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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Syllabus
SAGI – S5

Version Mai 2020
Responsable : L. Autrique
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.
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: 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:
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:

Prerequisites:

Objectives:

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.

Contents:

These objectives will be developed by the practice of collective and individual sports

Evaluation: Continuous assessment (100%)
Responsible : 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

**Prerequisite:**

**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](http://plcopen.org)
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...),
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 », J.L. Fanchon,
- Site WEB: http://www.aae.ens-cachan.fr/
- Tutoriels Solidworks, disponibles à partir du logiciel
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 :
- F. Authouart, La métrologie mais c’est très simple, ed. Crisalis, 262 pages, 2011.
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

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
Responsable : Rémy Guyonneau

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

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

Goal:
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 3A-SAGI, a specific action is carried out in order to promote cohesion between the different students arriving in the engineering cycle of Polytech’ Angers. It is also a pedagogical tool for students which ask questions about their professional desires in order to make their objectives and their skills in adequacy.

Some projects previously proposed …

- Arduino and neural networks
- Lorawan and TheThingsNetwork
- Telegram project
- Image analysis and control of a conveyor belt
- Serious Game Innovation
- Mecatronic Demonstrator : OpenDog
- Material charactérisation
- Harmonographe
- Robot Dobot Magician
- Virtual Fashion
- Robot Epson Scara
- Virtual Zoo
- Virtual Telerobot

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

http://blog.univ-angers.fr/polytechangers3asagi/
Responsable : 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
- Python for Unix and Linux System Administration, Efficient Problem Solving with Python, Noah Gift, Jeremy M. Jones, O'Reilly Media, 2008
Syllabus
SAGI – S6

Version Mai 2020
Responsable : L. Autrique
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.
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:

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:
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: 
- Organizational behavior, social influence, corporate structures, corporate culture
- Balance sheet, assets, liabilities, income statement, expenses, incomes

Prerequisites: none

Objectives: 
- To understand the human behavior in the organizations
- To meet the requirements to act more effectively in a professional situation
- To be able to understand the financial information of a business

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

Accounting: Chapter 1: Objectives and means of accounting
Chapter 2: The balance sheet and the impact of management options
Chapter 3: The income statement and interim management sales

Evaluation: 100% Continuous assessment.

Bibliography
- Colasse B., Comptabilité générale, Economica, 2000
- Schermerhorn JR. Et al. (collectif): « Comportements humains et organisation » Ed ERPI, 2010
Keywords:

Prerequisites:

Objectives:
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.

Contents:
These objectives will be developed by the practice of collective and individual sports.

Evaluation:
Continuous assessment (100%)
Responsable : Philippe Declerck

Keywords : Communication, structuration, method

Prerequisites : no

Objectives : the aim is to give the spirit of the methods allowing the modelling of process under the functional form and to clearly express the process.

Program : SADT, OMT improved

Examination : terminal examination and exercises

Bibliography :
- IGL technologie , "SADT un langage pour communiquer" Eyrolle 1989.
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 and 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 mind mapping
- Third course: Formalise your ideas with idea sheet and review them
- Fourth course: Evaluate your ideas with the radar method
- Fifth course: Build your 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:
ISO 9001, ISO 10018, ISO 10006, ISO 14001, ISO 9100, ISO 18001, ISO 5725
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. In EI4 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.
   - Synthesis :
     Transformation method.

Evaluation : Written examination and laboratory examination.

Bibliography :
  or any other good basic textbook on signal processing.
**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
Keywords: microcontrollers, AVR Atmel, ARDUINO board

Prerequisite: basics in digital systems

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
Responsable : Laurent Hardouin

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

Prerequisites: Mathematics and basics of Physics.

Objectives:

This course introduces some modelling techniques 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.

Examination: Written examination.

Bibliography:

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:
3) Robotics Modelling, Planning and Control, B. Siciliano, L. Sciavicco, L. Villani, G. Oriolo, Springer-Verlag 2009, 632 pages
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:**


**3D User Interfaces: Theory and Practice**

**Learning C# Programming with Unity 3D (English Edition)**
Alex Okita, Taylors and Francis, 2015
Responsable : Alain Godon

**Keywords**:
WEB, PHP, MYSQL, TWIG, REST, JWT

**Prerequisites**:
None

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

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

**Examination**:
100% Continuous assessment
Responsible : 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)
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
Responsable : Rémy Guyonneau & Service des relations internationales

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 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.
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.

