CENTRALE NANTES

ENGINEERING PROGRAMME

2023-2024

Year 1 - Initial training

PROGRAMME SUPERVISOR

Georges SALAMEH

Autumn Semester

Course unit	ECTS Credits	Course type	Course code	Title
SKS5	4			
		Elective courses	SOFTSKILLS	See soft skills syllabus
UE51	6			
		Core course	EPSS5	Sports and Physical Education
		Elective courses	LVC	Modern languages 2 (Chinese - English - German - Italian - Japanese - Russian - Spanish)
		Elective courses	LVO	Modern languages 1 (English - French Foreign Language)
UE52	2			
		Core course	ENGCIT1	Civic engagement 1
UE53	6			
		Core course	MeMCo_S5	Modelling approaches in mechanical engineering
UE54	6			
		Core course	CODEP_S5	Product Design and Development
		Core course	ENCLI_S5	Energy, Environment and Climate Challenges
UE55	6			
		Core course	FLUID_S5	Physics and Fluid Dynamics
		Elective courses	CC	Engineering elective (Applied Thermodynamics - Biology - Electronics, Electric Actuators, Embedded Systems - Information systems - Materials - Production management)

Spring Semester

Course unit	ECTS Credits	Course type	Course code	Title
SKS6	5			
		Elective courses	SOFTSKILLS	See soft skills syllabus
UE61	6			
		Core course	EPSS6	Sports and Physical Education
		Elective courses	LVC	Modern languages 2 (Chinese - English - German - Italian - Japanese - Russian - Spanish)
		Elective courses	LVO	Modern languages 1 (English - French Foreign Language)
UE62	1			
		Core course	CME	First Year Internship
UE63	6			
		Core course	MATHS_S6	Engineering mathematics
UE64	6			
		Core course	CCUBE_S6	From measurement to control
UE65	6			
		Core course	ALGPR_S6	Algorithms and Programming
		Elective courses	CC	Engineering elective (Applied Thermodynamics - Biology - Electronics, Electric Actuators, Embedded Systems - Information systems - Materials - Production management)

German [ALLS5]

LEAD PROFESSOR(S): Katja BORCK

Objectives

The students will learn basic communication skills (enough to communicate on a daily basis at a non-specialist level - corresponding to a B1 level according to the CEFRL standards) including the comprehension of the particular country's social, political and cultural context through written and televised press in their chosen language. The acquisition and reinforcement of basic vocabulary, syntax, and pronunciation by both traditional means and using multimedia resources. The teaching approach is 'communicative' meaning that the language is not only the subject matter of the course, it is also a means of communication.

Course contents

The course activities cover a whole range of practical language and communication exercises that span written and oral comprehension and expression.
Written: multiple choice, gap filling, rephrasing, text production.
Oral: awareness of registers, intonation, syntax as it applies to different situations, debates, study of unique situations, linguistic consequences of cultural differences, using different types of media and real-life situations.

Course material

Preparation manuals for the various foreign language certificates. Written and televised press, various internet sources, general civilization documents, digital tools, excepts of movies and television series, music and literature.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
German	-	0 hrs	26 hrs	0 hrs	0 hrs	0 hrs

English [ANGS5]

LEAD PROFESSOR(S): Mark Julien BECK

Objectives

Course objectives include the acquisition and reinforcement of vocabulary, syntax, and pronunciation by traditional means and multimedia resources.

The teaching approach is 'communicative': language is not only the subject matter, it is also a means of communication that the students should appropriate in an optimal manner.

The students must obtain a language competence certificate: TOEIC (850 points). This qualification ensures that by the end of the first year, students will have acquired the language competence required to pursue specialized studies.

Course contents

The course activities cover a whole range of practical language and communication exercises that span written and oral comprehension and expression. The principle focus for this semester is "presentation skills".

Written: multiple choice, gap filling, rephrasing.
Oral: awareness of registers, intonation, syntax as it applies to different situations, debates, linguistic consequences of cultural differences, using media, telephoning.

Course material

Preparation manuals for the various foreign language certificates. Written and televised press, internet, general civilization documents.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	-	0 hrs	26 hrs	0 hrs	0 hrs	0 hrs

Chinese [CHIS5]

LEAD PROFESSOR(S): Jianping GUNST

Objectives

The course is intended for beginners in Mandarin Chinese. Acquisition of the lexicon, syntax and basic pronunciation by using all traditional and numerical aids.
Master certain elements of grammar specific to the Chinese language. To be able to use vocabulary relating to everyday situations. To know how to read and write in characters. To be able to pronounce syllables with different tones. Be aware of Chinese culture.

Course contents

The course activities cover a whole range of practical language and communication exercises that span written and oral comprehension and expression.

Written: multiple choice, gap filling, rephrasing;

Oral: awareness of registers, intonation, syntax as it applies to different situations, debates, study of unique situations, linguistic consequences of cultural differences, using media, telephoning.

Course material

Méthode d'Initiation à la Langue et à l'Ecriture chinoises (Joël Bellassen)
Written and televised press, internet, general civilization documents, digital tools.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
Chinese	-	0 hrs	52 hrs	0 hrs	0 hrs	0 hrs

English [ENGS5]

LEAD PROFESSOR(S): Mark Julien BECK

Objectives

Course objectives include the acquisition and reinforcement of vocabulary, syntax, and pronunciation by traditional means and multimedia resources.

The teaching approach is 'communicative': language is not only the subject matter, it is also a means of communication that the students should appropriate in an optimal manner.

The students must obtain a language competence certificate: TOEIC (850 points) in English. These qualifications ensure that by the end of the first year, students will have acquired the language competence required to pursue specialized studies.

Course contents

The course activities cover a whole range of practical language and communication exercises that span written and oral comprehension and expression. The principle focus for the first semester is presentation skills.

Written: multiple choice, gap filling, rephrasing.
Oral: awareness of registers, intonation, syntax as it applies to different situations, debates, linguistic consequences of cultural differences, using media, telephoning.

Course material

Preparation manuals for the various foreign language certificates. Written and televised press, internet, general civilization documents.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	-	0 hrs	26 hrs	0 hrs	0 hrs	0 hrs

Sports and Physical Education [EPSS5]

LEAD PROFESSOR(S): Gildas GUIHENEUF-LALERE / Grégory GARNIER

Objectives

Sports and physical education contribute significantly to an engineer's physical, psychological, social and intellectual development, as well as to his/her general well being. These activities:
- strengthen self-esteem,
- trigger a sense of competition and solidarity, team spirit and the desire to succeed,
- prepare for the demands of a career by fostering team and individual initiative,
- encourage a sense of responsibility related to positive characterisation and identity.

Course contents

Sports and physical education develop social communication through:
- various team activities (on small and large playing fields),
- physiological-directed activities (development of cardiopulmonary and muscular functions),
- organisation of sports events

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	0 hrs	26 hrs	0 hrs	0 hrs	0 hrs

Spanish [ESPS5]

LEAD PROFESSOR(S): Josep PINYOL VIDAL / Marta HERRERA

Objectives

Acquisition and reinforcement of the 4 competencies in written and oral expression & comprehension.

Acquisition of vocabulary, syntax and pronunciation by both traditional means and through the use of digital resources.

Discovery of the Spanish-speaking worlds.

