Common Core

PROGRAMME
2022 - 2023

UNIVERSITÉ DE LYON

ÉCOLE CENTRALELYON

SUMMARY

SUMMARY

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COMMON CORE

MTH - Mathematics - S5

ANALYSE APPLIQUÉE

APPLIED ANALYSIS

Lecturers: Elisabeth MIRONESCU, Philippe MICHEL

| Lecturers : 14 | TC : 20.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

This course presents the basic tools of mathematical analysis necessary for the study of the models encountered in engineering and research.

Keywords : Mathematical analysis, integration, optimization, ordinary differential equations.

Programme

Notions of differential calculus. Optimization: free and bound extrema. Integration. Ordinary differential equations.

Learning outcomes

- Be able to study an optimization problem without or with constraint, existence of extremum, optimality conditions, Lagrange multipliers.
- Mastering integral calculus.
- Be able to study a system of differential equations (existence, elementary qualitative analysis).
- Knowing how to situate the degree of difficulty in the mathematical analysis of a problem.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

J. Saint Raymond, *TOPOLOGIE, CALCUL DIFFÉRENTIEL ET VARIABLE COMPLEXE.*, Calvage and Mounet, 2008
G. Allaire *ANALYSE NUMÉRIQUE ET OPTIMISATION.*, Editions de l'Ecole Polytechnique, Ellipses, 2005
S. Benzoni*CALCUL DIFFÉRENTIEL ET ÉQUATIONS DIFFÉRENTIELLES.*, Dunod, 2014

Assessment

Final mark = 80% Knowledge + 20% Know-how
Knowledge mark = 100% final exam + 0% continuous assessment
Know-how mark = 0% final exam + 100% continuous assessment

ANALYSE NUMÉRIQUE

NUMERICAL ANALYSIS

Lecturers: Laurent SEPPECHER, Grégory VIAL

| Lecturers : 12.0 | TC : 14 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

We will present basic numerical methods useful for engineering. Applications are given, which motivate the development of such methods, together with a systematic analysis of the accuracy.

Keywords : Approximation, linear systems, numerical integration, differential equations, optimisation.

Programme

- Linear systems, eigenvalues.
- Optimization, non-linear equation.
- Interpolation, numerical integration.
- Numerical approximation of ordinary differential equations.
- Discretization of linear partial differential equations.

Learning outcomes

- Identify the procedure of numerical simulation.
- Make a choice between different methods.
- Implement simple algorithms with Matlab.
- Combine several numerical methods.

Independent study

Objectifs : Learning basics, preparation of numerical simulations with Matlab.

Méhodes : Training exercises.

Core texts

A. QUARTERONI, R. SACCO, F. SALERI, *NUMERICAL MATHEMATICS*, Springer, 2006
J.RAPPAZ,M.PICASSO *INTRODUCTION À L'ANALYSE NUMÉRIQUE*, Presse polytecniques et universitaires romandes, 1998
G.ALLAIRE S.M. KABER*ALGÈBRE LINÉAIRE NUMÉRIQUE*, Ellipses, 2002

Assessment

valuation = 75% knowledge + 25% know-how (Knowledge = 100% final exam and know-how = 100% continuous assessment).

PROBABILITÉS STATISTIQUE

PROBABILITY THEORY AND STATISTICS

Lecturers: Marie-Christophette BLANCHET, Céline HARTWEG-HELBERT

| Lecturers : 14.0 | TC : 16.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

This first part of the course deals with the modelling with random variables. We introduce the notion of density. Some methods of probability calculus, approximations and asymptotic theorems are studied. A important part of the course is devoted to the numerical simulation with MATLAB. The second part of the course deals with statistics. The notions of estimators and tests are introduced. A chapter is devoted to linear regression.

Keywords : Probability law, random variables, gaussian vectors, Monte-Carlo method, estimators, biais, statistic tests, linear regression.

Programme

Probability : (1) Random Variables (2) Mean and variance (3) Random vectors (4) Random variables sequences- Asymptotic results- Monte-Carlo method.

Statistic : (5) Estimation (6) Estimation by confidence intervalle (7) Statistic tests(8) Linear regression

Learning outcomes

- Be able to compute probabilities.
- Be able to simulate random varaibles with Matlab
- Be able to estimate some parametres of law from data.
- Be able to construct and analyse a linear regression.

Independent study

Objectifs :

Méhodes : On moodle: QCM, Reminders, Exercises on discrete random variables
Exercises with solutions
Exams of the past years

Core texts

Gilbert SAPORTA, *PROBABILITÉS, ANALYSE DES DONNÉES ET STATISTIQUE.* , Technip, 2011
Jean-Pierre Lecoutre *STATISTIQUE ET PROBABILITÉS*, Coll. Eco Sup. Dunod, 2012
Mario Lefebvre*PROBABILITÉS, STATISTIQUES ET APPLICATIONS*, Presse Internationales Polytechnique, 2011

Assessment

Final mark = 75% Knowledge + 25% Know-how
Knowledge mark = 100% final exam
Know-how mark = 100% continuous assessment

MATHÉMATIQUES ADAPTÉES I : ANALYSE - ALGÈBRE

ADAPTED MATHEMATICS I : APPLIED ANALYSIS - ALGEBRA

Lecturers: Abdel-Malek ZINE, Hélène HIVERT

| Lecturers : 18.0 | TC : 20.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

We present basic tools for algebra and analysis : vector spaces, polynomials, orthogonalization, matrices and diagonalization, integration, differential calculus, optimization, ordinary differential equations

Keywords : Polynomials, Hilbert spaces, matrix diagonalization, integration, functional space, ODE, differential calculus, optimisation

Programme

Algebra : Polynomials. Hilbert spaces, euclidean spaces. Matrices, determinant. Eigenvalues, eigenvectors and applications.

Analysis : Recap and complements. Lebesgue's integration. Integration : theorems and functional spaces. Differential calculus and optimization. Ordinary differential equations.

Learning outcomes

- Be able to use the fundamental tools of algebra.
- Be able to justify the computation of an integral with several variables.
- Be able to determine the extrema of a function defined over R^d.
- Be able to determine qualitative properties of the solution of an ordinary differential equation

Independent study

Objectifs : Gain experience with exercises.

Méhodes : WIMS.

Core texts

C. Gasquet, P. Witomski, *ANALYSE DE FOURIER ET APPLICATIONS*, Masson, 1990
J.-M. Monier *MATHÉMATIQUES, MÉTHODES ET EXERCICES MP.* , Dunod, 2009
D. Fredon*MATHÉMATIQUES, RÉSUMÉ DU COURS EN FICHES MPSI-MP*, Vuivert, 2010

Assessment

Final mark = 75% Knowledge + 25% Know-how
Knowledge mark = 100% final exam
Know-how mark = 100% continuous assessment

MATHÉMATIQUES ADAPTÉES II : PROBABILITÉS STATISTIQUE

ADAPTED MATHS II : PROBABILITY THEORY AND STATISTICS

Lecturers: Céline HARTWEG-HELBERT, Marie-Christophette BLANCHET

| Lecturers : 14.0 | TC : 16.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

This first part of the course deals with the modelling with random variables. We introduce the notion of density. Some methods of probability calculus, approximations and asymptotic theorems are studied. A important part of the course is devoted to the numerical simulation with MATLAB. The second part of the course deals with statistics. The notions of estimators and tests are introduced. A chapter is devoted to linear regression.

Keywords : Probability laws, Random variables with density, numerical simulations, estimators, parametric tests, linear regression.

Programme

1) Random Variables (Probability, density, distribution function)
2) Mean, Variance
3 Random vectors
4) Asymptotic theorems
5) Estimators
6) Estimators with confidence intervals
7) Statistical tests
8) Linear Regression

Learning outcomes

- Doing some calculus with computers.
- Simulations with MATLAB.
- Be able to run numeric calculus to solve statistical inference problem.
- Be able to construct and analyse a linear regression.

Independent study

Objectifs : First steps in random simulation with MATLAB.

Méhodes : Exercises and previous tests.

Core texts

GilBErT SaPorTa. , *PROBABILITÉS, ANALYSE DES DONNÉES ET STATISTIQUE*, Technip, 2011
Jean-Pierre Lecoutre *STATISTIQUE ET PROBABILITÉS*, coll. Eco Sup. Dunod, 2012
Mario Lefebvre*PROBABILITÉS, STATISTIQUES ET APPLICATIONS.*, Presse Internationales Polytechnique, 2011

Assessment

Final mark = 75% Knowledge + 25% Know-how
Knowledge = 100% final exam
Know-how = 100% continuous assessment

COMMON CORE

ECS - Electrical energy and Systems Control - S5-S6

AUTONOMIE ECS

ACADEMIC SUPPORT ECS

Lecturers: Eric BLANCO, Arnaud BREARD

| Lecturers : 0.0 | TC : 4 | PW : 0.0 | Autonomy : 14 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Acquire additional knowledge in electrical energy courses and automatic linear processes by working autonomously around the use of software applications (Matlab or dedicated).

Keywords : Automatic, Electrical Engineering

Programme

Theme 1: linear Automatic, analysis of a physical device, modeling, synthesis of regulators
Theme 2: Electrical Engineering, magnetostatic, power electronics

Learning outcomes

- Being able to analyze a complex problem
- To be able to acquire specific knowledge in order to solve a problem.
- To implement the methods seen in the course.
- Analyze simulation results and make sense of them.

Independent study

Objectifs : To understand and implement yourself all approaches seen during teaching

Méhodes : A 2h classroom with teacher is scheduled so as to start properly the study.
Then all the work is done outside any scheduled classroom.
At the end of the semester a 20minute-individual discussion leads to an evaluation.

Core texts

, Editeur ouvrage 2
Auteur ouvrage 3

Assessment

Every student is evaluated during a 20minute-individual talking. According to random selection only one thematic (Automatic or Electrical Engineering) is considered.

ENERGIE ELECTRIQUE

ELECTRICAL ENERGY

Lecturers: Arnaud BREARD, Christian VOLLAIRE

| Lecturers : 12.0 | TC : 14.0 | PW : 4.0 | Autonomy : 0.0 | Study : 2.0 | Project : 0.0 | Language : FR

Objectives

Introduce students to the basic concepts implemented in electrotechnical systems. Particular emphasis is placed on the energy aspect. Methods and tools for analysis and design of electrical systems allow the understanding of the functioning of electrical equipment used in the production, transportation and utilization of electrical energy. For each topic, the course begins with an overview of industrial applications of everyday life in which the production, transportation, processing or use of electrical energy comes. Technological aspects and the orders of magnitude are discussed. The set aim, in teaching terms, is the acquisition of a global comprehension of the energy conversion systems that an engineer will meet in his professional and personal

Keywords : Maxwell's equations and the various simplifications, Conduction currents, displacement currents, propagation ; Behaviour of variables at the interfaces ; EM properties of the materials ; Ampere theorem, flow conservation ; Some models of complex structures ; Power electronic.

Programme

- Kirchhoff network.
- Three phase systems.
- Low frequency electromagnetism.
- Induction - application to transformer.
- Static conversion of electrical energy.

Learning outcomes

- Acquire knowledge about the main functions present in the energy conversion systems.
- Acquire knowledge about techniques which are associated for the energy conversion systems.
- Acquire knowledge about orders of magnitude and the specific vocabulary.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

F. de COULON et M. JUFFER, *INTRODUCTION À L'ÉLECTROTECHNIQUE, VOLUME 1*, EPFL DUNOD
A. FOUILLE *ELECTROTECHNIQUE À L'USAGE DES INGÉNIEURS*, DUNOD
M. BORNAND*ELECTROTECHNIQUE*, VUIBERT

Assessment

Theoretical note: Nth
Practical note: Ntp
Global note: 0.9*Nth+01*Ntp

AUTOMATIQUE LINÉAIRE

LINEAR CONTROL

Lecturers: Eric BLANCO, Anton KORNIIENKO

| Lecturers : 12 | TC : 14 | PW : 4 | Autonomy : 0.0 | Study : 2 | Project : 0.0 | Language : FR

Objectives

This course aims to identify the common features of any linear control problem: the choice of instrumentation, the expression of the specifications and the choice of the control structure. Analysis and resolution procedures are presented with pole placement (including RST control) and frequential analysis.

Keywords : Structure and Control laws, SISO Process, poursuit and regulation, reference model, pole placement, RST, frequential analysis

Programme

- Problematics
- From specifications to reference model
- Regulators implemetation
- Empirical methods
- Modelisation, a survey
- Pole placement design
- Frequential design

Learning outcomes

- To formulate a control problem from its specifications
- To predict process temporal behaviour from poles position
- To elaborate a mere control law allowing pole placement ou frequential properties
- To implement a numerical regulatorf from his continous transfer

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Philippe de LARMINAT, *ANALYSE DES SYSTÈMES LINÉAIRES*, Editions Hermès, 2002
Philippe de LARMINAT *AUTOMATIQUE, COMMANDE DES SYSTÈMES LINÉAIRES*, Editions Hermès, 1993
L. MARET*RÉGULATION AUTOMATIQUE*, Presses Polytechniques Romandes, 1987

Assessment

Final mark = 90% Knowledge + 10% Know-how (Knowledge = 80% final exam + 10% TD preparation + 10% microtest / Know-how = TP + synthesis classroom)

RÉGULATION ET ENTRAÎNEMENT ÉLECTRIQUE

ELECTRIC DRIVE CONTROL

Lecturers: Ayyoub ZOUAGHI, Giacomo CASADEI

| Lecturers : 0.0 | TC : 0.0 | PW : 4.0 | Autonomy : 0.0 | Study : 4.0 | Project : 0.0 | Language : FR

Objectives

The objective of this activity is to show the concepts and technological aspects of an automated process involving an electric power drive. Through BE and TP sessions, students are encouraged to think about solutions and carry out studies to meet the specifications of a system representative of a large number of industrial applications.

Keywords : Regulation, correctors, power electronics converters, direct current motor

Programme

- 2 hours of problem analysis (BE).
- 4 hours of experimental work on one of the two themes : control and electrical engineering (TP).
- 2 hours of capitalization and oral feedback in front of the other part of the group and a teacher (BE).

Learning outcomes

- Know how to distinguish the different subsystems of an automated process and those of power, of an electric drive.
- Be able to identify the setpoint, command and disturbance quantities.
- Be able to associate in the control-process chain, actuator, sensor and regulator.
- Know how to choose the structure and parameters of the necessary control law.

Independent study

Objectifs : Preparation of the oral presentation.

Méhodes : Construction of visual supports and associated explanations.

Core texts

Assessment

Final mark = 100% know-how
Know-how = 100% continuous assessment

COMMON CORE

FLE - Fluids and Energy - S5-S6

FLUIDES ET ENERGIE - CONCEPTS ET APPLICATIONS

FLUIDS AND ENERGY - CONCEPTS AND APPLICATIONS

Lecturers: Pierre DUQUESNE, Ariane EMMANUELLI

| Lecturers : 22.0 | TC : 16.0 | PW : 4.0 | Autonomy : 8.0 | Study : 0.0 | Project : 0.0 | Language : MI

Objectives

This teaching component (AF) introduces the whole FLE (Fluids & Energy) teaching unit (UE) through a hands-on exploration of flow physics and presents next the key concepts of fluid mechanics and heat transfers

Keywords : Discovery of fluid mechanics, fundamental governing equations, simplifying frameworks

Programme

- Kinematics and fundamental laws
- Newtonian viscous fluid
- Reynolds number
- Flow regimes and flow features as a function of the Reynolds number
- Turbulent flows
- Energy, thermodynamics and compressible flows
- Vorticity and introduction to aerodynamics
- Heat transfer Mixtures

Learning outcomes

- Be able to describe the fundamental laws of fluid flows and heat transfers and their various levels of approximation.
- Be able to identify the main flow features and flow regimes.
- Be able to perform a dimensional analysis and an order of magnitude analysis for a boundary problem.
- Know the basics of continuous flux systems and head balances.

Independent study

Objectifs : Illustration of key concepts.
Training on report writing and result formatting.

Méhodes : 2 TD (2 x 2h) : Exercices
1 TP (2h) : Training document + 5-page laboratory report writing

Core texts

E. Guyon, J.-P. Hulin, L. Petit., *HYDRODYNAMIQUE PHYSIQUE.* , CNRS Editions, EDP Sciences., 2012
G. K. Batchelor *AN INTRODUCTION TO FLUID DYNAMICS.* , Cambridge University Press, 1967
C. Bailly & G. Comte-Bellot*TURBULENCE.*, Springer, 2015

Assessment

Final mark = 60% Knowledge + 40% Know-how
Knowledge = 100% final exam
Know-how = 100% continuous assessment

FLUIDES ET ENERGIE - MÉTHODES EXPÉRIMENTALES ET NUMÉRIQUES

FLUIDS AND ENERGY - EXPERIMENTAL AND NUMERICAL METHODS

Lecturers: Pierre DUQUESNE, Andrea MAFFIOLI, Didier DRAGNA

| Lecturers : 0.0 | TC : 0.0 | PW : 8.0 | Autonomy : 4.0 | Study : 6.0 | Project : 0.0 | Language : FR

Objectives

This teaching activity presents experimental and numerical methods in fluid mechanics, and the approach to be adopted for their practical implementation.

Keywords : Experimental protocal, Measurement techniques, Numerical simulation, Comparison model/experiment, Uncertainties

Programme

- Practical work on flow speed measurement in a jet
- Practical work on Bernoulli or Air treatment
- 4 BE sessions on a practical introduction to numerical simulation in fluid mechanics

Learning outcomes

- Know how to make use of experimental and numerical methods in fluid mechanics and energetics.
- Know how to design an experimental protocol to characterize a phenomenon.
- Know how to present the results of simulations or experiments.
- Know how to compare a model and measurements.

Independent study

Objectifs : Getting started with a numerical simulation software in fluid mechanics.
Exploitation of results from numerical simulation.

Méhodes : Use of the commercial software FLUENT.
Simulations performed under supervision during the three first BE and autonomously in the last BE.

Core texts

Assessment

Final mark = Know-how
Know-how mark = continuous assessment

FLUIDES ET ENERGIE - ETUDES THÉMATIQUES

FLUIDS AND ENERGY - PROJECT LABS

Lecturers: Pierre DUQUESNE, Alexis GIAUQUE, Michel GERON

| Lecturers : 0.0 | TC : 0.0 | PW : 9.0 | Autonomy : 7.0 | Study : 6.0 | Project : 0.0 | Language : FR

Objectives

This module aims at applying all the knowledge and know-how acquired throughout the whole "Fluid Mechanics and Energy" course. From the choice of a topic and the set-up of the relevant practical work sessions, to the presentation of the results, going through performing and interpreting the experiments, the students will have to illustrate a scientific theme (head losses, similarity, heat transfer, hydraulic networks, ...) in order to deliver both an oral presentation to fellow students and a written report.

Keywords : Experiments and numerical simulations. Team work and project mode

Programme

- Defining the project and setting-up of the practical work sessions
- Performing the experiments
- Post-processing and analysing the results
- Oral and written reporting

Learning outcomes

- Be able to identify key flow features and flow regimes
- Be able to perform a dimensional and an order of magnitude analysis
- Be able to apply fundamental tools on flow analysis : flux balance, head loss analysis
- Be able to apply experimental and numerical techniques

Independent study

Objectifs : Performing the measurements, post-processing and analysing the results

Méhodes : 1h during each practical work session.
2h devoted to post-processing and analysis.

Core texts

Assessment

The work carried out in FLEtc3 is evaluated by a note which is based on
• Oral synthesis: Noral.
• The project report: Nreport.

COMMON CORE

INF - Computer Science - S5-S6

ALGORITHMES ET STRUCTURES DE DONNÉES

ALGORITHMS AND DATA STRUCTURES

Lecturers: Romain VUILLEMOT

| Lecturers : 8.0 | TC : 17.0 | PW : 0.0 | Autonomy : 5.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The objective of this course is to introduce the fundamentals of algorithms and data structures, necessary for students who intend to become engineers. Students will be introduced to the analysis of problems, the design and implementation of algorithms but also to their applications in the industry, through lectures, practical sessions and a business opening. practical work sessions and a business opening. The concepts covered will be implemented in the Python language.

Keywords : algorithmic, data structures, problem solving, algorithm implementation, complexity complexity

Programme

- Data structures.
- Introduction to complexity.
- Sorting algorithms.
- Graph algorithms.
- General paradigms and examples: divide and conquer, dynamic programming, gluttonous algorithms algorithms, heuristics.

Learning outcomes

Independent study

Objectifs : Understand and assimilate the course concepts implemented in the TDs.

Méhodes :

Core texts

T. H. Cormen, C. E. Leiserson, R. L. Rive, *INTRODUCTION TO ALGORITHMS*, The MIT Press and McGraw-Hill Book Company, 2001., 2009

Assessment

CONCEPTION ET PROGRAMMATION OBJET

OBJECT-ORIENTED DESIGN AND PROGRAMMING

Lecturers: Emmanuel DELLANDREA

| Lecturers : 8.0 | TC : 17.0 | PW : 0.0 | Autonomy : 5.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The goal is to provide students with a basic knowledge of the design and development of programs using the object approach. These notions will be implemented through the Python language for programming and UML for modelling. The traditional lectures are limited in order to favour a practical approach in the form of programming exercises and short projects, some of which are evaluated.

Keywords : Object programming, object-oriented design, Python programming language

Programme

- Object-oriented design: Classes and instances. Encapsulation, attributes, methods. Aggregation, composition. Inheritance and polymorphism. Operator overloading.
- Implementing concepts in Python.
- Development of graphical interfaces.

Learning outcomes

- Know how to establish an object-oriented model of a computer application.
- Know how to use the UML formalism.
- Know how to implement an object model using the Python language.
- Know how to implement an IT project, and write a report.

Independent study

Objectifs : To understand and deepen the course concepts implemented during practical works.

Méhodes : Q&A sessions with teachers following the practical works to help with the completion of homework assignments.

Core texts

Bertrand Meyer, *CONCEPTION ET PROGRAMMATION ORIENTÉES OBJET.*, Eyrolles, 2008
Delannoy Claude *S'INITIER À LA PROGRAMMATION ET À L'ORIENTÉ OBJET.*, Eyrolles, 2016
Pascal Roques, Franck Vallée*UML 2 EN ACTION : DE L'ANALYSE DES BESOINS À LA CONCEPTION*, Eyrolles, 2007

Assessment

Grade = 50% knowledge + 50% know-how
Knowledge grade = 100% final exam
Know-how grade = 100 % Average of 2 reports

PROJET D'APPLICATION WEB

PRACTICAL IT PROJECT

Lecturers: Daniel MULLER, René CHALON

| Lecturers : 8.0 | TC : 10.0 | PW : 0.0 | Autonomy : 12.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The objective of this lecture is to put into practice the notions and skills introduced by the other lectures of Computer Science, in the framework of a group project based on the design and development of a web application. The architecture of this application will be based on a dynamic web interface, and a service developed in Python on the server side.
The project will concern the whole application: data model, server, user interfaces (GUI) and client-server interactions.

Keywords : WebApp, Webservice, client-server architecture, HTML5, CSS3, Javascript, Ajax, JSON, Python, SQL.

Programme

- Web development context and tools.
- Data model.
- Client-server architecture and application protocol.
- Principle of a server.
- User interfaces.

Learning outcomes

- Master the basic tools and languages for web programming (HTML, CSS, Javascript).
- Understanding client-server architecture based on web services.
- Know how to do software testing.
- Master the specific characteristics of IT project management (versioning).

Independent study

Objectifs : Design, development and testing of an application

Méhodes : The students are divided into project groups of 4 to 5 people. They have to write a specification, deliver a functional and tested application, and perform the acceptance test of an application made by a competing group.

Core texts

Ben Frain, *RESPONSIVE WEB DESIGN WITH HTML5 AND CSS: DEVELOP FUTURE-PROOF RESPONSIVE WEBSITES USING THE LATEST HTML5 AND CSS TECHNIQUES, 3RD EDITION*, Packt, 2020
David Flanagan *JAVASCRIPT: MASTER THE WORLD'S MOST-USED PROGRAMMING LANGUAGE*, O'Reilly, 2020
Leonard Richardson*RESTFUL WEB APIS: SERVICES FOR A CHANGING WORLD*, O'Reilly,

Assessment

Final mark = 50% knowledge + 50% know-how (Knowledge = 100% final exam and know-how = 100% project deliverables).

