tools for electrical design (i.e. TR-CIEL, Caneco HT and BT, AutoCAD MEP, Ecodial)

Coursework

- Trouble-shooting in electric networks by studying the symmetrical components
- Distribution networks, components and dimensions
- Security issues and protections
- Grounding
- Design and construction of an electrical system

MAJOR: IA-DES[5]

ENERGY and SIGNALS

ENERGY AND HIGH VOLTAGE
IA DES 201, 202, 203 = 4 ECTS credits

(IADES 201-F) Electric Power Distribution: 9 hours lecture

Objectives

- To study how electric networks function and are used
- To understand the development and management of electrical networks
- To acquire strategies to secure electrical networks
- To use software (CANECO) to size an installation according to design specifications

Coursework

- Introduction to energy distribution networks
- Fundamentals of electrical engineering
- Protecting energy networks
- Energy network voltage schematics

(IADES 202-F) Energy Project: 2 hours class, 8 hours tutorial

Objectives

- To propose an energy-saving solution for an installation while taking into account financial and technical aspects; then defend the given solution

Coursework

- A case study of cogeneration plant (technical aspects, carbon balance, energy resale)
- Tutored group-work project followed up with an oral presentation

(IADES 203-F) Commercial & Industrial Electrical Engineering: 13 hours lecture, 8 hours class, 12 hours laboratory

Objectives

- To size tertiary and industrial electrical installations (from transformer to distribution) respecting NF C15-00 European norms
- Propose a strategy for protecting a tertiary / industrial site
- Implement a solution complying with current regulations for various environments (i.e. ATEX, nuclear, aerospace, national defence)

Coursework

- NF C15-100
- Protecting electrical installations
- Electrical apparatus

BUSINESS ENGINEERING
IA DES 204 & 205 = 3 ECTS credits

(IADES 204-F) Business Engineering -Concepts and Tools: 28 hours lecture

Objectives

- Describe and explain the fundamental aspects that govern prospecting, conduct, and negotiation of a case
- Describe and qualify a given market
- Propose market segmentation from a net worth analysis
- Analyze the context of a given market
- Analyze client issues and build an offer meeting their needs as well as offering a convincing argument.
- Describe the specificities of public and private tender
- Explain the 5 stages of a life cycle
- Describe the content of a call for tenders, the procedure, and the mandatory elements of a response
- Explain the role and responsibility of the players when responding to a call for tenders

[5] In this document, IA DES's coursework has been organized according to the Excel spreadsheet and NOT the Word document

Coursework

- Situating your position
- Prospecting and piloting an offer
- Contracts and tenders
- How a call for tenders is put together and carried out

(IADES 205[6]-F) Excel for Professionals & Projects: 15 hours labwork

Objectives

- Create complex Gantt diagrams for an MS project (> 20 tasks)
- Use the main functions of MS Project and Excel
- Compose Excel pivot tables and VBA programs

Coursework

- Build a schedule with MS Project
- Basic Excel functions
- Pivot tables
- Introduction to VBA macros

LOW VOLTAGE

IA DES 205, 206, 207, 208 & 209 = 5 ECTS credits

(IADES 205-F) Wireline Networks: 4 hours lecture, 6 hours class

Objectives

- Interpret the characteristics of a cable from a datasheet
- Size a connection between two terminals while considering given specifications
- Analyze the architecture of a wireline network for digital data and voice communication, and be able to describe the characteristics specific to ADSL
- Analyse the architecture of a wireline network for powerline communications
- Point out the advantages and drawbacks to the major types of coding for digital signals used with wireline networks

Coursework

- Characteristics, norms and certification of wireline networks
- Telecom networks / ADSL, modulation and frequency division multiplexing (FDM)
- Wireline network architecture via powerline telecommunication (PLT)
- Coding used in wireline networks

(IADES 206-A) Wireless Networks: 12 hours lecture, 2 hours class, 2 hours tutorial (Course in English)

Objectives

- To learn about the fundamental concepts around wireless and mobile networks
- To describe the phenomena governing wireless communication (radio), communication protocols, coding and error correction.
- To design wireless communication solutions while considering available resources and an imposed zone of coverage
- To list the architectures, protocols and techniques for various wireless networks; to be able to give advantages and disadvantages, and fields of application for the aforementioned
- To describe how WPAN (Wireless Personal Area Networks) and WLAN (Wireless Local Area Networks) systems work and how they are run.
- To look at and assess the various solutions and technologies associated with the rollout of a wireless network

Coursework

- Basic principles of digital transmissions, transmission error detection, link budget
- The various wireless network architectures, cellular networks, private networks, ad hoc networks
- Data transmission with cellular and private networks
- Case study of sizing a radio communication system

(IADES 207-A) Fiber Optics: 7 hours lecture, 2 hours class (Course in English)

Objectives

- To list and describe the various technologies used with fiber optics

[6] In the Excel file, there are two IADES 205 courses (Excel & Wireline Networks)

- To be able to evaluate the types, connections and performance of various fiber optics
- To choose (amongst existing technologies) the right type of fiber optic when considering a specific application for a proposed network
- To calculate the transmission performance for an optical signal for a particular fiber optic

Coursework

- Structures, principles, performance and other topics related to fiber optic networks
- Fiber optic systems: optical transmission performance, communication systems infrastructures, various norms

(IADES 208-F) Building Management Systems (BMS): 12 hours lecture, 3 hours laboratory

Objectives

- To explain the principles of communication for building management systems
- Analyze the various contraints of a BMS (Building Management System) / BAS (Building Automation System)
- Put together a diagnostic and design specifications for a company or infrastructure's needs for a BMS
- Choose appropriate solutions for a given scenario