Course contents

The course activities cover a whole range of practical language and communication exercises that span written and oral comprehension and expression.

Methods
individual and group production & presentations
Written, digital and audiovisual tools

Content
Personal environment
Academic and professional activities

Evaluation
The final grade is based on a combination of practical work, course attendence and assessments.

Course material

Preparation manuals for the various foreign language certificates. Written and televised press, internet, general civilization documents, digital tools.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
Spanish	-	0 hrs	26 hrs	0 hrs	0 hrs	0 hrs

French Foreign Language [FLES5]

LEAD PROFESSOR(S): Silvia ERTL

Objectives

The objective is to familiarise the learner with the French language and French culture through an entertaining task-based approach.

Course contents

The course activities cover a whole range of practical language and communication exercises that span written and oral comprehension and expression.
French as a Foreign Language:
The classes are organised into workshops to alternate work on the four language skills in level groups.
Workshops:
- Theatre / song / oral expression / phonetics
- Film / cinema
- Media / oral comprehension (TV-radio)
- Written expression / news writing
- Grammar games
- Interculturalism / advertising / language register / idiomatic expressions
- CVs/ cover letters / job interviews / telephone skills

- TFI diploma; Common theme linking the workshops: grammar items.
1) Theatre (all levels).
Work based on plays (Molière, Cyrano) with emphasis on phonetics. Beginner level: simple dialogue, production and roleplays. Production: Arts column - video, reviews.
2) Cinema (advanced level):
Multimodal interpretation of a selection of French films (L'Auberge Espagnole, Entre les murs, Ressources Humaines, etc.). Description of images, analysis, interaction (gestures etc). Production: Arts column, cinema reviews, surveys, visit or exchange with ESMA film school.
3) Media (all levels):
Listening exercises adapted to different levels. Advanced level: work on caricatures (les Guignols). Production: quiz or crosswords, Web-TV
4) Written expression (all levels):
Work on the different columns of a newspaper and the specific vocabulary, according to the group level. Production: articles, ads
5) Grammar games (all levels):
Grammar work essentially using teaching aids, according to the group level. Production: interactive platform game.
6) Interculturalism (advanced level):
Explore and debate cultural differences. Work on language register and idiomatic expressions through advertising. Production: advertising inserts, debates, Web-TV.
7) Job applications & job interview (French as a second language students):
Write a CV and cover letter work on specific vocabulary. Prepare a job interview. Production: Job offers / ready to go applications
8) TFI (all levels):
Familiarise with the B2 certification format. Alongside workshops work on field experiences:
- Linguistic challenges https://monnantesamoi.wordpress.com
- photo rally and information on monuments
- weekend activity log
- cinema and theatre outings + reviews and/or interviews
- photo exhibitions with textual descriptions
- surveys (student / leisure / holiday budgets)

- sketches on the theme of French characters

Course material

Preparation manuals for the various foreign language certificates. Written and televised press, internet, general civilization documents, digital tools.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	0 hrs	26 hrs	0 hrs	0 hrs	0 hrs

Italian [ITAS5]

LEAD PROFESSOR(S): Annunziata CALECA

Objectives

As well as for preparing the certificates required in English (or French as a foreign language), the students will learn basic communication skills (enough to communicate on a daily basis at a non-specialist level) including the comprehension of the particular country's social, political and cultural context through written and televised press in their chosen language. The acquisition and reinforcement of basic vocabulary, syntax, and pronunciation by both traditional means and using multimedia resources. The teaching approach is 'communicative' meaning that the language is not only the subject matter of the course, it is also a means of communication.

Course contents

The course activities cover a whole range of practical language and communication exercises that span written and oral comprehension and expression.

Written: multiple choice, gap filling, rephrasing;

Oral: awareness of registers, intonation, syntax as it applies to different situations, debates, study of unique situations, linguistic consequences of cultural differences, using media, telephoning.

Course material

Preparation manuals for the various foreign language certificates. Written and televised press, internet, general civilization documents, digital tools.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
Italian	-	0 hrs	26 hrs	0 hrs	0 hrs	0 hrs

Japanese [JAPS5]

LEAD PROFESSOR(S): Kyoko LEVACHER / Yukie NAKAO

Objectives

The aim of the course is for students to acquire the linguistic elements needed for everyday communication, but also for academic communication. In the first year (beginner level), learners will study characters (hiragana, katakana and some kanji) and basic structures with the aim of communicating simply in speech and writing.

Course contents

The course activities cover a whole range of practical language and communication exercises that span written and oral comprehension and expression.

Course material

Preparation manuals for the various foreign language certificates.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
Japan	-	0 hrs	52 hrs	0 hrs	0 hrs	0 hrs

Russian [RUSS5]

LEAD PROFESSOR(S): Larissa GEORGET

Objectives

As well as for preparing the certificates required in English (or French as a foreign language), the students will learn basic communication skills (enough to communicate on a daily basis at a non-specialist level) including the comprehension of the particular country's social, political and cultural context through written and televised press in their chosen language. The acquisition and reinforcement of basic vocabulary, syntax, and pronunciation by both traditional means and using multimedia resources. The teaching approach is 'communicative' meaning that the language is not only the subject matter of the course, it is also a means of communication.

Course contents

The course activities cover a whole range of practical language and communication exercises that span written and oral comprehension and expression.

Written: multiple choice, gap filling, rephrasing;

Oral: awareness of registers, intonation, syntax as it applies to different situations, debates, study of unique situations, linguistic consequences of cultural differences, using media, telephoning.

Course material

Preparation manuals for the various foreign language certificates. Written and televised press, internet, general civilization documents, digital tools.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
Russian	-	0 hrs	26 hrs	0 hrs	0 hrs	0 hrs

Civic engagement 1 [ENGCIT1]

LEAD PROFESSOR(S): Georges SALAMEH

Objectives

This is a voluntary, unpaid commitment which benefits a community outside the school. In the service of the general interest, it can be carried out with:

- an association (NB school association: derogation required)
- a local authority (town hall, local council, 'département', region)
- a public establishment (museum, middle school, high school, prison, etc.)

and in 9 main areas: culture and leisure, international development and humanitarian action, education for all, environment, emergency response in case of crisis, memory and citizenship, health, solidarity, sport.

Course contents

How does it work?

- Compulsory activity, in addition to the first year internship
- Duration: 100 hours (either in one shot - e.g. one month during the holidays, or on a weekly basis)
- Subject to tutor approval, it can be split into two or more projects.

Project approval (30h accepted by the tutor) before the jury of S5; completion of 80 hours before the jury of S7; completion of 100 hours before the jury EI2

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	0 hrs	0 hrs	0 hrs	0 hrs	0 hrs

Modelling approaches in mechanical engineering [MeMCo_S5]

LEAD PROFESSOR(S): Laurent STAINIER

Objectives

This is an introductory course to continuum mechanics, and more generally to modelling approaches in mechanics. It aims to provide the tools needed and used by engineers for mechanical design. It also establishes the foundation for more advanced courses in solid and fluid mechanics, for example dealing with non-linear cases.

At the end of the course, students should (at the minimum):
- be able to translate mechanics problems (fluids, deformable solids) into equations: select appropriate equations and specify associated boundary conditions;
- have a good understanding of notions such as strain (tensor), stress (tensor), constitutive model;
- have gained a first experience in numerical methods to obtain approximate solutions to mechanics problems expressed in equations.