COMMON CORE

SEM - Economics and management S5

ECONOMIE GÉNÉRALE

INTRODUCTION TO ECONOMICS

Lecturers: Laure FLANDRIN

| Lecturers : 18.0 | TC : 10.0 | PW : 0.0 | Autonomy : 4.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Understanding the contemporary economic world as an interlocking set of crises:
- Understanding the dysfunction of capital and labour markets.
- Understanding the global crisis of inequality.
- Understanding the global crisis of ecosystems.

Keywords : Capitalism; Crises; Growth instability; Secular stagnation; Financial instability; Unemployment; Inequality; Globalisation; Innovations; Negative externalities; Carbon prices; Regulation; Pollution rights market.

Programme

Three main parts:
- Crises of capitalism: capital and labour markets in turmoil
- Crisis of globalisation and inequality
- Global crisis of ecosystems: markets for pollution rights, carbon tax, research subsidies

Learning outcomes

- C2I3 Thinking and acting in an unpredictable and uncertain environment.
- C5N2 Making sense.

Independent study

Objectifs : No

Méhodes :

Core texts

Michel Aglietta, *CAPITALISME. LE TEMPS DES RUPTURES*, Odile Jacob, 2019
Olivier Blanchard, Daniel Cohen et David Johnson *MACROÉCONOMIE*, Pearson, 2013

Assessment

Literature review with questions.

GESTION D'ENTREPRISE

ENTERPRISE MANAGEMENT

Lecturers: **Sylvie MIRA**

| Lecturers : 14.0 | TC : 14.0 | PW : 0.0 | Autonomy : 4.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The course is designed to provide students with the fundamentals of accounting , finance and cost management.

Keywords : Accounting, finance , cost management

Programme

- Accounting: data recording and design of final documents (balance sheet and P&L).
- Finance: analysis of accounting data and financial diagnosis.
- Cost management: costs and breakeven.
- Business game.

Learning outcomes

- Know how to read and interpret accounting documents.
- Know how to prepare financial documents and analyse them.
- Know how to calculate a cost and a break-even point.

Independent study

Objectifs : Get additional knowledge.

Méhodes : Learning on an digital platform.

Core texts

FRIEDRICH Jean-Jacques, *COMPTABILITÉ GÉNÉRALE ET GESTION DES ENTREPRISES*, Hachette, 2021
NICOLAS Franck *FINANCE POUR NON-FINANCIERS*, Dunod, 2016
DUBRULLE Louis, JOURDAIN Didier, SERVAN Roger*COMPTABILITÉ ANALYTIQUE DE GESTION PARUTION*, Dunod, 2013

Assessment

Quiz on e-learning platform, business game score, individual exam.

COMMON CORE

STI - Information Science and Engineering - S5-S6

AUTONOMIE STI

AUTONOMY

Lecturers: Ian O CONNOR, Alberto BOSIO, Julien HUILLERY

| Lecturers : 0.0 | TC : 0.0 | PW : 0.0 | Autonomy : 12.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The autonomous work of UE STI aims to facilitate the assimilation of concepts learned during the courses of Electronic Systems (AF STItc1) and Signal Processing (AF STItc2).
Through the theoretical study of methods to answer a given problem and their implementation in a simulation environment, the objective is to introduce students to a fundamental professional practice in engineering sciences.

Keywords : Theoretical analysis, Simulation, LTSpice, Matlab-Simulink

Programme

1- Regarding Electronic Systems, the autonomous work consists of the study in simulation - with the help of the LTSPICE software - of systems treated on paper during the tutorial sessions. This work is done in the first part of the semester, as the tutorials progress.
2- Regarding Signal Processing, the autonomous work consists of a mini-project where it is asked to fully study a method allowing to answer a given problem. The work goes from the theoretical study of this method to its validation in simulation under Matlab-Simulink and mobilizes all the knowledge and know-how acquired during the supervised sessions. It is carried out in the second part of the semester.

Learning outcomes

- Understand proposed methods for solving a problem.
- Know how to implement these methods with a simulation tool.
- Know how to analyse simulation results.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Assessment

Final mark = 100% know-how
Know-how = 100% final exam

SYSTÈMES ÉLECTRONIQUES

ELECTRONIC SYSTEMS

Lecturers: Ian O CONNOR, Alberto BOSIO

| Lecturers : 14.0 | TC : 14.0 | PW : 6.0 | Autonomy : 2.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The evolution of electronic systems is linked to Moore's Law according to which the complexity of integrated circuits doubles every eighteen months. In order to be able to grasp the complexity of current systems and understand their evolution, it is necessary to know the basics of electronic technology.
The objective of the "Electronic systems" course is therefore to provide the engineering student with the scientific and technological bases necessary for the understanding of the functioning of electronic systems and their evolution as well as for the design of complex systems composed of circuits for processing information represented as analog as well as digital signals.

Keywords : PN junction, CMOS transistor, analog circuits, digital circuits, processors.

Programme

- Introduction to electronics
- MOS transistor
- High frequency modelling, presentation of the CMOS amplifier
- Detailed study of the MOS inverter
- Digital circuits, combinatorial logic. Boolean algebra and Karnaugh tables. Digital circuits, sequential logic
- Microprocessor architecture

Learning outcomes

- Be able to understand the scope of the field of electronics: from device to processor.
- To be able to describe the evolution of microelectronic systems.
- Know how to identify circuit design methods and techniques.

Independent study

Objectifs : Learn more about the topics covered in tutorials (TD).

Méhodes : Perform electrical simulations with a reference simulator (LTSPICE) to analyse the operation of devices and circuits.

Core texts

Rousseau Eric, *PSPICE : MÉTHODOLOGIE D'UTILISATION ET TECHNIQUES AVANCÉES*, DL, 2007
Dusausay Serge *COMPRENDRE L'ÉLECTRONIQUE PAR LA SIMULATION : 43 CIRCUITS SIMULÉS & RAPPELS DE COURS*, DL, 2000
Poitevin Jean-Marc*ÉLECTRONIQUE ANALOGIQUE ET NUMÉRIQUE : AIDE-MÉMOIRE* , DL, 2008

Assessment

Final mark = 90% Knowledge + 10% Know-how
Knowledge mark = 100% final exam
Know-how mark = 50% TP1 report + 50%TP2 report

TRAITEMENT DU SIGNAL

SIGNAL PROCESSING

Lecturers: Julien HUILLERY, Gérard SCORLETTI

| Lecturers : 12.0 | TC : 14.0 | PW : 4.0 | Autonomy : 2.0 | Study : 2.0 | Project : 0.0 | Language : FR

Objectives

Signal processing consists of all the techniques used to describe the acquisition, storage, modification, coding and transmission of information. Faced with the mass of the signals that need to be processed, often in real time, technological systems of great complexity have invaded our society. In response to current challenges, powerful scientific methods have been developed to manage such complexity. The mastery of these methods becomes inescapable in the practice of the engineer whatever the field to which it is destined. The objective of this course is to present the preliminary bases for the acquisition and mastery of these methods and to illustrate them by their application.

Keywords : Deterministic and random signals, Analog and digital signals, Time domain and frequency domain analysis, Fourier and Laplace transforms, Analog and digital filtering, Sampling, Fast Fourier transform, Signal models

Programme

1) Modelling and characterizing a signal: time domain and frequency domain analysis
2) Modelling and characterizing a system: convolution and filtering
3) Autocorrelation and intercorrelation for deterministic signals
4) From analog signals to digital signals
5) Digital Filtering
6) From deterministic signals to random signals

Learning outcomes

- Be able to analyse a signal in the time and frequency domains.
- Be able to sample a signal.
- Be able to design analog and digital filters.
- Be able to model a signal.

Independent study

Objectifs : Follow an engineering approach by mobilizing knowledge and know-how acquired during the AF.

Méhodes : Solve a practical and original signal processing problem by applying the numerical methods and tools acquired during the course.

Core texts

G. Scorletti, *TRAITEMENT DU SIGNAL*, Polycopié de cours, SDEC – École Centrale de Lyon, 2021
E. Tisserand, J.F. Pautex et P. Schweitzer *ANALYSE ET TRAITEMENT DES SIGNAUX*, Sciences sup. Dunod, 2004
E.W. Kamen et B.S. Heck*FUNDAMENTALS OF SIGNALS AND SYSTEMS WITH MATLAB*, Pearson Prentice Hall, 2007

Assessment

Final mark = 90% knowledge + 10% know-how
Knowledge = 80% final exam + 20% continuous assessment
Know-how = 100% continuous assessment

CONVERSION A/N POUR LES SYSTÈMES AUDIO

ANALOG TO DIGITAL CONVERSION

Lecturers: Cédric MARCHAND, Laurent BAKO

| Lecturers : 0.0 | TC : 0.0 | PW : 4.0 | Autonomy : 0.0 | Study : 4.0 | Project : 0.0 | Language : FR

Objectives

Through the study of analog-digital conversion, this AF illustrates the complementarity of electronics and signal processing for the design of information management systems. The operation, simulation and then realization of an analog-digital converter "Sigma-Delta" will be studied. This converter has an excellent behaviour with respect to the quantization error inherent to the analog-to-digital conversion. These good performances justify its important use in the audio field for consumer applications such as CD recorders. In this AF, we focus on highlighting the link between the theoretical and technical aspects that accompany the design of an electronic system.

Keywords : Analog-to-digital conversion, electronic systems, Sigma-Delta modulator, digital signal, quantization, signal-to-noise ratio, filtering

Programme

- 1st session (BE 2 h): uniform conversion (Presentation of analogue / digital conversion; Principle and properties of uniform analog / digital conversion; Practical Activity (1h): Simulation and study of a uniform converter with matlab)
- 2d session (BE 2 h): Conversion Sigma-Delta (Principle and properties of the Sigma-Delta converter; Practical Activity (1h): Simulation and study of a Sigma-Delta converter under matlab / simulink)
- 3d session (TP 4 h): Electronic realization of a Sigma-Delta modulator (Design of the electronic circuit carrying out a Sigma-Delta modulation; Observation and analysis of signals in the space of time and frequency)

Learning outcomes

- Know how to describe the theoretical principle of the Sigma-Delta converter.
- Be able to conduct a simulation of the system under Matlab-Simulink.
- Being able to design an electronic circuit making a Sigma-Delta modulator.
- Be able to analyse signals in time and frequency.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Sangil Park., *PRINCIPLES OF SIGMA-DELTA MODULATION FOR ANALOG-TO-DIGITAL CONVERTERS.*, Rapport Technique Motorola APR8.
Joshua Reiss *UNDERSTANDING SIGMA–DELTA MODULATION: THE SOLVED AND UNSOLVED ISSUES.* , Journal of the Audio Engineering Society, 2008

Assessment

Final mark = 100% Know-how
Know-how mark = 100% continuous assessment

COMMON CORE

GM - Mechanical engineering - S6

GÉNIE MÉCANIQUE TECHNOLOGIE-MÉCANIQUE GÉNÉRALE-RDM

MECHANICAL ENGINEERING

Lecturers: Christophe JANOLIN, Damien CONSTANT, Emmanuel RIGAUD, Hélène

| Lecturers : 18.0 | TC : 22.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The aim of this module is to study the technical design, dimensioning and realization of a mechanical system, as well as the study of its functioning. The first part allows the students to understand the architecture of a mechanical system from the description of the connections between the parts and to define the toleranced geometry of the functional surfaces. The second part allows the students to establish the equations of motion of a system of rigid bodies, using a Newtonian or a Lagrangian approach based on the principle of virtual powers. The third part makes it possible to dimension thin deformable structures as beams, according to stresses and displacements criterion, starting from the internal forces induced by the loading and the reactions to the

Keywords : Effects and connections, Functional dimensioning, Analytical mechanics, Principle of virtual powers, Lagrange equations, Beam theory, Sizing : stresses, strains, and displacements

Programme

- Mechanical technology: Efforts and connections in mechanical systems. Functional specifications and product definition. Obtaining parts by machining using cutting tools.
- General and analytical mechanics of rigid solids systems: Description of the movement, fundamental principle, principle of the virtual powers (PVP), hypotheses of the model. PVP for a single solid, definition of different torsors, kinetic energy theorem. PVP for a system of solids, schematization of the connections, equations of Lagrange. Discussion on the limitations of the model.
- Strength of materials: Definition, schematization of a beam and model hypotheses. Elastic dimensioning. Constitutive relation.

Learning outcomes

- To know how to analyse the architecture of a mechanical system and its geometrical description from the technical drawings.
- To know how to design a mechanical system an define its functional tolerancing that respect the conditions of good functioning.
- To be able to analyse the dynamic behaviour of a rigid solids system.
- To know how to dimension a slender piece subjected to static loading.

Independent study

Objectifs : Understanding and assimilating the course.

Méhodes : Exercises complementary to the tutorials available online, to be solved in self-evaluation (DidacTest).
Corrected exercises available on teaching server.

Core texts

Trotignon J.P., *PRÉCIS DE CONSTRUCTION MÉCANIQUE TOMES 1 ET 2*, Nathan, 2007
Brousse P. *MÉCANIQUE ANALYTIQUE*, Vuibert, Paris, 1981
Timoshenko S.P.*RÉSISTANCE DES MATÉRIAUX, TOMES 1 ET 2*, Dunod, Paris, 1990

Assessment

Final mark = 100% Knowledge
Knowledge mark = 84% final exam + 16% continuous assessment

ACTIVITÉS PRATIQUES DE GÉNIE MÉCANIQUE

TECHNOLOGY ANALYSIS & PRODUCT DEVELOPMENT

Lecturers: Bertrand HOUX, Hélène MAGOARIEC, Olivier DESSOMBZ

| Lecturers : 0.0 | TC : 0.0 | PW : 20.0 | Autonomy : 0.0 | Study : 10.0 | Project : 0.0 | Language : FR

Objectives

The objective of the training action is to put into practice (know-how) the skills of the GM Teaching Unit. The objective of the technological product development project is to implement all the stages of design, manufacture and control of the geometric conformity of the components of a mechanical system. The other practicals aim to analyze the architecture of a real mechanical system, to carry out a performance diagnosis, according to the external stresses and the technological elements used to make the connections between solids or to put the system into action.

Keywords : Architecture of a mechanical system; Building elements; Design; Manufacturing; Metrology; Elastic sizing; Performance diagnostics.

Programme

- Discovery lab program - Technological analysis (4h)
- BE drawing - Technological project (2h)
- BE quotation - Technological project (4h)
- BE manufacturing - Technological project (2h)
- BE machining range - Technological project (4h)
- Machining TP - Technological project (4h)
- Dimensional metrology practical work - Technological project (4h)
- Design work in RdM (4h)
- Dynamic lab (4h)

Learning outcomes

- Knowing how to analyze the architecture of a mechanical system.
- Master the stages of design and manufacture of a mechanical system.
- To be able to control the geometric conformity of a mechanical system.
- To be able to diagnose the performance of a mechanical system.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Trotignon J.P., *PRÉCIS DE CONSTRUCTION MÉCANIQUE TOMES 1 ET 2*, Nathan, 2007
Brousse P. *MÉCANIQUE ANALYTIQUE*, Vuibert, Paris, 1981
Timoshenko S.P.*RÉSISTANCE DES MATÉRIAUX, TOMES 1 ET 2*, Dunod, Paris, 1990

Assessment

Final mark = 100% know-how
Know-how mark = 100% continuous assessment.

MODÉLISATION ET CONCEPTION

MECHANICAL DESIGN

Lecturers: Olivier DESSOMBZ, Francesco FROIIO

| Lecturers : 4.0 | TC : 4.0 | PW : 0.0 | Autonomy : 0.0 | Study : 12.0 | Project : 0.0 | Language : FR

Objectives

Give more advanced notions on the mechanics of solids and structures, having a direct link with applications.

Keywords : Dimensioning, truss, static, dynamic

Programme

- Course 1 and TD 1: Calculation of isostatic and hyperstatic lattices. Buckling.
- Course 2 and TD 2: Small movements in vibration. Clean modes, free response and forced response.
- Design office 1 and 2: Calculation of the coverage of a gymnasium (static sizing and dynamic analysis)

Learning outcomes

- Apply the concepts of structural statics to the design of a truss.
- Apply the concepts of structural dynamics to the design of a truss.
- Use digital calculation platforms (Matlab, Scilab) for the analysis of structures.
- Report on the static and dynamic analysis of a structure.

Independent study

Objectifs : Finalize the work of the design office.

Méhodes : Group work: case study and report writing.

Core texts

Assessment

Score = 100% know-how
Know-how score = 100% continuous assessment

CONCEPTION DE MÉCANISME

MECHANICAL DESIGN

Lecturers: Didier LACOUR

| Lecturers : 4.0 | TC : 4.0 | PW : 0.0 | Autonomy : 0.0 | Study : 12.0 | Project : 0.0 | Language : FR

Objectives

Knowledge and dimensioning of power transmission elements, particularly those used in ground transport, understand their operation and analyse their performance.

Keywords : power transmission, gearbox, vehicle, hydraulics transmission

Programme

- Elements of technology for power transmission.
- Epicyclic trains and applications.
- Gearboxes and drives.
- Hydraulics transmissions.
- Hybrid vehicle architectures.
- Three 4h studies: Analysis of the operation of a DSG7 gearbox. Simulation of the operation of a gearbox and a DPC differential (with Catia software and applications). Analysis of the power transmission system of a 4x4 vehicle

Learning outcomes

- Be able to perform functional analysis of a mechanical transmission system.
- Be able to analyse and simulate the operation of a mechanical transmission system

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Esnault F., *CONSTRUCTION MÉCANIQUE, TOME 1*, Dunod, 2009
Esnault F. *CONSTRUCTION MÉCANIQUE, TOME 2*, Dunod, 2009
Esnault F.*CONSTRUCTION MÉCANIQUE, TOME 3*, Dunod, 2009

Assessment

Final mark = 100% Know-how
Know-how mark = 100% continuous assessment

COMMON CORE

IDM - Materials Engineering - S6

DE LA MATIÈRE AUX MATÉRIAUX : STRUCTURE ET PROPRIÉTÉS

FROM MATTER TO MATERIALS: STRUCTURE AND PROPERTIES

Lecturers: Bruno BERTHEL

| Lecturers : 8.0 | TC : 32.0 | PW : 0.0 | Autonomy : 6 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

This module introduces a basis grounding on the materials currently used , on their structures and properties as well as the characterization methods. In particular, the approach used will underline the relation between the properties (mechanical and physical) and the structure of the material at a relevant scale (from nano to macroscopic). This knowledge will enable the student to propose well-considered selection of materials in relation to the elaboration and manufacturing processes for a given application. Practical work (IDM tc2) completes this teaching.

Keywords : Mechanical behaviour of materials (elasticity, plasticity, fracture, fatigue, creep), crystallography, heat treatment, metallic alloys, glasses, polymers, composites, solid state physics, electrical conductivity.

Programme

General introduction to materials engineering (2h Lec.). | Chapter 1: Materials: mechanical properties, structure (10h TC and 2h Aut.) : mechanical behavior ont the macroscopic scale ; Interatomic bonds, structure and defects ; relation between mechanical properties and structure/defects. | Chapter 2: Families of materials: elaboration, modification of properties (2h lec., 14h TC and 2h Aut.) : Metals and metal alloys ; Polymers; Ceramics and inorganic glasses; Composites. | Chapter 3: Physical properties of materials (4h lec., 8h TC and 2h Aut.) : From Drude's model to Sommerfeld's free electron theory ; Nearly free electron model ; Electrical, thermal conductivity and magnetic properties of materials.

Learning outcomes

- To know the main families of materials and their specificity
- To know the materials processes and manufacture
- Be able to use the mechanical constitutive laws of materials (elasticity, plasticity, fracture)
- Know the physical properties of materials

Independent study

Objectifs : Acquisition and oral restitution of knowledge, situational exercises and problem-solving.

Méhodes : Personal and group work:
- Chapters 1 and 2: reading documents and doing exercises.
- Chapter 3: preparing an exercise and presentation during a tutorial

Core texts

J.-P. Baïlon et J.-M. Dorlot., *DES MATÉRIAUX*, Presses internationales polytechnique Montréal, 2002
M. Ashby et D. Jones. *MATÉRIAUX (TOMES 1 ET 2)*, Edition Dunod, 2008
C. Kittel*PHYSIQUE DE L'ÉTAT SOLIDE*, Edition Dunod, 2007

Assessment

Final mark = 100% Knowledge
Knowledge mark = 90% final exam + 10% continuous assessment

TRAVAUX PRATIQUES EN SCIENCE ET GÉNIE DES MATÉRIAUX ET DES SURFACES

PRACTICAL COURSES IN MATERIAL AND SURFACE SCIENCE

Lecturers: Bruno BERTHEL, Clotilde MINFRAY, Gaylord GUILLONNEAU, Michelle

| Lecturers : 0.0 | TC : 0.0 | PW : 32.0 | Autonomy : 12 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The practical work of the IDM course provides the practical insight essential to the engineer's training and completes the notions developed in the course, relating to the three main families of construction materials: metals, polymers and ceramics. These practical exercises are grouped according to four themes: "Mechanical Behaviour of Materials", "Tribology and Surfaces", "Heat Treatment of Metal Alloys" and "Polymers and Composites".

Keywords : Mechanical behaviour of materials, tribology, heat treatment, metallic alloys, glasses, polymers and composites

Programme

Objectives (8h PW and 3h Aut. Per PW) : (i) Mechanical Behaviour of Materials: to introduce and practice the most commonly used tests to access the properties and mechanical behaviour materials. (ii) Tribology and Surfaces: to address, through a practical approach, some simple problems of wear and lubrication in a multidisciplinary framework combining mechanics, materials science and surfaces. (iii) Heat Treatment of Metal Alloys: to establish the relationships between chemical composition, heat treatment, microstructure and mechanical properties. (iv) Polymers and Composites: acquire knowledge of the processing of polymers and composites and then make the link between the process and the properties of the material.

Learning outcomes

- Know how to predict the mechanical properties of materials and their structures according to thermo-mechanical treatments
- Know how to identify the elaboration and treatment processes to adapt the properties of materials to a specification
- Know how to identify the relevant scale for a given property
- Be able to explain the basic principles of tribology (friction, wear, lubrication)

Independent study

Objectifs : Acquisition and oral restitution of knowledge, situational exercises and problem solving.

Méhodes : Personal and teamwork: reading documents, using databases, writing reports.

Core texts

J. Barralis, G. Maeder, *PRÉCIS DE MÉTALLURGIE*, Précis Afnor-Nathan, 2005
A. Dobraczinsky, M. Piperaud, J.-P. Trotignon, J. Verdu *PRÉCIS DE MATIÈRES PLASTIQUES*, Précis Afnor-Nathan, 2006
J.-P. Baïlon et J.-M. Dorlot*DES MATÉRIAUX*, Presses internationales polytechnique Montréal, 2002

Assessment

Final mark = 100% Know-how
Know-how mark = average of practical works maks

COMMON CORE

MSS - Solids Mechanics and Structures - S6

MÉCANIQUE DES SOLIDES DÉFORMABLES

CONTINUUM MECHANICS OF SOLIDS

Lecturers: Jean-Jacques SINOU, Fabrice THOUVEREZ

| Lecturers : 16.0 | TC : 14.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Keywords :

Programme

Learning outcomes

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

J. Salençon., *MÉCANIQUE DES MILIEUX CONTINUS – TOME 1.* , Ed. de l'Ecole Polytechnique, 2005
M. Géradin, D. Rixen. *THÉORIE DES VIBRATIONS – APPLICATION À LA DYNAMIQUE DES STRUCTURES*, Elsevier Masson, 1999
G. Dhatt, G. Touzot, E. Lefrançois.. *MÉTHODE DES ÉLÉMENTS FINIS*, Lavoisier Hermès Science Publicatio, 2005

Assessment

MÉCANIQUE DES SOLIDES DÉFORMABLES ASPECTS EXPÉRIMENTAUX

EXPERIMENTAL ANALYSIS IN CONTINUUM AND SOLID MECHANICS

Lecturers: Baptiste CHOMETTE, Francesco FROIIO

| Lecturers : 0.0 | TC : 0.0 | PW : 16.0 | Autonomy : 0.0 | Study : 4.0 | Project : 0.0 | Language : FR

Objectives

(1) become aware of physical phenomena in mechanics,
(2) know different techniques for measuring useful variables in mechanics (extensometry, accelerometry, photoelasticimetry, stroboscopy, etc.),
(3) develop the practical implementation of theoretical concepts and thus promote their assimilation,
(4) knowing how to validate experimental results: critical analysis of the quality and relevance of the measurements carried out, comparing experimental results and results from theoretical or numerical approaches,

Keywords : Deformations, stresses, equilibrium, eigenmodes, resonance, static and dynamic measurements, experimental and numerical methods, finite element method

Programme

- Discovery labs: Study of the resonance phenomena of a flexible structure. Photoelasticimetry: understanding and analysis of the phenomenon of stress-induced birefringence; isocline and isochromatic; comparison with an explicit solution.
- Practical work Measurements and analyses: Determination of the eigenmodes of continuous elastic structures. Measurements by strain gauges with calculation of the tensor, application to the determination of the stress field, comparison and verification of the balance.
- "Finite elements" design office: Calculation of structures using software. Interpretation of static and dynamic cases.