Coursework

- Home and building automation (BMS / BAS)
- Benefits of these systems
- Operating principles and components
- Applications
- Intelligent buildings
- Road traffic (modelling and management)

(IADES 209-F) Low Voltage Applications: 12 hours lecture, 3 hours class

Objectives

- Analyze and size a low-voltage installation working from design specifications and respecting legal norms

Coursework

- Fundamentals of low voltage in buildings
- Architecture: communication, support, installations
- Safety & security equipment: fire safety systems, sound systems, walkie-talkies, alarms, access control, video surveillance, and other equipment
- Energy management for lighting and technical systems

IA IR
I.T. and NETWORKS

BUSINESS INTELLIGENCE = 4 ECTS Credits

(IAIR 201-F[7]) Business Intelligence: 26 hours lecture, 8 hours class, 24 hours laboratory

Objectives – Taking a BI project from design to implementation

- Recognize and use the language of I.T. systems architecture
- List and describe various types of architectures
- Analyse and comment on a type of architecture
- Describe the importance of decision architecture
- Define some decision architectures
- Understand the constraints related to information quality and quantity
- Design and work with a multidimensional models
- Design a star schema adapted to a company's BI needs
- Explain the roles of various players for IT projects and most notably that of the architect
- Explain the various life cycle phases for a BI project

With the help of SAP Business Objects and BDD Oracle, the student will be able to

- Put in place a data warehouse (DW) meeting specific needs
- Define various tables (aggregate, detail, dimension, fact)
- Write SQL queries to contribute to the warehouse
- Define queries
- Complete a BI project

NETWORK ARCHITECTURE

IAIR 202, 203& 204 = 4 ECTS Credits

(IAIR 202-F) Network Architecture: 14 hours lecture, 10 hours class

Objectives

- Model the architecture of an operator network (backbone, NRA/NRO, Collection, local loop etc.) and its associated services
- Design a Wide Area Network (WAN), whatever type (MPLS/MultiProtocol Label Switching, IP Sec, etc) taking into account the technical and economic constraints (QoS needs, cost, bandwidth requirements)
- Carry out a LAN/WLAN redesign project taking into account limitations: number of ports required, POE budget, throughput, aggregation, distances, cable categories, etc.
- Model Cloud and Virtualization approaches, know how to present the impacts (advantages and disadvantages) in an already existing context in order to convince decision-makers (internal or customer)
- Realize a perimeter security architecture for a company WAN. Master UTM/Unified Threat Management functions. Know what types of threats UTM can address.

(IAIR 203-F) Quality of Service: 5 hours class, 15 hours laboratory

Objectives

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

- Explain concepts related to the interconnection of TCP/IP networks. For example, address translation, filtering, and routing.
- Complete an advanced configuration of Cisco routers and switches using a network architecture with several segments.
- Explain and evaluate QoS models and propose configuration diagrams of the DifServ model

(IAIR 204-F) Network Services: 6 hours class, 18 hours laboratory

Objectives

At the end of the Network Services module, students will be able to

- Set up services on a secure network architecture
- Describe the role of the main services (Web servers, FTP, DNS and mail, Active Directory) that can be set up on a network
- Install, configure and use some services on Linux or Windows: Web servers, FTP, DNS, email, etc.
- Secure network access using a firewall and proxy on Linux

[7] Same course as BDTN 201-A

BI PROJECT MANAGEMENT = 4 ECTS Credits

(IAIR 205-F) Business Intelligence (BI) Project Management: 20 hours lecture, 9 hours class, 21 hours laboratory

Objectives

At the end of this course students will be able to

- Analyze BI decision-making
- Implement a BI system architecture,
- Migrate a project from SAP-BO WEB BI4 to Microstrategy
    - SQL applied to BI, SQL: IBM DB2, The request as an analysis tool
- Acquire a methodology allowing students to carry out and manage a BI project
    - Respond to a given list of specifications
    - Carry out a team project

MAJOR: ICOM
TELECOMMUNICATIONS ENGINEERING

PHYSICAL LAYER
ICO 201, 202, 203& 204 = 4 ECTS Credits

(ICO 201 - F) Fiber Optics: 15 hours lecture, 3 hours class

Objectives

At the end of this course students will be able to

- calculate the attenuation of a fiber optic link
- calculate the maximum bandwidth for multimode or monomode fibers
- choose a type of fiber for a specific for a given problem

Coursework

Geometric optics

- Multi-mode and monomode fibers
- Dispersion and maximum flow
- Attenuation, loss and reflection
- Reflection and refraction, light

Telecom fibers

- FOP, OM1 to OM4, G652, G655, G657
- Production processes, cable laying and hook-up
- ST, SC, FC, LC connectors, PC (Physical Contact) polish and APC finishes, loss

Fibre measurements

- Attenuation, spectrums, reflectometry, precautions

(ICO 202 - A) Optical Components: 13 hours lecture, 3 hours class (Course in English)

Objectives

- To understand terminal active optical components, to choose the right components, to know how a laser works, to draw electric schemas with laser or photodiodes

Coursework

- LED and semiconductor lasers, principles, uses in telecom, performance
- How to modulate: direct light modulations, external electro-optical modulation, OOK and other modulation formats
- Photodiodes, how they work, how to choose, which schematics

(ICO 203 - F) Antennae: 11 hours lecture, 6 hours class, 6 hours laboratory

Objectives

- To understand microwave transmission
- Recognize types of antennae
- Target important information in technical documents for antennae
- Calculate a link budget using antenna gain

