Syllabus en anglais de la spécialité :

Automatique et Informatique

Control Engineering and Computer Engineering

En formation initiale sous statut étudiant (FISE)

Nom d’usage : SAGI

Systèmes Automatisés et Génie Informatique
Syllabus – Spécialité Automatique et Informatique

[Syllabus en anglais]

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(*) taught in English
Compétences développées

| (C.2) adapt to the specific requirements of the company and society (economic, societal, environmental) |
| (C.3) take into account the organizational, personal and cultural dimension (innovate, work in an international and multicultural context, know oneself, self-evaluate, manage one's skills) |

Keywords: Communication skills, Cross-cultural skills, Professional Environment

Prerequisites: Level B2 / CEFR

Objectives:
- Meeting the requirements of the CEFR (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction to achieve proficiency in everyday and professional situations.
- Cross-cultural skills: knowledge of international environment

Organization of Language proficiency levels groups based on Toeic practice scores from the TOEIC. A base TOEIC score is required in the final year to graduate as an Engineer.

Contents:
Oral and written communication skills
Looking for a mandatory training experience abroad, writing a cover letter, a CV
Communication skills in companies (letters, memos, emails, phone conversations, interviews etc.)
Current political, economic and social and professional issues
Speech and presentation techniques.
Regular pronunciation and accent work.
**LV2 : German or Spanish or French**

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**Compétences développées**

(C.2) adapt to the specific requirements of the company and society (economic, societal, environmental)

(C.3) take into account the organizational, personal and cultural dimension (innovate, work in an international and multicultural context, know oneself, self-evaluate, manage one's skills)

**Keywords:** Communication skills, Cross-cultural skills, Professional Environment

**Prerequisites:** Basic oral and written communication skills

**Objectives:**
- Meeting the requirements of the CEFR (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction
- Cross-cultural skills: knowledge of international environment

Organization of Language proficiency levels whenever it is possible.

The target for the advanced group is CEFR B2 ; A2 or B1 for the intermediate group,

Successful completion of a linguistic certification is compulsory in the last year of the LV2 engineering cycle depending on the level of the students.

For students in the confirmed group, obtaining an additional external certification may be recommended in the last year of the engineering cycle.

**Programme:**
- Looking for a training experience abroad, writing a cover letter, a CV, an abstract
- Oral and written communication skills
- Communication skills in Companies
- Political, economic and social news

**Evaluation**
- 100% Continuous assessment

**Learning outcomes:**

**Intermediate groups**
- The student can write a CV in German/Spanish
- The student can speak for a few minutes on a topical issue or a topic of personal interest.
- The student can take part in a conversation on simple topics that can be related to his/her personal interests.

**Advanced groups**
- The student can write a cover letter in German/Spanish
- The student can read an article or listen to a program in a standard language and comment on it.
Keywords: market, economic growth, political economics, sharing economy

Prerequisites: none, except interest and curiosity

Objectives:
- Understanding the issues of current economic debates
- Knowing about vocabulary and economic indicators

Contents:
Economics challenge
- The basis of economics
- Economic news and analysis (students reports)
- Sharing economy

Evaluation:
Continuous assessment (100%)
**Keywords**: Sports ; Scientific mediation ; NaN

**Prerequisites**: None

**Objectives:**

**Sport**: Physical and sports education courses help train future engineers, promote their physical and mental balance, facilitate their integration, strengthen the team spirit and the dynamics of the school. Being able to work as a team, communicate, build relationships of trust, be healthy and resist stress are qualities that are required of future engineers. The proposed sports activities involve new motor acquisitions, individual and collective strategies, and an adaptation to the effort. These elements contribute to development and are additional assets for their training. Our missions are to participate in the training of future engineers, to promote the physical and psychic balance of the students, to facilitate the integration of the students of the school, to strengthen the team spirit.

**Scientific mediation** aims to offer our students to create a link, an exchange, between the scientific / technical world and young students. It is important to note that a special place is given to the social responsibility of our future engineers who must contribute as significantly as possible to the dissemination of knowledge. This specific scenario also allows students who choose this activity to develop their interpersonal skills, to think about the best approach to impart skills and finally to implement elements to ensure that the learner has really progressed. The students involved in this action start by following training in scientific mediation which they then put into practice by sponsoring a group of young students during the robotics trophies. This national meeting puts teams of young students in competition around scientific and technical challenges.

**NaN**: This is an interdisciplinary, inter-institution program on the theme of Digital Arts-Sciences. This program is supported by the Research-Training-Innovation program in Pays de la Loire as the winner of the call for projects "innovative initial training". Since 2017, the workshop takes the form of a time weekly (Thursday afternoon, from 2:00 p.m. to 5:00 p.m.) of experiments and collective work led and supervised jointly by teachers from ESAD TALM and Polytech Angers. It brings together an average of twenty students, half registered at ESAD TALM Angers (having chosen the workshop from the TALM grids) and the other half registered at Polytech Angers. The work carried out by the students is presented during events: exhibitions at the Musée des Beaux-Arts d'Angers (in 2018 and 2019), installation at the Jean Lurçat museum in 2018, conference performed at the Quai in 2019, exhibition within the Lycée Joachim du Bellay in Angers in 2019.

**Contents:**
Specific actions are implemented during participation in one of the following three components:
- the practice of team and individual sports
- or scientific mediation
- or the NaN workshop

**Evaluation:**
Continuous assessment (100%)
**Connaissance de l’entreprise et comptabilité**

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**Compétences développées**

(C.2) adapt to the specific requirements of the company and society (economic, societal, environmental)
(C.3) take into account the organizational, personal and cultural dimension (innovate, work in an international and multicultural context, know oneself, self-evaluate, manage one's skills)

**Responsable Connaissance de l’entreprise (8h) : D. Rigole**

**Keywords:** corporate functions, legal status, group, social economy, collaborative economy, CSR, business and corporate strategies

**Prerequisite:** None

**Objectives:**
- Discover:
  - the main functions in companies
  - the diversity of companies
  - business and corporate strategies
  - corporate social responsibility

**Program:**

I- The main functions in companies
II- All forms of companies : size, legal status, social economy, collaborative economy
III- CSR
IV- Business and corporate Strategies:

**Evaluation:**  100% Continuous assessment.

**Learning outcomes:**
- The student must be able to present any company: global presentation (activities, brands…).

**Responsable Comptabilité « Fondamentaux de la Gestion Comptable et Financière » (8h) : V. Billaudeau**

**Keywords:** Accounting, balance sheet, income statement, expense, income, assets, liabilities, cash, investment, financing

**Prerequisite:** none

**Objectives:**
- Discover the fundamentals of accounting and financial management

**Program:**

Section 1: Presentation: Balance sheet and income statement
- Management accounts: expense / income
- Balance sheet accounts: assets / liabilities

Section 2: Reconstruction of the balance sheet and the income statement
- Go from the income statement to the balance sheet and vice versa
- Impact study: cash flow / result
- The result and the cash flow

Section 3: Financing and investment operations

Section 4: Some specific accounting concepts
- VAT
- …

**Evaluation:** 100% Continuous assessment.

**Bibliography:** Colasse B., Comptabilité générale, Economica, 2000.
**Responsable**: Anthony Delamarre

**Keywords**: Engineering, components, CAD, applied mechanics

**Prerequisites**: None

**Objectives**: To give the basics of mechanical technology

**Contents**:

- **Part 1: Mechanical Technology**
  22h40 CM  8hTD (2CM et 6TD) : Ensure bases : Technical drawing / knowledge of mechanical components (bearing / gear / etc) / linking piece / kinematic - goal : understand a mechanism

- **Part 2: CAD**
  12h TP (9TP) : Ensure CAD bases : design and / or use the digital model of a mechanism

- **Part 3: Applied Mechanics**
  2h40 CM  6h40 TD (2CM et 5TD) : Ensure bases of applied Mechanics: force, torque, wrench, Equilibrium equations, mechanical calculation (speed, power, energy, etc.)

**Evaluation**: 100% CC

**Bibliography**:
- « Système mécanique : Théorie et dimensionnement », M. Aublin et co, Edition DUNOD
- « Guide des sciences et technologies industrielles », JL. Fanchon,
- Tutoriels Solidworks, disponibles à partir du logiciel
**Responsable:** Sébastien Lahaye

**Keywords:** Industrial automated systems, formal representation and control synthesis, programmable logic controller (PLC) programming, IEC 61131 and CEI 61499 standards, motion control, safety

**Objectives:** Prepare students to become a privileged interlocutor, or even a member, of an automation engineering and design office, able to interact with other offices, suppliers and/or customers.

**Outline:**
- Automated system: definition, structure and components
- Sequential digital systems
  - Formal representation
  - Modelling and control synthesis
- Programmable logic controllers
  - Hardware structure
  - Programs processing
- IEC 61131-3 standard: PLC programming
  - Projects architecture
  - Data structures
  - Programming languages: SFC, LD, ST and LIST
- Motion control
  - Theoretical and technical aspects (cams, speed profiles, …)
  - Hardware implementation (selection and sizing of components)
  - Software implementation
- Safety
  - Challenges and issues
- Integration of safety aspects in an automation project

**Examination:** continuous assessment (written examinations and laboratories).

**References:**
- http://plcopen.org
Responsable: Laurent Hardouin

Keywords: System, model, Euler method, Runge-Kutta method.

Prerequisites: Mathematics and basics of Physics.
Programmation: Algorithmique, Langage C

Objectives:
This course introduces some modelling technics for mechanical systems, hydraulic systems and biological systems. Numerical methods (such as Euler method or Runge-Kutta method) for the simulation of these systems are also presented and illustrated using the Python language.

Program:
Introduction on differential equations and the state representation

Modelization:
- Modeling of compartmentalized systems, biological models (Lotka-Volterra, prey-predator, SIR epidemiological model, etc.).
- Modelling of hydraulic systems (multi-tank systems, dairy supervision application, etc.).
- Modelling of mechanical systems (inverted pendulums, mobile robots, autonomous boats, submarines, etc.)

Simulation:
- Euler method
- Runge-Kutta method
- Simulation based on Python, 2D graphical representation

Examination: Written examination.

Bibliography:
- Books on Physics (mechanics, electricity, ...),
**Basis of mechatronic engineering**

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**Competences développées**

(S.1) control industrial processes  
(S.2) model and analyze continuous or discrete dynamic systems  
(S.6) control and operate industrial robots  
(S.7) design and operate embedded, mobile systems and/or robotics equipment  
(C.1) apply scientific and technical knowledge

**Responsable:** Laurent Autrique

**Keywords:** Industrial sensors, computer technology for instrumentation, signal processing, Electric motors,

**Requirements:** Basic knowledge on electricity (PEIP-1), Sensors (PEIP-2), Applied mathematics and signal processing (PEIP-2)

**Courses Objectives:** The aim is to provide students with concepts related on the one hand to industrial instrumentation and on the other hand to electric motors.

**To master the techniques for data acquisition in an industrial environment**

The global framework relates to engineering services in instrumentation. Several investigations are proposed: principles of various physical measurements (used in the context of industrial applications), computing tools for the communication and recording of the collected data, implementation of mathematical methods to ensure information analysis.

**To investigate the main principles of electric motors**

In an automated system, the need for a servomechanism can be expressed as follows:
- a set of mechanical quantities
- associated with a defined production system
- has to follow a specified behavior
- with specified performance
- in a given production context.

In this part, we are focused on the servomotor and more specifically on the electric motor and the variable speed drive.

**Evaluation:** written examination and practical work evaluation.

**Bibliography:**
C Programming

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Compétences développées
(S.9) apply the procedural and object-oriented programming paradigms
(C.1) apply scientific and technical knowledge

Responsable: Laurent Hardouin

Prerequisites

Knowledge in algorithmic basis, in C Language (first part given in the cycle préparatoire), or the common skill for engineers or for students from bachelor level

Objectives

Get the skills to develop software in C language. Open mind to the Object programming and genericity.

Outline

Chapter 1: Arrays and functions
Chapter 2: Structure and type definition
Chapter 3: Dynamic Arrays
Chapter 4: File in C language
Chapter 5: Genericity
Chapter 6: Linked list

TP 1: Sort algorithm and list, using of generic function qsort
TP 2: Structured Data, Game: Navy Battle
TP 3: File handling, transforming a file from csv format to html format.
TP 4: dynamical programming and cellular automata, game programming 'Minesweeper'

Examination

Exam, and laboratories examinations and home exercises
**Lesson**: GNU / Linux  

**3A / Semester 5**  

**8h CM – 12h TP24**  

**Génie informatique**  

### Competences developed

- (S.9) apply the procedural and object-oriented programming paradigms
- (S.13) manage computer networks (infrastructure, services, control and command functions)
- (S.14) administer computer servers
- (C.1) apply scientific and technical knowledge

**Responsible**: Nicolas Delanoue

**Keywords**: Unix operating system, Unix commands, shell scripts, Python language.

**Prerequisites**: algorithmics and programming

**Objectives**: Knowledge of concepts and commands regarding the Unix operating system. Use of the shell and Python for different activities (e.g. search on the filesystem, file editing, permission modifications, user creation).

**Content**:

- **Unix**:
  - User and administrator (root)
  - Filesystem and permissions
  - Command for managing files and directories
  - Shell: flow redirection, pipeline
  - Regular expressions and manipulation of file data
  - Shell scripts

- **Python**
  - Data types, control flow and files

- **Python-Unix coupling**
  - Interoperability between Python program and Unix commands
  - Graphical user interface and Unix commands
  - Network, web and Unix commands

**Evaluation**: written examination

**References**:

- *Introduction to Unix*, Jerry Peek, Grace Todino & John Strang, Editions O'Reilly
### Database (SQL)

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<td>(S.13) manage computer networks (infrastructure, services, control and command functions)</td>
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<td>(S.14) administer computer servers</td>
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<td>(S.15) manage databases in different environments</td>
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#### Responsable
Mehdi Lhommeau

#### Key-words
Relational Data Model, SQL

#### Prerequisites:

#### Objectives:
Introduces the fundamental concepts for design and development of database systems. Emphasizes relational data model and conceptual schema design using ER model, practical issues in commercial database systems, database design using functional dependencies, and other data models. Develops a working relational database for a realistic application.