Learning outcomes

- Master the basic notions of deformations and stresses for the deformable solid.
- Understand the link between assumptions, modeling and associated physical phenomena.
- Know how to identify the elements of a measurement chain.
- Know how to write a report of practical work and design office.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Assessment

MAQUETTAGE NUMÉRIQUE

DIGITAL MOCK-UP

Lecturers: **Didier LACOUR**

| Lecturers : 2.0 | TC : 0.0 | PW : 0.0 | Autonomy : 4.0 | Study : 14.0 | Project : 0.0 | Language : FR

Objectives

The aim of this training course is to enable engineers to understand the various aspects of digital modelling (volume and surface modelling, integration with simulation (kinematics, calculation, manufacturing, etc.), which are necessary in particular for other training Two Mechanical and Mechanical Engineering Units of Solids and Structures.

Keywords : Digital Mock-Up, Numerical modelling, Simulation, Finite element calculations, PLM, Bézier surfaces, Modelling curves and surfaces

Programme

- Mathematical modeling of pole surfaces.
- Getting Started with the Catia V5 Software (Part Design).
- Surface modeling with Catia V5.
- Information about the 100% web-based Onshape solution.
- Mini-project: Implementation of modeling, simulation and calculation tools on a concrete problem of design or optimization of a technical system.

Learning outcomes

- Be able to model a technical solution using computer tools
- Know how to manipulate current modelling and simulation tools
- To be able to understand all the scientific and technical aspects of a project
- Knowing the software tools of numerical modelling used in industry.

Independent study

Objectifs : Objectives: Develop and deepen the subject of the mini-project.
Methods: CAD sessions with teacher assistance.

Méhodes :

Core texts

Pierre Bezier, *L'UTILISATION DES COURBES ET SURFACES EN CAO*, Hermes Sciences Publicat, 1988
Jean-Claude Fiorot *COURBES ET SURFACES RATIONNELLES - APPLICATIONS À LA CAO*, Dunod, 1989
Dassault Systemes*MANUEL UTILISATION CATIA V5*, Dassault Systemes, 2020

Assessment

Final mark = 100% Know-how
Know-how mark = 100% continuous assessment

COMPLÉMENTS DE DYNAMIQUE DES STRUCTURES, OPTIMISATION

STRUCTURAL DYNAMICS

Lecturers: Sebastien BESSET

| Lecturers : 4.0 | TC : 4.0 | PW : 4.0 | Autonomy : 0.0 | Study : 8.0 | Project : 0.0 | Language : FR

Objectives

The aim of this course is to deepen the techniques of modal synthesis: truncation effects, structural modifications, and to extend the dynamic models to the situations of structures subjected to large displacements and / or combined loads, to anticipate and control the associated phenomena during the design process: risks of instability and floating. The pedagogical content is based on additional training in the form of courses and TD, a practical session on the effect of a static pre-load on the dynamic behavior of a structure and a project which will serve as a support example.

Keywords : Component mode synthesis, large displacements, prestress loading

Programme

- Modal synthesis: description of the dynamic behavior of a structure based on the eigenmodes. Definition of the number of modes taken into account depending on the domain Frequency of excitation, effects of modal truncation. Prediction of the effect of a localized structural change.
- Large displacements, static pre-stresses: equations on simple cases, qualitative prediction of the expected phenomena, implementation of simulations.
- TP: modifications of the eigenmodes of a structure subjected to a static loading increasing. Buckling phenomenon.
- BE: project to design a structure or to simulate the behavior of a structure.

Learning outcomes

- To be able to propose a model of predictive simulation of dynamic behavior of a structure.
- To be able to gather the necessary information and estimate their degree of importance and reliability.
- To know how to evaluate the validity limits of a model.
- To understand the concepts necessary for the use of a dynamic computation code

Independent study

Objectifs : Students are faced with a modelling problem in a quasi-industrial application.

Méhodes : The teacher presents the problem and intervenes as a resource.

Core texts

T. Gmür, *DYNAMIQUE DES STRUCTURES : ANALYSE MODALE NUMÉRIQUE.*, Presses Polytechniques et Universitaires Romandes, 1997
Michel Géradin, Daniel Rixen *THÉORIE DES VIBRATIONS, APPLICATION À LA DYNAMIQUE DES STRUCTURES.*, Elsevier-Masson, 1999
Olgierd Cecil Zienkiewicz*LA MÉTHODE DES ÉLÉMENTS FINIS*, McGraw Hill, 1979

Assessment

Final mark = 67% Knowledge + 33% Know-how
Knowledge N1 = 100% continuous assessment
Know-how N2 = 100% continuous assessment

PLASTICITÉ, MISE EN FORME

PLASTICITY, FORMING

Lecturers: Christophe JANOLIN, Hélène MAGOARIEC

| Lecturers : 4.0 | TC : 4.0 | PW : 8.0 | Autonomy : 0.0 | Study : 4.0 | Project : 0.0 | Language : FR

Objectives

The aim is to raise awareness of the link between materials forming processes and elastoplastic properties of metallic materials. The first part of the course focuses on the main processes for metal forming: plastic metal stretching, foundry, etc. The second part of the course introduces the classical elastoplastic model. The objective is to understand the limits of the elastic model and the main issues to address in order to introduce plastic behaviour. The model is established following the interpretation of simple homogeneous mechanical tests (tension and tension-torsion) and a phenomenological approach. Practical works allow, among other things, an understanding of the influence of the metal forming process on the elastoplastic properties.

Keywords : Plastic metal forming, foundry, Yield stress, Elastic strains, Plastic strains, Isotropic hardening, Kinematic hardening, Yield criterion, Normality rule.

Programme

2 courses to present the basic concepts + 2 exercises to practice these notions on elastoplastic structures + 3 practical works:
PW1 - Metal forming: sand casting, permanent mould, machining operation with cutting tool
PW2 - Behaviour identification: identification of the elastoplastic properties of the materials formed during PW1 (tension and torsion mechanical tests); Study of the influence of forming process on these mechanical properties.
PW3 - Structural design: finite element analyses of structures made of material identified during PW2.

Learning outcomes

- To know how to perform two foundry processes.
- To understand phenomenological plasticity.
- To know how to manage experiments to identify the elastoplastic behavior of materials.
- To know how to interpret results of an elastoplastic finite elements simulation.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

R. Hill, *THE MATHEMATICAL THEORY OF PLASTICITY*, Oxford University Press, 1998
P. Suquet *RUPTURE ET PLASTICITÉ*, Ecole Polytechnique, 2006
J.J. Marigo*PLASTICITÉ ET RUPTURE*, Ecole Polytechnique, 2012

Assessment

Final mark = 100% know-how.
Know-how mark = 100% continuous assessment

COMMON CORE

PCM - Physics and Chemistry of Matter - S6

TRAVAUX PRATIQUES CHIMIE-PHYSIQUE, PHOTONIQUE

LAB SESSIONS PCM

Lecturers: Christelle YEROMONAHOS, Anne LAMIRAND

| Lecturers : 0.0 | TC : 0.0 | PW : 24.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

These practicals allow through lab experiments a better understanding of fundamental concepts taught in physics and chemistry lectures and tutorials, giving concrete applications of these concepts. Finally, important notions for an engineer, such as measurements validity and protocol set-up, are provided.

Keywords : Nanotechnology, Imaging, Laser, Spectroscopy, Chromatography, Chemical kinetics, Electrochemistry, Intermolecular bonds

Programme

- Students will follow 3 practical works (TP) in physics: Fourier optics. Infrared thermography / solar cell. Spectrophotometry.
- The students will follow 3 practical works (TP) in chemistry: Electrochemical study of galvanic corrosion of metals. Study of redox reactions by UV-Visible spectrophotometry - Chemical kinetics. Gas chromatography.

Learning outcomes

- C2N1: Defines a system and its boundaries, identifies the phenomena involved and proposes a simple model. Formulate the hypotheses.
- C2N3: Characterizes the complexity of a system, identifies interactions and sources of uncertainty.
- C3N3 : Communicates in a synthetic way in writing and orally to report and enhance the results.
- C5N3 :

Independent study

Objectifs : Prepare for practical work.

Méhodes : Reading documents on intranet.
Questionnaire to be completed and included in the report (chemistry) / Oral evaluation of the preparation at the start of the session (physics).

Core texts

Assessment

Score = 20% knowledge + 80% know-how. Knowledge score = preliminary test. Know-how score = report + handling and participation.

CHIMIE

CHEMISTRY

Lecturers: Virginie MONNIER-VILLAUME, Naoufel HADDOUR

| Lecturers : 8.0 | TC : 12.0 | PW : 0.0 | Autonomy : 5.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

This lecture aims to provide bases in chemistry and physico-chemistry of materials necessary to understand properties of materials at the microscopic scale (kinetics, reactivity, thermodynamics, weak bonds, electrochemistry). Applications such as new materials to produce energy (organic solar cells), power plants or vehicles working with renewable fuels, will be used to illustrate quantum chemistry and molecular interactions notions.

Keywords : Chemistry, materials, molecular orbitals, statistical thermodynamics, weak bonds, kinetics, electron transfer

Programme

- Quantum model of the chemical bond.
- Introduction to statistical thermodynamics.
- Chemical reactivity and elements of chemical kinetics.
- Electron transfer at interfaces.
- Weak bonds.

Learning outcomes

- Build and use a diagram of molecular orbitals for a molecular structure.
- Make the link between physico-chemical properties at the macroscopic and at the microscopic scale of the matter.
- Identify molecular interactions and binding energies involved in a molecule.
- Select adapted theoretical knowledge to be applied to concrete new problems in chemistry.

Independent study

Objectifs : Learn and digest basic notions before each lecture, to use them between lectures and tutorials. Understand the links between the different notions of the lecture. Remobilize lecture concepts in concrete new situations.

Méhodes : Reading of the duplicated lecture notes and self-evaluation with the corrected exercises on Moodle platform.

Core texts

Michel GUYMONT, *STRUCTURE DE LA MATIÈRE. ATOMES, LIAISONS CHIMIQUES ET CRISTALLOGRAPHIE*, Belin, 2003
P. W. ATKINS, J. DE PAULA *CHIMIE PHYSIQUE*, De Boeck, 2013
J. P. PEREZ, A. M. ROMULUS*THERMODYNAMIQUE. FONDEMENTS ET APPLICATIONS.*, Masson, 2001

Assessment

Final mark = 100% Knowledge.
Knowledge = 70% final exam + 30% continuous assessment.

PHYSIQUE

PHYSICS

Lecturers: Emmanuel DROUARD, Anne-Segolene CALLARD, Magali PHANER

| Lecturers : 16.0 | TC : 22.0 | PW : 0.0 | Autonomy : 3.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The aim of this course is to provide the basic knowledges of quantum physics necessary to describe both the matter at microscopic scale and the main processes of radiation - matter interaction (emission, diffusion, absorption). These processes will be addressed both from classical and quantum point of view, and studied in particular in the frame of applications such as light sources and detectors, and lasers.

Keywords : Quantum mechanics, atomic and nuclear physics, photon - matter interactions, wave propagation in media

Programme

- Wave propagation, dispersion.
- Classical description of electromagnetic waves/material media interactions: optical properties of dielectrics and metals.
- Limits of classical physics.
- Wave - particle duality. Schrödinger equation and applications.
- Atomic and molecular physics. Physics of the nucleus.
- Semiclassical/quantum description of the photon matter interaction.
- Light sources and detectors.
- Principles of laser. Properties and applications of lasers.

Learning outcomes

- To be able to apply the Schrödinger equation to simple systems.
- To know how to rely macroscopic properties of matter to their microscopic origins.
- To know how to describe the different radiation - matter interactions.
- To be able to give the orders of magnitude of the energies implied in these interactions.

Independent study

Objectifs : Understanding and assimilating the course.

Méhodes : Now how to remake and interpret tutorials.
On line exercises & multiple choice training.
Microtest and Questions/Answers session with teachers.

Core texts

B. Cagnac, *ATOMES ET RAYONNEMENT, INTERACTIONS ÉLECTROMAGNÉTIQUES*, Dunod, 2005
B. Cagnac *L'ATOME, UN ÉDIFICE QUANTIQUE.*, Dunod, 2005
B.E. Saleh, M.C. Teich*FUNDAMENTAL OF PHOTONICS*, Wiley, 2007

Assessment

Mark=100% knowledge. Mark of knowledge = 85 % final exam + 15%.

COMMON CORE

LC - Modern Languages - S5-S6

S05_LC_C_0

CHINOIS S5

CHINESE

Lecturers: **Cheng SUN**

| Lecturers : 0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The Chinese course is for those who wish to discover the Chinese language, culture and civilisation and/or who want to prepare for a stay in China (semester 8, internship, 3rd year or double degree). There are 4 weekly hours over 3 years. The course aims at developing oral skills, oral comprehension, written expression and at discovering the various feature of Chinese culture. Students may prepare for the HSK (Chinese-language proficiency test).

Keywords : Pinyin, Chinese characters, business Chinese, cultural immersion, interaction, international mobility

Programme

First year :
- A1-A2 (beginners) : acquiring basic skills to understand and be understood (pronunciation of Pinyin, basic vocabulary, grammar, main linguistic structures, most common Chinese characters). Preparing for HSK level 1.
- B1-B2 (non beginners) : expanding language skills (in everyday and professional situations), oral and written comprehension, oral expression, note-taking, summaries... Preparing for HSK level 2 or 3.

Learning outcomes

- Master Pinyin.
- Developing oral expression.
- Developing oral comprehension.
- Developing written expression and learning about culture.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Arslangul Arnaud, Lamouroux Claude, Pillet Isabelle, *"NI SHUO NE" ET LES CAHIERS D'ACTIVITÉS 1 ET 2*, Editions Didier
Arslangul Arnaud, Jin Yezhi, Lamouroux Claude, Pillet Isabelle *"NI SHUO BA" ET LE CAHIER D'ACTIVITÉS*, Editions Didier

Assessment

Final mark = 100% know-how
Know-how = 50% final exam + 50% continuous course work assessment.

ANGLAIS S5

ENGLISH

Lecturers: **Alain DOUGNAC-GALANT**

| Lecturers : 0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The aim of this course is to bring all the students to the level required for validation (590 IPT TOEFL, 825 TOEIC, 7 IELTS). This level is the B2 level of CEFRL ("Independent User - Vantage") and bring as many students as possible up to the C1 level of CEFRL ("Proficient User - Effective Operational Proficiency"). It is also to extend knowledge of the Anglo-Saxon world and of its diversity and improve methodological and rhetorical skills to achieve structured thinking and precise expression. IMPORTANT: the English course is compulsory for students below the threshold level.

Keywords : TOEFL, grammatical consolidation, expanding vocabulary, basic linguistic competences, interactivity, debating, civilisation, Anglo-Saxon, United States, United Kingdom, methodology, rhetoric, adjustment, efficiency, credibility, excellence

Programme

- Intensive oral-comprehension exercises (long and demanding material).
- Speaking in small student groups: mini-dialogues, simulations, debates, presentations.
- Preparing for the TOEFL ITP test.
- Depending on levels: Revising grammar, expanding vocabulary and idioms, and improving pronunciation. Studying the civilisation of Anglo-Saxon countries. Notably, acquiring the knowledge and using the interpretative tools to understand the American society from a political, economic, social, societal, geopolitical, and cultural angle. Making students aware of global environmental and social issues.

Learning outcomes

- Understanding oral and written English.
- Interacting and expressing oneself in English whatever the context.
- Comprehending the cultural and civilisational features of the Anglo-Saxon world.
- Participating to and leading a debate.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Assessment

Final mark = 100% know-how
Know-how = 50% final exam + 50% continuous course work assessment.

ESPAGNOL S5

SPANISH

Lecturers: **Nathalie PASTOR**

| Lecturers : 0.0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Keywords :

Programme

Learning outcomes

Independent study

Objectifs :

Méhodes :

Core texts

Assessment

Final mark = 100% know-how
Know-how = 50% final exam + 50% continuous course work assessment.

PORTUGAIS S5

PORTUGUESE - BRAZIL

Lecturers: Florence MILON

| Lecturers : 0.0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Brazilian Portuguese classes are for beginners and false beginners. They will learn a new language, discover the various features of a continent-scale country and move beyond classic stereotypes. Portuguese is easy for Romance-language speakers. Mastery of the language opens the door to a double degree or an internship in Brazil.

Keywords : Brazil, Portugal, Angola, Macao, Portuguese-speaking countries, Latin America, Mercosur, academic and professional life, cross-cultural communication, cultural practices.

Programme

Courses focus on communication, oral and written comprehension through varied classroom activities (roleplays, simulations, presentations, debates, pronunciation) and studying the main historical, political and sociocultural features of Brazil.
A1-A2 : acquisition of language and cultural skills in familiar situations, to meet immediate needs in everyday contexts.
A2+-B1 : expanding skills to communicate easily in familiar, academic and professional situations.

Learning outcomes

- CEFRL (from A1 to B1), with special focus on interaction and on cultural or cross-cultural competences.
- Learning enough skills for academic and/or professional immersion.
- Apprehending the various realities of modern Brazil.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Assessment

Final mark = 100% know-how
Know-how = 50% final exam + 50% continuous course work assessment.

S05_LC_J_0

JAPONAIS S5

JAPANESE

Lecturers: Mariko NICOL-AKUTSU

| Lecturers : 0.0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Japanese courses are meant principally for beginners, but not exclusively. The aim of the courses is to learn about Japanese culture, acquire basic grammatical skills and widen knowledge of the language and civilisation, both for personal enrichment and for a potential professional experience in the country of the Rising Sun (semester 8, double degree, internship). Teaching is based on everyday and professional situations. Students are encouraged to prepare for the JLPT (Japanese-language test administered by the Japan Foundation.)

Keywords : Hiragana, Katakan, Kanji, culture, business Japanese

Programme

Courses are provided with various materials (textbooks, vocabulary and ideogram lists, audio files, etc...)

3,5 weekly hours (grammar 2h, conversation 1,5h) : learning the Japanese alphabets (Hiragana, Katakana), acquiring basic vocabulary and grammar.

Learning outcomes

- Understanding common written expressions and sentences.
- Understanding conversations on common topics of everyday life.
- CEFRL A1/A2.
- JLPT 5.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

, *MINNA NO NIHONGO 1*, 3A Corporation, 2012

Assessment

Final mark = 100% know-how
Know-how = 50% final exam + 50% continuous course work assessment

ALLEMAND S5

GERMAN

Lecturers: **Waltraut WUNDER**

| Lecturers : 0.0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

- Level A1 : Acquisition of basic lexical and grammatical skills. Understanding and use of familiar everyday expressions.
- Level A2: Consolidation of basic lexical and grammatical skills. Development and use of language in a everyday and professional context.
- Level B1/B2 : Reinforcement of basic lexical and grammatical skills. Learning about the culture of German-speaking countries.
- Level B2+: Development of oral skills and learning about culture in the wider context.

Keywords : Cross-cultural, Franco-German relations, project work, news topics, cross-disciplinary approach, culture

Programme

Subjects are in line with course levels. The focus is on social and topical issues : everyday life, campus life, politics, Franco-German relations, the environment, history, the media, cultural specifics, the cinema, literature; CV writing. Students interested in a mobility programme are offered an additional (optional) tandem course with students of TU Darmstadt in S6.

Learning outcomes

- CEFRL (from A1 to C2): acquiring all competences of expression and understanding.
- Being able to interact in personal and professional situations.
- Developing cultural and cross-cultural skills.
- Acquiring learing and memorising skills.

Independent study

Objectifs : Follow-up work and teamwork.

Méhodes : Preparation and follow-up work before and after group sessions. Work supervision, use of the Padlet and Quizlet platform, project work and group work.

Core texts

Assessment

Final mark = 100% know-how
Know-how = 50% final exam + 50% continuous course work assessment.

ARABE S5

ARABIC

Lecturers: Florence MILON

| Lecturers : 0.0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Introduction to writing and to communication in Arabic, acquisition of knowledge about Arab culture.

Keywords : Discovering, curiosity, cross-cultural communication, cultural practices, Arab civilisation.

Programme

There are two levels : a beginner's course and an intermediate course (both two hours per week).
The course focuses on classical Arabic, the language of the press and of the media and on Modern Standard Arabic.

Learning outcomes

- Oral understanding and expression (dialogues and expression in Modern Standard Arabic).
- Learning vocabulary through games.
- Learning to write (calligraphy).
- Learning about culture (discovering the socio-cultural environment, ethnic groups, religions, civilisation, music, and arts).

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Assessment

Final mark = 100% know-how
Know-how = 50% final exam + 50% continuous course work assessment.

ITALIEN S5

ITALIAN

Lecturers: Florence MILON, Francesco GIANNETTO

| Lecturers : 0.0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The main objective is to enable students to be self-reliant in everyday situations, in an academic or professional setting. Courses are taught in Italian right from the beginning to acquire immersive comprehension skills. Classes are interactive to enable students to express themselves and speak with each other.

Keywords : Communication, immersion, interaction, simulation, multimedia, culture, arts, task-based approach, projects, exchanges, international, cross-cultural communication and comprehension

Programme

Level 1 : beginners, 3 hours per week. Acquiring basic skills to understand and be understood.
Level 3 : low competence acquired in secondary school, 1:30 hours per week. Reaching the threshold level required for an academic or professional experience in Italy.
Level 4 : medium competence acquired in secondary school, 1:30 hours per week. Understanding (all media), note-taking, summaries, speaking individually or in groups, debating.
Preparation for the CELI.

Learning outcomes

- CEFRL (from A2 to C1), with special focus on interaction and on cultural or cross-cultural competences.
- Communicating with Italians.
- Getting ready for a stay in Italy.
- Learning about Italian culture.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Assessment

Final mark = 100% know-how
Know-how = 50% final exam + 50% continuous course work assessment.

RUSSE S5

RUSSIAN

Lecturers: Florence MILON

| Lecturers : 0.0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Russian courses are meant for beginners and non-beginners. Language learning may pave the way for a double degree with a Russian university or for internship in Russia. Learning about Russia will help discover the country and move beyond classic stereotypes.

Keywords : International mobility, academic life, discovering, curiosity, cross-cultural communication, cultural practices.

Programme

- Level 1 (A1-A2) : beginners, 3 hours of class per week.
Learning the Cyrillic alphabet, learning basic grammar, learning basic vocabulary, assimilating the main language structures, discovering the cultural background.
- Level 3/4 (B1-B2) : students who have already studied Russian in high school, 1:30 hours per week.
Learning about the sociocultural environment, with a focus on social issues and the news (everyday life, the economy, cultural features...).

Learning outcomes

- Developing oral and written comprehension on topics related to everyday life and campus life.
- Learning to speak and write on topical issues.
- Using language skills in specific situations.
- Learning about culture.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Maria Zeltchenko, *KOHTAKT! MÉTHODE DE RUSSE POUR DÉBUTANTS. LANGUE ET CIVILISATION*, Ellipses marketing, 2017
Monika Brosch *JASNO B1*, Klett Sprachen GmbH, 2015

Assessment

Final mark = 100% know-how
Know-how = 50% final exam + 50% continuous course work assessment.

FRANÇAIS S5

FRENCH AS A FOREIGN LANGUAGE

Lecturers: Florence MILON

| Lecturers : 0.0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The main objective is to enable students to follow the courses given at École Centrale, to be self-reliant in everyday situations and to make the most of their stay in France. French in 1st year is taught through 2 levels with linguistic and sociocultural objectives. The course provides the tools for understanding and communicating about topical and social issues, for interacting with French people on the campus and at work. Foreign double-degree students who have not graduated from secondary school in France have to obtain, during their 2nd year (March session), at least a DELF B2 level to validate their degree.

Keywords : Integration, autonomy, communication, interactions, immersion, cross-cultural communication and comprehension, international, culture, cultural practices, social issues, academic life, working life, multimedia.

Programme

During semesters 5 and 6, the focus is on the skills required for oral and written expression and on social and topical issues with a preference for authentic audio and video material.