Course contents

The course is structured into 14 modules (2h lectures + 2h tutorials), successively covering the following topics:
- Introduction
- Kinematics
- Stresses
- Conservation laws and energetic theorems
- Constitutive models (elasticity, Newtonian fluids)
- Numerical methods
- Recap and closing

In parallel to these modules, 4 laboratory sessions (4h) will allow students to explore these topics through experimental and numerical practice.
A significant amount of personal work is also expected.

Course material

- Introduction to Continuum Mechanics, W. Michael Lai, David Rubin and Erhard Krempl, Elsevier, 2010 (ebook accessible: http://www.sciencedirect.com/science/book/9780750685603)
- Mécanique des milieux continus, Jean Coirier, Carole Nadot-Martin, Dunod, 2013
- Continuum Mechanics, A.J.M. Spencer, Dover, 2004

Assessment

Collective assessment: EVC 1 (coefficient 0.2)
EVC 2 (coefficient 0.2)

Individual assessment: EVI 1 (coefficient 0.3)
EVI 2 (coefficient 0.3)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	28 hrs	28 hrs	16 hrs	0 hrs	4 hrs

Product Design and Development [CODEP_S5]

LEAD PROFESSOR(S): Jean-François PETIOT

Objectives

To train the students in the different stages of the product design and development processes. The focus is placed on the different phases of the design process and on the different stakeholders (marketing, design team, prototyping, industrialization, quality control). The students will acquire the knowledge required to:
- understand and define customer needs (specifications)
- analyse the functioning of industrial products, as defined by technical documents and specifications
- model and simulate systems (CAD modeling, sizing)
- consolidate technical solutions and justify choices
- make different sub systems or parts, by using differents industrial processes (machining, welding, cutting, boiler making) and ensure quality control

Course contents

Lectures in:
The product development process
Identification of user needs - Functional Analysis
Machine Elements
Industrial design and architecture
Manufacturing processes
Machine elements
Bearings - gears

Tutorials in:
Graphical elements
CAD modeling and sketching
Functional analysis
Design for Manufacturing

The knowledge acquired is consolidated through the undertaking of a design project (APP) with CAD models (DFM, greendesign)

Practicals on manufacturing processes:
- Introduction to different manufacturing processes
- Computer Aided Manufacturing
- Machining, welding, innovative processes
- Industrialization -prototyping

Course material

Product Design and Development. K. T. Ulrich and S. D. Eppinger. third edition, Mc Graw Hill, Irwin.
Product Design. Eger A., Bonnema M., Lutters E., Vand der Voort M. Eleven international publishing.
La conception Industrielle de Produits. Hermès Lavoisier, sous la direction de B. Yannou, H. Christophol, Jolly D., Troussier N.

Assessment

Collective assessment: EVC 1 (coefficient 0.3)
EVC 2 (coefficient 0.3)

Individual assessment: EVI 1 (coefficient 0.4)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	4 hrs	16 hrs	16 hrs	0 hrs	2 hrs

Energy, Environment and Climate Challenges [ENCLI_S5]

LEAD PROFESSOR(S): Pierre MARTY

Objectives

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.

Course contents

CM1: Energy issues
CM2: Science and critical thinking
CM3: Climate issues
CM4: Economy issues
CM5: Environmental Issues
CM6: Raw materials
CM7: Solutions: Towards 0
TD1: Introduction, factfulness, energy-climate exercises, carbon footprint calculation
TD2-3: Flipped Classes on 12 themes
TD4: Mini simulation of energy transition scenarios
TP: "Climate collage" workshop.

Course material

J.-M. Jancovici, Dormez tranquilles jusqu'en 2100. Odile Jacob, 2015.
V. Smil, Energy and Civilization: A History. The MIT Press, 2017.
S. Pinker, Enlightenment Now: The Case for Reason, Science, Humanism, and Progress. Les Arènes, 2018.
Y. N. Harari, Sapiens: Une brève histoire de l'humanité. Albin Michel, 2015.
"BP Statistical Review of World Energy 2019," 2019.
IPCC, "Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]," Cambridge, United Kingdom and New York, NY, USA, 2013.
C. C. Mann, The Wizard and the Prophet: Science and the Future of Our Planet. Picador, 2019.
P. Bihouix, L'Âge des low tech. Vers une civilisation techniquement soutenable. Le Seuil, 2014.
S.Goldstein-Rose, The 100% solution: A Plan for Solving Climate Change. Melville House, 2020

Assessment

Collective assessment: EVC 1 (coefficient 0.3)
EVC 2 (coefficient 0.2)

Individual assessment: EVI 1 (coefficient 0.5)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	18 hrs	14 hrs	4 hrs	0 hrs	2 hrs

Biology [BIOLO_S5]

LEAD PROFESSOR(S): Sophie LIMOU

Objectives

Introduction to life and biology
Bioinformatics in the medical field
Examples of biomedical engineering applications
Practice in applied biology

Course contents

Introduction to life and biology: bases of life, cell and molecular biology, human physiology
Bioinformatics in the medical field: big data challenges, Shell and R
Examples of biomedical engineering applications: image analyses and single-cell transcriptomics for in vitro fertilization, vascular tissue engineering
Practice in applied biology: genetic code and medical genetics in R

Course material

Assessment

Collective assessment: EVC 1 (coefficient 0.2)
EVC 2 (coefficient 0.2)
EVC 3 (coefficient 0.2)

Individual assessment: EVI 1 (coefficient 0.4)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	14 hrs	16 hrs	6 hrs	0 hrs	2 hrs

Applied Thermodynamics [ENERG_S5]

LEAD PROFESSOR(S): Jean-François HETET

Objectives

- To understand the fundamental laws of thermodynamics.
- To apply these laws to study industrial processes involving energy transformation or transfer phenomena.
- To take account of the environmental impact of energy production and consumption.

Course contents

- History of the main ideas in thermodynamics.
- Laws of thermodynamics and selected elementary results: closed/open systems, perfect and real fluids - a phenomenological study.
- Energy transformations-compressors, nozzles, turbines
- Phase transitions: properties of mixtures, thermodynamic tables and diagrams.
- Thermodynamic cycles and thermal machines. Direct cycles: Carnot, Rankine, Hirn, reheating cycles, Joule's cycle, Beau de Rochas and Diesel cycles. Introduction to turbocharging. Inverse compression cycles: Carnot and Joule's cycles, heat pump, refrigeration and air conditioning. Humid air. Steam absorbtion cycles.

Course material

Thermodynamique et énergétique par M. BOREL (Presses polytechniques Romandes)
Thermodynamique générale et application par R. KLING (Technip)
Thermodynamique par J.P. PEREZ (Masson)
Energétique par M. FEIDT (Dunod)
Introduction aux problèmes énergétiques globaux par R. GICQUEL (Presses des Mines)

Assessment

Collective assessment: EVC 1 (coefficient 0.2)
EVC 2 (coefficient 0.2)

Individual assessment: EVI 1 (coefficient 0.6)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	12 hrs	16 hrs	8 hrs	0 hrs	2 hrs

Physics and Fluid Dynamics [FLUID_S5]

LEAD PROFESSOR(S): David LE TOUZÉ

Objectives

Teach the fundamentals of fluid dynamics and describe the main fluid phenomena. Present the main classes of approximation used in fluid dynamics, and develop the classic methodologies to resolve fluid problems. Give an overview of applied hydrodynamics and aerodynamics in engineering.

