CENTRALE NANTES

Foundation Master

ACADEMIC YEAR 2022/2023

The programme

Courses	First Semester			Second Semester		
	Hours	Student workload (hours)	ECTS Credits	Hours	Student workload (hours)	ECTS Credits
Core Curriculum Courses						
Mathematics	20	40	3	20	40	3
Energetics and Environment	20	40	3	-	-	-
Computer Programming and Data Analysis	20	40	3	-	-	-
Project	60	120	9	60	120	9
English and Business Environment	30	60	3	30	60	3
French language	30	60	3	30	60	3
Mechanics & Environment Track						
Engineering Materials	20	40	3	-	-	-
Basics of continuum mechanics	20	40	3	-	-	-
Mechanics for Civil Engineering	-	-	-	20	40	3
Design of Special Structure	-	-	-	20	40	3
Design of Building Materials	-	-	-	20	40	3
Dynamics and Vibrations	-	-	-	20	40	3
Signal, Control & Robotics Track						
Robotics	20	40	3	20	40	3
Control Systems	20	40	3	20	40	3
Digital Image processing	-	-	-	20	40	3
Industrial Automation System	-	-	-	20	40	3

CENTRALE NANTES

First Semester: from September to January

Mathematics (S122MAT1)

Course Information
Code: S122MAT1 **Responsible**: Francoise Foucher **Contact**: francoise.foucher@ec-nantes.fr **Department**: Mathematics, Computer Science and Biology Department **Language**: English **Credits (ECTS)**: 3 **Number of hours**: 20 **Semester**: 1 **Recommended prerequisites:** None **Evaluation**: Final exam **Organization**: Nine x 2h lectures, with personal homework + 2 hours exam **Link**:
Objective
The objective of this course is to supplement student's knowledge of both for theoretical and practical use of mathematical tools required in advanced engineering. This course focuses on linear algebra and some applications.
Content
1- Vectors spaces, linear mappings, matrices, linear systems, real and complex inner products, orthogonal projection, Gram-Schmidt orthogonalization 2- Eigenvalues and eigenvectors, eigenbases, diagonalization, triangulation, spectral radius, matrix norms, application to quadratic forms, application to the study of the stationary points of a multivariate function. **Reference:** [1] Erwin Kreyszig, *Advanced Engineering Mathematics*, 10th edition, John Wiley & Sons, 2010, 1264 p. (Chapters 7, 8)

Energetics and Environment (S122E&E)

Course Information
Code: S122E&E **Responsible**: Georges Salameh **Contact**: georges.salameh@ec-nantes.fr **Department:** Fluid Mechanics and Energetics Department **Language**: English **Credits (ECTS)**: 3 **Number of hours**: 20 **Semester**: 1 **Recommended prerequisites**: no prerequisites recommended. **Evaluation**: 100% exam **Organization**: 10h lecture, 8h tutorial work, 2h exam **Link**:
Objective
Understand and master the major energy, climate and environmental challenges of this century. The students will have to master the fundamental concepts and the large orders of magnitude, know how to make "back of an envelope" calculations in order to quickly analyze a solution while developing finely-tuned critical thinking skills.
Content
Energy issues Climate issues Environmental Issues Introduction, factfulness, energy-climate exercises, carbon footprint calculation Mini simulation of energy transition scenarios "Climate collage" workshop.

Computer Programming and Data Analysis (S122CPD)

Course Information
Code: S122CPD **Responsible**: Hugues Digonnet **Contact**: hugues.digonnet@ec-nantes.fr **Department**: Mathematics, Computer Science and Biology Department **Language**: English **Credits (ECTS)**: 3 **Number of hours**: 20 **Semester**: 1 **Recommended prerequisites:** None **Evaluation**: 25% continuous assessment, 75% final exam **Organization**: 9 x 2h sessions with Matlab + 1 exam (2h) **Link**:
Objective
This course aims to provide students with basic knowledge of computer programming with Matlab, and to introduce more advanced tools for data analysis (visualization, statistical analysis, numerical methods).
Content
This course includes an introduction to the Matlab programming environment, the use of matrix variables and matrix manipulations. Scripts and functions are introduced, together with basic programming structures, conditions and loops. Graphics manipulation and statistical tools for data analysis are presented, and general programming rules and tips for efficient computations are provided.