Learning outcomes

- CEFRL (from A2 to B2), with special focus on interaction and on cultural or cross-cultural competences.
- Reading comprehension and written expression : reading newspaper articles, novels, writing letters, CVs, essays.
- Oral expression : pair-work, group-work (role plays, simulations, thematic presentations on society, countries of origin, argued points of view).
- Oral comprehension (mainly through authentic audio and video material : radio, TV, films...).

Independent study

Objectifs : Follow-up work, alone or through pair-work to develop learning and memorising techniques.

Méhodes : Autonomous work on articles, novels, novel extracts, film extracts, TV reports or dedicated language exercises. Presentations, individual or group projects.

Core texts

Assessment

Final mark = 100% know-how
Know-how = 50% final exam + 50% continuous course work assessment.

COMMON CORE

APPRO - In-depth Courses - S7

SYSTÈMES MÉCANIQUES POLYARTICULÉS

MULTI-BODY MECHANICAL SYSTEMS

Lecturers: Emmanuel RIGAUD, Bertrand HOUX

| Lecturers : 12.0 | TC : 12.0 | PW : 14 | Autonomy : 10 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Multibody mechanical systems represent a wide spectrum of practical applications from industrial robots to many mechanisms (connecting rod-crank, automotive suspension, wiper, catenary, etc.).
The course presents and implement the general methods of description, modelling and analysis of multibody mechanical systems, as well as the the tools for the design and synthesis of these systems.
During the design office activities, the behavior of an industrial robot and an automotive wiper system are fully simulated and visualised.

Keywords : Robots, mechanisms, geometric model, kinematic model, dynamic model

Programme

- Architecture of an multibody mechanical systems and techological elements
- Modeling of the multibody mechanical sydtem for open-loop kinematic chains: case of robotics (geometric, kinematic and dynamic models).
- Closed-loop kinematic chains: case of mechanisms.
- Robot design office + motor vehicle wiper design office.

Learning outcomes

- Know the technological elements and the rules for design of mechanical systems.
- Master the geometric and kinematic modeling methods fof multibody mechanical systems.
- Dynamic model: apply energcal methods to evaluate the forces required to activate multibody mechanical systems.
- Implement numerical tools that allow simulation and visualization of the multibody mechanical systems behavior.

Independent study

Objectifs : Implement numerical tools that allow simulation and visualization of the multibody mechanical systems behavior.

Méhodes : Exploitation of models in the dedicated digital environment in order to evaluate and summarize the performance of the mechanical systems modeled in the form of an illustrated report.

Core texts

KHALIL W., DOMBRE E., *MODÉLISATION, IDENTIFICATION ET COMMANDE DES ROBOTS* ., Hermès, 1999

Assessment

Final mark = 50% Knowledge + 50% Know-how
Knowledge = 100% final exam
Know-how = 100% continuous assessment

CONVERSION ÉLECTROMÉCANIQUE

ELECTROMECHANICAL CONVERSION

Lecturers: Eric VAGNON

| Lecturers : 14.0 | TC : 14.0 | PW : 6.0 | Autonomy : 14.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The objective of this course is to present the electromagnetic phenomena with their energetic aspects and to show how to pass, starting from the fundamental concepts of electromagnetism, to the design of an electric machine. This approach is presented on the example of the synchronous machine and illustrated by the various uses of this machine. This approach will be generalized to other types of electric motors in order to design electrical models that can be used for speed variation.

Keywords : Electromagnetic energy, force and power, actuator, conversion structures, frequency-power, synchronous machine, alternator, network, motor, electrical behaviour models, control

Programme

- Introduction: historical aspects and background of converter design.
- Force and mechanical power in electromagnetic systems
- Conversion structures
- Constitution of a synchronous machine
- Technological aspects
- Electrical models
- Control and command in the main applications.

Learning outcomes

- Adapt the fundamental concepts of electromagnetism into terms of designing an electrical machine.
- Adapt this approach to the synchronous machine.
- Create electromagnetic models of different levels from constructive data.
- Analyse an electrical model of an electromechanical converter in view of its control and or command.

Independent study

Objectifs : Autonomous work consists in sizing a system based on specifications and establishing a model that will validate this sizing. The system will be studied in pairs with a student following the Power electronics module.The evaluation is carried out through an exchange of each pair with a teacher of the discipline in order to demonstrate the relevance of the dimensioning carried out and the

Méhodes : Sizing a device using an analytical approach. Construction of a model and verification of the relevance of the design elements.

Core texts

Marcel JUFER, *ELECTROMÉCANIQUE* , raité d'électrcité de l'EPFL - vol XIV, 1995
Ernest MATAGNE *ELECTROMÉCANIQUE - CONVERTISSEURS D'ÉNERGIE ET ACTIONNEURS*, DUNOD, 2009

Assessment

Final mark = 70% knowledge + 30% know-how
Mark knowledge = 100% final exam
Mark know-how = 50% final exam + 50% continuous assessment

AUTOMATIQUE ET PHÉNOMÈNES NON-LINÉAIRES

AUTOMATIC CONTROL WITH NONLINEAR PHENOMENA

Lecturers: Gérard SCORLETTI, Giacomo CASADEI

| Lecturers : 12.0 | TC : 18.0 | PW : 4.0 | Autonomy : 14.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The performance requirements in technological systems have led to the widespread use of feedback control and the emergence of non-linear phenomena. However, the most commonly used correctors are based on linearity. The course present the behaviour of non-linear systems and introduces methods for predicting the occurrence of these non-linear behaviours in closed-loop systems designed under the linearity assumption - it will address how to modify the control architecture to avoid these phenomena. The course will also present how to design a control architecture for a system which is described by a non-linear model. (Prerequisite to the Master "Automatic Control Engineering" and basis for the options "Aeronautics" and "Ground Transportation").

Keywords : Automatic control, Nonlinear Systems, Control, Analysis

Programme

- Introduction and problem formulation.
- Analysis of closed-loop systems in presence of nonlinearities.
- Analysis of nonlinear systems: a general approach.
- Control of nonlinear systems.

Learning outcomes

- Analysis of the dynamical closed loop system behavior in presence of nonlinearities.
- Control of nonlinear systems.
- Pratical application to industrial cases.

Independent study

Objectifs : Develop an engineering design procedure by relying on the knowledge acquired during the AF.

Méhodes : Solve a practical and original control problem in the presence of non-linearities by applying the methods and tools acquired during the AF.

Core texts

G. Casadei et G. Scorletti, *AUTOMATIQUE & PHÉNOMÈNES NON LINÉAIRES*, Document de cours ECS a 3, 2021
G. Scorletti *COMMANDE MULTI-ACTIONNEURS MULTI-CAPTEURS.*, Document de cours ECS a 4, 189 pages, 2018
H. Khalil*NONLINEAR SYSTEMS 3D EDITION*, Prentice Hall, 2002

Assessment

Final mark = 200/3% Knowledge + 100/3% Know-how
Knowledge mark = 100% final exam
Know-how mark = 100% final exam

COMMANDE MULTI-ACTIONNEURS MULTI-CAPTEURS

MULTI-SENSOR, MULTI-ACTIVATOR CONTROL

Lecturers: Gérard SCORLETTI, Catherine MUSY, Eric BLANCO

| Lecturers : 12.0 | TC : 18.0 | PW : 4.0 | Autonomy : 14.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Performance requirements in technological systems have led to the use of advanced control laws dedicated in the past to high-tech systems for everyday systems (automotive, subway, building or irrigation canal). Actual industrial challenges lead to highly tight specifications, for more and more complex processes, with shorter and shorter conception times. An important issue is therefore to design controllers for systems with several actuators and several sensors, so called multivariable systems (piloting aircraft, space launchers). Prerequisite for the Master "Automatic Control Engineering" and basis for the "Aeronautics", 'Energy" and "Ground Transportation" options.

Keywords : Automatic control, State space representation, State/output feedback, multivariable control, observers

Programme

- Modelling and analysis of dynamic using state-space approach.
- Introduction to non linear-systems analysis.
- Modal control (pole assignment).
- Observer and virtual sensor.
- Disturbance rejection and Set-point change.
- Cases studies.

Learning outcomes

- Analyze the static and dynamic behaviour of a system.
- Design a modal controller.
- Design a multivariable control ensuring a set of specifications.
- Design an observer by a modal approach.

Independent study

Objectifs : Develop an engineering design procedure by relying on the knowledge acquired during the AF.

Méhodes : Solve a practical and original control problem in the presence of non-linearities by applying the methods and tools acquired during the AF.

Core texts

G. SCORLETTI, *COMMANDE MULTI-ACTIONNEURS MULTI-CAPTEURS*, Polycop ECL, 2014
R.C. DORF and R.H. BISHOP *MODERN CONTROL SYSTEMS*, Pearson Prentice Hall, 2005
G. F. FRANKLIN, J. D. POWELL and A. EMAMI-NAENI*FEEDBACK CONTROL OF DYNAMIC SYSTEMS*, AddisonWesley, 1986

Assessment

Individual written final test 2 hours (knowledge) and individual oral evaluation of autonomy (know-how). Final AF mark =2/3*K+1/3*KH.

INSTABILITÉ DES ÉCOULEMENTS ET INTRODUCTION À LA TURBULENCE

STABILTY OF FLOW AND INTRODUCTION TO TURBULENCE

Lecturers: Christophe BAILLY, Andrea MAFFIOLI

| Lecturers : 20.0 | TC : 16.0 | PW : 0.0 | Autonomy : 12.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The turbulent state is encountered in industrial processes, in the atmosphere and the ocean for geophysical flows, as well as in biological fluids, to mention only a few examples. The first objective of this course is to present the analytical tools to characterize stability of flow, by considering small perturbations around a basic flow. The second part is an introduction to turbulence for free shear flows such as mixing layers, jets and wakes (intermittency, entrainment, fully developed flow).

Keywords : Laminar flow, linear stability, inviscid (Rayleigh) and viscous (Orr-Sommerfeld) approaches, turbulent signals, intermittency, entrainment, free shear flows

Programme

General introduction - Stability of flows - basic notions and tools. Local and global instabilities. Instability thresholds and dimensionless parameters. Linearization. Parallel plane flows. Orr-Somerfeld equation. Non-viscous instabilities: Rayleigh equation. Piecewise linear profiles. Monotonic profiles and neutral modes. Effects of weak nonlinearities. - Turbulent flows - transition to turbulence, analysis of turbulent flow signals, general equations of turbulent flows; turbulent flows with free edges: intermittency, entrainment, identification of turbulent structures

Learning outcomes

- Master the concepts of linear stability analysis of flows
- Know how to characterize turbulent signals
- Be more familiar with the phenomenology of turbulent flows
- Know how to physically exploit the results of a stability analysis

Independent study

Objectifs : The work to be done independently allows the course to be illustrated by case studies, and to deepen certain aspects of the course.

Méhodes : Analytical solution of elementary cases for flow stability
Solving the Rayleigh equation on computer for the mixing layer
Analysis of measured turbulent signals (statistics, intermittency)

Core texts

GODRÈCHE C., MANNEVILLE P., *HYDRODYNAMIC AND NON LINEAR INSTABILITIES*, Cambridge University Press, 1998
SCHMID, P.J., HENNIGSON, D.S. *STABILITY AND TRANSITION IN SHEAR FLOWS*, Springer, 2001
BAILLY, C., COMTE-BELLOT, G.*TURBULENCE*, Springer, 2015

Assessment

Final mark = 50% Knowledge + 50% Know-how
Knowledge mark = 50% final exam + 50% continuous assessment
Know-how mark = 50% final exam + 50% continuous assessment

ACOUSTIQUE ET ONDES DANS LES FLUIDES

ACOUSTICS AND WAVES IN FLUIDS

Lecturers: Didier DRAGNA, Gilles ROBERT

| Lecturers : 20.0 | TC : 24.0 | PW : 4.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Many types of waves propagate in fluids. Among them, acoustic waves play a particular role in everyday life. They allow for human communication and are the support of music. The course is made of two parts. The first part aims at giving basic knowledge in acoustics. The second part extends the study to other types of waves in fluids (surface and internal gravity waves). It aims at understanding the phenomena of dispersion and propagation in inhomogeneous media.

Keywords : Acoustics, Sound, Noise, Waves, Dispersion relation, Phase and group velocities.

Programme

Elements of formalization and resolution of an acoustic problem (wave equation, boundary conditions, Green's function, ...).
Characterization of acoustic fields (near and far fields, compact source, directivity, structure radiation).

Waves in fluids: notion of dispersion, group and phase velocities through the example of surface gravity waves.
Propagation in inhomogeneous medium and geometric approximation.

Learning outcomes

- Basic calculations in acoustics (sound pressure levels, source power, dB, ...)
- Kknowledge of elementary sources (plane and spherical)
- Know the basics about the dB scale, the characterization of noise pollution and its perception
- Master the general techniques to analyse linear propagation of waves in fluids: dispersion relation, high-frequency approximation

Independent study

Objectifs : Analysis and design of a muffler.

Méhodes : TD is partly done in autonomy from a framing sheet and a resource teacher. In the case study, the students analyze the problem in order to formalize the specifications, to propose a solution and finally to discuss possible improvements.

Core texts

S. Temkin, *ELEMENTS OF ACOUSTICS*, John Wiley & Sons, 1981
J. Lighthill *WAVES IN FLUIDS*, Cambridge University Press, 1978
M. J. Crocker et al.*HANDBOOK OF ACOUSTCIS*, John Wiley & Sons, 1998

Assessment

Final mark = 0.6*Knowledge + 0.4*Know-how
Knowledge = final exam
Know-how = continuous assessment

ECOULEMENTS SUPERSONIQUES

SUPERSONIC FLOW

Lecturers: Didier DRAGNA, Marc JACOB

| Lecturers : 16.0 | TC : 16.0 | PW : 2.0 | Autonomy : 10.0 | Study : 4 | Project : 0.0 | Language : FR

Objectives

This course is devoted to high velocity compressible flows and to the study of pressure waves, expansion waves and shock waves. It is an extension of the core course Fluids and Energy and aims at deepening the knowledge in gas dynamics. Applications mainly concern external aerodynamics around high speed vehicles.

Keywords : Compressible flow, Supersonic flow, Shock waves, Expansion waves

Programme

-Introduction.
- Conservation laws.
- Quasi-one-dimensional flows.
- Normal shock waves.
- Two-dimensional flows.
- Oblique shock waves and expansion waves.
- Interactions and unsteady waves.
- Linearized flows.

Learning outcomes

- Determine the behavior of a compressible fluid subjected to thermal or mechanical stresses.
- Design a convergent-divergent nozzle under different downstream conditions.
- Determine the flow structures developing around an obstacle in a supersonic flow.
- Perform a comparative and critical analysis of experimental, numerical and analytical results.

Independent study

Objectifs : Apply the theoretical concepts of the course and compare analytical, numerical and experimental results.

Méhodes : Method 1: design a ramjet and perform a parametric study of its performance.
Method 2: analyze and compare the supersonic flow structures around a diamond profile (test performed in a supersonic wind tunnel).

Core texts

J. D. Anderson, *MODERN COMPRESSIBLE FLOW*, McGraw Hill, 2021
A. H. Shapiro *THE DYNAMICS AND THERMODYNAMICS OF COMPRESSIBLE FLUID FLOW*, Ronald Press Company, 1953

Assessment

Final mark = 0.65*Knowledge + 0.35*Know-how
Knowledge = final exam
Know-how = continuous assessment

THERMIQUE ET COMBUSTION

THERMICS AND COMBUSTION

Lecturers: Mathieu CREYSSELS, Andrea MAFFIOLI, Mikhail GOROKHOVSKI

| Lecturers : 20.0 | TC : 18.0 | PW : 10.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Describe and quantify energy transfer phenomena, in particular heat transfer, which are essential both for energy production (turbines, engines, turbojets) and for limiting energy consumption for more sustainable development (more efficient engines and low energy or positive energy buildings). The course provides essential knowledge and skills for industrial or environmental applications involving thermal phenomena such as: energy exchange in a quiet environment, fires, explosions, burners, engines or jet engines.

Keywords : Energy, heat transfer, convection, radiation, heat exchangers, combustion, flames, engines, more sustainable development

Programme

Heat transfer :
1) Description of heat transfer modes (conduction / natural, forced and mixed convection / radiation)
2) Formulation of the coupled dynamic and thermal equations.
3) Heat transfer coefficients and dimensionless numbers.
3) Conductive heat transfer in stationary and non-stationary regime.
4) Forced convection in laminar and turbulent regime.
5) Heat exchangers. Calculation of thermal efficiencies.

Learning outcomes

- Know the different modes of heat transfer (conduction, convection, radiation).
- Describe the phenomenon of combustion and the physics of flames.
- Know how to estimate and calculate heat transfer numerically (using Matlab or Python tools).
- Use the Fluent simulation tool to numerically model a heat transfer flow.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Jean Taine, Franck Enguehard, Estelle Iacona, *TRANSFERTS THERMIQUES*, Dunod, 2021
Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. DeWitt *FUNDAMENTALS OF HEAT AND MASS TRANSFER*, Wiley, 2019
Irvin Glassman, Richard A. Yetter, Nick G. Glumac*COMBUSTION*, Elsevier, 2014

Assessment

Final mark = 50 % Knowledge + 50 % Know-how
Knowledge mark = 100 % final exam
Know-how mark = 100 % continuous assessment

INGÉNIERIE MÉCANIQUE

MECHANICAL ENGINEERING

Lecturers: Olivier DESSOMBZ, Jean-Jacques SINOU

| Lecturers : 4.0 | TC : 4.0 | PW : 0.0 | Autonomy : 16.0 | Study : 24.0 | Project : 0.0 | Language : FR

Objectives

Study the design of mechanical systems and structures present in various fields of application (engineering civil, aeronautical, automotive...) by linking technological, static and dynamic aspects.

Keywords : Design, methodology and modelling

Programme

Course / TD program :
- Introduction to the dimensioning issue.
- Dynamic sizing.

Synthesis Studies:
- Two studies make it possible to show the existing links between the different aspects of the dimensioning of a system or a mechanical structure.
- Examples of themes addressed: sizing of a bridge, dimensioning of a lifting clamp, sizing of an automotive clutch, sizing of a wind turbine.

Learning outcomes

Independent study

Objectifs : Work on BE, formatting of results and writing.

Méhodes : Study of the systems offered in BE, preparation of evaluation presentations.

Core texts

Georges Spinnler, *CONCEPTION DES MACHINES, TOMES 1, 2 & 3*, Presses polytechniques et universitaires romandes, 1997
Daniel Gay & Jacques Gambelin *DIMENSIONNEMENT DES STRUCTURES, UNE INTRODUCTION*, Hermès science publications, 1999
Claude Chèze*DIMENSIONNEMENT DES STRUCTURES*, Ellipses, 2012

Assessment

Score = 50% knowledge + 50% know-how
Knowledge score = 100% terminal exam
Know-how score = 100% continuous assessment

ENDOMMAGEMENT ET RUINE DES MATÉRIAUX

DAMAGE AND RUIN OF MATERIALS

Lecturers: Vincent FRIDRICI, Bruno BERTHEL

| Lecturers : 22 | TC : 14 | PW : 0.0 | Autonomy : 12.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Structural safety, the new approach related to cindynics (risk science) and circular economy concepts (taking into account sustainable development) keep the requirements related to the durability of structures at the highest level. The essential functions of the structure must be taken into account from the first steps of the design. The engineer must be able to take a step back in order to perform appropriate selection of materials, based on the loading conditions. The objectives of this module are therefore to give, in the continuity of the common core modules of the UE IDM (and partly of the UE GM and MSS), in-depth knowledge of the damage of materials in mechanical structures.

Keywords : Materials damage, fracture mechanics, fatigue, corrosion, tribology

Programme

- The main steps in the life of a structure (2h).
- Plastic deformation and damage (2h).
- Fracture mechanics (4h).
- Fatigue damage (6h).
- Elements of expertise of ruptures (2h).
- Tribology and wear (4h).
- Corrosion (4h).
- Elements of non-destructive testing (2h).
- Industrial conferences (nuclear, transport, etc.) (4h).

Learning outcomes

- Understand major industrial issues related to the risk of structural ruin.
- Understand the different damage mechanisms of materials.
- Formalize predictive tools and implement palliative solutions.

Independent study

Objectifs : This work aims to understand the different types of damage and to understand the issues in a specific industrial sector or for a given material.

Méhodes : Bibliographic study in groups of 2 students and if possible application of the concepts seen in class on the studied topic. This work is accompanied by a presentation of the selection of topic at the beginning and a mid-term review with a teacher.

Core texts

JP. BAILON, JM DORLOT, *DES MATÉRIAUX*, Presses internationales Polytechnique, 2000
C. BATHIAS, J.-P. BAILON *LA FATIGUE DES MATÉRIAUX ET DES STRUCTURES*, Hermès - Lavoisier, 1997
J.-M. GEORGES*FROTTEMENT, USURE ET LUBRIFICATION*, Eyrolles, 2000

Assessment

Final mark = 50% Knowledge + 50% Know-how
Knowledge = 100% final exam
Know-how = 100% continuous assessment

MATÉRIAUX AMORPHES POUR STRUCTURES FONCTIONNELLES INNOVANTES

AMORPHOUS MATERIALS FOR INNOVATIVE FUNCTIONAL STRUCTURES

Lecturers: Maria-Isabel DE BARROS BOUCHET, Frédéric DUBREUIL

| Lecturers : 12.0 | TC : 14.0 | PW : 4.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Amorphous materials are synthetic or natural materials widely used in a large number of applications. For these materials, the industrial and technological development has often preceded scientific concerns in terms of characterization, structure-property relationship and modelling of the behavior and their life cycle. Currently, the science of glasses is a field rich in developments, with numerous technological impacts in industrial sectors such as the transportation, civil engineering, medical, agri-food... This course offers a deepening of the knowledge on the specificities of these materials and on their applications. External speakers will be present and a visit to a plastic bottle recycling centre will be organised.

Keywords : Glass, vitreous state, oxides, polymers, elastomers, glass transition, semi-crystallinity, rheological behavior, recycling

Programme

- The amorphous state: origins of order and disorder...
- Manufacturing processes.
- Networks and crystallization phenomena.
- Characterization methods: thermal analysis, X-ray, infrared...
- Structure and rheological behavior.
- Functional properties: optics, shape memory, damping, thermal insulation, electrical conduction and innovative applications in various industrial sectors.
- Life cycle, characterization and recyclability of a packaging (example of a soda bottle).

Learning outcomes

- Acquire knowledge on the structure and characterisation techniques of amorphous materials in the objective to better understand their properties.
- Define the characterisation and identification techniques to be used according to the material to be analysed.
- Have notions concerning the recycling of amorphous materials.
- Use acquired knowledge to analyse the issues of their life cycle and make a critical analysis.

Independent study

Objectifs : Control of all the stages of the life of a part made of amorphous material from its manufacturing to its after-use destination.

Méhodes : The autonomous work consists of preparing practical works, writing reports and carrying out a bibliographic project on a problem related to the recyclability of these materials. All these activities are teamwork.

Core texts

Powell, Peter C, *ENGINEERING WITH POLYMERS*, Chapman & Hall, 1992
Jerzy, Zarzycki *GLASSES AND THE VITREOUS STATE*, Cambridge University Press, 1991
Duval, Claude*PRÉSENTATION MATIÈRES PLASTIQUES ET ENVIRONNEMENT - RECYCLAGE, VALORISATION, BIODÉGRADABILITÉ, ÉCO-CONCEPTION*, Dunod, 2009

Assessment

0.5: knowledge (100% final exam: quiz + exercises); 0.5: know-how (50% oral presentation of the project+50% practical work report).

MULTIMÉDIA : CONCEPTS ET TECHNOLOGIES

MULTIMEDIA : CONCEPTS AND TECHNOLOGIES

Lecturers: Emmanuel DELLANDREA, Mohsen ARDABILIAN

| Lecturers : 16.0 | TC : 0.0 | PW : 18.0 | Autonomy : 14.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

This course aims to familiarize students with the fundamental concepts of multimedia and technologies, systems and methods of multimedia analysis. Communication is one of the factors for the development of industry and the individual in modern societies. The rapid change in emerging societies and technologies is testament to the ever-changing nature of media and environments, as well as the messages conveyed. Indeed, today it is increasingly easier to convey an idea through a combination of text, image, audio and video documents than through a simple text document. A multimedia document thus follows a life cycle that undergoes various transformations. This course describes the fundamental concepts by placing them in a global

Keywords : Interactivity, Information, Media, Digital, Video, Audio, Text, Audiovisual, System, Content, Content analysis, Compression, Standard, Standard

Programme

1) Basic terminologies and concepts: Visual and auditory perception. Sampling and quantification. Acquisition of sound, image and video. Acquisition systems.
2) Multimedia analysis and its applications: Multimodal content analysis (visual modality, audio modality, temporal modality). The principles of coding and compression. Automatic indexing. Automatic structuring (summary, chaptering, etc.).
3) Presentation of standards and standards for description, compression and synchronization: H.26x, JPEGs, MPEGs, SMIL and others.