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: 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:

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: occupational health and safety, occupational risks, ergonomic, occupational psychology, musculo skeletal disorder, psychosocial risks, single document

Prerequisites: Business organization, rules and regulation

Objectives:
This module is constructed on the base of the referential BES&ST «Bases Essentielles en Santé et Sécurité au Travail» formalised in 2005 (Inrs). It is intended to give to any future engineer essential skills in order to integrate occupational hygiene within all of his/her professional activities.

- **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: Tutorials
- 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 Santé et sécurité au poste de travail, article se3950, octobre 2008.
Keywords: Physical and Sports Education

Prerequisites: None

Objectives:
Sports education courses help train future engineers by promoting physical and psychological development, by facilitating their integration, and by strengthening the team spirit and dynamics of the school.
Having the ability to work as part of a team, to communicate effectively, to build relationships of trust, be healthy and to withstand stress, are all qualities required of future engineers.
The sports activities proposed involve the acquisition of new motor skills, the implementation of individual and collective strategies, the resolution of problematic situations, while simultaneously requiring a constant adaptation of one’s effort.
All of these elements contribute to the development of the engineers in the making and will be additional advantages for their training and their socio-professional integration.

Program:
The program of physical sports and artistic activities is built over the first four years of study at the school. Each engineering student must choose a different activity per semester from the five individual and team sports offered.

Evaluation:
100% Continuous assessment

Learning outcomes:
Each student is expected to participate actively. This requires serious commitment, both physically by “doing” and also reflectively by demonstrating “know how”, with a cultural understanding of the activity. Physical investment will be carried out via the management of one’s own physical and psychological integrity, and those of others (with adapted muscular, joint and cardio-respiratory warm-ups, and also respect of basic safety precautions).
The student will also have to demonstrate his / her ability to acquire skills specific to each sporting and artistic activity that he / she chooses. These teaching contents are grouped into three types of General Competences:
C1: To progress technically, tactically and / or behaviorally on one’s individual and initial level.
C2: Achieve a performance in an enabling context.
C3: Produce the best possible result in a reference situation.

References:
Site UA Moodle : http://moodle.univ-angers.fr/course/view.php?id=2687
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
Responsable : Bertrand Cottenceau

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 : Stéphane Crépet

**Key-words:** 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 : 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 :
<table>
<thead>
<tr>
<th><strong>Keywords</strong></th>
<th>Local Area Networks, Industrial Networks, Programmable Logic Controller (PLC)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prerequisites</strong></td>
<td>PLC programming, Norm for state functional charts (Grafset)</td>
</tr>
<tr>
<td><strong>Objectives</strong></td>
<td>To present concepts and standards for industrial networks. The focus is mainly about necessary precautions for PLCs programming when network communication is required. Several examples are presented as a conveying system or some retro-ingeneering studies over an CAN bus “black box”... Several practical works enable the students to test theirs solutions on two standard networks: Profinet and CAN bus. Finally, the role towards SCADA (Supervisory Control And Data Acquisition) systems is addressed by the use of the Modbus TCP/IP protocol.</td>
</tr>
<tr>
<td><strong>Program</strong></td>
<td>Semaphore principle (synchronization of PLCs) ; Profinet Network (Configuration of a network between three PLCs and remote I/O) ; CAN Bus (Serial Bus widely used, in the car industry for instance) ; Modbus TCP/IP protocol (Master/Slaves mode, SCADA systems, TCP/IP, …).</td>
</tr>
<tr>
<td><strong>Labs</strong></td>
<td>Automation of a robotized transfer chain (3 Siemens PLCs) ; Reverse-Ingeneering over a “black box” with a CAN interface ; Management of a remote monitoring system with Modbus TCP/IP.</td>
</tr>
<tr>
<td><strong>Examination</strong></td>
<td>Written examinations (tests and final examination) and labs evaluation (devotion, achievements and reports).</td>
</tr>
</tbody>
</table>
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
Responsable : Stéphane Crepet

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 occur, 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:

Responsable : 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:

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
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
Keywords: Java - oriented programming object - class - inheritance - polymorphism - layered architectures - JDBC (Java Database Connectivity) - graphic user interfaces

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: elementary data, elementary instructions, Java program structure, exceptions management, passing of parameters to a method.
- Classes and interfaces: study of the class Person, inheritance, polymorphism, interfaces, packages.
- Classes of common use: String, ArrayList, Arrays, Hashtable
- Graphic user interfaces: the basics of graphic interfaces, building an interface with Netbeans IDE, the main Swing components.
- Management of databases with the API JDBC: main steps in the exploitation of a database.
- Layered architectures. Introduction to the Spring framework. Unit testing with JUnit.