English and Business Environment (S122ENL1)

Course Information

Code: S122ENL1

Responsible: Spencer Hawkridge

Contact: spencer.hawkridge@ec-nantes.fr

Department: Communication, languages and business

Language: English

Credits (ECTS): 3

Number of hours: 30

Semester: 1

Recommended prerequisites: None

Evaluation: 50% continuous assessment (class participation), 30% oral exam (presentation), 20% final exam (TOEIC practice exam)

Organization: The students are dispatched into different groups according to their level.

Link: pedagogical server (https://hippocampus.ec-nantes.fr; anglais LVO)

Objective

In this course, you will learn how to:

- Develop an understanding of inter-cultural practice
- Develop oral and written communication adapted to different contexts (mainly inter-cultural situations)
- Organize, lead and participate in a meeting
- Strengthen self-confidence and level of conviction
- Work on professional documents in English
- Acquire presentation skills
- Express feelings and practice assertiveness
- Develop active listening and understanding to reformulate, explain and argue
- Develop well-being at work and a sense of responsibility
- Negotiate, innovate and propose innovative solutions
- Enhance team work

Content

Those objectives will be achieved by doing:

- English: full range of practical communication language exercises (reading comprehension, listening comprehension, written expression, oral expression)
- Business English: introduction to marketing and business practices

Educational projects are adapted to the level of the group (scenarios, role plays, simulations).

Analysis of a short story or an extract of a novel in order to explain the cultural components of the text.

Projects in a cultural context "Ted talk presentation", "Edge.org assignment", etc.

French Language (S122FRL1)

Course Information

Code: S122FRL1

Responsible: Julie Pourquier

Contact: Julie.Pourquier@ec-nantes.fr

Department: Communication, languages and business

Language: French

Credits (ECTS): 3

Number of hours: 30

Semester: 1

Recommended prerequisites: None

Evaluation: 25% continuous assessment, 25% oral exam, 25% final exam, 25% project work (booklet)

Organization: French for beginners/intermediate level. The students are dispatched into different groups according to their level.

Link: https://centralefle.wordpress.com/

Objective

The main objective is to familiarize the learner with the French language and French culture through an entertaining task-based communicative language teaching, focused on speaking combined with:

- Phonetics
- Self-correcting exercises on our pedagogical platform
- Learning Lab activities
- Project work
- Tutoring

Course objectives include the acquisition and reinforcement of vocabulary, syntax, and pronunciation by both traditional means and through the use of digital resources.

After completing this course, the students will be able to communicate in spoken and written French, in a simple but clear manner on familiar topics in the context of study, hobbies etc. Another important goal of this course is to introduce to French culture.

Content

A full range of practical communication language exercises is used: reading comprehension, listening comprehension, written expression, oral expression.

Educational projects are adapted to the level of the group:

- Main project : Log book project “One year at Centrale Nantes” (Booklet)
- France vs China/Nantes vs Hometown project
- French way of life project (traditions, housing, iconic objects…)
- Photo-Babble project
- Field studies and interviews
- Flipped classroom – grammar project
- Family tree project

Engineering Materials (S122EMA)

Course Information
Code: S122EMA **Responsible**: Guillaume RACINEUX **Contact**: Guillaume.Racineux@ec-nantes.fr **Department**: Mechanics, Materials and Civil Engineering Department **Language**: English **Credits (ECTS)**: 3 **Number of hours**: 20 **Semester**: 1 **Recommended prerequisites**: **Evaluation**: Project **Organization**: Lectures: 4h, Tutorials: 6h, Laboratory work: 8h, Exam: 2h. **Link**:
Objective
Today there are more than 150,000 materials available for product design. In the past, the low number of materials was a design limitation; today their great number constitutes a possibility of innovation. In order to best exploit this diversity of materials within the framework of a design it is necessary to have a method presented.
Content
Course objectives: The course aims to provide the necessary elements for the choice of materials. For this you must have: - a good knowledge of the families of materials; - a good understanding of their properties; - a methodology for choosing those that best meet the design requirements (specifications). Upon completion of this course, students should: - know the different families of materials and their properties; - be able to choose a material according to the specifications. Teaching plan: - Presentation of the main families of materials (metallic, polymers and ceramics) and the associated physical properties. - Presentation of the methodology for choosing materials proposed by Ashby. - Case study. Concepts teached - Family of materials; - Material properties; - Methodology of choice of materials; - Performance indexes References - Materials - Engineering, Science, Processing and Design, 4th Edition - Michael Ashby, Hugh Shercliff, David Cebon - Materials Selection in Mechanical Design, 5th Edition, Michael Ashby