#### Program:
- Database Design - This will include design philosophies such as E-R and Relational Algebra, along with studies of normal forms for databases;
- Query Languages - The main topic will be an in-depth study of SQL;
- Physical Implementation - This will cover the basics of how the information in a database is stored and accessed on various systems;

#### Examination:
- Written examination

#### Bibliography:
Responsable : Laurent Hardouin

Objective

Presentation of the basics of computer network.
OSI model. How to Ethernet, and TCP/IP.

Outline

Computer Networks :

1. Introduction to computer network and OSI Model
2. Ethernet, ARP, TCP/IP Protocols
3. Internet organization
4. How to make a Local ARea Network with Linux and Windows
5. Sever configuration : DHCP, DNS, with Linux
6. Socket API, how to program with internet

Evaluation

written exam and laboratories exams

References

Internet and Computer Network, Campus Press, D. E. Comer

CISCO website, : http://www.cisco.com
### Semestre 6 340 h/E

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**Keywords:** Communication skills, Cross-cultural skills, Professional Environment

**Prerequisites:** Level B2 / CEFR

**Objectives:**
- Meeting the requirements of the CEFR (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction to achieve proficiency in everyday and professional situations.
- Cross-cultural skills: knowledge of international environment

Organization of Language proficiency levels groups based on Toeic practice scores from the TOEIC. A base TOEIC score is required in the final year to graduate as an Engineer.

**Contents:**
Oral and written communication skills
Looking for a mandatory training experience abroad, writing a cover letter, a CV
Communication skills in companies (letters, memos, emails, phone conversations, interviews etc.)
Current political, economic and social and professional issues
Speech and presentation techniques.
Regular pronunciation and accent work.
LV2 : German or Spanish or French

3A/Semester 6
12h TD

UE 6-1
Formation Générale

Compétences développées

(C.2) adapt to the specific requirements of the company and society (economic, societal, environmental)

(C.3) take into account the organizational, personal and cultural dimension (innovate, work in an international and multicultural context, know oneself, self-evaluate, manage one's skills)

Keywords: Communication skills, Cross-cultural skills, Professional Environment

Prerequisites: Basic oral and written communication skills

Objectives:
Meeting the requirements of the CEFR (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction
Cross-cultural skills: knowledge of international environment

Organization of Language proficiency levels whenever it is possible.
The target for the advanced group is CEFR B2 ; A2 or B1 for the intermediate group.
Successful completion of a linguistic certification is compulsory in the last year of the LV2 engineering cycle depending on the level of the students. For students in the confirmed group, obtaining an additional external certification may be recommended in the last year of the engineering cycle.

Programme:
Looking for a training experience abroad, writing a cover letter, a CV, an abstract
Oral and written communication skills
Communication skills in Companies
Political, economic and social news

Evaluation
100% Continuous assessment

Learning outcomes:
Intermediate groups
- The student can write a CV in German/Spanish
- The student can speak for a few minutes on a topical issue or a topic of personal interest.
- The student can take part in a conversation on simple topics that can be related to his/her personal interests.

Advanced groups
- The student can write a cover letter in German/Spanish
- The student can read an article or listen to a program in a standard language and comment on it.
Keywords: presentation, Internship report, poster

Prerequisites: none

Objectives:
- Present a synthetic work experience
- Write an internship report
- Create a poster
- Stakes of the intercultural

Examination: oral presentation and poster

Bibliography:

Sport / Parrainage scolaire / NaN

3A / Semestre 6
12h
UE 6.1
Formation générale

Compétences développées

(C.1) apply scientific and technical knowledge
(C.2) adapt to the specific requirements of the company and society (economic, societal, environmental)
(C.3) take into account the organizational, personal and cultural dimension (innovate, work in an international and multicultural context, know oneself, self-evaluate, manage one's skills)

Keywords: Sports ; Scientific mediation ; NaN

Prerequisites: None

Objectives:

Sport: Physical and sports education courses help train future engineers, promote their physical and mental balance, facilitate their integration, strengthen the team spirit and the dynamics of the school. Being able to work as a team, communicate, build relationships of trust, be healthy and resist stress are qualities that are required of future engineers. The proposed sports activities involve new motor acquisitions, individual and collective strategies, and an adaptation to the effort. These elements contribute to development and are additional assets for their training. Our missions are to participate in the training of future engineers, to promote the physical and psychic balance of the students, to facilitate the integration of the students of the school, to strengthen the team spirit.

Scientific mediation aims to offer our students to create a link, an exchange, between the scientific / technical world and young students. It is important to note that a special place is given to the social responsibility of our future engineers who must contribute as significantly as possible to the dissemination of knowledge. This specific scenario also allows students who choose this activity to develop their interpersonal skills, to think about the best approach to impart skills and finally to implement elements to ensure that the learner has really progressed. The students involved in this action start by following training in scientific mediation which they then put into practice by sponsoring a group of young students during the robotics trophies. This national meeting puts teams of young students in competition around scientific and technical challenges.

NaN: This is an interdisciplinary, inter-institution program on the theme of Digital Arts-Sciences. This program is supported by the Research-Training-Innovation program in Pays de la Loire as the winner of the call for projects "innovative initial training". Since 2017, the workshop takes the form of a time weekly (Thursday afternoon, from 2:00 p.m. to 5:00 p.m.) of experiments and collective work led and supervised jointly by teachers from ESAD TALM and Polytech Angers. It brings together an average of twenty students, half registered at ESAD TALM Angers (having chosen the workshop from the TALM grids) and the other half registered at Polytech Angers. The work carried out by the students is presented during events: exhibitions at the Musée des Beaux-Arts d'Angers (in 2018 and 2019), installation at the Jean Lurçat museum in 2018, conference performed at the Quai in 2019, exhibition within the Lycée Joachim du Bellay in Angers in 2019.

Contents:
Specific actions are implemented during participation in one of the following three components:
- the practice of team and individual sports
- or scientific mediation
- or the NaN workshop

Evaluation:
Continuous assessment (100%)
Management

3A / Semester 6
20h TD

General Skill

Compétences développées
(C.2) adapt to the specific requirements of the company and society (economic, societal, environmental)
(C.3) take into account the organizational, personal and cultural dimension (innovate, work in an international and multicultural context, know oneself, self-evaluate, manage one's skills)

Keywords:
- Organizational behavior, social influence, corporate structures, corporate culture

Prerequisites: none

Objectives:
- To understand the human behavior in the organizations
- To meet the requirements to act more effectively in a professional situation

Program:

Management: Introduction to Organizational Behavior
I- Individual characteristics and behavior
II-Groups
III- The impact of the organizational context on behavior

Evaluation: 100% Continuous assessment.

Bibliography
- Schermerhorn JR. Et al. (collectif): « Comportements humains et organisation » Ed ERPI, 2010
Functional analysis

3A / Semester 6
5h20 CM – 14h40 TD
UE 6.2 Sciences de l’ingénieur

Compétences développées
(S.1) control industrial processes
(S.2) model and analyze continuous or discrete dynamic systems
(S.6) control and operate industrial robots
(C.1) apply scientific and technical knowledge

Responsable: Philippe Declerck

Keywords: Communication, structuration, method

Prerequisites: none

Objectives: the aim is to present the spirit of the methods allowing the modelling of a process under the functional form and to clearly express its functions and data.

Program: SADT, OMT improved

Examination: terminal examination and exercises

Bibliography:
- IGL technologie, "SADT un langage pour communiquer" Eyrolle 1989.
  • J. Gabey, "Merise et UML pour la modélisation des systèmes d'information. Un guide complet avec études de cas", Dunod, 2001
**Signal processing**

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<td>6h40 CM – 8h TD – 5h20 TP16</td>
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**Competences développées**

- (S.2) model and analyze continuous or discrete dynamic systems
- (S.7) design and operate embedded, mobile systems and/or robotics equipment
- (C.1) apply scientific and technical knowledge

**Responsable** : Etienne Belin

**Keywords** : Deterministic signal, Digital signal, Frequency processing, Filtering.

**Prerequisites** : Mathematical bases: Differentiation and integration of elementary functions, complex numbers, trigonometric functions.

**Objectives** : The bases of signal processing are reviewed, with corresponding applications, as useful for a curriculum in industrial engineering, automation and computer engineering. Special emphasis is placed on deterministic signals, and frequency-domain processing of signals and their interactions with linear systems. These notions are presented both in the realm of continuous-time signals (physical level of the measured signals) and in the realm of discrete-time signals (digital processing). For each important notion, typical applications are addressed, such as harmonics in electric power systems, modulation / demodulation, detection of signals in noise, statistical processing of measured data, electrical or mechanical systems modeling, digital processing of signals and data.

**Program** :

1) General notions on signal processing.
2) Frequency representation of signals :
   - Fourier series, Fourier transform (FT).
   - Dirac delta function : definition, properties, relation to FT.
3) Interaction of signals with linear systems :
   - Definition of a linear system, Impulse response, Convolution.
   - Transfer function in frequency, Filtering, identification, deconvolution.
4) Sampled signals :
   - Shannon sampling condition, z transform, truncation window,
   - discrete Fourier transform, fast Fourier transform.
5) Linear digital filters :
   - Analysis : Recurrence equation in time, Impulse response, z transfer function,
   Frequency transfer function, Example of the integrator filter.

**Evaluation** : Written examination and laboratory examination.

**Bibliography** :

**Introduction to Quality and Innovation**

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<th>Competences développées</th>
<th>(C.1) apply scientific and technical knowledge</th>
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<td>(C.2) adapt to the specific requirements of the company and society (economic, societal, environmental)</td>
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<td>(C.3) take into account the organizational, personal and cultural dimension (innovate, work in an international and multicultural context, know oneself, self-evaluate, manage one's skills)</td>
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**Responsable:** Anthony Delamarre

**Keywords:** Quality approach, innovation process approach

**Prerequisites:** no prerequisites

**Objectives:** to teach the innovation process and the quality approach to give a global view of these processes to the students. To allow students to understand the position of the methodological courses in a global process.

**Contents:**

The course is divided in 2 parts : 12hTD describing the innovation process and 4h CM +8h TD describing the Quality approach.

The agenda of the innovation process is divided in courses of 1h20 like this :

- 3 courses of introduction of innovation :
  - Definitions ;
  - Risk of innovation : the degree, the nature et intensity of innovation ;
  - Panorama of innovation approaches : from project to open innovation
  - The innovation organisation : from start-up to innovation cell
  - Managing innovation portfolio
- 6 courses of working group on designing a product by an innovation process
  - First course : thematic choice and brainstorming
  - Second course : organise your ideas with the mindmapping
  - Third course : Formalise your ideas with idea sheet and review them
  - Fourth course : Evaluate your ideas with the radar method
  - Fifth course : Build you prototype or model (CAD, photomontage)
  - Sixth course : Build your marketing speech to sell your idea

The quality program is as follows:

- Presentation of the World of Quality
- 8 principles of quality management
- Main Standards
- Approach Process and Quality Indicators
- Introduction to the 6 Sigma method
- Introduction to quality control, statistical control of processes

**Evaluation:** CC (100%)

**Bibliography:**

Responsable : Sébastien Lahaye

Keywords: linear systems, systems identification, parameter estimation discrete-time and continuous-time state-space representation, stability, controllability, observability, state feedback, state observer.

Prerequisites: introduction to automatic control, Modélisation et simulation (UE5-3)

Objectives and outline:

To provide students with a basic understanding of and an overview about the principles of identification of linear systems. The focus is in particular on procedures allowing to estimate the order of systems parameter estimation (ordinary and recursive least squares regression).

To provide students with a basic understanding of and an overview about the principles of state-space representation for linear systems:
- Analysis (stability, controllability, observability)
- control techniques (state feedback, pole placement, state observer).

Examination:
written examination and laboratories examination

Bibliography:


*Cours d'automatique: Tome 3*, M. Rivoire, J.-L. Ferrier, édition Eyrolles

*Automatique : commande des systèmes linéaires*, Ph. De Larminat, édition Hermès

*Représentation d'état pour la modélisation et la commande des systèmes*, L. Jaulin, Hermès science, éditions Lavoisier, 2005

*Control System Design: An Introduction to State-Space Methods*, B. Friedland, 1986
This lecture aims at tackling some elementary notions about programmable digital systems. First, we recall some usual descriptions of numbers in digital systems and we explain how processors execute programs. Then we introduce microcontrollers and their usual integrated input-output devices. All the examples are given with the Arduino UNO board.

Outline:
Recalls on the binary description of numbers for processors (signed/unsigned integers, floats) 
Description of the execution cycle of a processor
What is a microcontroller? processor + memory + IO
Integrated IO devices on a microcontroller: digital IO, timers/counters, interrupts, Analog to Digital Converter, Two Wire Interface, …
Applications in C language for ARDUINO
Labs: small applications using switches, LED, 7-segment displays, rotary encoders …

Examination:
written examination and laboratories examination
**Robotics**

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**Competences développées**

(S.5) model, analyze and predict robots behavior.
(S.6) control and operate industrial robots
(S.7) design and operate embedded, mobile systems and/or robotics equipment
(C.1) apply scientific and technical knowledge

**Responsable**: Jean-Louis Boimond

**Keywords:**
industrial robot, link, position, orientation, degrees of freedom, joint space, operational space, homogeneous transformation, geometric model

**Objectives:** Introduction to robotics

**Program:**

- General definitions:
  Definitions
  Components of a robot
  Classification of robots
  Characteristics of robots
  Generations of robots
  Robot programming
- Degrees of freedom - Architecture:
  Positioning of a solid in space
  Link
  Mechanisms
  Morphology of manipulator robots
- Geometric model of a simple chain robot:
  Need for a model
  Operational coordinates
  Translation and rotation
  Homogeneous transformation matrix

**Examination:**
Written examination and laboratories examination.

**Bibliography:**

Responsable : Bertrand Cottenceau

Keywords : C# language, .NET, object oriented programming, Windows Form applications

Prerequisite : procedural programming (C language)

Outline : this lecture aims at introducing the object oriented paradigm with the C# language. First, we give some simple examples of classes, and then we introduce the inheritance in C#. The class diagram of UML is used to give a graphical description of relations between classes. Several concepts have to be tackled along the lecture such as interfaces, abstract classes, virtual methods and events. Moreover, some basic classes of the .NET framework are presented (string, List<T> and LinkedList<T>).