Examination: 1 mini-project, 1 final written exam

Bibliography / Webography:
- Book: Programmer en JAVA, Claude Delannoy, Eyrolles publications
- PDF written course: http://tahe.developpez.com/java/cours
Responsable : Alain Godon

**Keywords** :
LINUX, NETFILTER, SQL INJECTION, BUFFER OVERFLOW

**Prerequisites** :
None

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

**Content** :
Stakes of security  
SQL injection  
Classical leaks with PHP  
Buffer overflow  
Secured services  
Netfilter firewall

**Examination** :
100% CC
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**:
Syllabus
SAGI – S8

Version Mai 2020
Responsable : L. Autrique
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 practise 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: 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
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:
- 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).
Keywords: Physical and Sports Education

Prerequisites: None

Objectives:
Sports education courses help train future engineers by promoting physical and psychological development, by facilitating their integration, and by strengthening the team spirit and dynamics of the school.
Having the ability to work as part of a team, to communicate effectively, to build relationships of trust, be healthy and to withstand stress, are all qualities required of future engineers.
The sports activities proposed involve the acquisition of new motor skills, the implementation of individual and collective strategies, the resolution of problematic situations, while simultaneously requiring a constant adaptation of one’s effort.
All of these elements contribute to the development of the engineers in the making and will be additional advantages for their training and their socio-professional integration.

Program:
The program of physical sports and artistic activities is built over the first four years of study at the school. Each engineering student must choose a different activity per semester from the five individual and team sports offered.

Evaluation:
100% Continuous assessment

Learning outcomes:
Each student is expected to participate actively. This requires serious commitment, both physically by “doing” and also reflectively by demonstrating “know how”, with a cultural understanding of the activity. Physical investment will be carried out via the management of one’s own physical and psychological integrity, and those of others (with adapted muscular, joint and cardio-respiratory warm-ups, and also respect of basic safety precautions).
The student will also have to demonstrate his / her ability to acquire skills specific to each sporting and artistic activity that he / she chooses. These teaching contents are grouped into three types of General Competences:
C1: To progress technically, tactically and / or behaviorally on one’s individual and initial level.
C2: Achieve a performance in an enabling context.
C3: Produce the best possible result in a reference situation.

References:
Site UA Moodle : http://moodle.univ-angers.fr/course/view.php?id=2687
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:
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.
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:

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
Lecturer: Paul Richard

**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**:
Responsable : Bertrand Cottenceau

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 ...)
Responsable : Bertrand Cottenceau

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).
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: 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

Programme:
• 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
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.
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: 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 SCHOLES, 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:
Sports education courses help train future engineers by promoting physical and psychological development, by facilitating their integration, and by strengthening the team spirit and dynamics of the school.
Having the ability to work as part of a team, to communicate effectively, to build relationships of trust, be healthy and to withstand stress, are all qualities required of future engineers.
The sports activities proposed involve the acquisition of new motor skills, the implementation of individual and collective strategies, the resolution of problematic situations, while simultaneously requiring a constant adaptation of one’s effort.
All of these elements contribute to the development of the engineers in the making and will be additional advantages for their training and their socio-professional integration.

Program:
The program of physical sports and artistic activities is built over the first four years of study at the school. Each engineering student must choose a different activity per semester from the five individual and team sports offered.

Evaluation:
100% Continuous assessment

Learning outcomes:
Each student is expected to participate actively. This requires serious commitment, both physically by “doing” and also reflectively by demonstrating “know how”, with a cultural understanding of the activity. Physical investment will be carried out via the management of one’s own physical and psychological integrity, and those of others (with adapted muscular, joint and cardio-respiratory warm-ups, and also respect of basic safety precautions).
The student will also have to demonstrate his / her ability to acquire skills specific to each sporting and artistic activity that he / she chooses. These teaching contents are grouped into three types of General Competences:
C1: To progress technically, tactically and / or behaviorally on one’s individual and initial level.
C2: Achieve a performance in an enabling context.
C3: Produce the best possible result in a reference situation.