Coursework

- Dipole antenna, $\lambda/4$ antenna, Yagi aerial, Tri-sector antenna, Satellite dish, RFID antenna, Antenna gain, Link budget, Fresnel zone

(ICO 204 - F) Laboratory Fundamentals 1: 12 hours laboratory

Objectives

For students to learn how to

- Use and interpret the results of an optical time-domain reflectometer on a local and FTTH network.
- Measure parameters of fiber optic links and interpret the results
- Solder fiber optics and critique the after-product

Coursework

- Fiber optics
  - single-mode and multi-mode optical fibre reflectometry
  - Optical network simulation

ENCODING
ICO 205, 206& 207 = 4 ECTS Credits

(ICO 205 - F) Copper, Coding and Modulation: 19 hours lecture, 6 hours class

Objectives

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

- find the parameters of a copper cable in a reference guide and extrapolate the cable's performance capacities
- assess the usefulness of a certain type of coding
- select a type of digital modulation while considering the type of support and its capacity to serve a given application

Coursework

- Copper cables: coaxial cables and twisted-pair wire, measurements, how to limit static interference
- Coding: eye diagrams; 2,3,4 level coding; Ethernet
- Modulation
  - ASK, FSK, PSK, QAM
  - ODFM
  - Comparing performance
  - The ADSL (Asymmetric Digital Subscriber Line) example

(ICO 206 - F) Error-Correcting Code: 10 hours lecture, 6 hours class, 4 hours laboratory

Objectives

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

- Understand the value and limitations of detector/error-correction codes in digital transmissions.
- Understand the operation and use of the following codes: Linear block codes, Cyclic codes, Convolutional codes.
- Put into place cyclic codes using offset registers

Coursework

- Introduction
  - Interest of channel coding in digital transmissions, general operating principles
  - Linear block codes, principles, decoding rules, Hamming distance
  - Cyclical codes, properties, implementation
  - Convolutional codes, coding, decoding using the Viterbi algorithm.
- Classwork
  - Specific codes: Hamming codes, Cross-parity bit code, Autodual codes, Cyclic code C(7,4)
- Laboratory work
  - Studying binary division circuits, making a decoder and encoder for cyclic code C(7,4) with offset registers

(ICO 207 - F) Laboratory - Fundamentals 2: 12 hours laboratory

Objectives

For students to

- Measure the parameters of coaxial and twisted-pair cables
- Become familiar with wireless signal measuring tools
- Compare the characteristics of links and their performance by being able to interpret chronograms, specters and eye diagrams

Coursework

- Copper cables
  - Measurements
  - NRZ, RZ, and eye-diagrams (simulations)
- Hertz
  - QPSK and QAM (simulations)
  - NRZ, HDB3 and RF spectrum analysis
  - Measuring TNT signals

NETWORKS

ICO 208, 209, 210 & 211 = 4 ECTS Credits

(ICO 208 - F) Unified Communications & Networks: 13 hours lecture, 3 hours class

Objectives

- Explain the evolution of routing protocols in a unified communications network.
- Explain the development of convergence and protocol robustness (Is-Is) capabilities.
- Explain MPLS transmission techniques and the introduction of PBT (Provider Backbone Transport) for Ethernet-based services.

Coursework

- Transmission procedures: case study of the HDLC procedure
- Characteristics and functions of the protocols
- Routing techniques and autonomous systems
- Convergence and robustness of the Is-Is protocol
- Differentiated routing functions to strengthen QoS
- BGP (Border Gateway Protocol) routing
- PIM (Protocol Independent Multicast) multicast services
- The MPLS protocol: data and service plans
- The PBT for Ethernet-type services in the network of the access provider
- Routing protocols and network security

(ICO 209 - F) Excel: 12 hours lecture

Objectives

- To learn about and implement the main functions of Excel for telecom engineering
- Learn about VBA macros

Coursework

- movement, filters, creation, conditional formatting, display optimization, arithmetic and logic formulas, counting, search functions, tables and cross-dynamic charts, introduction to VB macros

(ICO 210 - F) Lab - Local Networks: 20 hours laboratory

Objectives

- Put together a complete LAN architecture made up of Cisco routers and switches with all the necessary network functions such as addressing, routing, switching, security (as established by a set list of project specifications).
- Doing simple configuration manipulations (host name, establishing password security, DHCP, etc.)
- Testing a basic configuration on Cisco interconnection equipement (switches, routers) in a local network using simple network functions (ping, telnet, arp, netsat, etc.)
- Putting together routing protocols (RIP, OSPF, EIGRP) in a given network with specifications
- Integrating the IP translation functions
- Defining a group of VLANs on Cisco switches to fulfil project specifications (such as dividing workgroups logically)
- Securing access to network resources by defining standard and more complex ACLs

Coursework

Fundamentals: Network architecture and norms

- OSI model
- MAC and IP addresses
- Interconnection equipment (routers, switches, hubs)
- Configuring a network with Cisco routers (passwords, IP addresses, DHCP)

IP routing

- IP routing, dynamic routing, using Cisco routers

IP addresses and NAT (Network Address Translation)

- Theoretical aspects (context, private/public IP addresses, why NAT)
- Configuring static NAT on Cisco routers
- Configuring dynamic NAT on Cisco routers
- PAT (Port Address Translation) on Cisco routers

Switches

- Basic functions, Frame transmission modes, Spanning-Tree,VLANs, putting together VLANs and Spanning-Tree protocol on Cisco routers

Local network security

- General principles
- Putting together ACLs (Access Control List) on Cisco routers