The examples are first given for console applications and then for Windows Form applications.

- The class keyword
- Value type vs reference type in .NET
- Constructors, Properties
- composition in C#
- inheritance in C#
- virtual methods
- Interfaces, abstract classes
- Delegates Events
- Windows Form Applications

Examination : written exams and labs

Bibliography :

C# in a nutshell (Joseph Albahari, Ben Albahari)
**Human-Computer Interaction & Virtual reality**

SAGI

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**Compétences développées**

(S.10) develop applications within the framework of software engineering (best practices, reliability, cost rationalization, monitoring, etc.)

(S.11) know the tools of augmented reality and immersive multimedia

(C.1) apply scientific and technical knowledge

(C.3) take into account the organizational, personal and cultural dimension (innovate, work in an international and multicultural context, know oneself, self-evaluate, manage one's skills)

**Lecturer:** Paul Richard

**Key-words:** Human-computer interaction, 3D interaction devices, immersive displays, haptic interfaces, physics simulation, virtual and augmented reality

**Prerequisites:** basic knowledge in computer programming (C# or C)

**Objectives:** to address the general principles of human-computer interaction, advanced human-computer interfaces such as 3D interaction devices, natural user interfaces, haptics interfaces and advanced visualization systems. Overview of interaction metaphors and 3D interaction techniques. Programming of 3D real-time application using Unity3D.

**Program:**

- Principles of human-computer interaction
- Advanced human-computer interfaces
- Metaphors and interaction techniques
- 3D application programming (Unity3D)

**Examination:** Continuous assessment

**Bibliography:**

- Learning C# Programming with Unity 3D (English Edition), Alex Okita, Taylors and Francis, 2015
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<thead>
<tr>
<th>Compétences développées</th>
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<tr>
<td>(S.10) develop applications within the framework of software engineering (best practices, reliability, cost rationalization, monitoring, etc.)</td>
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<tr>
<td>(S.12) master the tools and methods of project follow-up in computer science</td>
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<tr>
<td>(S.13) manage computer networks (infrastructure, services, control and command functions)</td>
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<td>(S.14) administer computer servers</td>
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<td>(S.15) manage databases in different environments</td>
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<td>(C.3) take into account the organizational, personal and cultural dimension (innovate, work in an international and multicultural context, know oneself, self-evaluate, manage one's skills)</td>
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**Responsable** : Alain Godon

**Keywords** :
PHP, SQL, TWIG, API REST, JWT

**Prerequisites** :
HTML/CSS, JS, SQL, ALGORITHMIC, PYTHON or C

**Objectives** :
Have an expert knowledge of the development of a website in PHP

**Content** :
PHP basics, forms, sessions, libraries

**Examination** :
100% Continuous assessment
Internship Objectives

Future engineers need to have both international and intercultural experience, not only to meet the demands of increasingly globally integrated companies, but also to enrich themselves through exposure to other cultural codes and lifestyles. The intern is asked to carry out a mission that is related to our Engineering programs. During the mission, the intern is required to develop autonomy, and take initiative in an unfamiliar cultural context.

The student internship lasts a minimum of 13 weeks and the intern is required to work full time. The intern's timetable can be established on a case by case basis. The intern must be present in the organization as specified in the agreement.

Evaluation

As stated in Article 4 of the agreement, both supervisor and university academic tutor assess the intern.

- Internship Supervisor. The Internship supervisor assesses the student's performance using an online questionnaire. There is only one assessment required for the full three month period but this feedback is extremely useful for the School of Engineering when evaluating the students commitment to the internship. It also serves to indicate if the organization would accept an intern the following year. The supervisor’s feedback will count for 1/4 of the mark on the final evaluation.

- University Academic Tutor. The student is also required to provide the school with a number of documents at the end of the internship:
  - A report of twenty pages in which the trainee must retrace the internship assignment and develop an original essay based on personal observations.
  - An A2 size poster
The assessment of these elements is carried out by the university academic tutor and is based on the internship supervisor's assessment comments.
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(*) taught in English
Keywords: Communication skills, Cross-cultural skills, Professional Environment

Prerequisites: Level B2 from the CEFR

Objectives:
- Validating TOEIC minimum score to graduate as an Engineer.
- Meeting the requirements of the CEFR (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction
- Cross-cultural skills: knowledge of international environment

A practice TOEIC test is organized at the beginning of term 7 to set up language proficiency groups for TOEIC Preparation.

Programme:
- Understanding the TOEIC test format and requirements.
- Practising oral and written communication skills.
- Reviewing and Strengthening English grammar skills.
- Regular practise of pronunciation and word stress.
- In company communication situations.
- Current political, economic and social issues.
- Oral proficiency practice.

Learning outcomes:
- The student can speak about a technical issue related to his/her field of expertise.
- The student can infer and understand gist, purpose and details in a spoken document related to a general or technical topic.
- The student can infer and understand gist, purpose and details in a written document related to a general or technical topic.
- The student can speak and write in a clear and fairly complex language.

Evaluation: Continuous assessment (100%)
Keywords: Communication skills, Cross-cultural skills, Professional Environment

Prerequisites: Basic oral and written communication skills

Objectives:
Meeting the requirements of the CEFR (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction
Cross-cultural skills: knowledge of international environment

Organization of Language proficiency levels whenever it is possible.
The target for the advanced group is CEFR B2 or C1; A2 or B1 for the intermediate group.
A certification in German/Spanish is recommended for advanced students in final year.

Program:
- Oral and written communication skills
- Communication skills in Companies
- Political, economic and social news

Learning outcomes:
Intermediate groups
- The student can speak for a few minutes on a topical issue or a topic of personal interest.
- The student can take part in a conversation on simple topics that can be related to his/her personal interests.

Advanced groups
- The student can read an article or listen to a programme in a standard language and comment on it.
- The student can write an abstract and a report in German/Spanish
- The student can make an oral presentation on professional topics
- The student can argue and justify his/her point of view fluently

Evaluation: 100% Continuous assessment
Keywords: Professional project, curriculum vitae, cover letter, meeting animation

Prerequisites: French language written and spoken

Objectives:
- Preparing for job search
- Meeting and group animation

Examination:
- Oral checks (50%)
- Written tests (50%)

Bibliography:

Entrepreneurship

4A / Semestre 7
18 h TD

UE 7.1
Formation Générale

Compétences développées
(C.2) adapt to the specific requirements of the company and society (economic, societal, environmental)
(C.3) take into account the organizational, personal and cultural dimension (innovate, work in an international and multicultural context, know oneself, self-evaluate, manage one's skills)

Responsable : A. Delamarre

Keywords : Entrepreneurship, intellectual property,

Presrequisite : none

Objectives :
Discern the entrepreneurial spirit, the passion of entrepreneurs, their needs to create and innovate and their orientation towards action
Propose entrepreneurial projects
Establish creativity and monitoring methods
Build a CANVAS business model

Program :
This introductory course in entrepreneurship aims to develop students' sense of initiative and entrepreneurship, in order to make them discover and exploit their full entrepreneurial potential. The program sweeps the entrepreneurial process. Students are introduced to the process of business creation: from idea creation to marketing. This course integrates the concepts of industrial property: brands, model and patent. The concepts are approached through the construction of a virtual business that the students will build on the basis of creativity methods, construction of CANVAS business model through the creation of the identity and values of the business to be built.

Evaluation : 100 % continuous assessment.

Acquis d'apprentissage :
The student is expected to identify the stages of business creation and be able to organize a process from the idea to the realization of his entrepreneurial project. The student must understand the issues of intellectual protection and know the broad outlines of the rules of law that govern all activity in society

Bibliographie :
BODELL, Richard W., Garry RABBIOR et Larry W. SMITH, Entrepreneuriat - L’esprit d’aventure, Montréal, Les Éditions de la Chenelière, 1994, 35 p. *
RIES E., Lean startup, ed Pearson, 2015, 319p
Keywords: Sports ; Scientific mediation ; NaN

Prerequisites: None

Objectives:

Sport: Physical and sports education courses help train future engineers, promote their physical and mental balance, facilitate their integration, strengthen the team spirit and the dynamics of the school. Being able to work as a team, communicate, build relationships of trust, be healthy and resist stress are qualities that are required of future engineers. The proposed sports activities involve new motor acquisitions, individual and collective strategies, and an adaptation to the effort. These elements contribute to development and are additional assets for their training. Our missions are to participate in the training of future engineers, to promote the physical and psychic balance of the students, to facilitate the integration of the students of the school, to strengthen the team spirit.

Scientific mediation aims to offer our students to create a link, an exchange, between the scientific / technical world and young students. It is important to note that a special place is given to the social responsibility of our future engineers who must contribute as significantly as possible to the dissemination of knowledge. This specific scenario also allows students who choose this activity to develop their interpersonal skills, to think about the best approach to impart skills and finally to implement elements to ensure that the learner has really progressed. The students involved in this action start by following training in scientific mediation which they then put into practice by sponsoring a group of young students during the robotics trophies. This national meeting puts teams of young students in competition around scientific and technical challenges.

NaN: This is an interdisciplinary, inter-institution program on the theme of Digital Arts-Sciences. This program is supported by the Research-Training-Innovation program in Pays de la Loire as the winner of the call for projects "innovative initial training". Since 2017, the workshop takes the form of a time weekly (Thursday afternoon, from 2:00 p.m. to 5:00 p.m.) of experiments and collective work led and supervised jointly by teachers from ESAD TALM and Polytech Angers. It brings together an average of twenty students, half registered at ESAD TALM Angers (having chosen the workshop from the TALM grids) and the other half registered at Polytech Angers. The work carried out by the students is presented during events: exhibitions at the Musée des Beaux-Arts d'Angers (in 2018 and 2019), installation at the Jean Lurçat museum in 2018, conference performed at the Quai in 2019, exhibition within the Lycée Joachim du Bellay in Angers in 2019.

Contents:
Specific actions are implemented during participation in one of the following three components:
- the practice of team and individual sports
- or scientific mediation
- or the NaN workshop

Evaluation:
Continuous assessment (100%)
Compétences développées

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<thead>
<tr>
<th>(C.2)</th>
<th>adapt to the specific requirements of the company and society (economic, societal, environmental)</th>
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<td>(C.3)</td>
<td>take into account the organizational, personal and cultural dimension (innovate, work in an international and multicultural context, know oneself, self-evaluate, manage one's skills)</td>
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Keywords: occupational health and safety, occupational risks, ergonomic, occupational psychology, musculoskeletal disorder, psychosocial risks, single document

Prerequisites: Business organization, rules and regulation

Objectives:

- Identify in any working organization the human, social, economic and legal issues of occupational hygiene
  - Regulatory and normative context, responsibilities
  - Internal and external actors of occupational hygiene
  - Occupational hygiene indicators and sources of information
- Integrate occupational hygiene in the management of its activities and projects
  - Vocabulary and definitions - Identify hazardous situations
  - Take into account the human factor at work including physical, physiological, cognitive and psychological dimensions, and the working reality
  - Identify et assess risks: a priori and a posteriori
  - Ergonomics, tools and methods
  - « Unique document » for risks assessment: methods and issue
  - Risks prevention – Prevention principles
- Contribute to occupational hygiene management
  - Occupational hygiene management and integrated management system, management commitment
  - Safety culture - Reflection on Lean Management: which issue for health at work?

Programme:

- Practice and study on concrete cases based on videos, photos and if possible role-playing, evaluation of working situations (human and technical)
- Calculation, analyses and interpretation of occupational hygiene indicators
- Analysis of the different dimensions of an occupational accident: causal tree method
- Identification and risks assessment: « unique document » construction and action plan

Evaluation: 100% Continuous assessment

Learning outcomes: Integration of occupational hygiene in its professional activity

Bibliography:

- Sources d'information en santé et sécurité au travail, L. Laborde, B. Berlioz, M. Ferreira, Techniques de l'ingénieur, collection Sante et sécurité au poste de travail, article se3950, octobre 2008.
Responsable : Jean-Baptiste Fasquel

**Keywords** : Acquisition, Digital images, Image processing, Classification

**Prerequisites** : Sensors, Algorithms and Programming Fundamentals

**Objectives** : Knowledge of classical applications encountered in machine vision, including the architecture of machine vision systems (from image acquisition to content exploitation).

**Content** :
- Applications
- Architecture of a vision system : sensor, lighting, data transfert, analysis.
- Image structure, video
- Basic tools : histogram, linear and non-linear filtering, connected components, object recognition (feature engineering, machine learning)
- Tutorial classes : segmentation, denoising, object recognition (shape descriptors, local descriptors, classification)
- Labs with an industrial camera (collaboration with a firm working in the field on industrial vision and automation)

**Evaluation** : written examination

**Bibliographie** :
Enterprise Resource Planning (ERP)

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Compétences développées

(S.1) control industrial processes
(S.3) develop supervision and traceability tools
(S.4) master the tools and methods for monitoring automation projects
(S.12) master the tools and methods of project follow-up in computer science
(S.15) manage databases in different environments
(C.1) apply scientific and technical knowledge
(C.2) adapt to the specific requirements of the company and society (economic, societal, environmental)

Responsable: Stéphane Crépet

Keywords: ERP, Information System, Management

Prerequisites: Information System

Objectives: This course is designed to provide the student with a thorough understanding of both the role that Enterprise Resource Planning Systems (ERPs) play in an organization and the challenging task of managing the Information Systems (IS) function. During the semester, concrete problems, coming from the world of the company, will allow the student to understand the challenges and the interest of these software packages. The objective is to have, for the student, a visibility on the expectations of a PGI and in particular to explore the interaction, through an ERP, between the various departments of a company dependencies, and other data models. Develops a working relational database for a realistic application.