Learning outcomes

- Understand the general principle of the different coding and compression processes applied to images, audio and video.
- To be able to identify the most suitable coding and compression techniques according to the nature of the multimedia data.
- Understand the principle of multimedia analysis methods.
- Know how to implement audio / video analysis methods (segmentation, classification).

Independent study

Objectifs : Allow students to assimilate notions and concepts seen in class and in BE.

Méhodes : Coaching and question-and-answer sessions.

Core texts

P. Bellaïche, , *LES SECRETS DE L'IMAGE VIDÉO.*, Eyrolles., 2002
T. Vaughan. *MULTIMEDIA-MAKING IT WORK (5ÈME ÉDITION)*, McGraw-Hill., 2002
N. Chapman & J. Chapman. *DIGITAL MULTIMEDIA.*, Wiley,, 2000

Assessment

Final mark = 63% Knowledge + 37% Know-how
Knowledge = final exam
Know-how = continuous assessment

STRATÉGIES DE RÉSOLUTION DE PROBLÈMES

PROBLEM RESOLUTION STRATEGIES

Lecturers: Alexandre SAIDI

| Lecturers : 8.0 | TC : 0.0 | PW : 28.0 | Autonomy : 12.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Deepen students' knowledge of analysis, algorithms, resolution methods, performance and programming. Among the course objectives, it is important to give students the knowledge and the practical methods and tools necessary for the implementation of the activity of modeling solutions and/or designing algorithms and their programming. The study of problems known to be complex and their solutions are proposed as well to complete this course.

Keywords : Algorithm, Algorithm analysis, Complexity, Graph, Problem Solving, Resolution strategy

Programme

- Analysis and the complexity computation of recursif algorithms (cf. CAML).
- Short introduction to TDAs and notable data types algorithmic solving strategies.
- Divide and Conquer Strategy, Dynamic Programming.
- Greedy approach (greedy / gradient approach).
- Algorithms with depth/breath first search , Back Tracking (AES and BT).
- Branch and Bound (B&B).
- Resolution of the characteristic equation for the complexity computation.
- Examples of complexity calculation.
- Proof methods (optional).

Learning outcomes

• The resolution of non-trivial problems in Computer Science requires a rigorous Mathematical approach. Once the problem has been posed, the research phases for a model, the algorithmic study of the solution and the calculation of its complexity are the important elements of this approach. The proof phase (and accuracy of the proposed solution) which completes this approach is not detailed in this course even if references will be given. Proving the correctness of what is written is nevertheless addressed.

• For the sake of a balanced theoretical / practical relationship, the objective of this course is to give students the knowledge and the practical methods and tools necessary

Independent study

Objectifs : Practical activities

Méhodes : Practical activities

Core texts

D.E. Knuth , *THE ART OF PROGRAMMING (RÉÉDITION),*, Addison Wesley, 2000
R. Neapolitan, K. Naimipour *FOUNDATIONS OF ALGORITHMS*, Health & Company,, 1996
P. Dohornoy (SMAI) *COMPLEXITÉ ET DÉCIDABILITÉ*, Springer-Verlag, 1993

Assessment

Practical marks and final exam mark (50%-50%)

APPLICATIONS CONCURRENTES, MOBILES ET RÉPARTIES EN JAVA

SOFTWARE ENGINEERING: MODEL AND PROCESS BASED SOFTWARE DEVELOPMENT

Lecturers: Stéphane DERRODE, Alexandre SAIDI

| Lecturers : 16 | TC : 0.0 | PW : 0.0 | Autonomy : 10 | Study : 22 | Project : 0.0 | Language : FR

Objectives

This teaching aims to continue the learning of object programming in Java language thanks to Human-Machine Interfaces (HMI) human-machine interfaces, or how to design ergonomic interfaces; concurrency, or how to use several cores of a microprocessor to perform a calculation in parallel; distributed programming, or how to make remote computers work together on a network (one of the operating principles of cloud computing); mobile programming, or how to program on Android.

Keywords : Computer science, Java, Android, concurrency, parallelism, distributed programming, HCI, user interface.

Programme

- The Java language
- Event-based programming (human-machine interfaces, HMI)
- Concurrent programming (processes, parallel computing)
- Distributed programming (Java RMI)
- Programming for mobile computing devices (Android / Android Studio)

Learning outcomes

- Know how to program in Java an application distributed on several computers linked by a network.
- Know how to develop a concurrent application using several processors.
- Know how to program a user interface (GUI) that is ergonomic and fluid.
- Be able to develop an Android application.

Independent study

Objectifs : Carry out several group tasks aimed at producing a functional application based on the concepts studied in class.

Méhodes : Projects in groups of 2 students, to be carried out in sessions and independently.

Core texts

Luigi Zaffalon, *PROGRAMMATION CONCURRENTE ET TEMPS RÉEL AVEC JAVA*, Presses Polytechniques Romandes, 2007
Reto Meier *DÉVELOPPEMENT D'APPLICATIONS AVANCÉES*, Pearson France, 2012
Serge Ungar, Nazim Benbourahla*DES FONDAMENTAUX DU DÉVELOPPEMENT JAVA À LA MISE EN PRATIQUE D'UNE APPLICATION SOUS ANDROID* , ENI, 2012

Assessment

Final mark = 50% knowledge + 50% Know-How
Knowledge mark = 100% final exam
Know-how mark = 100% continuous assessment

ANALYSE DE DONNÉES ET RECONNAISSANCE DES FORMES

DATA ANALYSIS AND PATTERN RECOGNITION

Lecturers: Emmanuel DELLANDREA

| Lecturers : 14.0 | TC : 20.0 | PW : 0.0 | Autonomy : 14.0 | Study : 0.0 | Project : 0.0 | Language : MI

Objectives

The purpose of data analysis and pattern recognition is to analyse and make explicit the concepts embedded in large amounts of data that can come from many sources. These methods have ever-increasing application benefits in fields as diverse and varied as computer vision, signal analysis, robotics, medicine, finance, electronic commerce, or military applications, etc. This course therefore aims to introduce the fundamental principles and techniques of data analysis and pattern recognition, and in particular descriptive approaches (automatic description of the concepts contained in the data), as well as predictive approaches.

Keywords : Data analysis, Pattern recognition, machine learning, classification, regression, neural networks

Programme

- Factor Analysis (PCA, AFC, ACM)
- Discriminant Analysis (LDA)
- Linear models for regression
- Logistic regression for classification
- Problem of over-fitting and regularization
- Neural networks: representation and learning
- Tips and Practices for Applying Machine Learning
- Design of machine learning systems

Learning outcomes

- Understand the principle of the main methods of data analysis and pattern recognition.
- Knowing how to choose the method of data analysis or pattern recognition to be implemented according to the data and the objectives of the study at hand.
- Know how to implement the main methods of data analysis and pattern recognition, and exploit their results.
- Understand the principles of statistical learning for regression and classification.

Independent study

Objectifs : Understand and assimilate the concepts of courses implemented through lab works.

Méhodes : Question / answer sessions with teachers following the tutorials to help with homework assignments.

Core texts

Christopher M.Bishop, *PATTERN RECOGNITION AND MACHINE LEARNING*, Springer, 2006
Richard O.Duda, Peter E.Hart, David G.Stork *PATTERN CLASSIFICATION*, John Wiley & Sons, 2001
Trevor Hastie, Robert Tibshirani, Jerome Friedman*THE ELEMENTS OF STATISTICAL LEARNING*, Springer, 2011

Assessment

Final mark = 50 % Knowledge + 50 % Know-how
Knowledge = 100 % final exam
Know-how = 100 % continuous assessment

VIBRATION DES SYSTÈMES MÉCANIQUES

VIBRATION ANALYSIS

Lecturers: Olivier DESSOMBZ

| Lecturers : 12.0 | TC : 16.0 | PW : 4.0 | Autonomy : 12.0 | Study : 4.0 | Project : 0.0 | Language : FR

Objectives

Within the framework of general mechanics and structural mechanics, the course constitutes an introduction to vibration mechanics and an opening towards non-linear phenomena and the stability of mechanical systems.

Keywords : Vibrations, discrete / continuous systems, damping, modal synthesis, non-linear systems

Programme

- Discrete Systems Program : Vibration response of systems. Insulation and damping of systems. Modal synthesis.
- Continuous systems : Calculation of beam modes. Building discrete models. Application of the finite element method.
- Non-linear systems.
- Stability of mechanical systems.

Learning outcomes

- To know how to put into equations a mechanical system within the framework of small movements.
- Know how to calculate normal eigenmodes and use them in modal synthesis.
- Understand the major approximation methods, in particular the finite elements method.
- Know how to take into account non-linearities in vibratory mechanics.

Independent study

Objectifs : Allow students to assimilate notions and concepts seen in class and in BE.

Méhodes : Formatting of results and writing.

Core texts

J-F. Imbert, *ANALYSE DES STRUCTURES PAR ÉLÉMENTS FINIS (3ÈME ED)*, Cépaduès éditions, 1991
M. Géradin & D. Rixen *THÉORIE DES VIBRATIONS. APPLICATION À LA DYNAMIQUE DES STRUCTURES*, Masson, 1993
P. Pahut & M. Del Pedro*MÉCANIQUE VIBRATOIRE. SYSTÈMES DISCRETS LINÉAIRES*, Presses polytechniques et universitaires romandes, 2003

Assessment

Score = 50% knowledge + 50% know-how
Knowledge score = 100% terminal exam
Know-how score = 100% continuous assessment

COMPORTEMENT ANÉLASTIQUE DES STRUCTURES

INELASTIC BEHAVIOUR OF STRUCTURES

Lecturers: Cécile NOUGUIER, Francesco FROIIO

| Lecturers : 12.0 | TC : 6.0 | PW : 0.0 | Autonomy : 20.0 | Study : 0.0 | Project : 10.0 | Language : FR

Objectives

To provide a more comprehensive knowledge of the behaviour of elastic and inelastic structures.

Keywords : Anisotropy, elastoplasticity, thermoelasticity, viscoelasticity

Programme

- Course 1 and 2 : Elements of anisotropy and ealstoplasticity.
- Course 3 and 4 : Displacement method and its application to the thermoelastic analysis of structures.
- Course 5 and 6 : Structural plasticity.

Learning outcomes

- Positioning of linear elasticity in a wider theoretical framework.
- To perform basic viscothermoelastic/elastoplastic analysis of structures.
- To develop a project-based approach to the resolution of mechanical problems.
- To deploy either numerical or analytical resolution methods.

Independent study

Objectifs : Analytical and/or numerical analysis of inelastic structures.

Méhodes : 3 groups of 8 students each will work on as many different projects. The total allocated time for each project is 30 hours (1/3 supervised).

Core texts

J. Lemaitre, J-L. Chaboche, *MÉCANIQUE DES MATÉRIAUX SOLIDES*, Dunod, 2001
Albiges, Coin, Journet *ETUDE DES STRUCTURES PAR LES MÉTHODES MATRICIELLES*, Eyrolles, 1969
S. Timoshenko*RÉSISTANCE DES MATÉRIAUX*, Dunod, 1968

Assessment

Mark = 60% knowledge + 40% know-how.
Knowledge mark = 100% final exam.
Know-how mark = 100% continuous assessment.

OUTILS MATHÉMATIQUES AVANCÉS POUR LES PROBABILITÉS ET L'APPRENTISSAGE

PROBABILITY THEORY AND INTRODUCTION TO RANDOM PROCESSES

Lecturers: Elisabeth MIRONESCU, Philippe MICHEL

| Lecturers : 18.0 | TC : 14 | PW : 0.0 | Autonomy : 12 | Study : 4 | Project : 0.0 | Language : FR

Objectives

Advanced mathematics for mathematical enginneering with a focus on measure theory, probability theory. This course is a pre-requisit for stochastic processes, machine learning, mathematical finance or biomathematics. The remaining of the course concerns the bases of functional analysis and a glimpse of partial differential equations.

Keywords : measure theory, integrals, topology, functional analysis, probability theory, partial differential equations

Programme

1) Measure theory, integrals, probability theory
2) Topology, functional analysis, introduction to partial differential equations

Learning outcomes

- understanding and proof mastering of analysis and probability
- using an appropriate tehoretical framework when dealing with complex problems
- giving examples and counter-examples to illustraite theoretical mathematical notions

Independent study

Objectifs : proving and writing proofs

Méhodes :

Core texts

N. imnios, V. Girardin, *PROBABILITÉS EN VUE DES APPLICATIONS*, Vuibert, 2008
H. Brézis *ANALYSE FONCTIONNELLE*, Dunod, 2020
P. Bilingsley*PROBABILITY AND MEASURE*, Wiley, 1995

Assessment

Final mark = 75% Knowledge + 25% Know-how
Knowledge mark = 100% final exam
Know-how mark = 100% continuous assessment

OUTILS MATHÉMATIQUES AVANCÉS POUR L'ANALYSE DES ÉQUATIONS AUX DÉRIVÉES

NUMERICAL APPROXIMATION FOR ODES AND PDES

Lecturers: Philippe MICHEL, Elisabeth MIRONESCU

| Lecturers : 18 | TC : 18 | PW : 0 | Autonomy : 12 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The training action aims to give students wishing to continue their engineering studies towards courses requiring an advanced level in mathematics the possibility of deepening the basic notions seen in S5 in the UE MTH with powerful theoretical tools. and to learn the theoretical bases which will be applied in the elective course (S8 - S9 - Mathematics and Risk Engineering option).

Keywords : Measure and integration theory, probability theory, topology, functional analysis, partial differential equations.

Programme

1) Measure theory, integration, probability theory.
2) Topology, functional analysis.

Learning outcomes

- Understand and demonstrate the theoretical elements of analysis and probability.
- Give examples and counterexamples.
- Mathematical modelling, notion of well-posed problems.

Independent study

Objectifs : Writing and demonstration work.

Méhodes :

Core texts

N. Limnios, V. Girardin, *PROBABILITÉS EN VUE DES APPLICATIONS*, Vuibert, 2008
H. Brezis *ANALYSE FONCTIONNELLE - THÉORIE ET APPLICATIONS*, Dunod, 2005
G. Allaire*ANALYSE NUMÉRIQUE ET OPTIMISATION*, Editions de l'Ecole polytechnique, 2005

Assessment

Final mark = 75% Knowledge + 25% Know-how
Knowledge mark = 100% final exam + 0% continuous assessment
Know-how mark = 0% final exam + 100% continuous assessment

MÉCANIQUE QUANTIQUE ET APPLICATIONS

QUANTUM MECHANICS AND APPLICATIONS

Lecturers: Anne-Segolene CALLARD, José PENUELAS

| Lecturers : 18.0 | TC : 18.0 | PW : 0.0 | Autonomy : 12.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Quantum mechanics is one of the most predictive and widespread physical theories we know. It allows us to describe the atoms and constituents of matter, but it also allows to understand the assemblies of molecules, the nature of light and the structure of solids. Quantum mechanics, as a fundamental science, is also at the origin of great applications upon which are based our modern society: most high-tech products are directly derived from quantum concepts (computer, laser, GPS, MRI ...). The objective of this course is to offer an introduction to quantum mechanics and its general principles using the Dirac formalism.

Keywords : Schrödinger Equation, quantum state, Quantum mechanics principles, superposition, Dirac formalism, Hamiltonian,Hilbert space, spin, fermion, boson, indistinguishable particles

Programme

- Back to wave / particle duality - Construction of quantum theory.
- Measurement / Time evolution of systems.
- The postulates of quantum mechanics.
- Two-state systems.
- The angular momentum.
- ½ spin.
- NMR.
- The identical particles.
- The fermions, the bosons.

Learning outcomes

- Identify the field of application of quantum mechanics and the quantum / classical limit.
- Apply the principles of quantum mechanics.
- Use Dirac formalism to solve a problem of quantum mechanics.
- Describe the state of several particles and their spin.

Independent study

Objectifs : Understand and assimilate the course.

Méhodes : Questions and answers sessions, corrections of former exams in session, exercises to be treated in autonomy.

Core texts

J-L Basdevant, J. Dalibard., *MÉCANIQUE QUANTIQUE*, Ed. de l'Ecole Polytechnique, 2002
C. Cohen-Tannoudj i. et al. *MÉCANIQUE QUANTIQUE I*, Hermann, 1973
C. Cohen-Tannoudj i. et al.*MÉCANIQUE QUANTIQUE II*, Hermann, 1973

Assessment

Final mark = 100% Knowledge
Knowledge mark = 90% final exam +10% continuous assessment

CHIMIE MOLÉCULAIRE ET SUPRAMOLÉCULAIRE

MOLECULAR AND SUPRAMOLECULAR CHEMISTRY

Lecturers: Christelle YEROMONAHOS, Naoufel HADDOUR

| Lecturers : 12.0 | TC : 18.0 | PW : 0.0 | Autonomy : 18.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Metabolites are low molecular weigth species, present in blood, among an abundant background of high molecular weight species. Metabolites are the biomarkers of a large range of pathologies. However their detection, for clinical use, is still a global challenge. Chemical functionalization of porous silicon surfaces, by using specific molecules, could allow the selective trapping of metabolites. Such a trapping could allow to improve the sensitivity of the detection tools, classically used in hospitals (mass spectrometry).
Objectives of this course is to study the effects of the physico-chemical properties of molecules (structure, hydrophile-liphophile balance, charges) on the intermolecular interactions. A large part of the course will be

Keywords : Intermolecular interactions, Molecular Dynamics simulations, innovative clinical diagnostic tools

Programme

This course will be presented in the form of a case study.

First, the physicochemical properties of single molecules will be presented (structure, hydrophilic hydrophobic balance, charges).
Secondly, the physicochemical properties of supramolecular structures will be analyzed from the properties of the single molecules that constitute them by molecular modeling (energy of interactions...).
The results of this analysis will be used to design a biomedical analysis tool.

Learning outcomes

- C2N1: Define a system and its boundaries, identifie the phenomena involved and propose a simple model. Formulate the hypotheses.
- C2N3: Characterize the complexity of a system, identifie interactions and sources of uncertainty.
- C1I1: Carrie out a state of the art and implement creative methods, on a problem open to technical-scientific-economic questions, and formalize the result.

Independent study

Objectifs : Molecular modeling on computer

Méhodes :

Core texts

Franck, *CHIMIE PHARMACEUTIQUE*, De Boeck, 2005
J.-M. Lehn *LA CHIMIE SUPRAMOLÉCULAIRE, CONCEPTS ET PERSPECTIVES*, De Boeck, 1997
Trong Anh*INTRODUCTION À LA CHIMIE MOLÉCULAIRE*, Ellipses, 1994

Assessment

Score = 50% knowledge + 50% know-how
Knowledge score = 50% final exam + 50% continuous assessment
Know-how score = = 50% final exam + 50% continuous assessment

ELECTROCHIMIE ET CHIMITRONIQUE.

ELECTROCHEMISTRY AND CHEMITRONICS

Lecturers: Naoufel HADDOUR

| Lecturers : 12.0 | TC : 12.0 | PW : 8.0 | Autonomy : 12.0 | Study : 4 | Project : 0.0 | Language : FR

Objectives

Objectives of this course is to study the physicochemistry of electronic transfers at electrode/ electrolyte interfaces and concepts of electrochemical engineering. A large part of the course will be based on a concrete example of an industrial effluent treatment process. This course is mainly conducted in the form of problem-based learning, in group work, with individual evaluation at the end of the project.

Keywords : Butler-Volmer model, fuel cells, corrosion, electrolysis, battery

Programme

This course will be presented in the form of a case study to address the following concepts:
1) Electrochemical thermodynamics: Spontaneous and non-spontaneous redox reactions. Maximum and minumum voltages for galvanic and electrolytic systems.
2) Electrochemical kinetics: Butler-Volmer model with and without transport limitations. Tafel plot analysis. Linear and cyclic voltammetry.
3) Transport / Fluidic: Diffusion, migration, and convection of electroactive species in different systems.
4) Electrochemical reactors: Architecture, characterization and scaling.

Learning outcomes

- Differentiate between galvanic and electrolytic reactions.
- Determine electrochemical thermodynamic efficiency and voltage of a redox system.
- Determine key kinetic models used to characterize electrochemical devices.
- Design electrodes and operating conditions with favorable performance for specific applications.

Independent study

Objectifs :

Méhodes :

Core texts

Fabien MIOMANDRE, Saïd SADKI, Pierre AUDEBERT, *ÉLECTROCHIMIE DES CONCEPTS AUX APPLICATIONS*, Dunod, 2011
Hartmut WENDT, Gerhard KREYSA *GÉNIE ÉLECTROCHIMIQUE*, Dunod, 2001
François COEURET, Alain STORCK*ÉLÉMENTS DE GÉNIE ÉLECTROCHIMIQUE*, ParisTec et doc, 1993

Assessment

PHYSIQUE DES SEMICONDUCTEURS ET DES DIÉLECTRIQUES

DIELECTRIC AND SEMICONDUCTOR PHYSICS

Lecturers: Christelle MONAT

| Lecturers : 13 | TC : 16.0 | PW : 0.0 | Autonomy : 13 | Study : 6 | Project : 0.0 | Language : FR

Objectives

Semiconductor materials are part of our modern life and sustain our technologies for computers, communications, lightning or energy conversion. After a presentation of the main physics processes in semiconductors and the resulting electronic and optical properties of these materials, the course will describe various device applications of semiconductors in microelectronics and optoelectronics.

Keywords : Semiconductors, dielectric materials, devices, microelectronics, optoelectronics

Programme

1/ Cristalline properties and fabrication of semiconductor materials
2/ Electronic band structures in semiconductors
3/ Electrical conduction of semiconductors
4/ Charge transport mechanisms in semiconductors
5/ PN junctions and applications
6/ Metal/ semiconductor junctions and applications
7/ Optoelectronic devices for light detection
8/ Optoelectronic devices for light emission

Learning outcomes

- Being able to explain the distinction between the properties of metals, insulators, and semiconductors and the origin of these differences
- Being able to use the concepts that describe the properties of semiconductor materials
- Being able to describe the processes responsible for electron transport and photon/ electron interactions in semiconductors
- Being able to describe how various classes of semiconductor devices work (transistors, photodiode, solar cells, laser diode)

Independent study

Objectifs : Group assignment to learn more about a particular topic in link with semiconductor physics and its applications in microelectronics/ optoelectronics

Méhodes : Various topics will be suggested (photovoltaics, blue LEDs, graphene and 2D materials, silicon photonics...)
Oral presentations will be prepared by each group and delivered at the final BE

Core texts

Henry Mathieu, *PHYSIQUE DES SEMICONDUCTEURS ET DES COMPOSANTS ÉLECTRONIQUES*, 5ème édition, Dunod,, 2009
Emmanuel ROSENCHER *OPTOÉLECTRONIQUE*, Masson, 1998

Assessment

Final mark = 80% Knowledge + 20% Know-how
Knowledge = 100% final exam
Know-how = 100% final exam

ESTIMATION ET TRANSMISSION DE L'INFORMATION

OPTIMAL FILTERING AND INFORMATION TRANSMISSION

Lecturers: Eric BLANCO, Julien HUILLERY, Laurent BAKO

| Lecturers : 12.0 | TC : 18.0 | PW : 4.0 | Autonomy : 14.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The growth of communication and information processing systems has led to the emergence of new services. This development is based on an ever greater appropriation by the industrial world of information theory and signal processing methods whose theoretical bases have been presented in the first year course STI tc2. The objective of the course is to complete the presentation of the basics and methods of signal processing in order to acquire a complete set of tools to address the modeling, analysis and filtering of signals, as well as the operation of communication channels. These principles are found in applications such as telecommunications, software sensors or GPS positioning.

Keywords : Stochastic signals, Generator system, Wiener filter, Kalman filter, Information theory, Source entropy, Channel capacity, Coding theorems

Programme

Part I: Optimal filtering
1- Stochastic signal
2- Wiener filtering
3- Kalman filtering
Part II: Information Transmission
1- Elements of information theory
2- Entropy and source coding
3- Capacity and channel coding

Learning outcomes

- Modelling a signal and build a generator process.
- Design an optimal filter in the time or frequency domains.
- Implementing an entropic source coding scheme.
- Calculate the limits of performance of a communication system.

Independent study

Objectifs : Implementation and evaluation of a complete system of information transmission through a channel. The work includes the realization of the coding/decoding, modulation/demodulation and channel equalization steps.