(ICO 211 - F) Radio-Frequency Identification (RFID): 6 hours laboratory

Objectives

- For students to understand how an RFID link works

Coursework

- Transmission standards at 125kHz, 13.56MHz, UHF / Features and performance / Information transfer / Products / Market and applications

MAJOR: IF
FINANCIAL ENGINEERING

FINANCIAL MARKETS

(IF 201-A) Financial Math and Applications: 16 hours lecture, 18 hours class, 22 hours laboratory = 3 ECTS Credits

Objectives

- Understand how trading functions
- Understand and master the fundamental concepts of interest rates, FX, equities and derivatives
- Use Python autonomously to put together a finance project
- Know how a trading room works and the fields involved
- Understand the concepts of proportional, actuarial and continuous rates (uses, specificities and notions of the different rates)
- Explain the essential concepts of discounting/capitalizing any sequence of cash flows
- Master the notion of Internal Rate of Return (IRR) of a sequence of financial transactions
- Calculate interest/cash loan installments
- Price any type of obligation according to various parameters as well as characteristics (Duration, Convexity, Sensitivity)
- Understand the notion of interest rate risk of an interest rate product
- Master the concepts of actuarial yield curve, zero-coupon yield curve and discount factor
- Get an overview of stocks and forex
- Global understanding and use of the different rate products

More practical objectives are:

- Understand the global architecture of Excel (Worksheet, Module, Functions, and so on)
- Programming in Python for a project in finance
  - Setting up the development environment
  - Discovery of the possibilities and syntax of Python
  - Introduction to the main libraries used in the world of finance (NumPy, Pandas, Matplotlib...) allowing to process time series, to generate financial graphs, to do mathematical calculations...

Students will complete a project in Python to process data and display a series of financial graphs.

(IF 202-A) Quantitative Analysis: 16 hours lecture = 2 ECTS Credits

Objectives

- Be comfortable with the notions of return and risk, know how to analyze data series, build a portfolio based on a risk/return ratio.
- Know the statistical functions of Excel and know how to use Python for quantitative analysis projects.

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

- Know what the return on a portfolio is, learn how to define and control the different risks
- Learn how to diversify a portfolio according to the assessed risk
- Learn how to determine the right level of risk based on desired returns
- Using the advanced functions of Excel (Statistical functions, Graphical representations, Data analysis with filters and sorting ...)
- Using Python: data analysis, filtering and sorting applications, graphical applications (histograms, linear regression curves...)

(IF 203-A) Market Risk: 18 hours lecture = 2 ECTS Credits

Objectives

To make students aware of market risks and various regulatory requirements. The approach will focus on credit derivatives (Bonds, CDS, CDS indices and synthetic products) and interest rate hedging products. A global approach to all types of financial products will also be addressed.

At the end of this module, the learner will be able to :

- Understand and calculate market risk indicators (Value at Risk, Stressed Value at Risk) on a portfolio and be able to explain them with risk factors as required by a regulator
- Understand and calculate market stress scenarios and be able to explain them with risk factors as required by the regulator.
- Understand and implement the current regulatory requirements requested by the European Central Bank for European Corporate Investment Banking.

At the end of this EU, students will have real knowledge of market risks in CIB. Instruction will be exclusively based on skills acquired through real-world experience. Exercises and case studies will be favoured for learning.

API.net Development & Microsoft Azur Cloud Computing

(IF 204-F) API.net & Microsoft Azur: 14 hours lecture, 34 hours laboratory = 3 ECTS Credits

Objectives: At the end of this course the student will be able to:

- Create a small application implementing a client/server database architecture. The application will be developed in a .NET environment with a SQL database. Agile methodology (related documentation also produced) using DevOps, Git, Docker and Azure will be used.
- Describe the Agile (SCRUM) process
- Produce precise specifications (functions are specified in a use case diagram)
- Design, build and test software written in C#.NET and ASP.NET using Agile processes
- Develop a class diagram that address a given problem (about 5 use cases and 5-10 classes) using a modelling tool such as Modelio
- Generate a database of about 4-5 tables from the model layer of the API, then extract the SQL script
- Estimate the cost of a software development project, with a given time-line, in a real-world context

Coursework

- Presentation of the Agile (SCRUM) method, the .NET environment, C#.NET, the code first approach, Docker, and Azure
- Writing design specifications
- Developing an application in 3 parts continuously integrating the Cloud Azure
  - ✓ API and BDD, clients, and testing

Programming languages C# and ASP.NET will be used. Projects will be developed then deployed on the AZURE Cloud.

ARCHITECTURE & I.T. AUDITING

(IF 205-F) Architecture & I.T. Auditing: 28 hours lecture = 2 ECTS Credits

Objectives

- Equip students with the fundamental notions, techniques and tools using for IT and architecture systems auditing

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

- Analyze and evaluate an existing architecture
- Complete an IT audit:
  - ✓ Define the risks associated with auditing (inherent, verification failure, non-detection, global)
  - ✓ Distinguish between compliance tests and substantive tests
  - ✓ Define statistical and discretionary sampling types
  - ✓ Describe the steps of an audit
- Propose solutions for improving an existing systems while respecting pre-determined design standards
- Design IT architecture

MAJOR: ISE-OC (Communicating Objects)
EMBEDDED SYSTEMS ENGINEERING

COMPLEX SYSTEMS DESIGN METHODOLOGY
ISE 201 & 202 = 4 ECTS Credits

(ISE 201-A) Fundamentals of Systems Approach: 16 hours lecture, 8 hours class *(Course in English)*

Objectives

- To review the elements of a systems approach and understand why it is used, what it is used for, (without the need to invoke all the theories of systems engineering) and applying it to real-world cases while gaining understanding of its contribution to project management.