Program:

1. Understand a business information system
2. Understand the different IS dimensions :
   a. Technical dimension
   b. Organizational dimension
   c. Managerial dimension
3. Understand the different IS elements :
   a. Steering system
   b. Decision-making system
   c. Operational system
4. Understand the articulation of the IS with the corporate strategy (IS Governance - IS project management)

Examination: Written examination

Bibliography:

Responsable : Philippe Declerck

Keywords: Numerical analysis, precision, memory execution time, complexities

Prerequisites: Basis in computer science, Scilab

Objectives: The aim is to highlight the basic difficulties which can be found in computer science for any used language. The questions can be as follows: The capacity for a computer to make a simple addition; The capacity to treat a real number; The possibility that a software ends.

Program:
- Initiation to state automata (connected to the course "progWeb")
- Raising awareness of the numerical problems in computer science
- Arithmetic operations of the computer
- Execution time and complexities

Examination: Continuous

Bibliography:
- Les super-calculateurs de Météo France
- Thomas H. Cormen, Algorithmes notions de base, Collection Dunod, BU 62 255 COR,
- Cours Béatrice Duval & Igor Stéphan, Structures de données et algorithmes, UFR Sciences Angers, 2012/2013.
- Cormen, Leiserson, Rivest, Introduction à l’algorithmique, Collection Dunod, BU 62 255 COR
| Compétences développées | (C.1) apply scientific and technical knowledge | (C.2) adapt to the specific requirements of the company and society (economic, societal, environmental) | (C.3) take into account the organizational, personal and cultural dimension (innovate, work in an international and multicultural context, know oneself, self-evaluate, manage one's skills) |
|------------------------|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|

**Responsable**: Laetitia Perez  

**Key-words**: Conferences, industrial issues, engineering missions  

**Prerequisite**: Lessons from the “Control engineering and Computer Engineering” department  

**Goals**:  

The speakers at conferences are mostly industrial, but sometimes academics (French or foreign) are invited to lead a conference on a particularly relevant topic.  

The areas covered are varied. They can obviously highlight the themes of control engineering (connected factory, PLC security, etc.) as well as computer engineering (AI, deep learning, etc.). The teaching team is also vigilant to go beyond the purely scientific and technical framework and subjects such as innovation, sustainable development, ecological transition, growth, corporate social responsibility, management, ethics, deontology even history could be discussed during these conferences.  

More specifically, in order to reinforce the adequacy between specific lessons ("cyber physical systems", "cyber security", "HCI-VR") and the expectations of the professional world, industrial speakers are invited.
**Industrial networks**

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**Compétences développées**

(S.1) control industrial processes  
(C.1) apply scientific and technical knowledge

**Responsable** : Rémy Guyonneau

**Keywords** : Local Area Networks, Industrial Networks, Programmable Logic Controller (PLC)

**Prerequisites** : PLC programming, Norm for state functional charts (Grafchet)

**Objectives** : To present concepts and standards for industrial networks. First general theoretical notions are presented. Then, three examples are detailed: the Profinet network and the CAN and ModBus buses. Several practical works enable the students to use those networks. The documents of this course are available here: https://gitlab.u-angers.fr/cours/industrial_network_student

**Program** :
- General introduction to networks and industrial networks (efficiency, logical and physical topologies, OSI model);
- Semaphore principle (synchronization of PLCs);
- Profinet Network (Configuration of a network between three PLCs and remote I/O with TIP Portal software);
- CAN Bus (Serial Bus widely used, in the car industry for instance), reading and processing frames with an oscilloscope;
- Modbus TCP/IP protocol (Master/Slaves mode, SCADA systems, TCP/IP, …).

**Labs** :
- Automation of a robotized transfer chain (3 Siemens PLCs - Profinet network with TIA Portal software);
- Reverse-Ingeneering over a “black box” with a CAN interface (electrical frame reading with an oscilloscope);
- Management of a remote monitoring system with Modbus TCP/IP (in python language).

**Examination** : Written examinations (tests and final examination) and labs evaluation (devotion, achievements and reports).

**Bibliography** :
- Siemens Technical documentation
- BOSCH CAN specification 2.0, 1991
SCADA systems

4A / Semester 7

4h CM – 8h TP24 – 8h TP16

UE 7-3

Automatique &

Automatisation

Competences
développées

(S.1) control industrial processes
(S.3) develop supervision and traceability tools
(S.6) control and operate industrial robots
(S.7) design and operate embedded, mobile systems and/or robotics equipment
(C.1) apply scientific and technical knowledge

Responsable : Sébastien Lahaye

Keywords: automated systems, supervisory control and data acquisition (scada)

Prerequisites: Automatismes industriels (UE5-3), Réseaux industriels (UE7-3), or equivalent

Objectives: Prepare students to become a privileged interlocutor, or even a member, of an automation engineering and design office, able to interact with other offices, suppliers and/or customers.

Outline:
1. Introduction to SCADA systems
   - Brief history and definition
   - Place and role inside the production monitoring and control system
   - Anatomy of a SCADA system
   - Software solution and protocols
2. Design of SCADA software using commercial packages
   - General principles
   - Design of graphic interfaces and animation of graphic depictions
   - Implementation of embedded programs
   - Communications with automated systems
   - Loggings
   - Deployment and administration

Examination: continuous assessment (written tests / laboratories)

References:
- Supervision homme-machine, Jacky MONTMAIN, Techniques de l’ingénieur, 2005
### Traceability

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<th>SAGI</th>
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#### Compétences développées

- (S.1) control industrial processes
- (S.3) develop supervision and traceability tools
- (C.1) apply scientific and technical knowledge
- (C.2) adapt to the specific requirements of the company and society (economic, societal, environmental)

### Responsable

Stéphane Crépet

### Keywords

Planification, Production, stock/inventory, quality control

### Prerequisites

programmable logic controller

### Objectives

Managing the traceability of manufacturing production is a very important issue for the productive apparatus of an industrialized country. This management stems from the observation that industrial process is not always perfect and that error can occurs, despite progress of development methods. Traceability management brings together methodologies and technical solutions to industrialize the traceability of production and make optimum use of it. This course presents the issues and the contexts of application by type of industry of this management. Next, it details the major features included in production traceability. It describes the real situations and possible technical solutions to implement this management.

### Program

1. Production traceability: issues and areas of application
   a. Challenges of production traceability
   b. Application Sectors
2. Overview of possible solutions
   a. Paper Traceability
   b. Computerization
3. Trends

### Evaluation

100% CC

### References

**Compétences développées**

(S.10) develop applications within the framework of software engineering (best practices, reliability, cost rationalization, monitoring, etc.)

(S.12) master the tools and methods of project follow-up in computer science

(C.1) apply scientific and technical knowledge

(C.2) adapt to the specific requirements of the company and society (economic, societal, environmental)

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**Responsable** : Nicolas Delanoue

**Keywords** : Software development, UML, unit testing, UML, Git

**Prerequisites** : Object oriented programming

**Objectives** : Generalities regarding the software development process, including development methods (V cycle, agile methods,…) and related activities (requirements, specifications, conception, coding, testing, deployment). Introduction to modeling with UML, unit testing, source code management (versioning)

**Content:**

- Generalities :
  - Actors, activities, life cycle
  - Development methodology : standard predictive/linear methods and agile ones (in particular Scrum).
  - Some good practices : modeling with UML, unit testing et versioning

- Labs :
  - Modeling from specifications ou from an existing code (restricted to class, object, package and sequence diagrams)
  - Implementation of unit tests from an existing code.
  - Source code management with GIT

**Evaluation** : written examination

**References:**

- OOP de Coad press
- UML de Booch, Rumbaugh, Jacobson
Oriented object programming in C++

4A / Semester 7
12h TP24 – 12h TP16
UE 7.4
Génie Informatique

Compétences développées
(S.9) apply the procedural and object-oriented programming paradigms
(C.1) apply scientific and technical knowledge

Responsable: Bertrand Cottenceau

Keywords: Object Oriented Programming, C++, classes

Prerequisite: C language and an OO language (C# or Java)

This lecture aims at giving an introduction to the C++ language used as an object oriented language. Students are assumed to have basics in another object oriented language (C# or Java) and some skills in C language, in particular the notion of pointer must be known. The syntax to write user-defined classes and to re-use classes with inheritance is presented. Some STL classes are introduced (vector<T>, list<T>, string) as well as the definition of user-defined operators.

All examples are written in the context of console applications.

Outline:
Automatic vs dynamic allocation
References in C++
Syntax for classes (methods, constructors, destructor)
User-defined operators
Re-use classes to create new classes
Initialization list (constructors)
Copy constructor
Operator =
STL : string, vector<T> et list<T>

Examination: written exams and labs

Bibliography:
- "Programmer en langage C++", Delannoy, Eyrolles
- "Pont entre C et C++" P.N. Lapointe, Addison-Wesley
- "Comprendre et utiliser C++ pour programmer objets", Clavel Trillaud Veillon, Masson
**Unix server Administration**

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<td>Génie informatique</td>
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**Competences développées**

- (S.13) manage computer networks (infrastructure, services, control and command functions)
- (S.14) administer computer servers
- (S.16) implement and develop tools in the context of IT security
- (C.1) apply scientific and technical knowledge
- (C.2) adapt to the specific requirements of the company and society (economic, societal, environmental)

**Responsible**: Mehdi Lhommeau

**Keywords**: Linux/UNIX, LDAP, SAMBA, SNMP, NFS, NIS, DOCKER

**Prerequisites**:

**Objectives**:
Students will learn how networking is implemented on UNIX/Linux Systems. Students will learn to install and configure network applications including NFS, SNMP, SAMBA, Docker and domain systems such as NIS and LDAP.

**Program**:

- Boot and shutdown UNIX processes
- **Network File System (NFS)**: File system sharing over the network; Remote Procedure Call (RPC) service; NFS server and client sides; NFS installation and configuration; static mount and automount configurations;
- **Network Information Service (NIS)**: Centralized authentication systems; sharing user and host information over the network; NIS server and client sides; NIS installation and configuration; compatibility mode; netgroups; security issues.
- **Integrating Linux and Windows**: Elements of Windows networking: NetBIOS, SMB/CIFS protocols, Domain Controller; Samba server on Linux for centralized Windows logon, file sharing; Samba client; Samba installation and configuration; accessing Windows file system from Linux and vice versa.
- **Docker**: Containers implementation
- **Lightweight Directory Access Protocol (LDAP)**: Overview of Unix Authentication and Naming services; introduction to LDAP: domain component (dc), organizational unit (ou), common names (cn), schemas, ldif format, services, ports and commands; Server and client sides; OpenLDAP installation and configuration; LDAP applications.

**Evaluation**: Written exam

**References**:

Developed skills
(S.9) apply the procedural and object-oriented programming paradigms
(S.10) develop applications within the framework of software engineering (best practices, reliability, cost rationalization, monitoring, etc.)
(C.1) apply scientific and technical knowledge

Responsible: Bertrand Cottenceau

Keywords: Java – object-oriented programming – N-tier architecture - JDBC (Java Database Connectivity) - microservice

Prerequisites: C Programming (UE6-2)

Objectives: Acquire intermediate knowledge of the Java language which is widely used in the industry and the services.

Program:
- Java introduction (similar to C#)
- Management of databases with the API JDBC: main steps in the exploitation of a database.
- Layered architectures: introduction to the Spring framework.
- Implementing a microservice using Spring Boot

Examination: 2 applications coded in limited time

Bibliography / Webography:

http://tahe.developpez.com/java/cours
Compétences développées

- (S.10) develop applications within the framework of software engineering (best practices, reliability, cost rationalization, monitoring, etc.)
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- (C.1) apply scientific and technical knowledge
- (C.2) take into account the organizational, personal and cultural dimension (innovate, work in an international and multicultural context, know oneself, self-evaluate, manage one's skills)

Responsable: Tarek Talbi

Keywords: ORACLE, Security, PL/SQL

Prerequisites: UE 5-3

Goals: This course is designed to give students a firm foundation in basic administration of Oracle Database. In this class, students learn how to install and maintain Oracle Database. Students gain a conceptual understanding of the Oracle database architecture and how its components work and interact with one another. Students learn how to create an operational database and properly manage the various structures in an effective and efficient manner including performance monitoring, database security, user management, and backup/recovery techniques. The lesson topics are reinforced with structured hands-on practices.

Program:
- Software installation and the creation of new databases.
- An in-depth exploration of the database architecture, including memory, process and data structures, and the management of those structures.
- Management of database files.
- Specialized facilities intended to maximize performance of enterprise-scale transactional applications, such as the shared SQL and PL/SQL cache, the result cache, the database buffer cache, and other similar components.
- Management of security policies and procedures, including administration of user accounts, roles, privileges and profiles.
- Performance monitoring, problem troubleshooting, and resolving lock and conflict issues.
- Using the Oracle Enterprise Manager and SQL interfaces for administration tasks.
- A primer on backup and recovery structures and strategies.

Examination: written examination

Bibliography:
**IT security**

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**Compétences développées**

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- (S.13) manage computer networks (infrastructure, services, control and command functions)
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- (S.16) implement and develop tools in the context of IT security
- (C.1) apply scientific and technical knowledge
- (C.2) adapt to the specific requirements of the company and society (economic, societal, environmental)

**Responsable:** Alain Godon

**Keywords:** LINUX, NETWORKING, SYSTEM, CRYPTOGRAPHY, SQL OSINT, SOFTWARE PROGRAMMING

**Prerequisites:** C Language, PHP, Linux User, Linux Admin

**Objectives:** Learn about stakes of security and technical views

**Content:**
- Stakes of security
- WEB vulnerabilities
- Buffer overflow
- Secure tools

**Examination:** 100% CC
Semestre 8  340 H/E

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(*) taught in English
Keywords: Communication skills, Cross-cultural skills, Professional Environment

Prerequisites: Level B2 from the CEFR

Objectives:
Validating TOEIC minimum score to graduate as an Engineer.
Meeting the requirements of the CEFR (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction
Cross-cultural skills: knowledge of international environment

Language proficiency level groups are reorganized according to the TOEIC test scores.

Programme:
- Practising oral and written communication skills.
- Strengthening grammar skills.
- Regular practice of pronunciation and word stress.
- Communication skills in companies.
- Political, economic and social news
- Presenting industrial projects.