Méhodes : Definition of specifications, signal / system modelling, implementation under matlab/simulink, implementation of an evaluation protocol of the proposed solutions.

Core texts

T. Assefi, *STOCHASTIC PROCESSES AND ESTIMATION THEORY WITH APPLICATIONS*, John Wiley & Sons, 1979
T. Cover, J. Thomas *ELEMENTS OF INFORMATION THEORY*, John Wiley & Sons, 2006
O. Rioul*THÉORIE DE L'INFORMATION ET DU CODAGE*, Hermes Sciences, 2007

Assessment

Final mark = 70% knowledge + 30% know-how
Knowledge = 80% final exam + 20% continuous assessment
Know-how = 100% final exam

ARCHITECTURES NUMÉRIQUES DE TRAITEMENT DE L'INFORMATION

DIGITAL ARCHITECTURES FOR COMPUTING AND INFORMATION PROCESSING

Lecturers: Ian O CONNOR

| Lecturers : 18 | TC : 10.0 | PW : 8.0 | Autonomy : 12 | Study : 0.0 | Project : 0.0 | Language : MI

Objectives

This course aims to study the hardware operation of digital electronic architectures for computing and information processing. It presents the components that are systematically present in digital architectures: control, data path and memory. The first part of the course will analyze the internal architecture of processors and the way in which they execute software instructions. The second part will focus on how (through the organization of the components) it is possible to improve the performance of the processor.

Keywords : Processors, datapath, software instructions, memory, pipeline architectures, cache memory

Programme

Architectural principles: von Neumann and (modified) Harvard, RISC, CISC
Datapath design, control and instruction flow
Instruction sets, memory, addressing types
Computing machine benchmarking.
Performance acceleration techniques: Pipeline, Cache memory

Learning outcomes

- Understand how a processor works
- Understand how processor hardware is programmed
- Understand the main performance metrics and parameters of architectures (memory footprint, speed, energy consumption)
- Know the main techniques to accelerate processor performance

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

John L. Hennessy, David A. Patterson, Morgan Kaufman, *COMPUTER ARCHITECTURE: A QUANTITATIVE APPROACH* , 2006
David A. Patterson, John L. Hennessy, Morgan Kaufman *COMPUTER ORGANIZATION AND DESIGN: THE HARDWARE/SOFTWARE INTERFACE* , 2008
David Harris, Sarah Harris*DIGITAL DESIGN AND COMPUTER ARCHITECTURE* , 2007

Assessment

Final mark = 50% Knowledge + 50% Know-how
Knowledge mark = 100% final exam
Know-how mark = 50% TP1 report + 50%TP2 report

CAPTEURS INTELLIGENTS COMMUNICANTS : SYSTÈMES D'INTERFACE

COMMUNICANT AND INTELLIGENT SENSORS

Lecturers: Cédric MARCHAND, David NAVARRO

| Lecturers : 16.0 | TC : 10.0 | PW : 8.0 | Autonomy : 14.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The objective of this course is to describe the different part of the acquisition chain in electronics systems (sensors, actuators, microcontroler). This course take example from modern sensing and communicating systems.

Keywords : Sensor, acquisition chain, microcontroler

Programme

0 - Introduction
1 - Sensors
2 - Filtering
3 - Conversion
4 - Modulation
5 - Microcontrolers

Learning outcomes

Independent study

Objectifs : Apply knowledge from lecture and exercises sessions to prepare lab sessions. Final report writing.

Méhodes : Exercise given before the Lab session.

Core texts

B.P. Lathi, *MODERN ANALOG AND DIGITAL COMMUNICATION SYSTEMS.*, Oxford university press, 1998
F. Cottet. *TRAITEMENT DU SIGNAL ET ACQUISITION DE DONNÉES*, Dunod, 2009
H. Mathieu, H. Fanet.*PHYSIQUE DES SEMICONDUCTEURS ET DES COMPOSANTS ÉLECTRONIQUES*, Dunod, 2009

Assessment

Final mark = 50 % Knowledge + 50% Know-how.
Knowledge mark = 100% final exam
Know-how mark = 100% continuous assessment

MATÉRIAUX ET TRAITEMENTS DE SURFACE INNOVANTS

MATERIALS AND INNOVATIVE SURFACE TREATMENTS

Lecturers: Stephane BENAYOUN, Stéphane VALETTE

| Lecturers : 16.0 | TC : 16.0 | PW : 4.0 | Autonomy : 12 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Keywords :

Programme

Learning outcomes

Independent study

Objectifs :

Méhodes :

Core texts

Assessment

ELECTRONIQUE DE PUISSANCE

POWER ELECTRONICS

Lecturers: Loris PACE, Arnaud BREARD

| Lecturers : 16 | TC : 10 | PW : 6.0 | Autonomy : 12 | Study : 4 | Project : 0.0 | Language : FR

Objectives

- Understand the interest and role of power electronics;
- Know : the fundamental concepts which govern this discipline, the main structures of electronic power converters;
- Be able to trace the shapes of currents and voltages in an electronic power converter from a block diagram;
- Be able to choose the electronic power switches for a given converter and specifications;
- Be able to assess the losses in an electronic power switch;
- Know the technologies used for the production of passive components in power electronics;

Keywords : Power electronics, static conversion of electrical energy, energy efficiency of systems, passive and active electronic components, EMC

Programme

Main introduction, concept of sources and switches, topologies of power converters.
Passive components in power electronics : Roles and importance
- Inductive components: Technology, Sizing
- Capacity components: Technologies, Choice criteria

Thermal problems in power electronics: Losses
Determination and implementation of control in power electronics:
- Close control of switches, Pulse width modulations

Electromagnetic compatibility (EMC): Introduction and generalities, EMC in power electronics, Conducted / radiated disturbances

Learning outcomes

- Understand the interest and role of power electronics
- Know the fundamental concepts which govern this discipline

Independent study

Objectifs : Autonomous work consists in sizing a system based on specifications and establishing a model that will validate this sizing. The system will be studied in pairs with a student following the electromechanical conversion module. It will be a converter - electromechanical actuator combination. Each student will therefore be able to take advantage of the teaching of his module and must be

Méhodes : Sizing a device using an analytical approach
Construction of a model and verification of the relevance of the design elements

Core texts

J.-P. Ferrieux, F. Forest, *ALIMENTATIONS À DÉCOUPAGE, CONVERTISSEURS À RÉSONANCE*, Masson
J.-L. Cocquerelle *CEM ET ÉLECTRONIQUE DE PUISSANCE*, Technip
R. W. Erickson, D. Moksimovic*FONDAMENTALS OF POWER ELECTRONICS*, Kluwer Academic Publishers

Assessment

Final mark = 75% Knowledge + 25% Know-how
Knowledge mark = 100% final exam + 0% continuous assessment
Know-how mark = 50% practical work + 50% autonomy work

ARCHITECTURES EMBARQUÉES ET INFORMATIQUE INDUSTRIELLE

EMBEDDED SYSTEMS ARCHITECTURES

Lecturers: David NAVARRO, Cédric MARCHAND

| Lecturers : 16.0 | TC : 10.0 | PW : 8.0 | Autonomy : 14.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The objective of this module is to describe the most commun computing systems in embedded system and industrial computing. Lecture and problem classes will be turn on the study of lightweight and modern computing systems with more details on the architecture and programming. Practical session will hightlight automotve and home automation applications.

Keywords : embedded electronic, microcontroler, architectures

Programme

- Introduction to analog, digital and mixed electronic
- programmable architectues : CPLD, FPGA
- microcontroler architectures (1)
- microcontroler architectures (2)
- microcontroler and DSP (Digital signal processing unit) architectures (3) and programming
- Processors and memory architectures and management
- Hardware and software architectures of wireless sensor network

Learning outcomes

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

C. Tavernier, Dunod, 978-2-10-049978-6, *MICROCONTRÔLEURS PIC - DESCRIPTION ET MISE EN ŒUVRE*

Assessment

Final mark = 70% Knowledge + 30% Know-how
Knowledge mark = 100% final exam
Know-how mark = 100% continuous assessment

BIOMÉCANIQUE DES TISSUS VIVANTS ET BIOMATÉRIAUX PROTHÉTIQUES

BIOMECHANICS OF LIVING TISSUE AND PROSTHETIC BIOMATERIALS

Lecturers: Clotilde MINFRAY, Thierry HOC, Vincent FRIDRICI

| Lecturers : 20.0 | TC : 4.0 | PW : 4.0 | Autonomy : 18.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

For developping artificial joint, it is necessary to know the properties of living materials to choose substitutes. This module proposes a detailed study of the mechanical properties of various living tissues (bone, skin, cell, organ, etc.). The choice of bio-compatible materials for artificial joint will then be discussed in particular the problems generated by the mechanical stresses and the surrounding environment (damage, biocompatibility ...). The aim of the course is to use notions of mechanics and materials science to justify the choices made today in terms of prostheses and bone reconstruction.

Keywords : Biomechanics, Biomaterials, Living tissues (bone), artificial joint

Programme

- Biomechanics.
- The bone : living and anisotropic materials.
- Soft tissues.
- From cell to organ.
- Biomaterials.
- Family of subtitutes materials (Ceramics, metals and polymers).
- Properties of biomaterials : biocompatibility, friction and wear, fatigue.
- BE: Synthesis of a scientific article on biomaterials .

Learning outcomes

- Identify mechanical law for living tissues.
- Know how to explain the process of bone regrowth.
- Know biocompatibility issues with materials.
- Know family of materials used in artificial joint.

Independent study

Objectifs : Case study to increase knowledge on a subject of your choice related to the course.

Méhodes : To be done in autonomy by group of two. A written report and an oral presentation are requested.

Core texts

B.D. Ratner , *BIOMATERIALS SCIENCE - THIRD EDITION. ACADEMIC PRESS, 2013*

Assessment

Mark = 50% knowledge + 50% know-how.
Mark knowledge = 100% final exam.
Mark know-how = 80% final exam + 20% continuous assessment.

COMMON CORE

GM - Mechanical engineering - S7

MODÉLISATION ET CONCEPTION

MECHANICAL DESIGN

Lecturers: Olivier DESSOMBZ, Francesco FROIIO

| Lecturers : 4.0 | TC : 4.0 | PW : 0.0 | Autonomy : 2.0 | Study : 10.0 | Project : 0.0 | Language : FR

Objectives

Give more advanced notions on the mechanics of solids and structures, having a direct link with applications.

Keywords : Dimensioning, truss, static, dynamic

Programme

- Course 1 and TD 1: Calculation of isostatic and hyperstatic lattices. Buckling.
- Course 2 and TD 2: Small movements in vibration. Clean modes, free response and forced response.
- Design office 1 and 2: Calculation of the coverage of a gymnasium (static sizing and dynamic analysis).

Learning outcomes

- Apply the concepts of structural statics to the design of a truss
- Apply the concepts of structural dynamics to the design of a truss.
- Use digital calculation platforms (Matlab, Scilab) for the analysis of structures.
- Report on the static and dynamic analysis of a structure.

Independent study

Objectifs : Finalize the work of the design office.

Méhodes : Group work: case study and report writing .

Core texts

Assessment

Score = 100% know-how
Know-how score = 100% continuous assessment.

CONCEPTION DE MÉCANISME

MECHANISMS DESIGN

Lecturers: Didier LACOUR

| Lecturers : 4.0 | TC : 4.0 | PW : 0.0 | Autonomy : 0.0 | Study : 12.0 | Project : 0.0 | Language : FR

Objectives

Knowledge and dimensioning of power transmission elements, particularly those used in ground transport, understand their operation and analyze their performance.

Keywords : power transmission, gearbox, vehicle, hydraulics transmission

Programme

- Elements of technology for power transmission.
- Epicyclic trains and applications.
- Gearboxes and drives.
- Hydraulics transmissions;
- Hybrid Vehicle Architectures.
- Three 4h Studies: Analysis of the operation of a DSG7 gearbox. Simulation of the operation of a gearbox and a DPC differential (with Catia software and applications). Analysis of the power transmission system of a 4x4 vehicle.

Learning outcomes

- Be able to perform functional analysis of a mechanical transmission system.
- Be able to analyse and simulate the operation of a mechanical transmission system.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Esnault F., *CONSTRUCTION MÉCANIQUE, TOME 1*, Dunod, 2009
Esnault F. *CONSTRUCTION MÉCANIQUE, TOME 2*, Dunod, 2009
Esnault F.*CONSTRUCTION MÉCANIQUE, TOME 3*, Dunod, 2009

Assessment

Final mark = 100% Know-how
Know-how mark = 100% continuous assessment

ACTIVITÉS PRATIQUES DE GÉNIE MÉCANIQUE

PRACTICTAL COURSES IN MECHANICAL ENGINEERING

Lecturers: Bertrand HOUX, Hélène MAGOARIEC, Olivier DESSOMBZ

| Lecturers : 0.0 | TC : 0.0 | PW : 20.0 | Autonomy : 0.0 | Study : 10.0 | Project : 0.0 | Language : FR

Objectives

The objective of the training action is to put into practice (know-how) the skills of the GM Teaching Unit. The objective of the technological product development project is to implement all the stages of design, manufacture and control of the geometric conformity of the components of a mechanical system. The other practicals aim to analyse the architecture of a real mechanical system, to carry out a performance diagnosis, according to the external stresses and the technological elements used to make the connections between solids or to put the system into action.

Keywords : Architecture of a mechanical system; Building elements; Design; Manufacturing; Metrology; Elastic sizing; Performance diagnostics.

Programme

- Discovery lab program - Technological analysis (4h)
- BE drawing - Technological project (2h)
- BE quotation - Technological project (4h)
- BE manufacturing - Technological project (2h)
- BE machining range - Technological project (4h)
- Machining TP - Technological project (4h)
- Dimensional metrology practical work - Technological project (4h)
- Design work in RdM (4h)
- Dynamic lab (4h)

Learning outcomes

- Knowing how to analyse the architecture of a mechanical system.
- Master the stages of design and manufacture of a mechanical system.
- To be able to control the geometric conformity of a mechanical system.
- To be able to diagnose the performance of a mechanical system.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Trotignon J.P., *PRÉCIS DE CONSTRUCTION MÉCANIQUE TOMES 1 ET 2*, Nathan, 2007
Brousse P. *MÉCANIQUE ANALYTIQUE*, Vuibert, Paris, 1981
Timoshenko S.P.*RÉSISTANCE DES MATÉRIAUX, TOMES 1 ET 2*, Dunod, Paris, 1990

Assessment

Final mark = 100% know-how
Know-how mark = 100% continuous assessment.

GÉNIE MÉCANIQUE TECHNOLOGIE-MÉCANIQUE GÉNÉRALE-RDM

MECHANICAL ENGINEERING

Lecturers: Olivier DESSOMBZ, Bertrand HOUX, Didier LACOUR, Emmanuel RIGAUD,

| Lecturers : 18.0 | TC : 22.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Approaching the design, dimensioning and construction of a mechanical system, as well as the study of its operation. The 1st part makes it possible to understand the architecture of a mechanical system from the description of the connections between the parts and to define the toleranced geometry of the functional surfaces. The 2nd part makes it possible to establish the equations of motion of a system of solids, from a Newtonian approach or a Lagrangian approach based on the principle of virtual power. The 3rd part makes it possible to dimension the slender deformable structures in stresses and displacements, from the internal forces induced by the loading and the reactions to the connections.

Keywords : Forces and connections, Functional dimensioning, Analytical mechanics, Principle of virtual power, Lagrange equations, Beam theory, Stress and displacement dimensioning

Programme

- Mechanical Technology Program: Forces and connections in mechanical systems. Functional specifications and product definition.
- General and analytical mechanics of rigid body systems: Description of the movement, fundamental principle, principle of virtual powers (PPV), model assumptions. PPV for a single solid, definition of the different torsors, kinetic energy theorem. PPV for a system of solids, diagramming of connections, Lagrange equations. Limits of the model.
- Strength of materials: Definition, diagram of a beam and model assumptions; inner efforts. Elastic sizing. Constitutive law. Limits.

Learning outcomes

- Knowing how to analyse the architecture of a mechanical system and its geometric description from technical drawings.
- Knowing how to design a mechanical system and define its rating that respects the conditions for proper operation.
- To be able to analyse the dynamic behavior of a system of rigid solids.
- Know how to size a slender part subjected to static loading.

Independent study

Objectifs : Understand and assimilate the course.

Méhodes : Complementary exercises to the tutorials available online, to be solved in self-assessment.
Corrected exercises available on the educational server.

Core texts

Trotignon JP, *PRÉCIS DE CONSTRUCTION MÉCANIQUE TOMES 1 ET 2*, Nathan,, 2007
Brousse P *MÉCANIQUE ANALYTIQUE*, Vuibert, 1981
Timoshenko SP*RÉSISTANCE DES MATÉRIAUX, TOMES 1 ET 2*, Dunod, 1990

Assessment

Final mark = 100% Knowledge
Knowledge = 84 % final exam + 16% continuous assessment

COMMON CORE

IDM - Materials Engineering - S7

TRAVAUX PRATIQUES EN SCIENCE ET GÉNIE DES MATÉRIAUX ET DES SURFACES

PRACTICAL COURSES IN MATERIAL AND SURFACE SCIENCE

Lecturers: Bruno BERTHEL, Fabrice DASSENOY, Gaylord GUILLONNEAU, Michelle

| Lecturers : 0.0 | TC : 0.0 | PW : 32.0 | Autonomy : 12 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The practical work of the IDM course provides the practical insight essential to the engineer's training and completes the notions developed in the course, relating to the three main families of construction materials: metals, polymers and ceramics. These practical exercises are grouped according to four themes: "Mechanical Behaviour of Materials", "Tribology and Surfaces", "Heat Treatment of Metal Alloys" and "Polymers and Composites".

Keywords : Mechanical behaviour of materials, tribology, heat treatment, metallic alloys, glasses, polymers and composites

Programme

Objectives (8h PW and 3h Aut. Per PW) : (i) Mechanical Behaviour of Materials: to introduce and practice the most commonly used tests to access the properties and mechanical behaviour materials. (ii) Tribology and Surfaces: to address, through a practical approach, some simple problems of wear and lubrication in a multidisciplinary framework combining mechanics, materials science and surfaces. (iii) Heat Treatment of Metal Alloys: to establish the relationships between chemical composition, heat treatment, microstructure and mechanical properties. (iv) Polymers and Composites: acquire knowledge of the processing of polymers and composites and then make the link between the process and the properties of the material.

Learning outcomes

- Know how to predict the mechanical properties of materials and their structures according to thermo-mechanical treatments
- Know how to identify the elaboration and treatment processes to adapt the properties of materials to a specification
- Know how to identify the relevant scale for a given property
- Be able to explain the basic principles of tribology (friction, wear, lubrication)

Independent study

Objectifs : Acquisition and oral restitution of knowledge, situational exercises and problem solving.

Méhodes : Personal and teamwork: reading documents, using databases, writing reports.

Core texts

J. Barralis, G. Maeder, *PRÉCIS DE MÉTALLURGIE*, Précis Afnor-Nathan, 2005
A. Dobraczinsky, M. Piperaud, J.-P. Trotignon, J. Verdu *PRÉCIS DE MATIÈRES PLASTIQUES*, Précis Afnor-Nathan, 2006
J.-P. Baïlon et J.-M. Dorlot *DES MATÉRIAUX*, Presses internationales polytechnique Montréal, 2002

Assessment

Final mark = 100% Know-how
Know-how mark = average of practical works maks

DE LA MATIÈRE AUX MATÉRIAUX : STRUCTURE ET PROPRIÉTÉS

FROM MATTER TO MATERIALS: STRUCTURE AND PROPERTIES

Lecturers: Bruno BERTHEL

| Lecturers : 8.0 | TC : 32.0 | PW : 0.0 | Autonomy : 6 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

This module introduces a basis grounding on the materials currently used, on their structures and properties as well as the characterization methods. In particular, the approach used will underline the relation between the properties (mechanical and physical) and the structure of the material at a relevant scale. This knowledge will enable the student to propose well-considered selection of materials in relation to the elaboration and manufacturing processes for a given application. Practical work (IDM tc2) completes this teaching.

Keywords : Mechanical behaviour of materials (elasticity, plasticity, fracture, fatigue, creep), crystallography, heat treatment, metallic alloys, glasses, polymers, composites, solid state physics, electrical conductivity.

Programme

General introduction to materials engineering (2h Lec.). | Chapter 1: Materials: mechanical properties, structure (10h TC and 2h Aut.) : mechanical behavior ont the macroscopic scale ; Interatomic bonds, structure and defects ; relation between mechanical properties and structure/defects. | Chapter 2: Families of materials: elaboration, modification of properties (2h lec., 14h TC and 2h Aut.) : Metals and metal alloys ; Polymers; Ceramics and inorganic glasses; Composites. | Chapter 3: Physical properties of materials (4h lec., 8h TC and 2h Aut.) : From Drude's model to Sommerfeld's free electron theory ; Nearly free electron model ; Electrical, thermal conductivity and magnetic properties of materials.

Learning outcomes

- To know the main families of materials and their specificity
- To know the materials processes and manufacture
- Be able to use the mechanical constitutive laws of materials (elasticity, plasticity, fracture)
- Know the physical properties of materials

Independent study

Objectifs : Acquisition and oral restitution of knowledge, situational exercises and problem-solving.

Méhodes : Personal and group work:
- Chapters 1 and 2: reading documents and doing exercises.
- Chapter 3: preparing an exercise and presentation during a tutorial

Core texts

J.-P. Baïlon et J.-M. Dorlot., *DES MATÉRIAUX*, Presses internationales polytechnique Montréal, 2002
M. Ashby et D. Jones. *MATÉRIAUX (TOMES 1 ET 2)*, Edition Dunod, 2008
C. Kittel*PHYSIQUE DE L'ÉTAT SOLIDE*, Edition Dunod, 2007

Assessment

Final mark = 100% Knowledge
Knowledge mark = 90% final exam + 10% continuous assessment

COMMON CORE

MSS - Solids Mechanics and Structures - S7

MÉCANIQUE DES SOLIDES DÉFORMABLES ASPECTS EXPÉRIMENTAUX

EXPERIMENTAL ANALYSIS IN CONTINUUM AND SOLID MECHANICS

Lecturers: Francesco FROIIO, Lyes NECHAK

| Lecturers : 0.0 | TC : 0.0 | PW : 16.0 | Autonomy : 0.0 | Study : 4.0 | Project : 0.0 | Language : FR

Objectives

(1) become aware of physical phenomena in mechanics,
(2) know different techniques for measuring useful variables in mechanics (extensometry, accelerometry, photoelasticimetry, stroboscopy, etc.),
(3) develop the practical implementation of theoretical concepts and thus promote their assimilation,
(4) knowing how to validate experimental results: critical analysis of the quality and relevance of the measurements carried out, comparing experimental results and results from theoretical or numerical approaches,

Keywords : Deformations, stresses, eigenmodes, resonance phenomenon, static and dynamic measurements, experimental and numerical methods, finite element method

Programme

Discovery lab
TP1: Study of the resonance phenomena of a flexible structure;
Practical work 2: Photoelasticimetry – Visualization of the stress field in 2D solids, measurement of stresses by photoelasticimetry.

Practical work Measurements and analysis
Practical work 3: Determination of the eigenmodes of continuous elastic structures;
Practical work 4: Extensometry (measurements by strain gauges) – Analytical examination, application to the determination of the stress field.

Learning outcomes

- Master the basic notions of deformations and stresses for the deformable solid
- Understand the link between assumptions, modeling and associated physical phenomena
- Know how to identify the elements of a measurement chain
- Know how to write a report of practical work and design office

Independent study

Objectifs : Be aware of the requirements and rigor of an experimental analysis.

Méhodes : Learning and mastering the instruments by direct handling during the measurement sequences, with assistance from the teachers

Core texts

Assessment

PLASTICITÉ, MISE EN FORME

PLASTICITY, FORMING

Lecturers: Christophe JANOLIN, Hélène MAGOARIEC

| Lecturers : 4.0 | TC : 4.0 | PW : 8.0 | Autonomy : 0.0 | Study : 4.0 | Project : 0.0 | Language : FR

Objectives

The aim is to raise awareness of the link between materials forming processes and elastoplastic properties of metallic materials. The first part of the course focuses on the main processes for metal forming: plastic metal stretching, foundry, etc. The second part of the course introduces the classical elastoplastic model. The objective is to understand the limits of the elastic model and the main issues to address in order to introduce plastic behaviour. The model is established following the interpretation of simple homogeneous mechanical tests (tension and tension-torsion) and a phenomenological approach. Practical works allow, among other things, an understanding of the influence of the metal forming process on the elastoplastic properties.