Course contents

Lecture and Tutorial n°1: Phenomenology et dimensional analysis
Lecture and Tutorial n°2: Navier-Stokes equations - Laminar and turbulent flows, boundary-layer concept
Lecture and Tutorial n°3: Statics of fluids - Surface tension
Lecture and Tutorial n°4: Perfect fluid approximation
Lecture and Tutorial n°5: Generalized Bernoulli equation - Head loss
Lecture and Tutorial n°6: Momentum budget - Fluid force calculation
Lecture and Tutorial n°7: Compressible flows and applied aerodynamics - Applied hydrodynamics

Course material

In the School library there is a section dedicated to fluid dynamics where numerous reference books can be found, in French and in English (by Candel, Chassaing, Spurk, Morel & Laborde, Meier & Kempf, Joulié, etc.)
In addition, the online available course by Homsy et al. is complete and well illustrated with numerous examples: https: //www.cambridge.org/core/homsy/ (select « Ecole Centrale de Nantes » under « Access provided by »).

Assessment

Collective assessment: EVC 1 (coefficient 0.4)

Individual assessment: EVI 1 (coefficient 0.6)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	14 hrs	14 hrs	8 hrs	0 hrs	2 hrs

Production management [GPROD_S5]

LEAD PROFESSOR(S): Catherine DA CUNHA

Objectives

- Understand the flows in a production environment
- Forecast demand and plan related activities

Course contents

- Physical flows
- Demand and forecasting
- Inventory management
- Data management (Bill of material, routings)
- Layout
- Planning

Lab sessions will allow the students to apply the concepts on a case study with manufacturing software

Keywords: Inventory management, forecasting, planning

Course material

Gestion de la production et des flux, V. Giard, 2003
Handbook of industrial and systems engineering, A. Badiru, 2013

Assessment

Collective assessment: EVC 1 (coefficient 0.5)

Individual assessment: EVI 1 (coefficient 0.5)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	16 hrs	12 hrs	8 hrs	0 hrs	2 hrs

Materials [MATER_S5]

LEAD PROFESSOR(S): Christian BURTIN

Objectives

This course offers an introduction to the science of materials. It provides the necessary grounding to make an informed choice of material according to the operational environment.

Course contents

Upon completion of this course the students should be able to:

- select a metal using a phase diagram
- understand the role of defects on the mechanical properties of materials
- know which solidification mechanisms increase the mechanical properties of materials
- take account of the specific characteristics of polymers - viscoelasticity, and of composite materials - anisotropy.

Course material

Des Matériaux, Jean Paul BAILON, presses internationales polytechnique

Assessment

Individual assessment: EVI 1 (coefficient 0.5)
EVI 2 (coefficient 0.3)
EVI 3 (coefficient 0.2)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	12 hrs	12 hrs	12 hrs	0 hrs	2 hrs

Electronics, Electric Actuators, Embedded Systems [SELEC_S5]

LEAD PROFESSOR(S): Mikael BRIDAY

Objectives

Embedded systems are increasingly present in all industrial sectors (automotive, avionics, electric traction, robotics, renewable energies, etc.).

This course presents how to make embedded computer control systems which are in most applications inseparable from the associations electronic - machine converter - micro-controller.

The three aspects of these systems are presented: the most common types of electric motors and generators, power electronics and power electronics, microcomputing, both from a hardware and software point of view.

Course contents

Introduction: historical evolution from the first electrical machines to microcontrollers.
Power electronics:
- Single-phase and three-phase sources and static transformers.
- Components of power electronics.
- Converters: choppers, inverters, rectifiers.
- DC motor and generator.
- Classical synchronous and magnet motor and generator.
- Asynchronous motor.
- Advanced machine models and controls.

Analog electronics (micro-controller interface):
- Equation of electronic assemblies.
- Diode modeling.
- Bipolar transistor modeling.

Introduction to embedded computing.
- Description of microcontrollers.
- General Purpose inputs / outputs.
- Analog inputs.
- Timers and PWM outputs.
- Periodic interrupts

Course material

J. Chiasson, Modeling and High-Performance Control of Electric Machines, IEEE series on Power engineering, Wiley-Interscience, ISBN 0-471-68449-X, 2005.

C. Le Trionnaire, J.-P. Picheny, Génie électrique vade-mecum d'électrotechnique, Ellipses -Technosup, ISBN13 : 978-2-7298-6101-8 2010.

P. Mayé, Moteurs électriques pour la robotique, Dunod, Techniques et Ingénierie, EAN13 : 9782100700363, 2013.

Albert Paul Malvino, David J. Bates, Principes d'électronique, Dunod, 2008, EAN13 : 9782100516131

P. Molinaro, A. Chriette, Électronique analogique : traitement des composants et circuits, éditions Ellipses Technosup, 2013, ISBN-13: 978-2729882273.

C. Valens, Maîtrisez les microcontrôleurs à l'aide d'Arduino, éditeur Publitronic-Elektor, 2013, ISBN-13: 978-2866611903.

F. Schaeffer, Programmation en C des microcontrôleurs RISC AVR, éditeur : ELEKTOR PUBLITRONIC, 2009, ISBN-13: 978-2866611699.

D. Patterson & J. Hennessy, Computer Organization and Design – ARM Edition, Morgan Kaufmann, 2017

Assessment

Collective assessment: EVC 1 (coefficient 0.5)

Individual assessment: EVI 1 (coefficient 0.5)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	14 hrs	10 hrs	12 hrs	0 hrs	2 hrs

Information systems [SSTEM_S5]

LEAD PROFESSOR(S): Morgan MAGNIN

Objectives

The goal of this course is to address the modeling and design of complex systems. The added value of engineers with general vocational training is their ability to understand the complexity of systems at the interface between different disciplines. To do that, the engineer has to be able to build a global, abstract and shareable view of the system he designs.

In particular, information systems are central to any kind of social or scientific structure (companies, schools, hospitals, etc.) - they deal with the development, use and management of an organization's infrastructure. An information system is literally a structured set of services, methods and tools that can answer questions relative to a specific organization or domain. Databases are one of the major underlying components of information systems: they store and process data as a permanent memory. Understanding the differences behind information systems, databases and Excel is thus crucial.

The course aims to develop skills in modeling and analysis of complex systems. It provides the essential knowledge in the field of information systems: design, deployment and their daily management. In such a context, databases require major attention. We present the main principles for modeling a system under the form of a database and give an introduction to relational algebra.

Finally, the course focuses on the legal issues surrounding information systems and databases: we give an overview of the European laws applying to such systems (with regard to data processing and rights resulting from the creation of databases, etc.)