Evaluation:
Continuous assessment (100%)

Learning outcomes:
- The student can speak about a technical issue related to his/her field of expertise.
- The student can infer and understand gist, purpose and details in a spoken document related to a general or technical topic.
- The student can infer and understand gist, purpose and details in a written document related to a general or technical topic.
- The student can speak and write in a clear and fairly complex language.
Keywords: Communication skills, Cross-cultural skills, Professional Environment

Prerequisites: Basic oral and written communication skills

Objectives:
Meeting the requirements of the CEFR (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction
Cross-cultural skills: knowledge of international environment
Organization of Language proficiency levels whenever it is possible.

The target for the advanced group is CEFR B2 or C1; A2 or B1 for the intermediate group.
A certification in German/Spanish is recommended for advanced students in final year.

Programme:
Oral and written communication skills
Communication skills in Companies
Political, economic and social news

Evaluation:
100% Continuous assessment

Learning outcomes:
Intermediate groups
- The student can speak for a few minutes on a topical issue or a topic of personal interest.
- The student can take part in a conversation on simple topics that can be related to his/her personal interests.

Advanced groups
- The student can read an article or listen to a programme in a standard language and comment on it.
- The student can write an abstract and a report in German/Spanish
- The student can make an oral presentation on professional topics
- The student can argue and justify his/her point of view fluently
Keywords: Challenges, Financial balance, Treasury, profitability, Teams, multidisciplinary

Prerequisites: Fundamentals in management, marketing, human resources, R&D, business strategy, inventory management, project management and corporate finance.

Objectives: In the continuity of the financial analysis course, develop an understanding of the operational and financial management of an international group in a competitive environment that is constantly evolving through the practice of a serious game.

Evaluation:

Continuous monitoring via enterprise game challenges

The performance of participants is measured and compared by both operational and financial indicators, including net income, market shares, return on capital, earnings per share, capacity utilization rates and employee productivity.

The overall performance of the teams is measured by the return to shareholders, which consolidates all the key success factors into a synthetic indicator that can be used to compare the teams.

Oral presentation

Sources

Cesim Global Challenges
**Sport / Parrainage scolaire**

| Compétences développées |  
|-------------------------|---
| (C.1) apply scientific and technical knowledge |  
| (C.2) adapt to the specific requirements of the company and society (economic, societal, environmental) |  
| (C.3) take into account the organizational, personal and cultural dimension (innovate, work in an international and multicultural context, know oneself, self-evaluate, manage one's skills) |  

**Keywords:** Sports ; Scientific mediation ; NaN

**Prerequisites:** None

**Objectives:**

**Sport:** Physical and sports education courses help train future engineers, promote their physical and mental balance, facilitate their integration, strengthen the team spirit and the dynamics of the school. Being able to work as a team, communicate, build relationships of trust, be healthy and resist stress are qualities that are required of future engineers. The proposed sports activities involve new motor acquisitions, individual and collective strategies, and an adaptation to the effort. These elements contribute to development and are additional assets for their training. Our missions are to participate in the training of future engineers, to promote the physical and psychic balance of the students, to facilitate the integration of the students of the school, to strengthen the team spirit.

**Scientific mediation** aims to offer our students to create a link, an exchange, between the scientific / technical world and young students. It is important to note that a special place is given to the social responsibility of our future engineers who must contribute as significantly as possible to the dissemination of knowledge. This specific scenario also allows students who choose this activity to develop their interpersonal skills, to think about the best approach to impart skills and finally to implement elements to ensure that the learner has really progressed. The students involved in this action start by following training in scientific mediation which they then put into practice by sponsoring a group of young students during the robotics trophies. This national meeting puts teams of young students in competition around scientific and technical challenges.

**NaN:** This is an interdisciplinary, inter-institution program on the theme of Digital Arts-Sciences. This program is supported by the Research-Training-Innovation program in Pays de la Loire as the winner of the call for projects "innovative initial training". Since 2017, the workshop takes the form of a time weekly (Thursday afternoon, from 2:00 p.m. to 5:00 p.m.) of experiments and collective work led and supervised jointly by teachers from ESAD TALM and Polytech Angers. It brings together an average of twenty students, half registered at ESAD TALM Angers (having chosen the workshop from the TALM grids) and the other half registered at Polytech Angers. The work carried out by the students is presented during events: exhibitions at the Musée des Beaux-Arts d'Angers (in 2018 and 2019), installation at the Jean Lurçat museum in 2018, conference performed at the Quai in 2019, exhibition within the Lycée Joachim du Bellay in Angers in 2019.

**Contents:**

Specific actions are implemented during participation in one of the following three components:
- the practice of team and individual sports
- or scientific mediation
- or the NaN workshop

**Evaluation:**
Continuous assessment (100%)
Keywords:
- Team management - Leadership
- Project management, needs analysis, planning, project management and management, project closure and evaluation

Prerequisites: Knowledge of a company

Objectives:
Team management: Understand the challenges of «team management».
- Acquire the relational fundamentals within a team.
- Know and develop leadership skills.

Project planning: The objective of this module is to make students aware of the concepts and tools of project management through scenarios, ongoing exchanges with the teacher from the definition and framing of a project, its planning and management until the project is completed and evaluated.

Program:
Team management:
- Leadership - Role of the manager - Mission - Objectives - Values.
- Human and managerial skills of the manager - Styles and types of authority
- Motivation - Assertiveness.
- Conflict management.

Project planning:
- Session 1: General
- Session 2: Preparation phase – needs analysis and project launch
- Session 3: Build and Plan – Project Preparation and Task and Activity Planning Phase
- Session 4: Driving and Piloting – Project Delivery and Project Team Facilitation Phase
- Session 5: Close and evaluate – Finalization phase of the experience capitalization project

Examination: 100% during classes - situational assessments

Bibliography:
- « L’essentiel de la gestion de projet » – Aim, Roger (Gualino 2016).
Process control

| SAGI | 4A / Semester 8 | UE 8.2
|      | 20h TP24 | Automatique & Automatisation

Compétences développées
(S.1) control industrial processes
(S.2) model and analyze continuous or discrete dynamic systems
(C.1) apply scientific and technical knowledge

Responsable: Laetitia Perez

Keywords: Control theory, identification, industrial process

Prerequisites: Control theory in preparatory classes and previous UE 6-3

Objectives: Industrial applications will be investigated in order to exhibit implementation in realistic configurations. The main goal is to discuss with students about the attractivity of automatic control in industrial context.

Program:
Lecture will be divided in several parts in order to investigate process control taking into account numerous industrial requirements. Theoretical aspects will be briefly described in accordance with engineering purposes. The following processes will be studied:

- **Situation 1:** Mining process
  - Delay system
  - Electronic device for control purpose
  - Stability and Routh criterion

- **Situation 2:** Temperature control in a wind tunnel
  - Electronic device for control purpose
  - Bode graph
  - Controller improvements

- **Situation 3:** Stabilization of an offshore platform
  - State representation
  - Stability
  - Proportional controller

- **Situation 4:** Control of a magnetic tape
  - MIMO system
  - State representation and feedback

Evaluation: 100% continuous assessment (written examination)

Bibliography:
Responsable: Philippe Declerck

Keywords:

Objectives:
In this course, the optimization problem consists in finding the minimum or the maximum of a linear function, named objective function, of several variables which are real numbers or integers, have to satisfy linear constraints. Another aim is the modelling of practical examples which can be solved by the presented approaches.

Program:
- Introduction to the optimisation
- Linear Programming (Fourier-Motzkin, Simplex)
- Integer Linear Programming
- Modelling of practical examples

Examination:
Continuous

Bibliography:
### Mobile robotics

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| Compétences développées | (S.5) model, analyze and predict robots behavior. |
|                        | (S.6) control and operate industrial robots    |
|                        | (S.9) apply the procedural and object-oriented programming paradigms |
|                        | (C.1) apply scientific and technical knowledge |

**Responsable:** Rémy Guyonneau

**Keywords:** UGV (Unmanned Ground Vehicle), Localization, Path Planning, Exploration...

**Requirements:** Python programming

**Courses Objectives:** To present an overview of mobile robotics issues and solutions, mainly for Unmanned Ground Vehicle. This module mainly focuses on navigation issues while the robot is moving in its environment (localization, mapping and path planning).

**Course agenda:** The course is presented as a set of labs, each one focusing on a common problem in mobile robotics (localization, path planning, shortest path, exploration...). The objective for the students is to implement a solution on a simulator (Python) - MonteCarlo Localization, RRT, A*, frontier exploration...

The robot considered on the simulator is a differential ground robot (two driving wheels and a caster wheel) equipped with a LiDAR sensor.

Each lab work starts with a presentation of the problem and its solution that the students will have to implement. A basic framework, including the simulator and the graphical interface (Python3 + Tkinter) is given to the students for each lab work.

**Evaluation:** The student achievements and the source code are evaluated.
**Real time, embedded software**

| Compétences développées | UE 8.2
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<td>Automatique &amp; Automatisation</td>
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<td>(S.6) control and operate industrial robots</td>
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<tr>
<td>(S.7) design and operate embedded, mobile systems and/or robotics equipment</td>
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<td>(C.1) apply scientific and technical knowledge</td>
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**Responsable** : Mehdi Lhommeau

**Keywords** : Scheduling, Synchronization, Mutual Exclusion, Unix/Linux, Xenomai

**Prerequisites** : C Language Course

**Objectives** : The monitoring and control of physical processes and systems are increasingly performed by computers. These real-time embedded systems must satisfy stringent timing and reliability constraints in addition to functional correctness requirements. For example, a word processor on a desktop machine pauses while the user is typing, it is merely annoying. In the case of a heavy machine controller, it could be catastrophic. This class will cover features typically found in real-time and embedded systems with those found in more traditional computer systems. Topics will include scheduling, synchronization, memory management, and architectural features of real-time and embedded systems

**Program** :

- Introduction to real-time and Embedded systems
- Scheduling techniques
- In-depth study of Rate-Monotonic Scheduler (RMS), EDF, LLF, and other schedulers
- Synchronization & mutual exclusion (real-time and non-real-time)
- Programming language and operating systems support (C, Linux, Xenomai)

**Examination** : Exam

**Bibliography** :

Keywords: virtual reality, animation techniques, physics modeling, collision detection, dynamic rendering, inverse kinematics.

Prerequisites: Human-computer interaction & virtual reality, C# language

Objective: deepen knowledge in virtual reality: advanced animation techniques, development of 3D real-time applications (Unity3D). Deepen the aspects relating to physical modeling and dynamic rendering (collision detection, behavior, optimization). Interaction with joint systems and inverse kinematics.

Program:
- Advanced virtual reality
- Procedural animation techniques
- Joint systems and inverse kinematics
- Physics modeling and dynamic rendering

Evaluation: continuous assessment

Bibliography:
- Enhancing Interaction in Mixed Reality: The Impact of Modalities and Interaction Techniques on the User Experience in Augmented and Virtual Reality
- Augmented Reality with Unity AR Foundation: A practical guide to cross-platform AR development with Unity 2020 and later versions
- Learning C# by Developing Games with Unity 2021: Kickstart your C# programming and Unity journey by building 3D games from scratch, 6th Edition, Harrison Ferrone
- C# Game Programming Cookbook for Unity 3D (English Edition), Jeff W. Murray, 2e Édition
Programmation JAVA J2EE

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Compétences développées

- (S.9) apply the procedural and object-oriented programming paradigms
- (S.10) develop applications within the framework of software engineering (best practices, reliability, cost rationalization, monitoring, etc.)
- (C.1) apply scientific and technical knowledge

Responsable: Nicolas Delanoue

Keywords: Java EE - oriented programming object - layered architectures - Java Persistence Api (JPA) - Java Server Faces (JSF) - Enterprise Java Beans (EJB3) - Spring - web services

Prerequisites: Object oriented programming II (JAVA, Part 1) (UE 8-2A)

Objectives: Acquire intermediate knowledge in web development with Java and frameworks such as JSF, Spring, EJB3

Program:
- Introduction to JPA (Java Persistence API), the object-relational mapping, JPA interface methods, Spring / JPA integration in layered architectures.
- Introduction to EJB (Enterprise Java Bean), EJB / JPA integration in layered architectures.
- Client - Server applications with web services.
- Introduction to JSF framework (Java Server Faces) to develop web applications.

Examination: 1 mini-project, 1 final written exam

Bibliography / Webography:
- Java Persistence with Hibernate, Christian Bauer and Gavin King, Manning publications
- PDF written course: http://tahe.developpez.com/java/jpa
- Java EE 5, Antonio Gonçalves, Eyrolles publications
- Java Server Faces, Chris Schalk et Ed Burns, Mc Graw-Hill pub
**Responsable:** Laetitia Perez

**Key words:** educational project, group work, professional project, applications

**Prerequisite:** those required for the project of each group of students

**Goals:**
This project is carried out in groups of 2 to 3 students supervised by one or more members of the teaching team.
The teaching team propose numerous specific subjects related to the context of control engineering, automated systems and computer engineering. These allow students to apply the knowledge introduced during the courses and to implement project management methods. The projects are built pedagogically and intermediate results are required and discussed with supervisors.

**Contents:**
For the 4A-SAGI, a specific action is carried out to refine the professional project of each student and make the most of the skills acquired during the training.

Some projects previously proposed ...

- Web site Security Challenge
- Mobile robots in warehouses
- « Culture au futur »
- E-co-ologic
- Rescue drone
- Web Explorer 2020 Productys
- Dobot Magician
- Facial recognition
- Ball Balancing Robot
- Robot Epson (4 axes)
- Level regulation
- Perceive RV
- Virtual Germination
- Virtual Supermarket
- Augmented guitar

**Evaluation:** written report, evaluation of the progress of the work, feedback requested from students (project, device, presentation ...)