Coursework

1) Introduction to systems engineering
2) Necessities and rationale
3) Operational analysis
3a) Context: What is it? How does it work? What is it for?
3b) Life cycle and phases
3c) Use case / life profile
4) Functional analysis
5) Specific case
6) Completeness
7) Link to organic analysis
8) The human side and real-world methods
10) Conclusion & summary

(ISE 202-A) Tools and Methods for Software: 6 hours lecture, 43 hours laboratory *(Course in English)*

Objectives

- Describe the principal norms for embedded system development
- Describe the principal consequences of these norms on software development
- Using the rules for writing in C (MISRA-C)
- Describe the main tools for software metrics and software validation
- Using C to develop embedded code incorporating the aforementioned notions

Coursework

- Norms IEC61508, DO178B, ISO26262 and others
- LDRA software validation tools
- Static or dynamic code analysis
- White box and black box testing
- Metrics for software (i.e. cyclomatic complexity)
- Testing limitations, coding tools, etc.

EMBEDDED I.T. and ELECTRONIC SYSTEMS
ISE 203 & 204 = 5 ECTS Credits

(ISE 203-A) Embedded Linux and Real-time: 10 hours lecture, 19 hours laboratory *(Course in English)*

Objectives

- To understand the possibilities and uses of the Linux as well as other operating systems for an embedded I.T. project
- To know the principle software tools used in the Linux/Unix world and how to use them to develop
- To be able to write a device driver for specific Linux run material

- To be able to combine tools to create advanced functions with a minimum of programming

Coursework

- Introduction to Linux
  - ✓ How an OS fits in an embedded system
  - ✓ History of Linux and Unix systems
  - ✓ Linux compared to other embedded OS
- Fundamental tools: command lines, shell scripts
- Linux development tools
- C programming with embedded systems
- Linux drivers
- Web connections and Remote Administration Tools (RATs)
- Compiling a Linux kernel

(ISE 204-A) Communication Buses: 14 hours lecture, 20 hours laboratory *(Course in English)*

Objectives: To overview wireless communication and how it relates to wired buses

Coursework

- The RS-232 / SPI (Serial Peripheral Interface) Bus / Bluetooth

COMMUNICATING OBJECTS
ISE 205 = 3 ECTS Credits

(ISE 205-A) Innovating with Android: 20 hours lecture, 20 hours laboratory

At the end of this course students will be able to

- understand the challenges and possibilities of mobile platforms
- use the Android development environment
- create a user interface
- develop communication applications
- develop an application using persistent data
- develop a multimedia application
- develop an application that works with Google maps
- make and publish an Android application

Coursework

- Embedded applications, possibilities, Android SDK
- Using views, creating advanced user interfaces
- Intent classes
- Persistent data
- Multimedia
- Geolocalisation
- Publishing

MAJOR: ISE-VA
(Autonomous Vehicles)
EMBEDDED SYSTEMS ENGINEERING
All courses are in English

METHODOLOGY FOR DESIGNING COMPLEX SYSTEMS
ISE 201 & 203 = 4 ECTS Credits

(ISE 201-A) Fundamentals of Systems Approach: 16 hours lecture, 8 hours class *(Course in English)*

Objectives

- To review the elements of a systems approach and understand why it is used, what it is used for, (without the need to invoke all the theories of systems engineering) and applying it to real-world cases while gaining understanding of its contribution to project management.

Coursework

1) Introduction to systems engineering
2) Necessities and rationale
3) Operational analysis
3a) Context: What is it? How does it work? What is it for?
3b) Life cycle and phases
3c) Use case / life profile
4) Functional analysis
5) Specific case
6) Completeness
7) Link to organic analysis
8) The human side and real-world methods
10) Conclusion & summary

(ISE 203-A) Tools and Methods for Software: 6 hours lecture, 43 hours laboratory

Objectives

- Describe the principal norms for embedded system development
- Describe the principal consequences of these norms on software development
- Using the rules for writing in C (MISRA-C)
- Describe the main tools for software metrics and software validation
- Using C to develop embedded code incorporating the aforementioned notions

Coursework

- Norms IEC61508, DO178B, ISO26262 and others
- LDRA software validation tools
- Static or dynamic code analysis
- White box and black box testing
- Metrics for software (i.e. cyclomatic complexity)
- Testing limitations, coding tools, etc.

I.T. & ELECTRONICS FOR EMBEDDED SYSTEMS
ISE 202 & 206 = 5 ECTS Credits

(ISE 202-A) Embedded Linux and Real-time: 10 hours lecture, 19 hours laboratory

Objectives

- To understand the possibilities and uses of the Linux as well as other operating systems for an embedded I.T. project
- To know the principle software tools used in the Linux/Unix world and how to use them to develop
- To be able to write a device driver for specific Linux run material
- To be able to combine tools to create advanced functions with a minimum of programming

Coursework

- Introduction to Linux
  - ✓ How an OS fits in an embedded system
  - ✓ History of Linux and Unix systems
  - ✓ Linux compared to other embedded OS
- Fundamental tools: command lines, shell scripts
- Linux development tools
- C programming with embedded systems
- Linux drivers
- Web connections and Remote Administration Tools (RATs)
- Compiling a Linux kernel

(ISE 206-A[8]) Communication Buses for Vehicles: 14 hours lecture, 20 hours laboratory

Objectives

- To study and understand the most widely used communication buses in the field of embedded processors, and understand the necessary corresponding specifications.