Objectives of the course in terms of skills development:
- Knowing how to design a global, abstract and shareable view of a physical or logical system
- Mastering the manipulation of digital data:
- Acquiring data
- Structuring data
- Searching for information
- Presenting the results in summary form (reporting)
- Understanding the challenges of big data

- Applications to various industrial case-studies

Objectives of the course in terms of knowledge:
- Modeling language (physical or logical system)
- Query language
- Methodological approach
- Legal issues

Course contents

1) Modelling of complex systems
- System-oriented approach
- Modeling organizations
- Modeling languages (UML, SysML)
- Application to various industrial case-studies

2) Information Systems
- Introduction to information systems: link between IS and organization
- Design, modeling, deployment, operation
- Organization, methods and tools for a company
- Legal issues applicable to information systems and databases

3) Databases: relational algebra and modeling
▪ Manipulation of data models
▪ Introduction to SQL
▪ Towards the decision IS and Business Intelligence
▪ Presentation of the different “business” and challenges of information systems and databases in companies

Course material

- Course syllabus available on the school's online learning platform
- Alain Faisandier. Systems engineering. Conference at AIP-PRIMECA Congress. April 2011.
- Documentation from PostgreSQL. http://docs.postgresqlfr.org/
- SysML Open Source Specification Project. http://www.sysml.org/

Assessment

Collective assessment: EVC 1 (coefficient 0.5)

Individual assessment: EVI 1 (coefficient 0.5)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	12 hrs	14 hrs	10 hrs	0 hrs	2 hrs

German [ALLS6]

LEAD PROFESSOR(S): Katja BORCK

Objectives

The students will learn basic communication skills (enough to communicate on a daily basis at a non-specialist level - corresponding to a B1 level according to the CEFRL standards) including the comprehension of the particular country's social, political and cultural context through written and televised press in their chosen language. The acquisition and reinforcement of basic vocabulary, syntax, and pronunciation by both traditional means and using multimedia resources. The teaching approach is 'communicative' meaning that the language is not only the subject matter of the course, it is also a means of communication.

Course contents

The course activities cover a whole range of practical language and communication exercises that span written and oral comprehension and expression.

Written: multiple choice, gap filling, rephrasing, text production.

Oral: awareness of registers, intonation, syntax as it applies to different situations, debates, study of unique situations, linguistic consequences of cultural differences, using different types of media and real-life situations.

Course material

Preparation manuals for the various foreign language certificates. Written and televised press, various internet sources, general civilization documents, digital tools, excepts of movies and television series, music and literature.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
German	-	0 hrs	26 hrs	0 hrs	0 hrs	0 hrs

English [ANGS6]

LEAD PROFESSOR(S): Mark Julien BECK

Objectives

Course objectives include the acquisition and reinforcement of vocabulary, syntax, and pronunciation by traditional means and multimedia resources.

The teaching approach is 'communicative': language is not only the subject matter, it is also a means of communication that the students should appropriate in an optimal manner.

The students must obtain a language competence certificate: TOEIC (850 points) in English. These qualifications ensure that by the end of the first year, students will have acquired the language competence required to pursue specialized studies.

Course contents

The course activities cover a whole range of practical language and communication exercises that span written and oral comprehension and expression. During this semester, time is spent ensuring all students have a CV and a cover letter in English.

Written: multiple choice, gap filling, rephrasing.
Oral: awareness of registers, intonation, syntax as it applies to different situations, debates, linguistic consequences of cultural differences, using media, telephoning.

Course material

Preparation manuals for the various foreign language certificates. Written and televised press, internet, general civilization documents, multimedia.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	-	0 hrs	26 hrs	0 hrs	0 hrs	0 hrs

Chinese [CHIS6]

LEAD PROFESSOR(S): Jianping GUNST

Objectives

As well as for preparing the certificates required in English (or French as a foreign language), the students will learn basic communication skills (enough to communicate on a daily basis at a non-specialist level) including the comprehension of the particular country's social, political and cultural context through written and televised press in their chosen language. The acquisition and reinforcement of basic vocabulary, syntax, and pronunciation by both traditional means and using multimedia resources. The teaching approach is 'communicative' meaning that the language is not only the subject matter of the course, it is also a means of communication.

Course contents

The course activities cover a whole range of practical language and communication exercises that span written and oral comprehension and expression.

Written: multiple choice, gap filling, rephrasing;

Oral: awareness of registers, intonation, syntax as it applies to different situations, debates, study of unique situations, linguistic consequences of cultural differences, using media, telephoning.

Course material

Preparation manuals for the various foreign language certificates. Written and televised press, internet, general civilization documents, digital tools.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
Chinese	-	0 hrs	52 hrs	0 hrs	0 hrs	0 hrs

English [ENGS6]

LEAD PROFESSOR(S): Mark Julien BECK

Objectives

Course objectives include the acquisition and reinforcement of vocabulary, syntax, and pronunciation by traditional means and multimedia resources.

The teaching approach is 'communicative': language is not only the subject matter, it is also a means of communication that the students should appropriate in an
optimal manner.

The students must obtain a language competence certificate: TOEIC (850 points). This qualification ensures that by the end of the first year, students will have acquired the language competence required to pursue specialized studies.

Course contents

The course activities cover a whole range of practical language and communication exercises that span written and oral comprehension and expression. During this semester time will be spent to ensure all students have a CV and cover letter in English.

Written: multiple choice, gap filling, rephrasing.
Oral: awareness of registers, intonation, syntax as it applies to different situations, debates, linguistic consequences of cultural differences, using media, telephoning.

Course material

Preparation manuals for the various foreign language certificates. Written and televised press, internet, general civilization documents.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	-	0 hrs	26 hrs	0 hrs	0 hrs	0 hrs

Sports and Physical Education [EPSS6]

LEAD PROFESSOR(S): Gildas GUIHENEUF-LALERE / Grégory GARNIER

Objectives

Sports and physical education contribute significantly to an engineer's physical, psychological, social and intellectual development, as well as to his/her general well being. These activities:
- strengthen self-esteem,
- trigger a sense of competition and solidarity, team spirit and the desire to succeed,
- prepare for the demands of a career by fostering team and individual initiative,
- encourage a sense of responsibility related to positive characterisation and identity.

Course contents

Sports and physical education develop social communication through:
- various team activities (on small and large playing fields),
- physiological-directed activities (development of cardiopulmonary and muscular functions),
- organisation of sports events

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	0 hrs	26 hrs	0 hrs	0 hrs	0 hrs

Spanish [ESPS6]

LEAD PROFESSOR(S): Josep PINYOL VIDAL / Marta HERRERA

Objectives

Acquisition and reinforcement of the 4 competencies in written and oral expression & comprehension.

Acquisition of vocabulary, syntax and pronunciation by both traditional means and through the use of digital resources.

Discovery of the Spanish-speaking worlds.

Course contents

The course activities cover a whole range of practical language and communication exercises that span written and oral comprehension and expression.

Methods
individual and group production & presentations
Written, digital and audiovisual tools

Content
Personal environment
Academic and professional activities

Evaluation
The final grade is based on a combination of practical work, course attendance and assessments.

Course material

Preparation manuals for the various foreign language certificates. Written and televised press, internet, general civilization documents, digital tools.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
Spanish	-	0 hrs	26 hrs	0 hrs	0 hrs	0 hrs

French Foreign Language [FLES6]

LEAD PROFESSOR(S): Silvia ERTL

Objectives

The objective is to familiarise the learner with the French language and French culture through an entertaining task-based approach.