---

**Compétences développées**

(S.4) master the tools and methods for monitoring automation projects
(S.8) master the tools and methods for monitoring robotic projects
(S.12) master the tools and methods of project follow-up in computer science
(C.1) apply scientific and technical knowledge
**Internship**

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<td>take into account the organizational, personal and cultural dimension (innovate, work in an international and multicultural context, know oneself, self-evaluate, manage one's skills)</td>
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**Responsable:** Laetitia Perez

**Presentation**

The 4th year internship is the first specialty internship. This internship is an essential part to refine the professional project. It must allow the student:
- to exercise their capacities of autonomy, creativity, organization, relationship and critical thinking
- to put into practice and deepen their knowledge in one or more areas covered during their university course
- to improve their skills of synthesis, written expression and communication through the internship report and oral presentation;
- to have professional experience, industrial contacts and prepare for life in a company.

**Organisation**

The internship is supervised by an internship supervisor within the company and a teaching tutor from Polytech Angers.
- The internship supervisor: he is the privileged contact in the host company. It can assist in the search for information. It gives the rules to be respected within the organization. It is also up to the internship supervisor to assess the student’s behavior and involvement.
- The teaching tutor: he is the contact person within Polytech Angers. If there is a problem, he has to be informed as soon as possible. Its role is to advise and support the student for the smooth running of the internship.

**Evaluation :**

The evaluation is based on: professional achievement in the company, quality of the written report and the defense. The first part (internship assignment) is essentially assessed on the basis of an opinion issued by the internship supervisor. The latter measures the qualities, skills, adaptation and development of the intern during the internship. The last two parts are evaluated by the jury (defense) and the teaching tutor (report).
Syllabus
SAGI – S9

Version Aout 2022
Responsable : L. Autrique
## Semestre 9  520 h

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| UE 9-5 Projet | 100 |

(*) taught in English
Keywords: Communication skills, Cross-cultural skills, Professional Environment

Required: TOEIC validation

Objectives:
- Meeting the requirements of the CEFR (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction
- Cross-cultural skills: knowledge of international environment
- Good command of oral techniques

Programme:
- Team work skills
- Presenting techniques for the final industrial project presentation (focusing on pronunciation, fluency, idiomatic expressions, etc…)
- Job/internship interview training
- Abstract writing

Evaluation:
Continuous assessment (Written and spoken)

Learning outcomes:
The student can carry out a job/internship interview.
The student can make a professional oral presentation on a long-term project (5th year industrial project)
The student can write a professional report, an abstract, a professional e-mail and a personal profile.
Keywords: Communication skills, Cross-cultural skills, Professional Environment, Certification

Prerequisites: B1-B2 level on listening and comprehension skills

Objectives:
- Meeting the requirements of the CEFRL (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction
- Cross-cultural skills: knowledge of German-speaking countries
- Preparation to an external certification

Programme: Training placement tests
Professional writing (abstract, report, e-mail)
Advanced grammar review

Evaluation: Self assessment with placement tests

Learning outcomes: Running meetings
Advanced grammar skills
Keywords: job, employability, hiring, integration, professional watch

Prerequisites: none

Objectives:
- Provide keys to facilitate the professional integration of students upon graduation
- Define your use profile
- Knowing how to value yourself

Program:

1. Prospective method
   - positioning of Polytech Angers students in terms of evolving trends
   - projections

2. The keys to integration into a team:
   - know yourself and have clear objectives to communicate
   - exchange of experiences on the fundamentals (codes, social life...)

3. Focus on skills
   - Evaluation of the individual skills of his speciality based on the expectations of the CTI
   - Convince in 3 minutes for an integration (professional or project)

4. Digital identity
   - Digital capsule to know everything
   - Audit of your online presence to be ranked at the top of the search list

Examination: 100% continuous assessment

Bibliography:
- Christophe BLAZQUEZ, Samir ZAMOUM, Développez votre identité numérique, GERESO ÉDITION, 2019.
Employment law

5A / Semestre 9
12 h TD
UE 9-1
Formation générale

Compétences développées

(C.2) s’adapter aux exigences propres de l’entreprise et de la société (économique, sociétale, environnementale)
(C.3) prendre en compte la dimension organisationnelle, personnelle et culturelle (entreprendre et innover, travailler en contexte international et multiculturel, se connaître, s’auto-évaluer, gérer ses compétences)

Keywords: Labour code, employment contract, Collective Agreements, justice

Prerequisites: None

Objectives:
- Knowing labour law is essential; either you are worker or employer. Nobody can ignore it.
- Labour legislation is in constant discussion. It is therefore important to understand the legal, economic and social issues

Programm:
• Introduction to labor law
• Justice in labor law
• Labor Inspections
• Job offer and maintenance
• The employment contract (from the signature to the termination of the employment contract)
• The rights and duties of the parties (employee / employers)
• Union representatives
• Payroll and exam preparation
• The 2020 novelties

Evaluation:
Table examination with practical case

Learning outcomes:
The student has understood the meaning of law and is able to read and understand a court decision

References:
- Code du travail , ed.Dalloz
RSE et Ethique

5A / Semestre 9
12h TD
UE 9.1
Formation Générale

Compétences développées

(C.2) adapt to the specific requirements of the company and society (economic, societal, environmental)
(C.3) take into account the organizational, personal and cultural dimension (innovate, work in an international and multicultural context, know oneself, self-evaluate, manage one's skills)

Responsable: N. Faisant

Keywords: social responsibility, environment, societal issues, business, skills, ethics, dilemma, values, training, engineer.

Prerequisites: none

Objectives:
- To integrate the impacts of corporate social responsibility internally and externally
- To position oneself
- To know how to promote yourself

Program:
1. Corporate Social Responsibility (CSR) = an imperative
   - CSR to give more meaning to work and innovate
   - Tools to involve employees and stakeholders in a CSR approach CSR to give more meaning to work and innovate.
   - https://fr.slideshare.net/Amorosx/lb-emergence-croissancedurablexavier-amoros
   - https://fr.slideshare.net/Altamire/matinale-rse-altamiremfqm2015toolight
2. Definition of ethics: societal approach and IESF's ethical charter for engineers.
   - the engineer in society
   - the engineer and his skills
   - the engineer and his job
   - the engineer and his missions
   - comparison with the ethical charter for engineers in Belgium https://www.fabi.be/l-ingenieur-charte
3. Ethics and the digital world: definition and legal approach
4. Ethics in everyday life

Actions to choose from:
A. The commitment of the citizen-engineer in society: carrying out an "honest engineer” project (organising a blood donation, developing artistic skills with children in difficulty, setting up an artistic and cultural week on the theme of “art and science”, going to meet sick children, running to collect vaccine doses, etc.)
B. To be a creative scientist with an open mind and the ability to question oneself: through the history of technology, the sociology of work and geopolitics, the student is led to weave links between his or her future profession as an engineer and the associated activities, considered in their historical, sociological and geopolitical context.
C. To be a relevant, honest, tolerant and fair professional: zetetics workshop (art of rational doubt). The student is brought to rub shoulders with critical analysis in a concrete way, seeking to distinguish scientific content from pseudo-scientific content, to detect lies with a commercial or propaganda aim, or to prevent the intrusion into the scientific method of ideologies such as racism or creationism.
D. To be an efficient, vigilant, forward-looking, rigorous and reactive leader: a force for proposals for the school and/or training

Assessment: 100% continuous assessment

Bibliography: NF ISO 26000 Novembre 2010, AFNOR.
**SAGI**

**Maitrise des couts projets**

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**Compétences développées**

(S.4) master the tools and methods for monitoring automation projects
(S.8) master the tools and methods for monitoring robotic projects
(S.12) master the tools and methods of project follow-up in computer science
(C.2) adapt to the specific requirements of the company and society (economic, societal, environmental)
(C.3) take into account the organizational, personal and cultural dimension (innovate, work in an international and multicultural context, know oneself, self-evaluate, manage one's skills)

**Keywords:** Market, investment, budget, cost

**Prerequisites:** financial analysis

**Objectives:** Be able to calculate the financial profitability of an industrial project and to monitor and control the costs of this project.

**Program:**

- Introduction
- Partie 1 : Analysis and diagnosis
  - external environment : the PESTLE model
  - industry : the PORTER strengths
  - market : the SWOT and the success factors analysis
  - firm : the SBU and the BCG matrix
- Partie 2 : Investment
  - fundamentals
  - actualization
    - NPV
    - IRR
- Partie 3 : Budget and financing plan
  - budget
    - definition and utility
    - building
    - operations vs cash flow
  - financing plan
    - operational cash flows
    - funding
- Partie 4 : Costs and profitability
  - full costs
  - partial costs
    - variable costs
    - fixed costs
  - break even

**Examination:** Continuous assessment (100%)

**References :**
- Stratégique – Gerry JOHNSON, Kevan SCHÖLES, Frédéric FRERY – Ed. PEARSON (10ème édition) – 2017
- Contrôle de gestion DCG 11 Manuel & applications – Ed. Dunod 2017
Keywords: Physical and Sports Education

Prerequisites: None

Objectives:

Physical education and sports activities contribute to the training of future engineers, promote their physical and psychological balance, facilitate their integration, and strengthen team spirit and the school's dynamic. Being able to work in a team, to communicate, to establish relationships of trust, to be in good health and to resist stress, are qualities that are required of future engineers.

The student is expected to be active in the practice of the activity, requiring a real commitment, both physical (the "Doing") and reflective (the "How to do"), and a cultural relationship to the activity. The physical investment will be made in mastering the management of one's physical and psychological integrity, and that of others (muscular, cardio-respiratory and articular warm-ups, respect for elementary safety criteria).
### Innovation

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#### Compétences développées

- **(C.2)** adapt to the specific requirements of the company and society (economic, societal, environmental)
- **(C.3)** take into account the organizational, personal and cultural dimension (innovate, work in an international and multicultural context, know oneself, self-evaluate, manage one’s skills)

---

**Responsible:** Anthony Delamarre

**Keywords:** Innovation approach, creativity Management, Innovation and digital

**Prerequisite:** introduction to innovation and quality

**Goals:** Approach the innovation processes in the digital trades. Position the SAGI engineer in relation to the innovative developments in his field and introduce methods of innovation to upgrade his knowledge and practices.

**Programm:**
- **Definitions**
  - Why innovate?
  - Innovation: product / service or process?
  - Common definition (OSLO manual, pahl and beitzh, …)

- **Components of innovation**
  - The need, the idea, the means (human technological)
  - The time factor: life cycle and control of inertia of change
  - Nature, degree and intensity of innovation

- **Risks to innovate**
  - Technological risk
  - Market risk
  - Strategic risk
  - Human risk

- **Innovation typology**
  - The fields of innovation (incremental / break, value chain, value proposition)
  - Innovation approaches (from total secrecy to open innovation)
  - Organization and innovation
  - Debate: should innovation be framed? Structurée? Or free?
  - Innovation Cell, Integrated Innovation, Open Innovation: Enterprise Organizational Models
  - The innovation cell: model and good practice

- **Methods of innovation**
  - Typology of innovation methods
  - Classification and 10 methods (Watch, creativity, value analysis, semiotics, trend analysis, problem solving, sociology of consumption, prospective marketing, genealogical anticipation, prospective)

- **Innovation and digital**
  - Responsible Innovation of the digital industries: missions, constraints and tools.

**Evaluation:** CC (100%)

**Bibliography:**
Responsable: Anthony Delamarre

Keywords: Industrial property, patent, R&D strategy

Prerequisite: None

Goals: Provide the essential legal background for intellectual property. Allow the future professional to be able to protect his creations and avoid counterfeits.

Programm:
- Introduction to Industrial Property
  - Definition of the law and positioning of industrial property
  - Definition of concepts of industrial property (patents, trademarks, models)
- A technical engineer's tool: the patent
  - Introduction to industrial property and its place in the life of engineers
  - Criterion of patentability
  - Structure of the patent document and information contained in the patent
- Patent Uses in Industrial Engineering (Patent Life Cycle, Corporate Use)
  - The industrial property strategies (business case study)
  - The brand strategy
  - The model strategy
- Cases studies

Evaluation: terminal examination (100%)

Bibliography:
- MARX, Bernard. La Propriété industrielle : sources et ressources d’informations. ADBS - Nathan, 2000
- DE KERMADEC, Yann. Innover grâce aux brevets. INSEP, 1999
- BREESE, Pierre, KERMADEC, Yann de : La propriété intellectuelle au service de l’innovation. Nathan, 2004
- VAJOU, Michel. Le brevet, un vecteur de valorisation et de veille. Ministère de la Recherche – INPI, 2000
### Machine learning

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**Compétences développées**

- (C.1) apply scientific and technical knowledge
- (S.9) apply the procedural and object-oriented programming paradigms

**Responsable**: Mehdi Lhommeau

**Keywords**: Machine learning, data mining, classification, big data

**Prerequisites**: Algorithmics

**Objectives**: The purpose is to provide to students an introduction to data sciences and, in particular, to data processing. The objective is also to present application examples as well as an overview of the major classes of data processing methods.

**Content**: The first part focuses on standard classification methods (supervised and unsupervised), as well as on the notion of « big data » with related specificities (data volume, notion of deep learning and convnets). The second part focuses on the practice of standard methods (both unsupervised and supervised), using various kind of datasets. For instance, one can mention clustering algorithms, bayesian classification approaches (statistics), decision tree (and random forest), neural networks.

**Evaluation**: written examination

**References**:

Data science : fondamentaux et études de cas, E. Biernat et M. Lutz, 2015
Responsable : Nicolas Delanoue

Keywords : Image processing, projective geometry, registration, pose estimation, intrinsic and extrinsic matrices.

Prerequisites: Computer vision and algorithmics

Objectives: The purpose is to provide to students an introduction to 3D vision, based on projective geometry, registration and image processing, with underlying applications to robotics (e.g. distance measurement) and augmented reality.

Content: One favors a practical approach for discovering these notions (« learn by doing ») : the class is organized around the development of a basic program allowing to manipulate and implement each concept.
More accurately, considered concepts are :
- The pinhole model and intrinsic matrix.
- Calibration
- Extrinsic matrix and homogeneous coordinates
- Marker detection, registration and automated estimate of the extrinsic matrix
- Application to the estimate of the distance between the camera and a target
- Application to augmented reality (superposition of a virtual object on a video stream)
- Extension to generic patterns : SURF descriptors and RANSAC-based pose estimation

Evaluation: written examination

References: Multiple View Geometry », Hartley and Zissermann, 2004
**SAGI**

Objets connectés et liaisons sans fils

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Compétences développées

(S.7) design and operate embedded, mobile systems and/or robotics equipment

(C.1) apply scientific and technical knowledge

**Responsable:** David Langin

**Keywords:** IoT, sensor, embedded computing, network, MQTT

**Requirements:** C language, object oriented programming, web server, arduino and raspberry Pi

**Objectives:** The main objective is to present an overview of IoT. More accurately, the purpose is to provide an overview of the set of existing IoT-based sensors (e.g. biomedical sensors, sensors involved in home automation), of underlying hardware and software architectures, as well as of low bandwidth networks.