Coursework

- RS-485 / I2C BUS, SPI BUS / CAN/VAN BUS

AUTONOMOUS VEHICLES

ISE 207 = 3 ECTS Credits

(ISE 207-A) Trajectography: 16 hours lecture, 24 hours laboratory

Objectives

- Be able to choose the best sensors for localization
- Encounter and resolve the problems associated with creating an autonomous robot
- Use C++ (Objet) with RTmaps and STL.

Coursework

- Understanding the various sensors used for navigation and their advantages and drawbacks
- Using an accelerometer for localization (accounting for noise and sensor problems)
- Using Lidar to detect obstacles
- Piloting a robot to manoeuver a set of obstacles
- Using algorhythms to plan (the best possible) trajectory
- Make the system reactive enough to handle changes in the surroundings

[8] Same course title as ISE 202 in ISE-OC but not same course content

MAJOR: ISN

I.T. SERVICES ENGINEERING

METHODS AND PROGRAMMING
ISN 201 & 202 = 7 ECTS Credits

(ISN 201-F) Software Engineering Project Management: 12 hours lecture, 6 hours class, 12 hours laboratory

Objectives

- Learn the principle causes of software project failure
- Learn the cycle of development (defining a V-model and other methods)
- Explain the main differences between Agile methods and a V-cycle
- Understand the role of UML diagrams for development and list the steps in the models given
- Structure diagrams
- Understand varying design patterns and be able to explain them
- Describe with precision the link between a simple class diagram and the code generated
- Write precise software requirement specifications (IEEE 830-1993) when working from a simple situation
- Explain the main testing strategies and what code coverage is
- Calculate the budget of a project using a COCOMO (Constructive Cost Model)
- Explain why Software Configuration Management (SCM) is important
- Do testing with JUnit

Coursework

- The present situation and statistics relating to software project failures
- Estimating the time / money investment for software development
- Design specifications
- Using UML to design and create
- Practice with generating Java code
- Software testing
- Practice with JUnit
- Software and system configuration management
- Practice with subversion

(ISN 202-A) Java/JEE Programming: 12 hours lecture, 58 hours laboratory *(Course in English)*

Objectives

At the end of this course students will be able to put together a JEE application using a MVC2 architecture and incorporating a Mysql database. Development follows a V-model and yields the associated documents.

Objectives specific to Java EE

- Implement programs in Java from a UML model with active classes
- Implement graphical user interfaces using a framework for GUIs
- Given a specification implement a client server program using standard components in Java with threads
- Implement programs using a framework for database manipulations from a problem description
- A comprehensive introduction to server-side programming with Java Servlets and Java server pages (JSP)

Objectives specific to engineering

- Name and explain succinctly the 2 cycles of development for a project
- Estimate the cost and deadline of a development project in a real-world context
- Describe with precision the steps of the V-cycle (what the steps are, the documents used at each step, what deliverables are and their contents)
- Develop, put together and test Java EE software using the V-cycle and writing the following documents: design specification document, validation and verification document, preliminary and detailed design documents, validation documents
- Put together use class diagrams and use case diagrams that answer a given problem (5 user cases and 5-10 classes) using a modeling tool such as Modelio and automatic programming
- Modeling a data base with 4-5 tables with a UML class diagram, then producing the SQL script that goes with the Mysql Workbench tool
- Perfecting a software program that meets imposed design specifications
- Assess the quality of deliverables made by another team and providing justification for remarks
- Respecting deadlines

- Lay out and update a dashboard that tracks time allotted, used, left and non-billed for each project task

Coursework – Part 1
*Collections, Interfaces, Swing Applications, Threads and class diagrams, Network API, JDBC
Coursework – Part 2
*Servlets, JSP, mvc2 architecture, Bootstrap framework
Coursework – Part 3 (project)
*The cycles and stages of software development
*Writing and putting together design specifications
*Writing the preliminary design documents
*Writing the detailed design documents
*Putting together the data sets and the software development
*Final testing

C# PROGRAMMING and NETWORK SERVICES
ISN 203 & 204 = 5 ECTS Credits

(ISN 203-F) C# Programming: 8 hours lecture, 22 hours laboratory

Objectives

- Develop an graphic application (using Visual Studio.Net) in Visual Basic.Net using C# from given design specifications
  - using the principal functions of Framework.Net
  - putting together the majority of graphic elements
  - managing exceptions
  - using functions such as reading and file writing
  - connecting data bases and queries while respecting programming norms (comments, naming, presentation, etc.)
- use MSDN (MicroSoft Developer Network) user guides
- test and debug a graphic application developed using C# and Framework.Net
- import and use a .Net or .com element in a Visual Basic.Net application
- explain: the general architecture of a Framework.Net by listing its major components / the advantages and disadvantages of Framework.Net and Vidual Studio compared to Eclipse

Coursework

- Presentation of Framework.Net
- Presentation of Visual Studio.Net (using IHM, developing a graphic interface, Visual Basic.Net language, events programming, non-graphic elements and advanced functions)
- Project work

(ISN 204-F) Network Services: 9 hours lecture, 3 hours class, 38 hours laboratory

Objectives

- To be able to describe the roles internet services play (Web servers, DNS, mail, LDAP, cloud, samba, and so on.) when put in place on a network.
- To install, configure and use services on machines run by Linux (Web servers, DNS, mail, LDAP, cloud, samba, and so on.)
- To secure network access via a Linux firewall