Course contents

The course activities cover a whole range of practical language and communication exercises that span written and oral comprehension and expression.
French as a Foreign Language:
The classes are organised into workshops to alternate work on the four language skills in level groups.
Workshops:
- Theatre / song / oral expression / phonetics
- Film / cinema
- Media / oral comprehension (TV-radio)
- Written expression / news writing
- Grammar games
- Interculturalism / advertising / language register / idiomatic expressions
- CVs/ cover letters / job interviews / telephone skills

- TFI diploma; Common theme linking the workshops: grammar items.
1) Theatre (all levels).
Work based on plays (Molière, Cyrano) with emphasis on phonetics. Beginner level: simple dialogue, production and roleplays. Production: Arts column - video, reviews.
2) Cinema (advanced level):
Multimodal interpretation of a selection of French films (L'Auberge Espagnole, Entre les murs, Ressources Humaines, etc.). Description of images, analysis, interaction (gestures etc). Production: Arts column, cinema reviews, surveys, visit or exchange with ESMA film school.
3) Media (all levels):
Listening exercises adapted to different levels. Advanced level: work on caricatures (les Guignols). Production: quiz or crosswords, Web-TV
4) Written expression (all levels):
Work on the different columns of a newspaper and the specific vocabulary, according to the group level. Production: articles, ads
5) Grammar games (all levels):
Grammar work essentially using teaching aids, according to the group level. Production: interactive platform game.
6) Interculturalism (advanced level):
Explore and debate cultural differences. Work on language register and idiomatic expressions through advertising. Production: advertising inserts, debates, Web-TV.
7) Job applications & job interview (French as a second language students):
Write a CV and cover letter work on specific vocabulary. Prepare a job interview. Production: Job offers / ready to go applications
8) TFI (all levels):
Familiarise with the B2 certification format. Alongside workshops work on field experiences:
- Linguistic challenges https://monnantesamoi.wordpress.com
- photo rally and information on monuments
- weekend activity log
- cinema and theatre outings + reviews and/or interviews
- photo exhibitions with textual descriptions
- surveys (student / leisure / holiday budgets)

- sketches on the theme French characters

Course material

Preparation manuals for the various foreign language certificates. Written and televised press, internet, general civilization documents, digital tools.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	0 hrs	26 hrs	0 hrs	0 hrs	0 hrs

Italian [ITAS6]

LEAD PROFESSOR(S): Annunziata CALECA

Objectives

As well as for preparing the certificates required in English (or French as a foreign language), the students will learn basic communication skills (enough to communicate on a daily basis at a non-specialist level) including the comprehension of the particular country's social, political and cultural context through written and televised press in their chosen language. The acquisition and reinforcement of basic vocabulary, syntax, and pronunciation by both traditional means and using multimedia resources. The teaching approach is 'communicative' meaning that the language is not only the subject matter of the course, it is also a means of communication.

Course contents

The course activities cover a whole range of practical language and communication exercises that span written and oral comprehension and expression.

Written: multiple choice, gap filling, rephrasing;

Oral: awareness of registers, intonation, syntax as it applies to different situations, debates, study of unique situations, linguistic consequences of cultural differences, using media, telephoning.

Course material

Preparation manuals for the various foreign language certificates. Written and televised press, internet, general civilization documents, digital tools.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
Italian	-	0 hrs	26 hrs	0 hrs	0 hrs	0 hrs

Japanese [JAPS6]

LEAD PROFESSOR(S): Kyoko LEVACHER / Yukie NAKAO

Objectives

The aim of the course is for students to acquire the linguistic elements needed for everyday communication, but also for academic communication. In the first year (beginner level), learners will study characters (hiragana, katakana and some kanji) and basic structures with the aim of communicating simply in speech and writing.

Course contents

The course activities cover a whole range of practical language and communication exercises that span written and oral comprehension and expression.

Course material

Preparation manuals for the various foreign language certificates.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
Japan	-	0 hrs	52 hrs	0 hrs	0 hrs	0 hrs

Russian [RUSS6]

LEAD PROFESSOR(S): Larissa GEORGET

Objectives

As well as for preparing the certificates required in English (or French as a foreign language), the students will learn basic communication skills (enough to communicate on a daily basis at a non-specialist level) including the comprehension of the particular country's social, political and cultural context through written and televised press in their chosen language. The acquisition and reinforcement of basic vocabulary, syntax, and pronunciation by both traditional means and using multimedia resources. The teaching approach is 'communicative' meaning that the language is not only the subject matter of the course, it is also a means of communication.

Course contents

The course activities cover a whole range of practical language and communication exercises that span written and oral comprehension and expression.

Written: multiple choice, gap filling, rephrasing;

Oral: awareness of registers, intonation, syntax as it applies to different situations, debates, study of unique situations, linguistic consequences of cultural differences, using media, telephoning.

Course material

Preparation manuals for the various foreign language certificates. Written and televised press, internet, general civilization documents, digital tools.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
Russian	-	0 hrs	26 hrs	0 hrs	0 hrs	0 hrs

First Year Internship [CME]

LEAD PROFESSOR(S): Georges SALAMEH

Objectives

The first year internship - stage CME - constitutes an introduction to industry/business and provides work experience at execution level.

Objectives:
- Discover the business world and different professions
- Work in a team and develop a professional demeanor
- Take ownership of the job search process, build your network

This experience should give the student a dual perspective:
- that of the worker they have been over the four weeks
- that of the manager they are preparing to become

Course contents

Duration: 4 weeks minimum, between years one and two.
Job description: must be approved by your school tutor
Location: in a company with at least 3 employees, in France or overseas.
Conditions: Internship agreement to be established between the 3 parties (company, school, student), which may/may not give rise to remuneration. 35 hours/week. A short-term contract may replace the agreement (process for internship agreement remains mandatory)

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	0 hrs	0 hrs	0 hrs	0 hrs	0 hrs

Engineering mathematics [MATHS_S6]

LEAD PROFESSOR(S): Françoise FOUCHER / Marie BILLAUD

Objectives

Mathematical knowledge in order to solve problems in engineering:
- To formulate a mathematical problem to approximate, simulate, predict unknown quantities
- To know and apply numerical methods, deterministic or statistical methods
- To set up numerical resolution on computers using numerical computation software (Matlab)
- To know how to analyze results, quantize errors and uncertainties

Course contents

- Introduction to numerical analysis, examples, finite difference method
- Direct methods to solve linear systems
- Iterative methods to solve linear systems
- Iterative methods to approximate eigenvalues
- Optimization without constraint, least squares, gradient methods
- Optimization with constraints, Lagrange multipliers, KKT conditions, gradient, Uzawa and penalization methods, case of linear problems
- Introduction to probabilistic modeling, examples
- Probability, random variables, laws
- Statistics, parameter estimators, confidence intervals, linear regression
- Lagrange and Hermite, interpolation, cubic splines, continuous and discrete least squares approximation
- Numerical integration, Newton-Cotes formulas, Gauss formulas

Course material

- Grégoire Allaire. "Analyse numérique et optimisation". Ellipses, 2005.
- Philippe Barbé et Michel Ledoux, "Probabilité", EDP Sciences, 2007.
- Maïtine Bergounioux. "Optimisation et contrôle des systèmes linéaires". Dunod, 2001.
- Michel Bierlaire. "Introduction à l'optimisation différentiable". PPUR, 2006.
- P.G. Ciarlet. "Introduction à l'analyse numérique matricielle et à l'optimisation". Masson,1988.
- Benjamin JOURDAIN, "Probabilités et statistiques", Ellipses, 2009.
- Patrick Lascaux, Analyse numérique matricielle appliquée à l'art de l'ingénieur, Tome 1, Tome 2, Dunod
- Ali Mansour, "Probabilités et statistiques pour les ingénieurs", Hermès Science publications, 2007.
- Michel Minoux. "Programmation mathématique". 2ème édition, Lavoisier, 2008.
- Jerôme Pagès, Pierre Cazes, Statistiques générales pour utilisateurs 1 Méthodologie, PAGES Jerôme, CAZES Pierre, Presses Universitaires de Rennes, 2005.