**Content:** After a general presentation of the IoT, labs will allow students to conceive and implement a complete hardware and software architecture: from the sensor to the retrieval of uploaded data. Labs include the data acquisition step, the data upload on a distant server (through a low bandwidth network, with the widely used MQTT communication protocol), data storage and finally data retrieval for further exploitation.
Développement Durable en SAGI

5A / Semester 9

16h

Sciences de l’ingénieur

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<td>(C.3) take into account the organizational, personal and cultural dimension (innovate, work in an international and multicultural context, know oneself, self-evaluate, manage one's skills)</td>
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Responsable: Mehdi Lhommeau

Key-words: Sustainable Development, Social Responsibilities of Engineers, Automated Systems and Computer Engineering

Prerequisite: Teachings of the “Automated Systems and Computer Engineering” department

Goals:
This subject, adapted to the curriculum of future engineers in "Automation and Computer Science", is part of environmental education, also called education relating to the environment (ERE) or education for sustainable development (EDD). This is an area of training and multidisciplinary educational action which should increase students' understanding of these crucial subjects and make them aware of their responsibilities in a professional setting where they will implement the skills science and technology provided by the teaching team and developed in self-training.

Various professionals from the department's privileged sectors of activity (robotics, IT management, design of special machines, IT engineering, etc.) will be invited to show how the objectives of sustainable development are taken into account in their various missions.

One of the strong points of this teaching will concern “La Fresque du Numérique” in which all students will participate. This is a fun and collaborative half-day workshop with a pedagogy similar to that of "La Fresque du Climat". The aim of this "serious game" is to raise awareness and train participants in the environmental issues of digital technology. This workshop also aims to explain the main lines of the actions to be put in place to evolve towards a more sustainable digital system, then to open discussions between the participants on the subject. A real team building tool, this workshop allows you to come together to learn together. It is primarily intended to be carried out face-to-face, but a remote format is also possible.

Bibliographie / webographie :
- www.fresquedunumerique.org
- http://www.fresqueduclimat.org/
**Responsable:** Mehdi Lhommeau

**Key-words:** Conferences, industrial issues, engineering missions

**Prerequisite:** Lessons from the “Control engineering and Computer Engineering” department

**Goals:**

The speakers at conferences are mostly industrial, but sometimes academics (French or foreign) are invited to lead a conference on a particularly relevant topic.

The areas covered are varied. They can obviously highlight the themes of control engineering (connected factory, PLC security, etc.) as well as computer engineering (AI, deep learning, etc.). The teaching team is also vigilant to go beyond the purely scientific and technical framework and subjects such as innovation, sustainable development, ecological transition, growth, corporate social responsibility, management, ethics, deontology even history could be discussed during these conferences.

More specifically, in order to reinforce the adequacy between specific lessons ("cyber physical systems", "cyber security", "HCI-VR") and the expectations of the professional world, industrial speakers are invited.
Responsable: David Langin

Keywords: Android, Tablet PC/Smartphone

Prerequisite: Java Programming, C programming

Goals:
This course aims to present the programming techniques implemented in the development of mobile applications (Smartphone/Tablet PC). The objective is to learn how to design and implement Android applications for mobile devices. The aim is to learn how to develop a mobile application from scratch, assuming a basic knowledge of Java. A part of the course is dedicated to the handling of Android Studio software. In particular, you will learn how to configure Android Studio, how to work with various activities and how to create simple and intuitive user interfaces. You will also learn how to use frameworks such as Cordova to encapsulate a web application on different mobile operating systems (Android, IOS...).

Program:
- Getting started with Android Studio
- Native Java code development under Android
- Development of user interfaces
- Implementation of mobility-related functionalities (GPS, ...)
- How to use Cordova

Evaluation: continuous assessment

Bibliography & Webography:
Responsable : Nicolas Delanoue

Keywords: Conception, UML, GRASP and Design patterns

Requirements: Software engineering 1, Object oriented programming and Java

Objectives: The purpose is to provide to students an introduction to best practices for the software conception.

Content: The first part concerns various criteria to be considered before starting programming a software (e.g. choice of the programming language, choice of third party packages, hardware constraints, data serialization). Basic good practices are also introduced, such as GRAPS (« General Responsibilities Assignment Software Patterns ») as well as pattern widely encountered in this domain (architectural patterns and design patterns). The second part concerns labs. Each exercise focuses on a specific issue encountered in software development and deals with the refactoring of an existing, incorrectly designed, program, including modeling with UML and the integration of the appropriate design pattern.

Evaluation : written examination
IT project management

5A / Semestre 9
16h TD
UE 9.3
Génie informatique

Compétences développées
(S.12) appliquer les outils et les méthodes de suivi de projets en informatique
(C.1) mettre en œuvre des connaissances scientifiques et techniques
(C.2) s’adapter aux exigences propres de l’entreprise et de la société (économique, sociétale, environnementale)
(C.3) prendre en compte la dimension organisationnelle, personnelle et culturelle (entreprendre et innover, travailler en contexte international et multiculturel, se connaître, s’auto-évaluer, gérer ses compétences)

Responsable: Mehdi Lhommeau

Keywords: Quality, Continuous integration, management of bugs and software evolutions.

Requirements: Object oriented programming

Courses Objectives:
Introduction to the management of projects concerning software development, by integrating, for instance, the notion of quality, continuous integration, bug management. Despite aspects regarding time, cost and human resources management, the main objective is to introduce good practices and widely used tools in the field of software development. The purpose is also to integrate some methods and tools using exercises: for instance, this can involve the installation and use of an information system allowing to manage versioning, to automate documentation generation, test running, as well as the management of bugs and evolution requests (« tickets »).

Contents:
- The current developer's job / market / employment
- Jenkins: a first step in continuous integration
- git: the 10 commands you need to know before starting to work
- JS frameworks: Angular / React / Ecosystem
- DevOps - Docker – Node

Evaluation:
Lab and QCM

Bibliography & webography:
Web development

5A / Semester 9
20h TP24
UE 9.3
Génie informatique

Compétences développées
(S.9) apply the procedural and object-oriented programming paradigms
(S.10) develop applications within the framework of software engineering (best practices, reliability, cost rationalization, monitoring, etc.)
(C.1) apply scientific and technical knowledge

Responsable : Mehdi Lhommeau

Keywords : Javascript, HTML 5, CSS 3, JQUER, Angular, React, NodeJS

Prerequisites : Basic knowledge of programming

Objectives : This course introduces web development based on Html5. The objective of the course is to be able to understand the fundamental concepts of front-end and back-end web development, through practice:
- The front-end will use HTML, CSS, Javascript framework, Angular/Typescript, SVELTE, Vue.js and React languages and technologies;
- The back-end will use the following languages and technologies: NodeJS, MongoDB, Flask/Python.

Program :

- JQUERY
  - DOM
  - AJAX
  - CANVAS
- NodeJS
  - Introduction
  - Event Loop in Node.js
  - Coding with Socket.io
  - ExpressJS
- AngularJS/TypeScript
- SVELTE
- React
- Flask/Python

Evaluation : Project

References:

### Advanced control

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#### Compétences développées

- (S.1) control industrial processes
- (S.2) model and analyze continuous or discrete dynamic systems
- (C.1) apply scientific and technical knowledge

#### Responsable

Laurent Autrique

#### Keywords

Control theory, sliding mode controller, robust and optimal control, predictive control, non linear systems

#### Prerequisites

Control theory (UE 6-3) ; Process control (UE 8-2)

#### Objectives

Lectures on control theory for complex dynamic systems

#### Program

Complex systems will be studied during this lecture dedicated to advanced control. Teacher will present in several parts considered as a whole:

- the investigated process
- the mathematical model
- the theoretical developments for controller design
- an implementation based on Matlab simulink

Sliding mode controller, robust and optimal control, predictive control, non linear systems will be highlighted. Physical systems such as heat exchangers, submarine torpedo, hot air balloon, will be investigated.

#### Evaluation

100% continuous assessment based on written examination

#### Bibliography

## Industrial challenge

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### Compétences développées

| (S.1) control industrial processes |
| (S.2) model and analyze continuous or discrete dynamic systems |
| (S.3) develop supervision and traceability tools |
| (S.4) master the tools and methods for monitoring automation projects |
| (S.5) model, analyze and predict robots behavior. |
| (S.6) control and operate industrial robots |
| (S.7) design and operate embedded, mobile systems and/or robotics equipment |
| (S.8) master the tools and methods for monitoring robotic projects |
| (C.1) apply scientific and technical knowledge |
| (C.2) adapt to the specific requirements of the company and society (economic, societal, environmental) |

### Responsible:
Laurent Autrique

### Keywords:
industrial context, engineering problem, collaborative research

### Prerequisite:
all the courses related to "cyber physical systems"

### Goals:
Provide to students a context where an industrial partner of the SAGI department submits a complex concrete problem. Students must then work as a team to provide one or more solutions based on their skills. One of the specificities of this challenge lies in the appropriation and then the resolution of a concrete subject in a limited time. One of the objectives is thus to increase their “job” potential in a situation where the engineer must seek his knowledge to respond “quickly” to a client.

### Contents:
Each year, the educational team discusses with an industrial partner to define the challenge scope. The calendar can be as follows for students enrolled in a school year n to n+1.
- March n to June n: choice of industrial partner, research of a problem, writing of specifications, development of calendar.
- October n: visit of the company, presentation by the industrial partner of the subject to the students, round table.
- November n: personal work of students
- December n: challenge in configuration 2 8-hour days with dedicated equipment.

### Evaluation:
during the challenge, quality of the work carried out, relevance of the responses, satisfaction of the industrial partner.

### Bibliography:
Provided for each challenge by the industrial partner and the educational team in order to be able to suggest lines of thought in order to resolve the problematic of the challenge.
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**Compétences développées**

- **(S.5)** model, analyze and predict robots behavior.
- **(S.6)** control and operate industrial robots
- **(S.7)** design and operate embedded, mobile systems and/or robotics equipment
- **(C.1)** apply scientific and technical knowledge

**Responsable**: Jean-Louis Boimond

**Keywords**: Direct geometric model, method of Denavit-Hartenberg, inverse geometric model, workspace, trajectory generation, programming language (Stäubli, Fanuc, Kuka).

**Prerequisites**: UE Robotique industrielle 3A

**Goals**: Provide a basis for theoretical and practical knowledge in robotics.

**Program**:

- Geometric model of a simple chain robot:
  - Computation of the direct geometric model
  - Method of Denavit-Hartenberg
  - Example
  - Exercises
  - Inversion of the geometric model - Method of Paul
  - Multiple solutions - Workspace - Aspects
- Trajectories generation:
  - Trajectory between 2 points in the articular space
  - Trajectory between several points in the articular space
- Programming of robots Stäubli RX 90, Fanuc LR & ARC Mate 100 IB, Kuka KR3.

**Examination**: Written examination and laboratories examination.

**Bibliography**:

1) *Cours de robotique*, J. Gangloff, ENSPS 3A, 221 pages
4) *Modélisation et commande des robots*, W. Khalil, G. Lebret, Cours EI3 Automatique de l'ECN 94/95
Simulation of discrete event systems

5A / Semester 9

16h TD – 8h TP16

UE 9.4.1

Voie d’approfondissement systèmes cyber physiques

Compétences développées

(S.1) control industrial processes
(S.2) model and analyze continuous or discrete dynamic systems
(S.5) model, analyze and predict robots behavior.
(S.6) control and operate industrial robots
(C.1) apply scientific and technical knowledge

Responsable : Jean-Louis Boimond

Keywords: Discrete event system, Petri net, language of simulation, Siman-Arena.

Prerequisites: Notion on production systems.

Objectives: Study on the discrete event systems simulation.

Program:

- Introduction to the simulation,
- Simulation of production systems,
- Recall on probability and statistics,
- Data on system input,
- Verification and validation of models,
- Interpretation of results,
- Basic notions on Petri nets,
- The Siman-Arena simulation language.

Examination:

Written examination.

Bibliography:


*Probabilités et statistiques*. 3ème édition, A. Ruegg, Presses Polytechniques Romandes.
SCADA systems

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Compétences développées

(S.1) control industrial processes
(S.3) develop supervision and traceability tools
(S.6) control and operate industrial robots
(S.7) design and operate embedded, mobile systems and/or robotics equipment
(C.1) apply scientific and technical knowledge

Responsable: Sébastien Lahaye

Keywords: automated systems, supervisory control and data acquisition (SCADA)

Prerequisites: Automatismes industriels (UE5-2), Réseaux industriels (UE7-3), supervision industrielle 1 (UE7-3), Programmation C# (UE6-4), Programmation Java (UE7-4).

Objectives: Prepare students to become a privileged interlocutor, or even a member, of an automation engineering and design office, able to interact with other offices, suppliers and/or customers.

Outline:
1. Introduction to SCADA systems
2. Communication standards for SCADA systems
   2.1. Challenges and overview of existing solutions
   2.2. OPC standard
      2.2.1. Presentation
      2.2.2. Data Access (DA) specification, implementation with .Net
      2.2.3. Unified Architecture (UA) specification, implementation with Java

Examination: continuous assessment

Bibliography:
OPC - From Data Access to Unified Architecture, Jürgen Lange, Frank Iwanitz, Thomas J. Burke, fourth edition, Verlag, 2010
http://www.opcfoundation.org/
Animation and behavioral simulation

| Compétences développées | (S.9) apply the procedural and object-oriented programming paradigms | (S.10) develop applications within the framework of software engineering (best practices, reliability, cost rationalization, monitoring, etc.) | (S.11) know the tools of augmented reality and immersive multimedia | (S.12) master the tools and methods of project follow-up in computer science | (C.1) apply scientific and technical knowledge |

Lecturer: Paul Richard

Keywords: 3D interaction techniques, motion capture, real-time animation, animation controller, behavioral simulation, artificial intelligence.