Basics of Continuum Mechanics (122BCM)

Course Information
Code: 122BCM **Responsible**: Patrice Cartraud, Grégory Legrain **Contact**: patrice.cartraud@ec-nantes.fr **Department**: Mechanics, Materials and Civil Engineering Department **Language**: English **Credits (ECTS)**: 3 **Number of hours**: 20 **Semester**: 1 **Recommended prerequisites**: None **Evaluation**: Final exam **Organization**: Lectures (12 hours), Tutorials (6 hours), final exam : 2 hours **Link**:
Objective
Introduce the fundamental concepts of continuum mechanics.
Content
Introduction to tensor; Kinematics; Strains; Balance laws; Constitutive relations : elasticity; Boundary value problems in elasticity Reference: [1] Lai, W. M., Rubin, D. H., Rubin, D., & Krempl, E. Introduction to continuum mechanics. (Fourth Edition), Butterworth-Heinemann, 2010.

Robotics (S122ROB1)

Course Information
Code: S122ROB1 **Responsible**: Sophie Sakka **Contact**: sophie.sakka@ec-nantes.fr **Department**: Automatic control and robotics **Language**: English **Credits (ECTS)**: 3 **Number of hours**: 20 **Semester**: 1 **Recommended prerequisites:** None **Evaluation**: 25% continuous assessment, 25% homework, 50% exam **Organization**: 9h lecture, 9h practice, 2h exam **Link**:
Objective
An overview of existing robots will first be made, then the course will focus on social robotics: its objective, constraints / characteristics, current uses and hopes it brings. Through practice, a social robotics program will be built, leading to a public show (exam). The abilities validated at the end of the course will include capacity to lead a social robotics program: setting objectives, programming, performing, and analyzing. The practice will use NAO humanoid robots (Softbank Robotics Europe).
Content
▪ Introduction (robots today) ▪ Social robotics: cost, impact and applications (therapeutic mediators, training, performance, etc.) ▪ Robotics performance ▪ Programming NAO robot (Softbank Robotics Europe) using Choregraph software ▪ Realizing a robotic performance with NAO robot ▪ Public show

Control Systems (S122CTR1)

Course Information

Code: S122CTR1

Responsible: Ina TARALOVA

Contact: ina.taralova@ec-nantes.fr

Department: Automatic control and robotics

Language: English

Credits (ECTS): 3

Number of hours: 20

Semester: 1

Recommended prerequisites: None

Evaluation: 30% continuous assessment (labs), 70% exam

Organization: 8 lectures (16h) + Laboratory works (2h) + 1 exam (2h)

Link:

Objective

Control theory has a plethora of applications in various fields: from automotive and aerospace industry, robotics, production/manufacturing processes to economics and nanotechnology.

Control is applied for trajectory tracking, to improve production efficiency, to minimize the energy, to make the process faster, etc.

Control laws are generally used to regulate physical variables, to follow given trajectory, to reject perturbations/noise and to palliate with model uncertainties.

The aim of this course is to:

- Learn basics concepts and tools on linear time invariant systems (LTI), modeling, transfer functions and state space, stability and stability margins, time responses. Learn to model and analyze the control system using Matlab and Simulink.
- Deal with real time applications of control such as level control, temperature control, speed control, etc.