Assessment

Collective assessment: EVC 1 (coefficient 1)

Individual assessment: EVI 1 (coefficient 1)
EVI 2 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	16 hrs	44 hrs	12 hrs	0 hrs	4 hrs

From measurement to control [CCUBE_S6]

LEAD PROFESSOR(S): Eric LE CARPENTIER

Objectives

A signal is a physical quantity which evolves over time. A system is a relationship between input signals (or excitations) and output signals (responses). A controlled system is a system which is driven by an autonomous process which tunes inputs according to the desired behavior of the outputs. To operate, such a process needs a measure of the output signals. This measure is given by sensors, and can be discrete (an event occurs or does not occur, e.g. a limit temperature is reached, this is a discrete event) or continuous (e.g. a temperature). The control process implements an algorithm, the control law, which computes the excitations which can be discrete (a gate is open or closed) or continuous (a gate position).

Nowadays, the measure of physical signals is always a voltage. This voltage can be obtained continuously over time (continuous time signal) or sampled (discrete time signals). The control process works on discrete times. Modern implementation faces the following conflicts:
- physical signals are in continuous time, but their measures are discrete time: this is the sampling process;
- the measure of continuous valued physical signals belongs to a finite set: this is the quantization process;
- automatic control laws are often theoretically derived in continuous time, but implemented in discrete time.

This course covers the:
- technological aspects of sensors;
- introduction to the automatic control of discrete and continuous event systems;
- practical consequences of sampling and quantization.

Course contents

A) Sensors
1) Measurement and instrumentation
- role of measurement in modern systems driving
- units, normative aspects
2) Sensors
- general principles
- metrological characterization
3) Conditioning
4) Signal digitizing
5) Instrumentation software (LabView)

B) Signal representation. Dynamical systems modeling and control
1) Discrete time and continuous time signals
- Fourier, Laplace, z
- sampling and Shannon theorem.
2) Discrete time and continuous time LTI systems modeling
- transfer, state space
- poles, zeroes, stability
- frequency response
- sampling
3) Control theory
- from open loop to closed loop
- Control with 2 degrees of freedom (compensator, precompensator)
4) Closed loop nominal and robust stability
5) Closed loop nominal and robust performances
6) PID controllers

C) Discrete events systems
1) Combinatory logic
2) Sequential logic
- synchronous and asynchronous models
- flip-flop, counter, decoder
- finite state machine
3) Control
- programmable devices: API
- languages: ladder diagram, Grafcet

Course material

Les capteurs en instrumentation industrielle. Georges Asch, Editeur: Dunod
LabVIEW : Programmation et applications. Francis Cottet, Editeur: Dunod
G.C. Goodwin, S.F. Graebe, M.E. Salgado, Control System Design. Prentice Hall, 2001.
S.Skogestad, I.Postlewaite. Multivariable Feedback Control, Analysis and Design. Second Edition, Wiley, 2005.
Ph. de Larminat, Automatique appliquée (2e édition revue et augmentée). Collection Hermes Science, Edition Lavoisier, Paris, 2009
P. Borne, G. Dauphin-Tanguy, J.P. Richard, F. Rotella, I. Zambettakis, Analyse et Régulation des processus Industriel, tome 1 Régulation Continue. Édition Technip, 1993.
Modern Signals and Systems, H. Kwakernaak, R. Sivan, Prentice Hall.
Signaux et systèmes linéaires, Cours, Y. Thomas, Masson.
Signaux et Images sous matlab, G. Blanchet et M. Charbit, Hermès

Assessment

Collective assessment: EVC 1 (coefficient 1)

Individual assessment: EVI 1 (coefficient 1)
EVI 2 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	26 hrs	26 hrs	20 hrs	0 hrs	4 hrs

Algorithms and Programming [ALGPR_S6]

LEAD PROFESSOR(S): Hugues DIGONNET / Vincent TOURRE

Objectives

- Algorithms: learn basic algorithms without reference to a programming language
- Programming: learning methods and programming tools, and IT project management

Course contents

- Algorithms:
. problem analysis,
. algorithmic structures,
. simple and structured data types
. functions.
. data organization: file processing, sort algorithms

- C++ programming:
. algorithmic structures translation
. subroutines, header files, libraries,
. input / output stream,
. project management,
. programming tools.

- Group project to implement the acquired knowledge.

Course material

Algorithms Courses with 957 exercises and 158 problems - 3rd edition, Thomas Cormen, Charles Leiserson, Ronald Rivest, Publisher Dunod Collection sup Sciences

C langage, ANSI, Brian Kernighan, Dennis M. Ritchie, Publisher Dunod Collection sup Sciences

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	6 hrs	12 hrs	18 hrs	0 hrs	2 hrs

Biology [BIOLO_S6]

LEAD PROFESSOR(S): Sophie LIMOU

Objectives

Introduction to life and biology
Bioinformatics in the medical field
Examples of biomedical engineering applications
Practice in applied biology

Course contents

Introduction to life and biology: bases of life, cell and molecular biology, human physiology
Bioinformatics in the medical field: big data challenges, Shell and R
Examples of biomedical engineering applications: image analyses and single-cell transcriptomics for in vitro fertilization, vascular tissue engineering
Practice in applied biology: genetic code and medical genetics in R

Course material

Assessment

Collective assessment: EVC 1 (coefficient 0.2)
EVC 2 (coefficient 0.2)
EVC 3 (coefficient 0.2)

Individual assessment: EVI 1 (coefficient 0.4)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	14 hrs	16 hrs	6 hrs	0 hrs	2 hrs

Applied Thermodynamics [ENERG_S6]

LEAD PROFESSOR(S): Jean-François HETET

Objectives

- To understand the fundamental laws of thermodynamics.
- To apply these laws to study industrial processes involving energy transformation or transfer phenomena.
- To take account of the environmental impact of energy production and consumption.

Course contents

- History of the main ideas in thermodynamics.
- Laws of thermodynamics and selected elementary results: closed/open systems, perfect and real fluids - a phenomenological study.
- Energy transformations-compressors, nozzles, turbines
- Phase transitions: properties of mixtures, thermodynamic tables and diagrams.
- Thermodynamic cycles and thermal machines. Direct cycles: Carnot, Rankine, Hirn, reheating cycles, Joule's cycle, Beau de Rochas and Diesel cycles. Introduction to turbocharging. Inverse compression cycles: Carnot and Joule's cycles, heat pump, refrigeration and air conditioning. Humid air. Steam absorbtion cycles.
-Thermodynamics of unbalanced systems - general principles.