Keywords : Plastic metal forming, foundry, Yield stress, Elastic strains, Plastic strains, Isotropic hardening, Kinematic hardening, Yield criterion, Normality rule.

Programme

2 courses to present the basic concepts + 2 exercises to practice these notions on elastoplastic structures + 3 practical works:
- PW1 - Metal forming: sand casting, permanent mould, machining operation with cutting tool
- PW2 - Behaviour identification: identification of the elastoplastic properties of the materials formed during PW1 (tension and torsion mechanical tests); Study of the influence of forming process on these mechanical properties.
- PW3 - Structural design: finite element analyses of structures made of material identified during PW2.

Learning outcomes

- To know how to perform two foundry processes.
- To understand phenomenological plasticity.
- To know how to manage experiments to identify the elastoplastic behavior of materials.
- To know how to interpret results of an elastoplastic finite elements simulation.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

R. Hill, *THE MATHEMATICAL THEORY OF PLASTICITY*, Oxford University Press, 1998
P. Suquet *RUPTURE ET PLASTICITÉ*, Ecole Polytechnique, 2006
J.J. Marigo*PLASTICITÉ ET RUPTURE*, Ecole Polytechnique, 2012

Assessment

Final mark = 100% know-how.
Know-how mark = 100% continuous assessment

MAQUETTAGE NUMÉRIQUE

DIGITAL MOCK-UP

Lecturers: Didier LACOUR

| Lecturers : 2.0 | TC : 0.0 | PW : 0.0 | Autonomy : 4.0 | Study : 14.0 | Project : 0.0 | Language : FR

Objectives

The aim of this training course is to enable engineers to understand the various aspects of digital modelling (volume and surface modelling, integration with simulation (kinematics, calculation, manufacturing, etc.), which are necessary in particular for other training Two Mechanical and Mechanical Engineering Units of Solids and Structures.

Keywords : Digital Mock-Up, Numerical modelling, Simulation, Finite element calculations, PLM, Bézier surfaces, Modelling curves and surfaces

Programme

- Mathematical modeling of pole surfaces.
- Getting Started with the Catia V5 Software (Part Design).
- Surface modelling with Catia V5.
- Information about the 100% web-based Onshape solution.
- Mini-project: Implementation of modelling, simulation and calculation tools on a concrete problem of design or optimization of a technical system.

Learning outcomes

- Be able to model a technical solution using computer tools.
- Know how to manipulate current modelling and simulation tools.
- To be able to understand all the scientific and technical aspects of a project.
- Knowing the software tools of numerical modelling used in industry.

Independent study

Objectifs : Objectives: Develop and deepen the subject of the mini-project.
Methods: CAD sessions with teacher assistance.

Méhodes :

Core texts

Pierre Bezier, *L'UTILISATION DES COURBES ET SURFACES EN CAO*, Hermes Sciences Publicat, 1988
Jean-Claude Fiorot *L'UTILISATION DES COURBES ET SURFACES EN CAO*, Dunod, 1989
Dassault Systemes *MANUEL UTILISATION CATIA V5*, Dassault Systemes , 2020

Assessment

Final mark = 100% Know-how
Know-how mark = 100% continuous assessment

COMPLÉMENTS DE DYNAMIQUE DES STRUCTURES, OPTIMISATION

STRUCTURAL DYNAMICS

Lecturers: Sebastien BESSET

| Lecturers : 4.0 | TC : 4.0 | PW : 4.0 | Autonomy : 0.0 | Study : 8.0 | Project : 0.0 | Language : FR

Objectives

The aim of this course is to deepen the techniques of modal synthesis: truncation effects, structural modifications, and to extend the dynamic models to the situations of structures subjected to large displacements and / or combined loads, to anticipate and control the associated phenomena during the design process: risks of instability and floating. The pedagogical content is based on additional training in the form of courses and TD, a practical session on the effect of a static pre-load on the dynamic behavior of a structure and a project which will serve as a support example.

Keywords : Component mode synthesis, large displacements, prestress loading

Programme

- Modal synthesis: description of the dynamic behavior of a structure based on the eigenmodes. Definition of the number of modes taken into account depending on the domain Frequency of excitation, effects of modal truncation. Prediction of the effect of a localized structural change.
- Large displacements, static pre-stresses: equations on simple cases, qualitative prediction of the expected phenomena, implementation of simulations.
- TP: modifications of the eigenmodes of a structure subjected to a static loading increasing. Buckling phenomenon.
- BE: project to design a structure or to simulate the behavior of a structure.

Learning outcomes

- To be able to propose a model of predictive simulation of dynamic behavior of a structure.
- To be able to gather the necessary information and estimate their degree of importance and reliability.
- To know how to evaluate the validity limits of a model.
- To understand the concepts necessary for the use of a dynamic computation code

Independent study

Objectifs : Students are faced with a modelling problem in a quasi-industrial application.

Méhodes : The teacher presents the problem and intervenes as a resource.

Core texts

T. Gmür, *DYNAMIQUE DES STRUCTURES : ANALYSE MODALE NUMÉRIQUE.*, Presses Polytechniques et Universitaires Romandes, 1997
Michel Géradin, Daniel Rixen *THÉORIE DES VIBRATIONS, APPLICATION À LA DYNAMIQUE DES STRUCTURES.*, Elsevier-Masson, 1999
Olgierd Cecil Zienkiewicz*LA MÉTHODE DES ÉLÉMENTS FINIS*, McGraw Hill, 1979

Assessment

Final mark = 67% Knowledge + 33% Know-how
Knowledge N1 = 100% continuous assessment
Know-how N2 = 100% continuous assessment

MÉCANIQUE DES SOLIDES DÉFORMABLES

CONTINUUM MECHANICS OF SOLIDS

Lecturers: Olivier BAREILLE, Fabrice THOUVEREZ, Joël PERRET LIAUDET

| Lecturers : 16.0 | TC : 14 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Keywords :

Programme

Learning outcomes

Independent study

Objectifs :

Méhodes :

Core texts

J. Salençon, *MÉCANIQUE DES MILIEUX CONTINUS – TOME 1*, Ed. de l'Ecole Polytechnique, 2005
M. Géradin, D. Rixen *THÉORIE DES VIBRATIONS – APPLICATION À LA DYNAMIQUE DES STRUCTURES*, Elsevier-Masson, 1999
G. Dhatt , G. Touzot, E. Lefrançois*MÉTHODE DES ÉLÉMENTS FINIS*, Lavoisier Hermès Science Publications, 2005

Assessment

COMMON CORE

PCM - Physics and Chemistry of Matter - S7

TRAVAUX PRATIQUES CHIMIE-PHYSIQUE, PHOTONIQUE

LAB SESSIONS PCM

Lecturers: Christelle YEROMONAHOS, Anne LAMIRAND

| Lecturers : 0.0 | TC : 0.0 | PW : 24.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

This training makes it possible to grasp through experience, and therefore in a more intuitive way, fundamental concepts tackled in the "UE PCM" and to see their applications, particularly in the industrial field. It also makes it possible to tackle important concepts for an engineer, related to measurement and in particular to the development of measurement protocols.
It is given only in the form of practical works.

Keywords : Nanotechnology, Imaging, Laser, Spectroscopy, Chromatography, Chemical kinetics, Electrochemistry, Intermolecular bonds

Programme

- Students will follow 3 practical works (TP) in physics: Frequency analysis - Fourier optics. Infrared thermography / solar cell. Spectrophotometry.
- The students will follow 3 practical works (TP) in chemistry: Electrochemical study of galvanic corrosion of metals. Study of redox reactions by UV-Visible spectrophotometry - Chemical kinetics. Gas chromatography.

Learning outcomes

- C2N1 (chemistry): Defines a system and its boundaries, identifies the phenomena involved and proposes a simple model. Formulate the hypotheses.
- C2N3 (chemistry): Characterizes the complexity of a system, identifies interactions and sources of uncertainty.
- C3N3 (chemistry): Communicates in a synthetic way in writing and orally to report and enhance the results.

Independent study

Objectifs : Prepare for practical work.

Méhodes : Reading documents on the intranet.
Questionnaire to be completed and included in the TP report.

Core texts

Assessment

Score = 20% knowledge + 80% know-how. Knowledge score = preliminary test. Know-how score = 37.5% report + 62.5% handling and participation.

CHIMIE

CHEMISTRY

Lecturers: Virginie MONNIER-VILLAUME, Naoufel HADDOUR

| Lecturers : 8.0 | TC : 12 | PW : 0.0 | Autonomy : 5.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

This lecture aims to provide bases in chemistry and physico-chemistry of materials necessary to understand properties of materials at the microscopic scale (kinetics, reactivity, thermodynamics, weak bonds, electrochemistry). Applications such as new materials to produce energy (organic solar cells), power plants or vehicles working with renewable fuels, will be used to illustrate quantum chemistry and molecular interactions notions.

Keywords : Chemistry, materials, molecular orbitals, statistical thermodynamics, weak bonds, kinetics, electron transfer

Programme

- Quantum model of the chemical bond.
- Introduction to statistical thermodynamics.
- Chemical reactivity and elements of chemical kinetics.
- Electron transfer at interfaces.
- Weak bonds.

Learning outcomes

- Build and use a diagram of molecular orbitals for a molecular structure.
- Make the link between physico-chemical properties at the macroscopic and at the microscopic scale of the matter.
- Identify molecular interactions and binding energies involved in a molecule.
- Select adapted theoretical knowledge to be applied to concrete new problems in chemistry.

Independent study

Objectifs : Learn and digest basic notions before each lecture, to use them between lectures and tutorials. Understand the links between the different notions of the lecture. Remobilize lecture concepts in concrete new situations.

Méhodes : Reading of the duplicated lecture notes and self-evaluation with the corrected exercises on Moodle platform.

Core texts

Michel GUYMONT, *STRUCTURE DE LA MATIÈRE. ATOMES, LIAISONS CHIMIQUES ET CRISTALLOGRAPHIE*, Belin, 2003
P. W. ATKINS, J. DE PAULA *CHIMIE PHYSIQUE*, De Boeck, 2013
J. P. PEREZ, A. M. ROMULUS*THERMODYNAMIQUE. FONDEMENTS ET APPLICATIONS.*, Masson, 2001

Assessment

Final mark = 100% Knowledge.
Knowledge = 70% final exam + 30% continuous assessment.

PHYSIQUE

PHYSICS

Lecturers: Emmanuel DROUARD, Anne-Segolene CALLARD, Magali PHANER

| Lecturers : 16.0 | TC : 22.0 | PW : 0.0 | Autonomy : 5.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The aim of this course is to provide the basic knowledges of quantum physics necessary to describe both the matter at microscopic scale and the main processes of radiation - matter interaction (emission, diffusion, absorption). These processes will be addressed both from classical and quantum point of view, and studied in particular in the frame of applications such as light sources and detectors, and lasers.

Keywords : Quantum mechanics, atomic and nuclear physics, photon - matter interactions, wave propagation in media

Programme

- Wave propagation, dispersion.
- Classical description of electromagnetic waves/material media interactions: optical properties of dielectrics and metals.
- Limits of classical physics.
- Wave - particle duality. Schrödinger equation and applications.
- Atomic and molecular physics. Physics of the nucleus.
- Semiclassical/quantum description of the photon matter interaction.
- Light sources and detectors.
- Principles of laser. Properties and applications of lasers.

Learning outcomes

- To be able to apply the Schrödinger equation to simple systems.
- To know how to rely macroscopic properties of matter to their microscopic origins.
- To know how to describe the different radiation - matter interactions.
- To be able to give the orders of magnitude of the energies implied in these interactions.

Independent study

Objectifs : Understanding and assimilating the course.

Méhodes : Now how to remake and interpret tutorials.
On line exercises & multiple choice training.
Microtest and Questions/Answers session with teachers.

Core texts

B. Cagnac, *ATOMES ET RAYONNEMENT, INTERACTIONS ÉLECTROMAGNÉTIQUES*, Dunod, 2005
B. Cagnac *L'ATOME, UN ÉDIFICE QUANTIQUE.*, Dunod, 2007
B.E. Saleh, M.C. Teich*FUNDAMENTAL OF PHOTONICS*, Wiley, 2007

Assessment

Mark=100% knowledge. Mark of knowledge = 85 % final exam + 15%.

COMMON CORE

SHS - Human and social sciences - S7

ETHIQUE

ETHICS

Lecturers: Romain SAUZET, Nicolas HOURCADE

| Lecturers : 14.0 | TC : 4.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

This course deals with ethical issues related to engineering professions, and, more broadly, to contemporary sciences and technologies. Ethics is an irreducible dimension of human action, with regard to its responsibilities, in various fields: personal or professional, individual or collective. Philosophy helps to analyze and understand the choices to make the best decisions in complex and unique situations.

Keywords : Ethics ; Morality ; Responsibility ; Technology

Programme

- Course 1 - Introduction
- Course 2 - What is a value?
- TD 1: The Ethics of Discussion
- Course 3 - Values and Technique
- Lessons 4 & 5 - The major ethical resolutions
- Course 6 - Values and problems of the engineering world
- Course 7 - Environmental ethics
- TD 2: The Ethics of Artificial Intelligence

Learning outcomes

- Understand ethical issues of engineering practices.
- Understand interest and limits of the professional deontology.
- Formalise a problem and identify the difficulties generated by an unpredictable and uncertain context.
- Being able to differentiate and articulate moral and ethical strategies.

Independent study

Objectifs : Documents'analysis (text or film).

Méhodes : TD1: analyse of extracts from a film related to the content of the ethics course. Instructions given at the beginning of the TD.
TD2: Upstream analyse of documents and answer to questions on them. The students have to present their work done in groups during the TD.

Core texts

Flandrin, Laure & Verrax, Fanny, *QUELLE ÉTHIQUE POUR L'INGÉNIEUR ?*, Charles Léopold Mayer., 2019
Billier, Jean-Cassien *INTRODUCTION À L'ÉTHIQUE*, PUF, 2014
Johnson, Deborah G. *ENGINEERING ETHICS. CONTEMPORARY AND ENDURING DEBATES*, Yale University Press, 2020

Assessment

Final mark = 100% Knowledge
Knowledge mark = 100% final exam

TRAVAILLER AUJOURD'HUI

WORK IN THE CONTEMPORARY SOCIETIES AND COMPAGNIES

Lecturers: Nicolas HOURCADE, Jacqueline VACHERAND REVEL

| Lecturers : 14.0 | TC : 4.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

This course questions the place occupied by work in our Western societies through the taking of a sociological perspective on contemporary organizations, their management's modes and the roles played by engineers. The objective is to empower students with organizations analysis tools which they can apply to their own experiences in companies: in which they have been (during their work internship) or will be (during their future internships and professional life) confronted. More than practical advices, this teaching aims to achieve an awareness of the various issues they will encounter during their professional life, such as operating methods and processes at work, opportunities and choices implied by the forms of management.

Keywords : Work, organizations, companies, management, psychosocial risks, health and safety at work, engineers, managers.

Programme

The course covers several topics:
- How and to what extent work structures Western societies.
- The evolution of the forms of organisation and management of companies by detailing current methods.
- Focus on the situation of engineers and managers in organizations.
- The TDs deepen these themes, through the study of documents (films, texts ...). In particular, focusing on the theme of professional stress and psychosocial risks at work.

Learning outcomes

- Understand what work means and represents in our societies.
- Understand the organizational context of companies.
- Understand the engineers' place in companies.
- Being able to understand the links between the organizational modes of companies to the social and economic context.

Independent study

Objectifs : Documents' analysis (text or documentary).

Méhodes : TD1: excerpts analyses from a documentary film highlighting the management methods of a company. Instructions given at the beginning of the TD.
TD2: upstream analyse of documents on psychosocial risks at work and questions. This work is done in groups of a few students. They then have to

Core texts

Assessment

Final mark = 100% Knowledge
Knowledge mark = 100% final exam

INDIVIDUS ET SOCIÉTÉ

INDIVIDUALS AND SOCIETY

Lecturers: Nicolas HOURCADE, Jacqueline VACHERAND REVEL

| Lecturers : 20.0 | TC : 4.0 | PW : 0.0 | Autonomy : 0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

From the study of a general theme ("Individuals and Society"), this course aims to present the approaches of the Human and Social Sciences, as for their modes of investigation and their fundamental concepts. Beyond an introduction to social psychology and sociology, the goal is to provide students tools to analyse the human and social situations they face. Far from providing them with ready-made answers, the intention is to lead them to carry out a questioning that is well-constructed and well-argued serving their understanding of human and social issues. A secondary objective consists in enhancing the capabilities of the students to analyse a human sciences 'text, and, more broadly, of topicality.

Keywords : Psychology, sociology, individuals, society

Programme

The lectures include sessions in social psychology and sociology. The main topics discussed are: the Human and Social sciences point of view; the deconstruction of social representations; the influence of groups on individuals and social change; the construction of social norms, socialization and forms of deviance; the coexistence of an egalitarian society and social inequalities...

Learning outcomes

- Being able to use the point of view of the human and social sciences to analyse the society.
- Being able to question one's representations about the world and society.
- Question the social construction process of individuals and groups.
- Understand and analyse a topicality document on a current issue.

Independent study

Objectifs : Learn to analyse a social science or news text.

Méhodes : Students are required to read and analyse texts before each class. A text analysis method is available on Moodle.

Core texts

Assessment

Final mark = 100% Knowledge
Knowledge mark = 100% final exam

COMMON CORE

LC - Modern Languages - S7

ESPAGNOL S7

SPANISH

Lecturers: **Nathalie PASTOR**

| Lecturers : 0.0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Keywords :

Programme

Learning outcomes

Independent study

Objectifs :

Méhodes :

Core texts

Assessment

Final mark = 100% know-how
Know-how = 50% final exam + 50% continuous course work assessment.

ANGLAIS S7

ENGLISH

Lecturers: Alain DOUGNAC-GALANT

| Lecturers : 0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

- Bringing all the students to the level required for validation (590 IPT TOEFL, 825 TOEIC, 7 IELTS). This level is the B2 level of CEFRL ("Independent User - Vantage").
IMPORTANT: the English course is compulsory for students below the threshold level.
- Bringing as many students as possible up to the C1 level of CEFRL ("Proficient User - Effective Operational Proficiency")
- Extending knowledge of the Anglo-Saxon world and of its diversity.
- Improving methodological and rhetorical skills to achieve structured thinking and precise expression.

Keywords : TOEFL, grammatical consolidation, expanding vocabulary, basic linguistic competences, interactivity, debating, civilisation, Anglo-Saxon, United States, United Kingdom, methodology, rhetoric, adjustment, efficiency, credibility, excellence

Programme

- Intensive oral-comprehension exercises (long and demanding material)
- Speaking in small student groups: mini-dialogues, simulations, debates, presentations.
- Preparing for the TOEFL ITP test.
- Depending on levels: Revising grammar, expanding vocabulary and idioms, and improving pronunciation. Studying the civilisation of Anglo-Saxon countries. Notably, acquiring the knowledge and using the interpretative tools to understand the American society from a political, economic, social, societal, geopolitical, and cultural angle. Making students aware of global environmental and social issues.

Learning outcomes

- Understanding oral and written English.
- Interacting and expressing oneself in English whatever the context.
- Comprehending the cultural and civilisational features of the Anglo-Saxon world.
- Participating to and leading a debate.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Assessment

Final mark = 100% know-how
Know-how = 50% final exam + 50% continuous course work assessment.

S07_LC_J_0

JAPONAIS S7

JAPANESE

Lecturers: Mariko NICOL-AKUTSU

| Lecturers : 0.0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Japanese courses are mainly intended for non-beginners (at least one year of learning the language). They continue to discover the Japanese language and culture, and deepen their understanding of basic grammar and key linguistic features. This is to reach a sufficient level for a stay in Japan (S8, double degree, internship in a Japanese company). We always encourage students to take the JLPT (Japanese Language Proficiency Test, issued by the Japan Foundation).

Keywords : Hiragana, Katakan, Kanji, culture, business Japanese

Programme

- The courses are provided with various materials, textbooks, vocabulary and ideogram lists, audio resources, etc.
- 5 hours of weekly classes (3.5 hours of grammar and 1.5 hours of conversation): the teaching aims at continuing the acquisition of current vocabulary and new kanji but also at consolidating grammatical knowledge.

Learning outcomes

- Understanding texts on common subjects written in Kana and basic Kanji.
- Conducting a simple conversation and expressing simple opinions.
- CEFRL A2/A2+.
- JLPT 4.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

, *MINNA NO NIHONGO 1*, 3A Corporation, 2012

Assessment

Final mark = 100% know-how
Know-how = 50% final exam + 50% continuous course work assessment

FRANÇAIS S7

FRENCH AS A FOREIGN LANGUAGE

Lecturers: Florence MILON

| Lecturers : 0.0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The main objective is to enable students to follow the courses given at École Centrale de Lyon, to be self-reliant in everyday situations and to make the most of their stay in France.
French in 2nd Year is taught through 3 levels with linguistic and sociocultural objectives. The course provides the tools for understanding and communicating about topical and social issues, for interacting with French people on the campus and at work. Foreign double-degree students who have not graduated from secondary school in France have to obtain, during their 2nd year (March session), at least a DELF B2 level to validate their degree.

Keywords : Integration, autonomy, communication, interactions, immersion, cross-cultural communication and comprehension, international, culture, cultural practices, social issues, academic life, working life, multimedia.

Programme

During semester 7, the focus is on professional life, on social issues (environment, sustainable development, ethics…) broached through cross-cultural presentations, and on preparation for DELF and DALF tests.

Learning outcomes

- CEFRL (from B2 to C2), with special focus on interaction and on cultural or cross-cultural competences.
- Reading comprehension and written expression : reading newspaper articles, novels, writing letters, CVs, essays, abstracts, reports.
- Oral expression : pair-work, group-work (thematic presentations on society, debates).
- Oral comprehension (mainly through authentic audio and video material : radio, TV, films).

Independent study

Objectifs : Follow-up work, alone or through pair-work to develop learning and memorizing techniques.

Méhodes : Autonomous work on articles, novels, novel extracts, film extracts, TV reports or dedicated language exercises. Presentations, individual or group projects.

Core texts

Assessment

Know-how = 50% final exam + 50% continuous assessment.

ARABE S7

ARABIC

Lecturers: **Florence MILON**

| Lecturers : 0.0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Introduction to writing and to communication in Arabic, acquisition of knowledge about Arab culture.

Keywords : Discovering, curiosity, cross-cultural communication, cultural practices, Arab civilization.

Programme

There are two levels : a beginner's course and an intermediate course (both two hours per week).
The course focuses on classical Arabic, the language of the press and of the media and on Modern Standard Arabic.

Learning outcomes

- Oral understanding and expression (dialogues and expression in Modern Standard Arabic).
- Learning vocabulary through games.
- Learning to write (calligraphy).
- Learning about culture (discovering the socio-cultural environment, ethnic groups, religions, civilization, music and arts).

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Assessment

Final mark = 100% know-how
Know-how = 50% final exam + 50% continuous course work assessment.

ALLEMAND S7

GERMAN

Lecturers: Waltraut WUNDER

| Lecturers : 0.0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

- Level A1 : Acquisition of basic lexical and grammatical skills. Understanding and use of familiar everyday expressions.
- Level A2: Consolidation of bases.Use of language in a everyday and professional context.
- Level B1/B2: Reinforcement of bases. Learning about the culture of German-speaking countries.
- Level B2+: Development of oral skills and learning about culture in the wider context.
- Level C1/C2: In depth oral, written and cultural skills, deeper awareness of cross-cultural issues.

Keywords : Cross-cultural, Franco-German relations, project work, news topics, cross-disciplinary approach, culture, work life and exploration of German businesses

Programme

- The focus is on professional life (work life, job-application, the German economy and industry, important industrial themes, such as energy, sustainable development, car industry, new technologies).
- 3rd-year or Double-Degree students are offered additional tuition to prepare for their mobility programme and for the Goethe Institute examinations (levels : B1 or B2/C1).
- Organised study trip to Freiburg.

Learning outcomes

- CEFRL (from A1 to C2), acquiring all competences of expression and understanding.
- Being able to interact in personal and professional situations.
- Developing cultural and cross-cultural skills.
- Developing learning and memorising skills.

Independent study

Objectifs : Follow-up work and teamwork.

Méhodes : Preparation and follow-up work before and after group sessions. Work supervision, use of the Padlet and Quizlet platform, project work and group work.

Core texts

Assessment

Final mark = 100% know-how
Know-how = 50% final exam + 50% continuous course work assessment.