Content

Part 1 – Control systems modeling and time responses:

- History of control systems, dynamical systems and control systems (2h)
- Open loop and close loop, feedback control (2x2h)
- Performances and canonical form (2h)
- Application to continuous time systems (course 2x2h, lab 2h)
- Application to discrete time systems (2x2h)
- Exam (2h)

Reference:

[1] R. C. Dorf and R. H. Bishop, *Modern Control Systems*, Pearson Education, Upper Saddle River, NJ, twelfth edition, 2011, ISBN-13:978-0-13-602458-3

Second Semester: from February to June

Mathematics (S222MAT2)

Course Information

Code: S222MAT2

Responsible: Francoise Foucher

Contact: francoise.foucher@ec-nantes.fr

Department: Mathematics, Computer Science and Biology Department

Language: English

Credits (ECTS): 3

Number of hours: 20

Semester: 2

Recommended prerequisites: Calculus fundamentals.

Evaluation: Final exam

Organization: Nine x 2h lectures, with personal homework + 2 hours exam

Link:

Objective

The objective of this course is to supplement student's knowledge of both the theoretical and practical use of mathematical tools required in advanced engineering. This course focuses on ordinary differential equations, probability and statistic.

Content

Part 1 - Ordinary differential equations (ODE)

1- *First-order ordinary differential equations.* Euler's method, equation with separate variables, linear ODEs.

2- *Second-order linear ordinary differential equations.* Homogeneous case, homogeneous case with constant coefficients, non homogeneous case, solution by variation of parameters.

3- *Higher order linear ordinary differential equations.*

4- *Systems of first-order ordinary differential equations.* Constant coefficient systems.

Part 2 - Probability and statistic

5- Probability, random variables, probability distributions

6- Vectors and sequences of random variables, independence, convergence in distribution, almost sure convergence

7- Statistic, point estimation, confidence interval

Reference:

[1] Erwin Kreyszig, *Advanced Engineering Mathematics*, 10th edition, John Wiley & Sons, 2010, 1264 p. (Chapters 1, 2, 3, 4, 24, 25)

English and Business Environment (S222ENL2)

Course Information

Code: S222ENL2

Responsible: Spencer Hawkridge

Contact: spencer.hawkridge@ec-nantes.fr

Department: Communication, languages and business

Language: English

Credits (ECTS): 3

Number of hours: 30

Semester: 2

Recommended prerequisites: None

Evaluation: 50% continuous assessment (class participation), 30% oral exam (presentation), 20% final exam (TOEIC practice exam)

Organization: The students are dispatched into different groups according to their level.

Link: pedagogical server (https://hippocampus.ec-nantes.fr; anglais LVO)

Objective

In this course, you will learn how to:

- Understand the general concepts of business English and marketing principles
- Build a professional project and explore international opportunities
- Develop strategies for inter-cultural practice
- Develop oral and written communication adapted to different contexts
- Organize, lead and participate in a meeting
- Work on professional documents in English
- Acquire a professional lexicon
- Understand the principles of corporate business models
- Acquire notions of corporate culture and values
- Develop well-being at work and a sense of responsibility
- Negotiate, innovate and propose innovative solutions

Content

Those objectives will be achieved by doing:

- English: full range of practical communication language exercises
- Business English: exercises to explore in practice the areas of management and marketing

Educational projects adapted to the level of the group (scenarios, role plays, simulations).

Analysis of a short story or an extract of a novel in order to explain the cultural components of the text.

Projects in a professional context "Start-up simulation", "marketing assignment", "advertising assignment", etc.

French Language (S222FRL2)

Course Information
Code: S222FRL2 **Responsible:** Julie Pourquier **Contact:** Julie.Pourquier@ec-nantes.fr **Department:** Communication, languages and business **Language:** French **Credits (ECTS):** 3 **Number of hours:** 30 **Semester:** 2 **Recommended prerequisites:** None **Evaluation:** 25% continuous assessment, 25% oral exam, 25% final exam, 25% project work (booklet) **Organization:** French for beginners/intermediate level. The students are dispatched into different groups according to their level. **Link:** https://centralefle.wordpress.com/
General course objective
The main objective is to familiarize the learner with the French language and French culture through an entertaining task-based communicative language teaching, focused on speaking combined with: ▪ Phonetics ▪ Self-correcting exercises on our pedagogical platform ▪ Learning Lab activities ▪ Project work ▪ Tutoring Course objectives include the acquisition and reinforcement of vocabulary, syntax, and pronunciation by both traditional means and through the use of digital resources. After completing this course, the students will be able to communicate in spoken and written French, in a simple but clear manner on familiar topics in the context of study, hobbies etc. Another important goal of this course is to introduce to French culture. At the end of course (60 hours), the complete beginners can achieve the level A1 and some aspects of A2 of The Common European Framework of Reference for Languages. More advanced students may aim the levels B1/B2.
Content
A full range of practical communication language exercises is used: reading comprehension, listening comprehension, written expression, oral expression. • Educational projects adapted to the level of the group: • Main project: Log book project “One year at Centrale Nantes” (Booklet) • French way of life project (traditions, housing, iconic objects…) • Expressing emotions and theatre project • Photo-Babble project • Field studies and interviews • Flipped classroom - grammar project