Prerequisites: Interaction homme-machine & Réalité virtuelle (3A), Réalité virtuelle (4A)

Objectives: Apply and deepen their knowledge of real-time animation of virtual entities (humanoids, robots or animals), simulation and behavioral interaction under the Unity3D environment.

1. Be able to integrate and animate complex virtual entities in real time
2. Be able to develop simulations integrating reactive virtual entities
3. Know how to develop simulations integrating autonomous virtual entities

Outline:

Implementation of real-time animation techniques
1. Animation controlled by the user (keyboard / mouse)
2. Animation triggered by proximity (distance / entity)
3. Animation triggered by behavior (gesture / voice)

Implementation of immersive behavioral simulations
1. Behavioral simulation integrating a virtual entity
2. Behavioral simulation integrating several entities
3. Simulation integrating interacting virtual entities

Examination: Continuous assessment

Bibliography:

Learning C# Programming with Unity 3D, Alex Okita, Taylors and Francis (2015)

Industrial challenge

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Compétences développées

(S.9) apply the procedural and object-oriented programming paradigms
(S.10) develop applications within the framework of software engineering (best practices, reliability, cost rationalization, monitoring, etc.)
(S.11) know the tools of augmented reality and immersive multimedia
(S.12) master the tools and methods of project follow-up in computer science
(C.1) apply scientific and technical knowledge

Keywords: virtual reality, 3D interaction techniques, behavioral interfacing, sensory / motor immersion, implementation, application, innovation.

Prerequisites:
Interaction homme-machine & Réalité virtuelle (3A), Réalité virtuelle (4A), Animation et simulation comportementale (5A), Multimodalité et interaction haptique (5A), Immersion et techniques d’interaction (5A).

Objectives: collaborative design and production (all students of the class) of an immersive virtual reality application integrating all the knowledge seen during lessons 3A, 4A and 5A. Offer an innovative, possibly collaborative application (virtual environment integrating several virtual entities in mutual interaction and with the submerged user(s)). Search for industrial partner.

Outline (48h00):

1. Group brainstorming
2. Analysis and distribution of tasks
3. Modeling of software bricks
4. Implementation and unit tests
5. Integration and initial assessment
6. Correction and delivery of the application

Examination: Continuous assessment

Bibliography:
- Enhancing Interaction in Mixed Reality: The Impact of Modalities and Interaction Techniques on the User Experience in Augmented and Virtual Reality
- Augmented Reality with Unity AR Foundation: A practical guide to cross-platform AR development with Unity 2020 and later versions
- Learning C# by Developing Games with Unity 2021: Kickstart your C# programming and Unity journey by building 3D games from scratch, 6th Edition, Harrison Ferrone
- *C# Game Programming Cookbook for Unity 3D (English Edition)*, Jeff W. Murray, 2e Édition
### Immersion and 3D interaction techniques

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<thead>
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<th>5A / Semester 9</th>
<th>UE 9.4.2</th>
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**Lecturer:** Paul Richard

**Keywords:** virtual reality, interaction techniques, behavioral interfacing, selection, manipulation, navigation, immersion.

**Prerequisites:** Interaction homme-machine & Réalité virtuelle (3A), Réalité virtuelle (4A)

**Objectives:**
- Implementation of 3D interaction techniques (selection, manipulation, navigation) and development of immersive applications under the Unity3D environment
- Being able to design and implement basic 3D interaction techniques
- Know how to develop immersive applications based on virtual reality headsets

**Outline:**

- **Analysis of interaction and immersive devices**
  1. Systems based on virtual reality headsets (HMD)
  2. Projection-based systems (CAVE)

- **Analysis, modeling and implementation of 3D interaction techniques**
  1. Techniques for selecting and manipulating virtual objects
  2. Navigation / locomotion techniques in virtual environment

**Examination:** Continuous assessment

**Bibliography:**

- Enhancing Interaction in Mixed Reality: The Impact of Modalities and Interaction Techniques on the User Experience in Augmented and Virtual Reality
- Augmented Reality with Unity AR Foundation: A practical guide to cross-platform AR development with Unity 2020 and later versions
- Learning C# by Developing Games with Unity 2021: Kickstart your C# programming and Unity journey by building 3D games from scratch, 6th Edition, Harrison Ferrone
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Tools and 3D modeling techniques

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Responsable: Paul Richard

Keywords: 3D modeling, 3D model, polygon, level of detail, 3D rendering, texturing, UV mapping, rigging, animation.

Prerequisites: none

Objectives:
- To know the modeling tools used in 3D computer graphics. Understand the basic problems and techniques of 3D modeling and animation. Export and use of static or animated models in the Unity3D environment.
- Being able to model and export a static 3D model for Unity3D
- Being able to animate, export and exploit a 3D character under Unity3D

Outline:
1. Modeling and optimization of a 3D object
2. Texture mapping and UV mapping
3. Export and use of a 3D model under Unity3D

Modeling, animation and exploitation of a 3D character
1. Modeling under 3DS max of a 3D character
2. Animation under 3DS max of a 3D character
3. Export, import and use of a 3D character in Unity3D

Examination: Continuous assessment

Bibliography:
- Learning C# Programming with Unity 3D, Alex Okita, Taylors and Francis (2015)
- Enhancing Interaction in Mixed Reality: The Impact of Modalities and Interaction Techniques on the User Experience in Augmented and Virtual Reality
- Augmented Reality with Unity AR Foundation: A practical guide to cross-platform AR development with Unity 2020 and later versions
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Multimodality and haptic interaction

5A / Semester 9
20h TP24
UE 9.4.2
IHM & RV

Compétences développées
(S.9) apply the procedural and object-oriented programming paradigms
(S.10) develop applications within the framework of software engineering (best practices, reliability, cost rationalization, monitoring, etc.)
(S.11) know the tools of augmented reality and immersive multimedia
(S.12) master the tools and methods of project follow-up in computer science
(C.1) apply scientific and technical knowledge

Lecturer: Paul Richard

Keywords: virtual reality, 3D interaction techniques, voice command / speech synthesis, multimodality, haptic interaction, sensory substitution.

Prerequisites: Interaction homme-machine & Réalité virtuelle 1 (3A), Réalité virtuelle (4A)

Objectives: In-depth knowledge of multimodal interaction (entry and exit)
General knowledge of haptic interfaces (tactile and kinesthetic)
Knowledge of the characteristics of haptic perception and rendering
Be able to propose and develop a multimodal haptic application

Outline:
Concepts and characteristics of multimodal interaction
Concepts and theoretical approaches to multimodality
Multimodality in input (fusion) and output (fission)
Integration of haptics for multimodal feedback
Sensory substitution and informational redundancy
Design and integration of force feedback interfaces
Mechanical architectures of force feedback interfaces
Classification of tactile and force feedback interfaces
Optimal integration of force feedback interfaces
Development of an application with haptic feedback

Examination: continuous assessment

Bibliography:
- Learning C# Programming with Unity 3D, Alex Okita, Taylors and Francis (2015)
- Enhancing Interaction in Mixed Reality: The Impact of Modalities and Interaction Techniques on the User Experience in Augmented and Virtual Reality
- Augmented Reality with Unity AR Foundation: A practical guide to cross-platform AR development with Unity 2020 and later versions
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- C# Game Programming Cookbook for Unity 3D (English Edition), Jeff W. Murray, 2e Édition
Unix system administration

5A / Semester 9

20h TP24

UE 9.4.3
Cyber security

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<tr>
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Responsable : Alain Godon

Keywords : VIRTUALIZATION, AUTOMATION, UNIX, DEVOP

Prerequisites : 
GNU/Linux (UE 5.3), Networking (UE 5.3), Unix Administration (UE 7.4), Cyber security (UE 7.4)

Objectives : 
In addition to 4A SAGI Course, it is focused on virtualization and containerization system and show how to improve and have good secured systems by using logging system, intrusions detectors and make some ethical pentests.

Outline: 
System virtualization: VMware, VirtualBox 
System containerization: Docker, Kubernetes 
Intrusion detection System: Wazuh, system logs, syslog and ELK export 
Automation: Ansible/puppet 
Day to day Devop task 
Forensics 

Examination : 
100% Continuous assessment.

Bibliography :
https://opensource.com/resources/virtualization
https://www.edureka.co/blog/chef-vs-puppet-vs-ansible-vs-saltstack/
**Applied Cryptology**

<table>
<thead>
<tr>
<th>SAGI</th>
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### Compétences développées

- (S.9) apply the procedural and object-oriented programming paradigms
- (S.16) implement and develop tools in the context of IT security
- (C.1) apply scientific and technical knowledge

**Responsable**: Alain Godon

**Keywords**: RSA, GPG, HTTPS

**Prerequisites**: Cyber security (UE 7.4)

**Objectives**: Computer security makes extensive use of concepts derived from cryptology, and many protocols are based on it. This course allows to scan these concepts through the implementation of various indispensable tools.

**Outline**:  
Symmetric and asymmetric encryption  
Diffie-Hellman, RSA, AES, SHA algorithms  
Hash functions, signature, integrity check  
Confidentiality and data integrity:  
  - encrypted containers  
  - encryption of communications (email, web, dns ...)

**Examination**:  
100% Continuous assessment
Network architecture

5A / Semester 9
12h TP24 – 12h TP16
UE 9.4.3
Cyber security

| Comptences développées | (S.13) manage computer networks (infrastructure, services, control and command functions) | (S.14) administer computer servers | (S.16) implement and develop tools in the context of IT security | (C.1) apply scientific and technical knowledge | (C.2) adapt to the specific requirements of the company and society (economic, societal, environmental) |

Responsable : Alain Godon

Keywords : VLAN, VPN, FIREWALL, ROUTING,

Prerequisites : Computing network (UE 5.3)

Objectives : This course is an EI3 course’s extension (Computing network), with a focus on all TCP/IP aspects as well as complex conception of local or wide network architecture. Virtualization and containerization for modern network is also a key concept for this course.

Outline: Internet global architecture (routing, DNS, protocols) Architecture and protection of local networks : VLAN, VXLAN, routing Firewall : Layer 3 vs 7, Stateless vs Statefull Concept of virtual networks (VPC, Overlay)

Examination : 100% Continuous assessment.

Bibliography :
https://blog.wescale.fr/2018/02/15/les-reseaux-doverlay-principes-et-fonctionnement/
https://www.pfsense.org/
https://storj.io/
https://ceph.io/
Responsible : Alain Godon

Keywords : CISO, PROTECTION, DRP, BCP, OSINT

Prerequisites : Cyber security (UE 7.4)

Objectives : This course is a follow up about IT security 4A SAGI with a deep focus on concept such as software and hardware firewall and by managing IT security risk in accordance with the latest standards. It will emphasis all aspect about cyber security threaten and ways to protect professional as well as personal data.

Outline:
IT Risks : CTO and RSSI (fr)
Programming best practices and main security flaw (top 10 OWASP)
Ethical Hacking (white hat)
IT response plan and data protection
Authenticate, Authorize, Accounting (AAA)
Legal aspects and laws.
RGPD (fr)
Data Backup.
IT Governance
OSINT

Examination :

100% Continuous assessment

Bibliography :
https://en.wikipedia.org/wiki/Internet_security
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### Responsable

Alain Godon

### Keywords:

Network, System

### Prerequisites:

None

### Objectives:

Training in the search for information on emerging technologies

### Outline:

Design of a network architecture
Implementation of a multi-station architecture

### Examination:

100% Continuous assessment
Responsable : Mehdi Lhommeau

Key words: educational project, group work, professional project, applications

Prerequisite: those required for the project of each group of students

Goals:
This project is carried out in groups of 2 to 3 students supervised by one or more members of the teaching team. The teaching team propose numerous specific subjects related to the context of control engineering, automated systems and computer engineering. These allow students to apply the knowledge introduced during the courses and to implement project management methods. The projects are built pedagogically and intermediate results are required and discussed with supervisors.

Contents:
For the 5A-SAGIs, special attention is paid to autonomy, the implementation of the engineering know-how to resolve a complex situation, the management of collaborative work and the rendering which must be professional type.

Some projects previously proposed ...
- Stabilization by reaction wheel
- Immersive virtual reality game
- IoT-based homemade box for healthcare
- Remote controlled car using a leap motion
- Kuka Robot
- Spying in buildings by IR camera

Evaluation: written report, evaluation of the progress of the work, feedback requested from students (project, device, presentation ...)
# Semestre 10

<table>
<thead>
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<th>UE 10-1 Stage</th>
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<th>H CM</th>
<th>H TD</th>
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<tr>
<td>Stage (5 mois)</td>
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</table>
Responsable: Mehdi Lhommeau

The 5th year internship is the second specialty internship. It normally precedes entry into working life. For this reason, it must be in line with the professional project of the students. This internship is an essential element to enrich interviews with future recruiters. It must allow the student:

- to exercise their capacities of autonomy, creativity, organization, relationship and critical thinking
- to put into practice and deepen their knowledge in one or more areas covered during their university course
- to improve their skills of synthesis, written expression and communication through the internship report and oral presentation;
- to have professional experience, industrial contacts and prepare for life in a company.

Organisation
The internship is supervised by an internship supervisor within the company and a teaching tutor from Polytech Angers.

- The internship supervisor: he is the privileged contact in the host company. It can assist in the search for information. It gives the rules to be respected within the organization. It is also up to the internship supervisor to assess the student’s behavior and involvement.
- The teaching tutor: he is the contact person within Polytech Angers. If there is a problem, he has to be informed as soon as possible. Its role is to advise and support the student for the smooth running of the internship.

Evaluation
The evaluation is based on: professional achievement in the company, quality of the written report and the defense. The first part (internship assignment) is essentially assessed on the basis of an opinion issued by the internship supervisor. The latter measures the qualities, skills, adaptation and development of the intern during the internship. The last two parts are evaluated by the jury (defense) and the teaching tutor (report).