Coursework

- Installing Linux, sectioning, IP configuration and gateways
- Using a Linux system with Raspberry Pi and basic system commands
- Using sensors (e.g. temperature and humidity) and shell scripting to process data
- Installing an apache/php web server and a MySQLdatabase
- PuTTY and WinSCP for remote connection and sending / receiving files
- Putting together web interfaces in PHP to display data coming from (graphic) sensors
- Configuring a NAT (Network Address Translation) firewall
- Putting a DNS (Domain Name System) server into place
- The LDAP (Lightweight Directory Access Protocol) and creating users
- Using a LDAP with PHP
- Introduction and installation of a coupled CMS architecture with an LDAP server
- Installation and configuration of a Samba server
- Installation and configuration of a cloud server
- Completing a project using a mix of functions targeted in the class

MAJOR: ISYMED
BIOMEDICAL ENGINEERING

Biomedical engineering brings together the sciences and engineering techniques in the field of health and healthcare. With the state of the art technologies and evolutions in electronics, I.T. and embedded systems bioengineering is taking off and requires new types skills to make the best of these new technologies and needs. The goal of the biomedical engineering major is to train engineers able to work from and with these developments and put them to their best uses.

BIOMEDICAL SIGNAL PROCESSING AND INSTRUMENTATION
ISY 201, 202 & 203 = 5 ECTS Credits

(ISY 201-F) Fundamentals in Vision and Image Processing: 8 hours lecture, 8 hours class, 12 hours laboratory

Objectives

- To understand the fundamental notions of image processing
- To be able to describe the image formation process
- To be able to improve the source images using pre-processing taking into account defects
- To be able to implement segmentation algorithms to separate an object of interest from the background
- To propose, code, and test a processing chain
- To become familiar with and learn how to use Matlab and OpenCV

Coursework

- Introduction to image processing
- Fundamental notions
- Image sensors
- Pre-processing
- Segmentation
- Mathematical morphology
- 3D reconstruction
- Tools for image processing

(ISY 202-A) Biomedical Imaging: 8 hours lecture, 10 hours laboratory *(Course in English)*

Objectives

- The objective of this course is to provide the fundamentals of medical imagery. How images are formed through algorithms and physiology. This course is interactive and incorporates theory and practice (with I.T. tools).

Coursework

- Fundamental principles (Fourier transforms, characteristics of medical imagery, brief introduction to Matlab)
- Ultrasound imagery (fundamental theories of sound waves, wave reflection, transmission, sources, simulations, forming images, B-mode images, Doppler images)
- X-ray images (fundamentals, imagery, tomodesitrometric, Radon transform, projection, algebraic methods)
- Magnetic resonance imagery (fundamentals, IRM, echos, K-space)

(ISY 203-A) Biomedical Signal Processing: 7 hours lecture, 7 hours class, 14 hours laboratory *(Course in English)*

Objectives:

To work with the fundamentals in digital signal processing in the context of healthcare. This class will work with data acquisition, sampling, filtering, encoding, extraction and modeling. Notions of statistics will be needed and provided so as to better work with signal classification and detection.

Coursework: data acquisition, sampling, filtering techniques, detection and classification of signals

TOMORROW'S HEALTH
ISY 205 & 206 = 4 ECTS Credits

(ISY 205-A) Android Apps for Healthcare: 10 hours lecture, 10 hours laboratory *(Course in English)*

Objectives

- The aim of this course is to provide to the students the competencies for developing an e-Health application related to health and well-being.

Coursework

- e-health, Wireframe and prototyping, Android Overview, Android Versions and story, Activities, Views and Layouts,TextView,EditText, Button,CheckBox, ToggleButton, ProgressBar, RadioBox, ListView, Multiples Activities, Options Menu, Permisions, Bluetooth Connection and data exchange between e-health devices

(ISY 206-F) Health Hackathon: 38 hours class

Course description currently not available

HEALTH & INFORMATION TECHNOLOGIES

ISY 207 & 208 = 3 ECTS Credits

(ISY 207-F) Tools and Methods for Software: 5 hours lecture, 13 hours laboratory

Objectives

- Describe the principal norms for embedded system development
- Describe the principal consequences of these norms on software development
- Using the rules for writing in C (MISRA-C)
- Describe the main tools for software metrics and software validation
- Using C to develop embedded code incorporating the aforementioned notions

Coursework:

- Safety standards IEC61508, DO178B, ISO26262, etc.
- LDRA testbed and testing software
- Statistic and dynamic analysis
- Black-box and white-box testing
- Software metrics (i.e. cyclomatic complextity)
- Testing limits, code tools, etc.

(ISY 208-F) Software Development with LabVIEW: 12 hours lecture, 8 hours laboratory

Objectives

- Design a program with LabVIEW for an electrocardiogram that monitors real and "noisy" data. This program must respect design standards and use standard programming and signal processing tools seen in the 2nd year. The application must respect standard LabVIEW practices (taken from the Certified LabVIEW Developer (CLD) test) and use a modular and evolving architecture

Coursework:

- Fundamental programming notions in LabVIEW
- LabVIEW program for an electrocardiogram
- Reading pulse rate
- Reading pathologies such as arrhythmia, hyperkalemia, etc.
- Creating an interface for patient data capture
- Learning good LabVIEW practices for form and structure in programming

MAJOR: MCTGE

MECHATRONIC AND ELECTRICAL ENGINEERING

MECHANICAL SYSTEMS: MODELLING & CONTROL
MGE 201, 202 & 203 = 4 ECTS Credits

(MGE 201-F) Advanced Automation Engineering for Mechatronics: 10 hours lecture, 8 hours laboratory