Course material

Thermodynamique et énergétique par M. BOREL (Presses polytechniques Romandes)
Thermodynamique générale et application par R. KLING (Technip)
Thermodynamique par J.P. PEREZ (Masson)
Energétique par M. FEIDT (Dunod)
Introduction aux problèmes énergétiques globaux par R. GICQUEL (Presses des Mines)

Assessment

Collective assessment: EVC 1 (coefficient 0.2)
EVC 2 (coefficient 0.2)

Individual assessment: EVI 1 (coefficient 0.6)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	12 hrs	16 hrs	8 hrs	0 hrs	2 hrs

Production management [GPROD_S6]

LEAD PROFESSOR(S): Catherine DA CUNHA

Objectives

- Understand the flows in a production environment
- Forecast demand and plan related activities

Course contents

- Physical flows
- Demand and forecasting
- Inventory management
- Data management (Bill of material, routings)
- Layout
- Planning

Lab sessions will allow the students to apply the concepts on a case study with manufacturing software

Keywords: Inventory management, forecasting, planning

Course material

Gestion de la production et des flux, V. Giard, 2003
Handbook of industrial and systems engineering, A. Badiru, 2013

Assessment

Collective assessment: EVC 1 (coefficient 0.5)

Individual assessment: EVI 1 (coefficient 0.5)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	16 hrs	12 hrs	8 hrs	0 hrs	2 hrs

Materials [MATER_S6]

LEAD PROFESSOR(S): Christian BURTIN

Objectives

This course offers an introduction to the science of materials. It provides the necessary grounding to make an informed choice of material according to the operational environment.

Course contents

Upon completion of this course the students should be able to:

- select a metal using a phase diagram
- understand the role of defects on the mechanical properties of materials
- know which solidification mechanisms increase the mechanical properties of materials
- take account of the specific characteristics of polymers - viscoelasticity, and of composite materials - anisotropy.

Course material

Des Matériaux, Jean Paul BAILON, presses internationales polytechnique

Assessment

Individual assessment: EVI 1 (coefficient 0.5)
EVI 2 (coefficient 0.3)
EVI 3 (coefficient 0.2)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	12 hrs	12 hrs	12 hrs	0 hrs	2 hrs

Electronics, Electric Actuators, Embedded Systems [SELEC_S6]

LEAD PROFESSOR(S): Mikael BRIDAY

Objectives

Embedded systems are increasingly present in all industrial sectors (automotive, avionics, electric traction, robotics, renewable energies, etc.).

This course presents how to make embedded computer control systems which are in most applications inseparable from the associations electronic - machine converter - micro-controller.

The three aspects of these systems are presented: the most common types of electric motors and generators, power electronics and power electronics, microcomputing, both from a hardware and software point of view.

Course contents

Introduction: historical evolution from the first electrical machines to microcontrollers.
Power electronics:
- Single-phase and three-phase sources and static transformers.
- Components of power electronics.
- Converters: choppers, inverters, rectifiers.
- DC motor and generator.
- Classical synchronous and magnet motor and generator.
- Asynchronous motor.
- Advanced machine models and controls.

Analog electronics (micro-controller interface):
- Equation of electronic assemblies.
- Diode modeling.
- Bipolar transistor modeling.

Introduction to embedded computing.
- Description of microcontrollers.
- General Purpose inputs / outputs.
- Analog inputs.
- Timers and PWM outputs.
- Periodic interrupts

Course material

J. Chiasson, Modeling and High-Performance Control of Electric Machines, IEEE series on Power engineering, Wiley-Interscience, ISBN 0-471-68449-X, 2005.

C. Le Trionnaire, J.-P. Picheny, Génie électrique vade-mecum d'électrotechnique, Ellipses -Technosup, ISBN13 : 978-2-7298-6101-8 2010.

P. Mayé, Moteurs électriques pour la robotique, Dunod, Techniques et Ingénierie, EAN13 : 9782100700363, 2013.

Albert Paul Malvino, David J. Bates, Principes d'électronique, Dunod, 2008, EAN13 : 9782100516131

P. Molinaro, A. Chriette, Électronique analogique : traitement des composants et circuits, éditions Ellipses Technosup, 2013, ISBN-13: 978-2729882273.

C. Valens, Maîtrisez les microcontrôleurs à l'aide d'Arduino, éditeur Publitronic-Elektor, 2013, ISBN-13: 978-2866611903.

F. Schaeffer, Programmation en C des microcontrôleurs RISC AVR, éditeur : ELEKTOR PUBLITRONIC, 2009, ISBN-13: 978-2866611699.

D. Patterson & J. Hennessy, Computer Organization and Design – ARM Edition, Morgan Kaufmann, 2017

Assessment

Collective assessment: EVC 1 (coefficient 0.5)

Individual assessment: EVI 1 (coefficient 0.5)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	14 hrs	10 hrs	12 hrs	0 hrs	2 hrs

Information systems [SSTEM_S6]

LEAD PROFESSOR(S): Morgan MAGNIN

Objectives

The goal of this course is to address the modeling and design of complex systems. The added value of engineers with general vocational training is their ability to understand the complexity of systems at the interface between different disciplines. To do that, the engineer has to be able to build a global, abstract and shareable view of the system he designs.

In particular, information systems are central to any kind of social or scientific structure (companies, schools, hospitals, etc.) - they deal with the development, use and management of an organization's infrastructure. An information system is literally a structured set of services, methods and tools that can answer questions relative to a specific organization or domain. Databases are one of the major underlying components of information systems: they store and process data as a permanent memory. Understanding the differences behind information systems, databases and Excel is thus crucial.

The course aims to develop skills in modeling and analysis of complex systems. It provides the essential knowledge in the field of information systems: design, deployment and their daily management. In such a context, databases require major attention. We present the main principles for modeling a system under the form of a database and give an introduction to relational algebra.

Finally, the course focuses on the legal issues surrounding information systems and databases: we give an overview of the European laws applying to such systems (with regard to data processing and rights resulting from the creation of databases, etc.)

Objectives of the course in terms of skills development:
- Knowing how to design a global, abstract and shareable view of a physical or logical system
- Mastering the manipulation of digital data:
- Acquiring data
- Structuring data
- Searching for information
- Presenting the results in summary form (reporting)
- Understanding the challenges of big data

- Applications to various industrial case-studies

Objectives of the course in terms of knowledge:
- Modeling language (physical or logical system)
- Query language
- Methodological approach
- Legal issues

Course contents

1) Modelling of complex systems
- System-oriented approach
- Modeling organizations
- Modeling languages (UML, SysML)
- Application to various industrial case-studies

2) Information Systems
- Introduction to information systems: link between IS and organization
- Design, modeling, deployment, operation
- Organization, methods and tools for a company
- Legal issues applicable to information systems and databases

3) Databases: relational algebra and modeling
▪ Manipulation of data models
▪ Introduction to SQL
▪ Towards the decision IS and Business Intelligence
▪ Presentation of the different “business” and challenges of information systems and databases in companies

Course material

- Course syllabus available on the school's online learning platform
- Alain Faisandier. Systems engineering. Conference at AIP-PRIMECA Congress. April 2011.
- Documentation from PostgreSQL. http://docs.postgresqlfr.org/
- SysML Open Source Specification Project. http://www.sysml.org/

Assessment

Collective assessment: EVC 1 (coefficient 0.5)

Individual assessment: EVI 1 (coefficient 0.5)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	12 hrs	14 hrs	10 hrs	0 hrs	2 hrs

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