Mechanics for Civil Engineering (S222MCE)

Course Information

Code: S222MCE

Responsible: Benoit HILLOULIN

Contact: benoit.hilloulin@ec-nantes.fr

Department: Mechanics, Materials and Civil Engineering Department

Language: English

Credits (ECTS): 3

Number of hours: 20

Semester: 2

Recommended prerequisites: None

Evaluation: Final Exam

Organization: 18h Lectures, 2h exam and personal homework

Link: Hippocampus

Objective

The objective of this course is to give students' skills in theoretical and practical use of mechanical tools required in civil engineering.

The course is dedicated to strength of materials backgrounds for common materials in Civil Engineering, bars and beams theories, and some insights into basic design considerations.

Content

- Introduction to common materials in Civil Engineering
- Stress. Strain and deformation. Theory of elasticity
- Traction. Tension and compression. Uniaxial problems
- Frames and truss structures.
- Deflections and stresses in beams
- Mohr's circles. Energy balance. Principle of virtual displacements
- Strain energy. Castigliano's theorem. Menabrea's thorem. Static equilibrium

References:

Stephen H. Crandall, Norman C. Dahl and Thomas J. Lardner, An introduction to the mechanics of solids, 2nd edition, McGraw-Hill Sciences, 1999, 604 p.
James M. Gere, Mechanics of materials, 8th edition, CENGAGE Learning Custom Publishing, 1056 p.
David W. A. Rees, Mechanics of Solids and Structures: Second Edition, 2nd edition, ICP, 848 p.
Russell C. Hibbeler, Mechanics of materials, 10th edition, Pearson, 2016, 896 p.

Design of Special Structures (S222DSS)

Course Information

Code: S222DSS

Responsible: Syed Yasir ALAM

Contact: syed-yasir.alam@ec-nnates.fr

Department: Mechanics, Materials and Civil Engineering Department

Language: English

Credits (ECTS): 3

Number of hours: 20

Semester: 2

Recommended prerequisites: mechanics of materials, continuum mechanics, strength of materials

Evaluation: Final Exam or individual project

Organization: Nine x 2-hours lectures, 2-hours exam or project defense, with personal homework.

Link: Hippocampus

Objective

The main objective of this course is to understand the principles of advanced design methods to be used for special structures. Simple design rules using building codes become obsolete and limited when it comes to structural stability in complex loadings or in sensitive environments. This course is dedicated to understanding of design of structures by local crack propagation criteria and by using fracture mechanics principles.

Content

Linear elastic fracture mechanics

Introduction to problem of fracture in materials. Design principles and equations using linear elastic fracture mechanics. Use of energy based criteria, stress intensity factor, R-curve, size effect.

Nonlinear fracture mechanics

Limitation of linear methods, Introduction to need of nonlinear methods, nonlinear and plastic field at the crack tip, equivalent elastic crack approach, design based on equivalent elastic crack approach, fictitious crack approach, design based on fictitious crack approach, applications to quasi-brittle materials.