ITALIEN S7

ITALIAN

Lecturers: Florence MILON, Francesco GIANNETTO

| Lecturers : 0.0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The main objective is to enable students to be self-reliant in everyday situations, in an academic or professional setting. Courses are taught in Italian right from the beginning to acquire immersive comprehension skills. Classes are interactive to enable students to express themselves and speak with each other.

Keywords : Communication, immersion, interaction, simulation, multimedia, culture, arts, task-based approach, projects, exchanges, international, cross-cultural communication and comprehension

Programme

Level 1 : beginners, 3 hours per week. Acquiring basic skills to understand and be understood.
Level 2 : students who have started Italian in the first year, 2 hours per week.
Level 3 : students with low competence acquired in secondary school who wish to study Italian in the 2nd year, one and a half hour per week.
Reaching the threshold level required for an academic or professional experience in Italy.
Level 4/5 : students with medium competence acquired in secondary school and those from European secondary-school programs, one and a half hour per week.
Understanding (all media), note-taking, summaries, debating. Preparation for the CELI.

Learning outcomes

- CEFRL (from A2 to C1), with special focus on interaction and on cultural or cross-cultural competences.
- Communicating with Italians.
- Getting ready for a stay in Italy.
- Learning about Italian culture.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Assessment

Final mark = 100% know-how
Know-how = 50% final exam + 50% continuous course work assessment.

RUSSE S7

RUSSIAN

Lecturers: Florence MILON

| Lecturers : 0.0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Russian courses in 2nd year are meant for students who have started Russian in the first year and non-beginners (who have studied Russian in high school).
Language learning may pave the way for a double degree with a Russian university or for internship in Russia. Learning about Russia will help discover the country and move beyond classic stereotypes.

Keywords : International mobility, academic life, cross-cultural communication, cultural practices.

Programme

- Level 2 (A2/B1), for students who have started Russian in the first year, 2 weekly hours.
Expanding basic vocabulary and basic grammar, discovering the cultural background.
- Level 3-4 (B1/B2), for students who have already studied Russian in high school, one and a half hours of class per week.
Learning about the sociocultural environment, with a focus on social issues and the news (everyday life, the economy, cultural features...).

Learning outcomes

- Developing oral and written comprehension on topics related to everyday life and campus life.
- Learning to speak and write on topical issues.
- Using language skills in specific situations.
- Learning about culture.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Maria Zeltchenko, *KOHTAKT! MÉTHODE DE RUSSE POUR DÉBUTANTS. LANGUE ET CIVILISATION*, Ellipses marketing, 2017
Monika Brosch *JASNO B1*, Klett Sprachen GmbH, 2015

Assessment

Final mark = 100% know-how
Know-how = 50% final exam + 50% continuous course work assessment.

CHINOIS S7

CHINESE

Lecturers: **Cheng SUN**

| Lecturers : 0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The Chinese course is for those who wish to discover the Chinese language, culture and civilisation and/or who want to prepare for a stay in China (semester 8, internship, 3rd year or double degree). There are 4 weekly hours over 3 years. The course aims at developing oral skills, oral comprehension, written expression and at discovering the various feature of Chinese culture. Students may prepare for the HSK (Chinese-language proficiency test).

Keywords : Chinese characters, Pinyin, business Chinese, cultural immersion, interaction, international mobility

Programme

- A2/B1 : learning more vocabulary and grammar, expanding oral skill through cross-cultural situations. Preparing for HSK level 2.
- B1/B2 : expanding language skills (in various fields and more complex situations), learning about the cultural and socio-economic background. Preparing for HSK level 3 .

Learning outcomes

- Developing oral expression and master a conversation in Chinese.
- Developing oral comprehension.
- Developing writing skills.
- Learning about culture.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Arslangul Arnaud, Lamouroux Claude, Pillet Isabelle, *NI SHUO NE ? ET LES CAHIERS D'ACTIVITÉS 1 ET 2*, Editions Didier
Arslangul Arnaud, Jin Yezhi, Lamouroux Claude, Pillet Isabelle *NI SHUO BA! ET LE CAHIER D'ACTIVITÉS*, Editions Didier

Assessment

Final mark = 100% know-how
Know-how = 50% final exam + 50% continuous course work assessment.

PORTUGAIS S7

PORTUGUESE - BRAZIL

Lecturers: Florence MILON

| Lecturers : 0.0 | TC : 0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Brazilian Portuguese classes are for beginners and false beginners. They will learn a new language, discover the various features of a continent-scale country and move beyond classic stereotypes. Portuguese is easy for Romance-language speakers. Mastery of the language opens the door to a double degree or an internship in Brazil.

Keywords : Brazil, Portugal, Angola, Macao, Portuguese-speaking countries, Latin America, Mercosur, academic and professional life, cross-cultural communication, cultural practices.

Programme

Courses focus on communication, oral and written comprehension through varied classroom activities (roleplays, simulations, presentations, debates, pronunciation) and studying the main historical, political and sociocultural features of Brazil.
A1-A2 : acquisition of language and cultural skills in familiar situations, to meet immediate needs in everyday contexts.
A2+-B1 : expanding skills to communicate easily in familiar, academic and professional situations.

Learning outcomes

- CEFRL (from A1 to B1), with special focus on interaction and on cultural or cross-cultural competences.
- Learning enough skills for academic and/or professional immersion.
- Apprehending the various realities of modern Brazil.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Assessment

Final mark = 100% know-how
Know-how = 50% final exam + 50% continuous course work assessment.

COMMON CORE

STE - Stage d'exécution - S6-S7

S06_STE_TC_0

STAGE D'EXÉCUTION - S6

FIRST YEAR TRAINING

Lecturers: Nicolas HOURCADE, Olivier BAREILLE

| Lecturers : 0.0 | TC : 0.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The aim of the work placement is to introduce the student to the organisation of a company, the nature of the work performed and the relationships between workers and managers. This internship consists of the performance, for a minimum of four weeks, of the work of a worker within a team of workers.
The educational objectives are twofold:
- to discover the world of the company ;
- to actively participate in a work group.

Keywords : Internship, company, organisation, management, workers, hierarchical relations

Programme

Learning outcomes

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Assessment

Final mark = 100% Know-how
Know-how mark = 100% continuous assessment

COMMON CORE

PRO - The engineering Profession - S5-S6-S7

OUVERTURE AUX ENJEUX DE LA TRANSITION ÉCOLOGIQUE

OUVERTURE AUX ENJEUX DE LA TRANSITION ÉCOLOGIQUE

Lecturers: Cécile LACOIN, Christian VOLLAIRE

| Lecturers : 10 | TC : 6 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Keywords :

Programme

Learning outcomes

Independent study

Objectifs :

Méhodes :

Core texts

Assessment

PROJET APPLICATION - INDUSTRIEL

PROJECT FOR INDUSTRIAL APPLICATION

Lecturers: David LENOIR

| Lecturers : 0.0 | TC : 50 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The Industrial Application Project (PAi) is aimed at students who wish to confront the reality of engineering work in all its operational complexity. They will have to respond to the request of a sponsor outside the school (large groups, SMEs/SMIs, public operators, start-ups, etc.) by offering them a project-process characterized around the cost/quality/deadlines triptych. Once the definition of this project has been validated, they will ensure its management and execution based on efficient reporting in order to adapt the proposed process to the difficulties encountered.
It is therefore a truly professional experience that is offered to students by the PAi, with a great diversity in the

Keywords : Work in project mode.

Programme

The PAi takes place in S7 and continues in S8 for a total of 75 hours. Supervised by a project adviser, the students will begin with an immersion and listening phase in order to fully understand the problem submitted to them and especially its context. They will then be able to propose and validate with their sponsor their Project Management Referential (PMR) for the end of November. The project execution and management phase will then begin, with a first meeting at the end of January which will give rise to an evaluation for the S7, then a final presentation at the end of S8 which will conclude the project.

Learning outcomes

- Understand a problem and its context.
- Structure and design a project.
- Lead and manage a project.
- Restitute and promote a project.

Independent study

Objectifs : Manage and lead a project,
Restitute and promote a project.

Méhodes : Capitalization of the tools and methods presented and implemented within the framework of the PE, in terms of project management and written and oral expression.

Core texts

Assessment

Rating = 100% know-how

PROJET APPLICATION - RECHERCHE

RESEARCH PROJECT

Lecturers: Cécile NOUGUIER

| Lecturers : 0.0 | TC : 50 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Research projects (PAr) are intended for students who wish to acquire a first research experience or for those who are simply curious to discover the research. In a research laboratory of the Ecole Centrale de Lyon, all of them internationally renowned, students are initiated, alone or in pairs, in the research activity. Most often integrated into a research group and sometimes into an existing project, students have the opportunity to meet the various research stakeholders, to discover the many facets of the profession of researcher and the context of academic research in France. They may also be offered the opportunity to participate in the life of the research laboratory hosting them (seminars or other events).

Keywords : Research, project work

Programme

The project takes place in S7 and continues in S8 for a total of 75 hours. Supervised by a scientific tutor and accompanied by a project management adviser, students search for and exploit bibliographic data, formulate hypotheses, experiment, simulate or model, face often unexpected results, interpret results , emit, validate or refute hypotheses, propose new ideas to explore... Two project reviews are organized by the students in S7 to report on the progress of the project.

Learning outcomes

- Structuring and managing a project.
- Implementing a research approach.
- Searching and citing bibliographic references.
- Writing a report or a scientific paper and making an oral presentation.

Independent study

Objectifs : Manage a project.
Carry out a research work.

Méhodes : Bibliographic search: after formation, using of online bibliographic databases.
Project management using appropriate methods and tools, under the supervision of a project management adviser.

Core texts

Assessment

Mark =100% know-how.

PROJET D'ÉTUDES

STUDY PROJECT

Lecturers: Thierry FARGERE

| Lecturers : 6 | TC : 7 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 100 | Language : FR

Objectives

In the 1st year, students are introduced to their future engineering profession by being entrusted with their first mission called a Study Project. In autonomous teams of 4-6 people, they choose a scientific or technical issue in the School's areas of expertise. They will then have to specify the targets of their mission, design the organization of their project (schedule, tasks to be carried out, division of responsibilities, deliverables to be provided) and manage the budget entrusted to them. Students are supervised by an educational team made up of a scientific tutor and 2 advisers (communication, project management). Partner companies and research laboratories can also get involved.

Keywords : Project, autonomy, team work

Programme

The project takes place all year round on Wednesday afternoons (minimum 100h). Students also follow different tutorials: 2 hours on bibliographic research, 2 hours on report writing, 4 hours on project management, 10 hours on communication (meeting management, written and oral expression). During this mission, with the support of the teaching team, the students research and use bibliographic data, formulate hypotheses and propose solutions, experiment or model, build prototypes. They must manage the vagaries of their project and report regularly on their progress to their tutors. They manage their purchases and seek additional funds if necessary. Two steering meetings are organized by the students during the year to report on the progress of the project.

Learning outcomes

• • Facing a complex problem without a single solution • Build and manage a team project (C3N1) • Search for skills and information • Put in place the means to carry out the project and achieve the defined objectives (C3N2) • Obtain results without achieving the obligation of success, given the formative nature of the approach • Master written and oral communication (C3N3)

Independent study

Objectifs : Achieve project goals

Méhodes :
- Documentary research: use of the digital tools available at the library.
- Construction of models or prototypes: use of the FabLab
- Use of digital simulation software
- Programming

Core texts

Assessment

• Final mark : 50% (work), 25% (final report), 25% (oral presentation)

EDUCATION PHYSIQUE ET SPORTS

PHYSICAL EDUCATION AND SPORT

Lecturers: Simon CHALTON

| Lecturers : 0.0 | TC : 90 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : MI

Objectives

The objectives of this training action are multiple. It is firstly a question of maintaining and developing one's physical abilities through individual or collective activities, competitive or not; to develop self-confidence and psychological development.
The teaching of sport and physical education is part of the development of professional and disciplinary skills, such as teamwork, autonomy, responsibility, knowledge of oneself and others, surpassing, commitment and perseverance.
Through original situations, this teaching calls upon all the student's resources : motor coordination, cognitive,

Keywords :

Programme

There are 20 activities the student can choose from.

The student can embark on a course with a weekly lesson of 2 hours or in a competition group of up to 2 training sessions per week + university competitions.

In addition to weekly lessons, many optional associative activities are offered during which the student can develop a variety of skills.

Learning outcomes

- Mobilize your resources (motor coordination, affective, cognitive, relational) to be efficient.
- Engage in a sustainable project for their health and well-being.
- Use a collective project approach.
- Take responsibility within a group, a team, an association. Know yourself better in your relationship with others. Communicate, listen. Demonstrate innovation and creativity.

Independent study

Objectifs : The course is organized so as to put the student in various situations requiring a good degree of autonomy.

Méhodes : Workshop work / self-help or co-supervision situations / associative projects

Core texts

Assessment

Attendance 40% - Mobilization of its resources 20% - Individual and collective commitment 20% - Progress, self-knowledge 20%

WEEX : EOLIEN

WEEX : WIND POWER

Lecturers: Pierre DUQUESNE, Giacomo CASADEI, Jean-Pierre CLOAREC

| Lecturers : 0.0 | TC : 0.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

- Increasing the capacity to work as an engineer in function.
- Apply theoretical course knowledge in a concrete situation.
- Link the different knowledge of a multidisciplinary technological object.
- Increasing the capacity to work in an uncertain/unpredictable environment that evolves over time.
- Increasing the team work capacity.

Keywords : Wind turbines, energy, team work

Programme

The activity is a role-playing game; "in the skin of an engineer."
Students, in groups, work in three engineering professions, linked to each other:
- Design/measurement engineer
- Project engineer.
- Operations engineer.

Learning outcomes

• First Engineer Mission: Design/measurement Engineer From measurement database model a wind turbine and a map of winds.
• Second Engineer Mission: Project Engineer Propose a wind turbine farm implantation projects on a territory to optimise the electricity production and respecting the constraints (progressing over time).
• Third Engineer Mission: Operations Engineer Solve all problems of the wind farms under the team responsibility.

Independent study

Objectifs : Most of the work is in autonomy to put students in the position of a working engineer.
Deliverables:
- Modelling reports.
- Presentation of modelling.

Méhodes : Team work in a limited time.
Automatic correction (server)
Presence required

Core texts

Assessment

Skills assessment:
- oral presentation
- group observation

WEEX : HYDROGÈNE

WEEX 1

Lecturers: Anne LAMIRAND, Jean-Pierre CLOAREC, Loris PACE

| Lecturers : 0.0 | TC : 0.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

This course aims to increase the students awareness about energy ressources and their management. The students form a team of engineers engaged to analyze the feasibility of an energy autonomous residential aera with zero carbon emissions. The district is powered by solar panels and a long term hydrogen storage system. In order to achieve this goal, each team has to mobilize their technical knowledges and soft skills.

Keywords : Hydrogen production, Hydrogen storage, Fuel cell, Off-grid micro-grid, zero carbon emission residential aera

Programme

- Introduction to hydrogen systems for energy-autonomous residential area
- Study of PV technologies, electrolyzer and fuel cell
- Sizing of PV system, power electronics and hydrogen boiler
- Study of material properties for hydrogen storage
- Design of openings in the storage area to ensure security, selection of H2 and/or smoke sensors
- Technical and economic analysis of the PV + H2 system using HOMER Pro software
- Conference linked with the topic made by an external speaker

Learning outcomes

- C5N3 : Clever use of the available resources
- C2I2 : Evaluate the relevance of the obtained results. Question the proposed method regarding relevant criteria and hypothesis.
- C3N3 : Valorize the obtained results through good writing and speaking abilities
- C4I2 : Generate performances individually and in his/her team. Positive interactions during team work. The student is involved in team work and promote cohesion in his/her team. C2I3 : Think and act in an unpredictable environment. Identify issues according to an unknown long-term context.

Independent study

Objectifs : Propose a PV + H2 energy system for an energy-autonomous residential area

Méhodes : Team work
Flipped classroom in most of the activities
Deliverables regularly required

Core texts

Dawood, F.; Shafiullah, G.; Anda, M., *STAND-ALONE MICROGRID WITH 100% RENEWABLE ENERGY: A CASE STUDY WITH HYBRID SOLAR PV-BATTERY-HYDROGEN*, Sustainability, 2020
Evangelos Kalamaras, Meltiani Belekoukia, Zhengyu Lin, Bing Xu, Huizhi Wang, Jin Xuan *TECHNO-ECONOMIC ASSESSMENT OF A HYBRID OFF-GRID DC SYSTEM FOR COMBINED HEAT AND POWER GENERATION IN REMOTE ISLANDS*, Energy Procedia, 2019

Assessment

S06_PRO_TC_2

ENQUÊTE DÉCOUVERTE

DISCOVERING ENGINEERING

Lecturers: **Grégory VIAL**

| Lecturers : 0.0 | TC : 4.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : MI

Objectives

The objective of this training is to discover various aspects of the engineer's job. Every student is invited to contact two engineers of his choice (one of them being centralien) and to meet them to talk about their career. Analyzing the different interviews will allow the student to build his own professional project. This training focuses on SD&CSR issues in companies as well.

Keywords : Engineer, career, professional project

Programme

Interviews of two engineers having different careers. Oral presentation by group of 6 students, in presence of a professor and an engineer

Learning outcomes

- Prepare and lead an interview
- Understand the realities of being an engineer
- Give a written and an oral report
- Build his own professional project

Independent study

Objectifs : Establish an individualized relationship with at least two active engineers, if possible from "Ecole Centrale de Lyon", with different profiles.

Méhodes : Preparation of the meetings (contact, questionnaire, ...). Report and preparation of the restitution (quick presentation of the survey framework, analysis of the information received and conclusions for the construction of the professional project)

Core texts

Assessment

Final mark = 100% Know-how
Know-how mark = 100% continuous assessment

WEEX : DÉCHETS ET POLLUTION

WEEX : WASTE AND POLLUTION

Lecturers: Andrea MAFFIOLI, Frédéric DUBREUIL, Jean-Pierre CLOAREC

| Lecturers : 0.0 | TC : 0.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : MI

Objectives

The WEEX DEPOL is a 5-day project to be conducted in teams of 7 students. Each team conducts an environmental investigation to determine the causes of a public health problem, using fluid mechanics, mathematics and environmental chemistry.

Keywords : pollution; waste; circular economy ; fluid mechanics; chemistry; materials;

Programme

The concepts used are: transport of pollutants (see Fluid Mechanics course); modeling and numerical simulation (see Mathematics course); deposition and speciation of pollutants in the environment, toxicology concepts.

Learning outcomes

- Dare: actively contribute to the smooth running of the working session in groups by a good balance between active listening and participation; take care of your language, adapt your communication to others; express yourself assertively: affirms your point of view while respecting differences of opinion.
- Knowing oneself, building oneself: analyze a situation based on the concepts of personal resources (strengths, values, motivations, etc.), emotional intelligence and self-esteem to be aware of your preferred modes of functioning and the diversity of behavioural profiles.

Independent study

Objectifs : Work in teams of 7 people. Each team carries out its project in semi-supervised autonomy, with intermediate deliverables to be handed in as the work progresses.

Méhodes : Investigate as a team using field data to determine which pollutants are responsible for a public health problem. Mobilize notions of the "tronc commun" (e.g. FLE, MATH, INFO...). Each team is composed of students with complementary know-how, according to the courses followed before ECL, and

Core texts

Assessment

WEEX : MOBILITÉS

WEEX : MOBILITY

Lecturers: Sylvie MIRA, Jean-Pierre CLOAREC, Olivier BAREILLE

| Lecturers : 0.0 | TC : 0.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : MI

Objectives

The course aims to have students work on a current, complex and multi-skilled theme: urban mobility.
Students will have to propose smart and sustainable mobility solutions on a delimited geographical space, by deploying modeling tools on mobility databases.
The course aims to anchor the analysis of mobility problems in a specific socio-historical context.

Keywords : urban mobility, traffic modeling, data visualization, business model

Programme

Analysis of urban mobility data bases in foreign languages (German, English, Spanish, French (for foreign students))
Problems identification
Modeling and optimization of flows
Data visualization
Usage scenarios and business model

Learning outcomes

- Know how to analyse mobility data bases in a foreign langage and accordingly with the cultural and historical context
- Be able to propose use and economic scenarios
- Knwo how to model and optimize mobility flows
- Know how to use data visualisation tools

Independent study

Objectifs : Present solutions to solve a mobility issue

Méhodes : Group work

Core texts

Assessment

Pitch the solution in the language of the concerned country (German, English, Spanish or French)
Detail the solution in a bilingal report

CONFÉRENCES UE PRO

CONFERENCES

Lecturers: Vincent CLAIR

| Lecturers : 0.0 | TC : 9 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Conferences presented by invited guests, experts in their domain. They address a wide range of topics.

Keywords : General knowledge, Industry, Social matter, Research, Engineering activities, activity field, Tools for engineering

Programme

Learning outcomes

- Develop an open mind.
- Know where to find informations for your professional project

Independent study

Objectifs : Empower engineering students for the elaboration of their professional project through the choice of conferences they attend.

Méhodes : Participation to the conferences.
Attending external conferences and write a short report (1 maximum per semester)

Core texts

Assessment

Validation of the activity by the attendance to conferences (or through the report for an external conference, with 1 external conference maximum per semester).

S06_PRO_TC_3

VISITES D'ENTREPRISE

COMPANY VISITS

Lecturers: ELISABETH COUZINEAU-ZEGWAARD, Delphine LAVERRIERE

| Lecturers : 0.0 | TC : 0.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Keywords :

Programme

Learning outcomes

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Assessment

CLIC - CENTRALE LYON INNOVATION CAMP

CLIC - CENTRALE LYON INNOVATION CAMP

Lecturers: Clotilde MINFRAY, Jean-Pierre CLOAREC

| Lecturers : 2 | TC : 2 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 28 | Language : FR

Objectives

- Awareness of all first year student to creativity.
- Appropriation and deployment of a methodological tool of creativity (C-K method).

Keywords : Innovation challenge, work in group (x5), C-K method

Programme

Pedagogical process put in place to respond by team of 5 students to an innovation challenge proposed by an industrial partner of Ecole Centrale de Lyon.
- 2h tutorial: appropriation of C-K method
- 1h tutorial: how to do a good pitch?
- Autonomous work by student teams on 4 days

Learning outcomes

- Make ideas emerge.
- Dare.
- Realise and create value.
- Generate individual and collective performance.

Independent study

Objectifs : Make ideas emerge, present them and convince a jury.

Méhodes : The autonomous work is organized in several phases: appropriation of the subject, phase of exploration, phase of analysis and selection, phase of deepening, restitution.
At the end of the work in autonomy, the students must submit three

Core texts

Lina Alami, *INNOVER ? INNOVEZ ! INNOVONS... HTTP://COMMENT-INNOVER.FR/* , 2015
Cabinet Stim *LES MÉTHODES D'INNOVATION À L'AIDE DE LA THÉORIE C-K.*, Licence Creative Commons, 2014

Assessment

Validation by competencies

ACCOMPAGNEMENT AU PROJET PROFESSIONNEL

CAREER PLAN - TUTORING

Lecturers: Catherine MUSY, Philippe THIMONIER

| Lecturers : 0.0 | TC : 5 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The construction of his own professional project is one of the major objectives that each student-engineer must achieve during their time at the Ecole Centrale de Lyon. The main objective of this activity is to allow the student to reflect on himself to advance in the construction of his short-term engineer training project and his longer-term professional career project. The accompanying activity to the professional project must allow each student, at their own pace, to conduct their personal reflection on his professional project, even their life plan.The professional project of each student is obviously bound to evolve and deepen during the course of schooling, and well beyond.

Keywords : Professional career project

Programme

In order to support the student in their reflection and in the construction of their professional project, a PCP (Principal Adviser) tutor is awarded to each student at the beginning of the course. This PCP tutor will follow their throughout their schooling, at least through 6 Bilateral Meetings (BM) scheduled during the common core. On the occasion of these BM, discussions will take place between the student and the PCP tutor on the progress of the reflection on the professional project and appraisal will be made at certain key moments of the curriculum. On these occasions, the PCP tutor will also be able to discuss with the student their integration into the life of the campus and their university results.

Learning outcomes

- To set up strategies to build their professional project.
- To argue their choices.
- To conduct their self-assessment.

Independent study

Objectifs : To build their professional project.
To learn to self assess their professional skills.

Méhodes : Professional skills sheet.
CV and Progress report.

Core texts

Assessment

Final mark = 100% Know-how
Know-how mark = 100% continuous assessment

ÉCOLE
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