Objectives

At the end of this course students will be able to

- Target the technical specificities of mechatronic systems
- Translate the technical specifications into design specifications
- Develop advanced techniques for control systems
- Do an in-depth study comparing different control by feedback methods

Coursework

- State space of systems
- Governance and observability of discrete systems
- Discrete systems and state space
- Real time for mechatronic systems

(MGE 202-F) Solid Mechanics: 12 hours lecture, 8 hours class, 6 hours laboratory

Objectives

- Determine the unknowns or external forces for imposed movement
- Give the law of motion in the form of differential equations when external forces are known
- To use and/or complete a numerical model to evaluate efforts or laws governing movement

Essential objectives:

- Choose the theorem or theorems for the solution of a problem
- If necessary, use the notions of working energy in as an approach to a dynamics problem
- Create a block diagram or the transfer function of an energy chain from dynamic equations
- Calculate kinetic quantities (kinetic torsor ,dynamic torsor, kinetic energy) for simple motions (rotation, translation, plane motion).
- Express Galilean power accrued by a mechanical action. Express the inter-effort power between 2 solids.
- Apply the principles and theorems of dynamics to solve a given problem.

Highly recommended objectives:

- Choose the theorem or theorems for the solution of a problem
- If necessary use the notions of wok and energy in the energetic approach of a dynamics problem.
- Elaborate a block diagram, or a transfer function of an energy chain from dynamic equations

Coursework

- Solid systems: Introduction, kinetics, dynamics
- Kinetic Energy: Introduction, power, theorem, potential energy, methodology

(MGE 203-F) Mechatronic Systems Design / Modelling & The Factory of The Future: 8 hours lecture, 6 hours class, 6 hours laboratory

Objectives

- This course introduces the fundamentals of mechatronics as well as the tools, languages and methodologies used when designing mechatronic systems. Labwork will allow students to study the design and modelling processes of simple mechatronic systems in order to apply knowledge and concepts seen in electronics, power electronics, mechanical and control engineering.

Coursework - Introduction to the field of mechatronics and complex systems

- Examples: Active Drive and NASA's Orion
- Specificity of mechatronic design, V-cycle
- Language/jargon, tools, methods, criteria for making choices
- SysML versus SADT, FAST, or APTE; Modelica versus Simulink, VHDL and so on.
- Using 3D
- SysML, Modelica, CATIA
- Examples: motorized tailgates, CDVE (Cooperative Design, Visualization and Engineering)

Labwork

Practicing modelling of simple mechatronic systems will help students to use their knowledge in electronics, power electronics and mechanical and control engineering. The various steps of control design are:

- simulating a mechatronic system using Matlab and/or Simulink
- elaborating control laws using IPD regulation (Integral Plus Derivative) and by feedback control, and comparing results

MECHATRONIC METHODOLOGY

MGE 204 = 4 ECTS Credits

(MGE 204-F) Mechatronic Approach to Systems: 14 hours lecture, 46 hours laboratory

Objectives

This course is designed to give students majoring in mechatronics the skills, know-how and knowledge to be able to bring together electronics, mechanical, automatic and I.T. engineering in order to design and create systems using electric actuators (servomotors, stepping motors and DC motors). More specifically aspects of multiphysical modelling, electronics interfaces and instrumentation and control of digital systems will be dealt with. This course alternates lectures with laboratory sessions and is focused around two projects (a motorized pan & tilt mechanism and an engine bench)

This class starts with an overview of the course objectives, learner expectations and type of assessments. The next step is for the students to put together the technical aspects and details of the two projects; simultaneously there are introductory sessions to the AMESim modelling tool. After, laboratory sessions are allotted for modelling, simulations and analysis of the projects in order to bring together control engineering concerns and the microcontroller cards for the finalization of the projects.

DIGITAL CONTROL OF POWER CONVERTERS for MECHATRONIC SYSTEMS

MGE 205, 206, 207 & 208 = 4 ECTS Credits

(MGE 205-F) Numerical Control for Mechatronics: 10 hours lecture and (MGE 206-F) Laboratory - Numerical Control for Mechatronics: 8 hours

Developments in mechatronics has led to significant changes in the design of control systems. Calculating power and low costs make these systems make them capable of taking charge of the control aspects, while out performing analog controllers.

Objectives

- To model mechatronic systems digitally
- When to sample
- To determine the stability of mechatronic systems
- To develop digital equalizers
- To do a comparative study of digital control methods (whilst considering given design specifications)

Coursework

- Representation of multivariable systems
- Stability of multivariable systems
- Polynomial methods for control /
- Numerical control
- Case study

(MGE 207-F) Converters and Electric Machines: 10 hours lecture, 6 hours class, 4 hours laboratory

Objectives:

- Students will master control laws of electrical machines, rules governing associations with static converters and the thermal and electric constraints while in use.

Coursework

- Electronic switching devices
- Electronic power inverters
- Direct current machines
- Scalar command of asynchronous machines
- Vector machine control

(MGE 208-A/F) Mechatronic Systems Identification: 6 hours lecture, 6 hours class, 6 hours laboratory

Objectives

- The aim of this course is to present methods for mechatronic systems (e.g. robots, mass spring systems, etc.). Two methods will be used: the first is based on parametric estimations, and the second is based on adaptive observers that conjointly estimate system states and unknown parameters.

Coursework

- Introduction of the problems of identification and mechatronic systems models
- Introduction to adaptive observers
- Adaptive observer summary for discrete linear models
- Applying identification methodology to mechatronic systems
- Identifying parameters for a mass-spring system
- Adaptive observer summary for a mass-spring system