Design of fiber reinforced composite structures

Applications of FRC, typical properties of fibers, mechanics of fiber reinforcements, fiber-matrix bond, design of FRC structures in flexure and tension, International design standards for FRC, Design of FRC structures for complex loadings and durability

References:

- Fracture and Size Effect in Concrete and Other Quasibrittle Materials By Zdenek P. Bazant, Jaime Planas · 1998
- Fracture Mechanics of Concrete : Applications of Fracture Mechanics to Concrete, Rock and Other Quasi-Brittle Materials by Surendra P. Shah, Stuart E. Swartz, Chengsheng Ouyang · 1995
- ACI Committee 544, “Fiber reinforced Concrete 544.1R-96, ACI Manual of Concrete Practice, Part 5, American Concrete Institute, Farmington Hills, MI (2001)
- Balaguru PN, and Shah SP. Fiber reinforced Composites. Mc-GrawHill Inc.1992,

Design of Building Materials (S222DBM)

Course Information
Code: S222DBM **Responsible:** Ahmed LOUKILI **Contact:** Ahmed.Loukili@ec-nantes.fr **Language:** English **Credits (ECTS):** 3 **Number of hours:** 20 **Semester:** 2 **Recommended prerequisites:** Principles of materials Sciences **Evaluation:** Exam and presentation **Organization:** 10h Lectures and 8h practical works **Link:**
Objective
The course aims to give basic notions on construction materials and their uses in civil engineering works. Understanding the concept of building construction and collaboration principles process. The course will put the theoretical data into practical concepts by practical works in the Civil engineering laboratory
Content
This course will introduce the students to : - Construction process; - General building materials, systems, and types of construction; - Building Codes and the collaborative building professions. - Study of basic materials used in construction, including research of building product specifications

Dynamics and Vibrations (S222D&V)

Course Information
Code: S222D&V **Responsible**: Patrick ROZYCKI **Contact**: patrick.rozycki@ec-nantes.fr **Department**: Mechanics, Materials and Civil Engineering Department **Language**: English **Credits (ECTS)**: 3 **Number of hours**: 20 **Semester**: 2 **Recommended prerequisites**: Classical mechanics, Mathematical bases (calculus, vectors, dot or cross product, derivatives, differential equations), Newtonian Equations of Motion **Evaluation**: Exam **Organization**: 8h Lectures, 10h tutorials, 2h exam **Link**: -
Objective
In the field of transportation, the commissioning of vehicles depends on ensuring the safety of passengers. Therefore, among certification procedures, the structure's vibration is one of the significant issues. Nevertheless, we can also cite the design of some structural parts for which it is essential to know the kinematics and the efforts in the corresponding joints. This course provides the skills and knowledge required to establish and solve (numerically) problems such as the movement of multibody systems or the vibration of systems. The methodology used is based on Lagrange Mechanics.
Content

1. Configuration
   a. Kinematically or not admissible configuration
2. Joints
3. Lagrange's equations
   a. Kinetic and potential energies, virtual work,...
4. Vibrations

Control Systems (S222CTR2)

Course Information

Code: S222CTR2

Responsible: Ina TARALOVA

Contact: ina.taralova@ec-nantes.fr

Department: Automatic control and robotics

Language: English

Credits (ECTS): 3

Number of hours: 20

Semester: 2

Recommended prerequisites: None

Evaluation: 30% continuous assessment (labs), 70% exam

Organization: 8 lectures (16h) + Laboratory works (2h) + 1 exam (2h)

Link:

Objective

Control theory has a plethora of applications in various fields: from automotive and aerospace industry, robotics, production/manufacturing processes to economics and nanotechnology.

Control is applied for trajectory tracking, to improve production efficiency, to minimize the energy, to make the process faster, etc.

Control laws are generally used to regulate physical variables, to follow given trajectory, to reject perturbations/noise and to palliate with model uncertainties.

The aim of this course is to:

- Learn basics concepts and tools on linear time invariant systems (LTI), modeling, transfer functions and state space, stability and stability margins, time responses. Learn to analyze and design the control system using Matlab and Simulink.
- Deal with real time applications of control such as level control, temperature control, speed control, etc.