References:
Site UA Moodle : http://moodle.univ-angers.fr/course/view.php?id=2687
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 : 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:
Cap Gemini, l’innovation, dernier des processus sauvages, Edition cap gemini, 2013
Responsable : Mehdi Lhommeau

**Keyworks:** 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 : Mehdi Lhommeau

**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.
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
Keyworks: 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 virtuel 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
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
Responsables : Vincent Voisin, Hugo Charles et Mathieu Deumié

**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:**

Responsable : Mehdi Lhommeau

**Keywords** : Javascript, HTML 5, CSS 3, JQUERY, Angular, React, Node.JS

**Prerequisites** : Basic knowledge of programming

**Objectives** : This course introduces Html development using Html 5, CSS3, JQuery, AngularJS, React and NodeJS. HTML5 is the latest version of HTML and XHTML. The HTML standard defines a single language that can be written in HTML and XML. It attempts to solve issues found in previous iterations of HTML and addresses the needs of Web Applications, an area previously not adequately covered by HTML. JQuery is a cross-browser JavaScript library designed to simplify the client-side scripting of HTML. CSS is used to control the style and layout of Web pages. CSS3 is the latest standard for CSS.

**Programme** :

- JQUERY
  - DOM
  - AJAX
  - CANVAS
- NodeJS
  - Introduction
  - Node.js Event loop
  - Working With Socket.io
- ExpressJS
  - Introduction to ExpressJS
  - Routing, Configuration, Views, NoSQL
- AngularJS
  - Introduction, MVC

**Evaluation** : Project

**References:**

Responsable : Clive Ferret-Canape

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.

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

Evaluation:
Project

Bibliography & Webography:
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**

**SAGI**

5A / Semester 9

16h TP24

**UE 9.4.1**

Voie d’approfondissement systèmes cyber physiques

**Responsable : 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.
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.
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
2) Robots. Principes et contrôle, C. Vibet, Ellipses 1987, 207 pages
4) Modélisation et commande des robots, W. Khalil, G. Lebret, Cours E3 Automatique de l'ECN 94/95
7) Robotics Modelling, Planning and Control, B. Siciliano, L. Sciavicco, L. Villani, G. Oriolo, Springer-Verlag 2009, 632 pages
Keywords: automated systems, supervisory control and data acquisition (SCADA)

Prerequisites: Automatismes industriels (UE5-3), 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/
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)

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:

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


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:

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


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** :

1. **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

2. **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** :
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:

Modeling and exploitation of a 3D model (3DS Max)
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:

3DS Max 2018, Frédéric Franken, 360 Pages, Ed. ENI.
**Unix system administration**

5A / Semester 9
16h TP24 – 4h TP16

UE 9.4.3
Cyber security

Responsable : Alain Godon

**Keywords :**
VIRTUALIZATION, AUTOMATION, UNIX, DEVOP

**Prerequisites :**
None

**Objectives :**
In addition to EI4 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, HyperV, Qemu
System containerization: docker, xen
Intrusion detection System. Log system.
Automation: ansible/puppet …
Day to day Devop task

**Examination :**
100% Continuous assessment.

**Bibliography :**
https://opensource.com/resources/virtualization
https://www.edureka.co/blog/chef-vs-puppet-vs-ansible-vs-saltstack/
Keywords:
RSA, GPG, HTTPS, DNSSEC, VERACRYPT

Prerequisites:
None

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
Responsable : Alain Godon

**Keywords** :
VLAN, VPN, FIREWALL, VIRTUALIZATION, ROUTING, STORAGE

**Prerequisites** :
None

**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**:
Layer 2 architecture and protection. Vlan, VXLan
Layer 3 routing: OSPF, BGP, IS-IS
Virtualization and container architecture. Overlay
Distributed storage, centralized storage, decentralized storage.
Cloud computing VPC concept
Layer 3/7 Firewall.

**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/
Responsable : Alain Godon

**Keywords** :
CISO, PROTECTION, DRP, BCP

**Prerequisites** :
None

**Objectives** :
This course is a follow up about IT security EI4 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 threats and ways to protect professional as well as personal data.

**Outline:**
- IT Risks
  - Programming best practices and main security flaw.
  - Ethical Hacking
  - IT response plan and data protection
  - Authenticate, Authorize, Accounting (AAA)
- Legal aspects and laws.
- Data Backup.
- IT Governance

**Examination** :
100% Continuous assessment

**Bibliography** :
https://en.wikipedia.org/wiki/Internet_security
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
Responsible : 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 ...)

![Diagram of a project setup with sensors, Raspberry Pi, Arduino, and data management system.]

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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).