Content

Part 2 - Frequency responses, controllers design in the frequency domain:

- Introduction to frequency responses, first and second order systems (2x2h)
- Bode plot, Nyquist plot and Black-Nichols chart (2x2h)
- Performance analysis, stability, gain and phase margins, robustness (2h)
- Design of controllers (P,PI,PID, lead and lag controllers) in the frequency domain (2x2h)
- Controller design labs (temperature control, level control, speed control, ...) (2x2h)
- Exam (2h)

Reference:

[1] R. C. Dorf and R. H. Bishop, *Modern Control Systems*, Pearson Education, Upper Saddle River, NJ, twelfth edition, 2011, ISBN-13:978-0-13-602458-3

Digital Image processing (S222DIP)

Course Information
Code: S222DIP **Responsible**: Diana MATEUS LAMA **Contact**: Diana.Mateus@ec-nantes.fr **Department**: Automatics and Robotics **Language**: English **Credits (ECTS)**: 3 **Number of hours**: 20 **Semester**: 2 **Recommended prerequisites: :** None **Evaluation**: 50% homework, 50% exam **Organization**: Lectures (12h) + Lab courses/Project (6h) + exam (2h) **Link**:
Objective
Modern sensing and measurement devices capture and yield massive numerical data. In many cases, data in structured or can be interpreted as an image. The aim of this course is to learn basics concepts and tools of Digital Image Processing. Starting from how images are formed and stored, the lecture will progress towards the elementary techniques to transform those images in the color, the spatial and the frequency domains. The lecture will be accompanied by numerous examples on selected applications and the practical implementation of methods with programming lab courses.
Content
▪ General notions on image formation, storage and quality measures ▪ Image histograms and intensity transformations ▪ Morphological operations ▪ Spatial Filtering ▪ Filtering in the frequency space ▪ Project developed throughout the lecture (examples of previous projects: image mosaicking, jpeg compression) **Reference**: [1] Digital Image Processing, 4th Ed. Gonzalez and Woods 2018, ISBN: 9780133356724

Robotics (S222ROB2)

Course Information

Code: S222ROB2

Responsible: Damien Chablat

Contact: damien.chablat@ec-nantes.fr

Department: Automatic control and robotics

Language: English

Credits (ECTS): 3

Number of hours: 20

Semester: 2

Recommended prerequisites: None

Evaluation: 25% continuous assessment, 25% homework, 50% exam

Organization: 6h lecture, 12h practice , 2h exam

Link:

Objective

The objective of this course is to discover industrial robots. In a first step, I will present the different robot's architectures and their main characteristics. Then we will do kinematic modeling to discover the properties of robots, workspace and singularities. After that, we will discuss the generation of trajectories in the articular and Cartesian space. I will introduce the different types of trajectory of the robots and the link with the industrial processes. The concept of optimal placement will be discussed as well as the simple methods that can be used in robotic CAD software. With this course, students will have tools to choose a robot for an industrial application.

The different stages of the course will be illustrated using the DELMIA software to create:

- a robot
- a tool
- a robotic cell with pick and place operations
- a robotic cell with welding operations

Content

Material Science:

- Introduction of industrial robots
- Modeling of robots
- Workspace and singularities
- Trajectory planning

References:

[1] W Khalil and E Dombre, *Robot: Modeling, Identification and Control*, Butterworth-Heinemann 2004

[2] E. Dombre, P. Chedmail, P. Wenger, *La CAO en robotique*, Hermès Science Publications, 1998

[3] J. Angeles, *Fundamentals of Robotic Mechanical Systems*, Springer, 2014

Industrial Automation Systems (S222IAS)

Course Information
Code: S222IAS
Responsible: Abdelhamid Chriette
Contact: Abdelhamid.Chriette@ec-nantes.fr
Department: Automatics and Robotics
Language: English
Credits (ECTS): 3
Number of hours: 20
Semester: 2
Recommended prerequisites: None
Evaluation:
Organization: 2 lectures (4h) + tutorial Works (6h) + Laboratory works (8h) + 1 exam (2h)
Link:
Objective
After completing this lecture, students should be able to: • Know the hardware organization of PLCs (Programmable Logic Controllers), its input-output and communication peripherals. • Able to recognize the structure and components of automated systems. • Able to analyze automation problems using combinatorial and sequential logic. • Be able to represent solutions by logic circuits and their translation into programmed logic: Ladder, GRAFCET. • Be able to program the control of simple processes using PLCs, sensors and actuators.
Content
• History • Automatic system • Programmable Logic Controllers (PLC) • Basics of the language • Basic structures • Particular structures