MASTER ELECTRICAL ENERGY SYSTEMS

IN BRIEF

Type of diploma : Master (LMD)
Ministry field : Sciences, Ingénierie et Technologies
Mention : Energie

MORE INFO

ECTS credits : 120

Level : BAC +5

Type of education
* Formation continue
* Formation initiale

Kind of education : Parcours

Internship : Obligatoire

LEARN MORE

http://www.toulousetech.net/en/programs/master-of-science-XB/sciences-engineering-and-technologies-SIT/msc-electrical-energy-systems-ees-program-program1-msc-electrical-energy-systems-ees-en.html

PARTNER SCHOOLS

Contact master EES / Email : master-EES @ univ-toulouse.fr

Presentation

Ce Master a pour objectif de former des ingénieurs, Chercheurs, Enseignant-Chercheur.

Cette mention a pour vocation d'apporter une formation professionnalisante (type d'activité : bureaux d'études, R&D, production, exploitation), pouvant naturellement ouvrir sur une poursuite au niveau PHD dans le domaine du Génie Electrique et de ses applications liées aux procédés de l'énergie.

Les activités professionnelles concernées sont :

- Conception et mise en oeuvre des systèmes de production de l'énergie sous ses différentes formes ;

- Conception et mise en oeuvre des systèmes conversion de l'énergie sous forme électrique, la maîtrise de son prélèvement sur les sources (hydrauliques, éoliennes, photovoltaïque) et son stockage ;

- Conception et mise en oeuvre des réseaux électriques et leur pilotage ; applications : réseaux embarqués (transports : aéronautique, ferroviaire, automobile) et autonomes ;

- Conception et mise en oeuvre des procédés mettant en oeuvre une diversité de formes d'énergie, centrées sur l'électricité (par exemple : dans l'habitat, électricité, gaz, chaleur ...)

- Conception et mise en oeuvre des procédés de conversion de l'énergie électrique : conversion statique, conversion électromécanique, mécatronique et leurs applications dans toutes les branches de l'industrie associées au Génie Electrique.

- Modélisation, conception et mise en oeuvre des dispositifs de contrôle et diagnostic de l'ensemble des procédés liés à la production, la conversion de l'énergie.

A l'issue du master Energie le diplômé doit avoir acquis les compétences suivantes :

- Maitriser les outils de modélisation en vue de l'analyse de problèmes multi-physiques

- Gérer et contrôler les systèmes énergétiques, par des techniques de modélisation, d'optimisation, d'acquisition et de traitement des données

- Modéliser des convertisseurs statiques ou électromécaniques à l'aide de modèles analytiques ou de codes de simulation numériques

- Avoir des compétences dans les domaines de l'électronique de puissance, des semi-conducteurs de puissance et des réseaux électriques, avec la capacité à concevoir et réaliser des systèmes de conversion statique,

- Avoir des compétences dans le domaine de l'électricité et de l'électrotechnique plus spécifiquement orientées vers la production, la conversion, la distribution et le stockage de l'énergie.

- Capacité à aborder la problématique des énergies renouvelables dans leurs principes, mais aussi celle de leurs associations, de leur pilotage et leur insertion dans les réseaux de distribution

- Concevoir et réaliser des « machines et actionneurs électromécaniques » y compris les actionneurs à base de matériaux « intelligents »

- Avoir des compétences en automatique dans les méthodes de modélisation, de traitement du signal et d'identification pour l'analyse, la conception et la simulation

- Avoir des compétences pour la commande, l'observation et le diagnostic des systèmes pluri-technologiques dynamiques

- Concevoir un système en tenant compte des exigences environnementales et sociétales (éco-conception et développement durable)

Egalement les Compétences transversales suivantes :

- Conduire dans son domaine une démarche innovante qui prenne en compte la complexité d'une situation en utilisant des informations qui peuvent être incomplètes ou contradictoires

- Conduire un projet (conception, pilotage, coordination d'équipe, mise en oeuvre et gestion, évaluation, diffusion) pouvant mobiliser des compétences pluridisciplinaires dans un cadre collaboratif et en assumer les responsabilités

- Identifier, sélectionner et analyser avec esprit critique diverses ressources spécialisées pour documenter un sujet et synthétiser ces données en vue de leur exploitation

- Actualiser ses connaissances par une veille dans son domaine, en relation avec l'état de la recherche et l'évolution de la règlementation

- Evaluer et s'autoévaluer dans une démarche qualité

- S'adapter à différents contextes socio-professionnels et interculturels, nationaux et internationaux

- Communiquer par oral et par écrit, de façon claire et non-ambiguë, en français et dans au moins une langue étrangère, et dans un registre adapté à un public de spécialistes ou de non-spécialistes

- Utiliser les outils numériques de référence et les règles de sécurité informatique pour acquérir, traiter, produire et diffuser de l'information de manière adaptée ainsi que pour collaborer en interne et en externe

Objectives

The « EES » MOST "Electrical Energy Systems" aims to provide professional training (type of activity: design offices, R & D, production, operations). It naturally offers the opportunity of a studies continuation at PHD level, in the field of Electrical Engineering and its applications related to energy processes.

Skills

* Proficiency of modeling tools for the analysis of multi-physics problems
* Ability to manage and monitor energy systems, modeling techniques, optimization, acquisition and processing of data
* Ability to model static or electromechanical converters using analytical models or computer simulation codes
* Expertise in the fields of power electronics, power semiconductors and power grids, with the ability to design and implement static conversion systems,

* Expertise in the field of electricity and electrical engineering specifically oriented towards production, conversion, distribution and storage of energy.
* Ability to address the issue of renewable energy in their principles but also of their organizations, their management and their integration into the distribution networks
* Skills for control, observation and diagnosis of dynamic multi-technology systems
* Ability to design a system taking into account the environmental and social requirements (eco-design and sustainable development)

Training content

Plein temps pour les semestres 7, 8 et 9, le semestre 10 est un stage.

Organization

MASTER ELECTRICAL ENERGY SYSTEMS M1
MASTER ELECTRICAL ENERGY SYSTEMS M2

Trainings

Internship project (6 months) in industry (production, offices, R & D) or academic research laboratories.

Access conditions

Pour être inscrits dans les formations conduisant au diplôme de master, les étudiants doivent justifier :

- soit d'un diplôme national conférant le grade de licence dans un domaine compatible avec celui du diplôme national de master ;

- soit d'une des validations prévues aux articles L 613-3, L. 613-4 et L.613-5 du code de l'éducation

Further study

PhD

Professional insertion

The following fields of professional activities are concerned:

* The production of energy in its various forms;
* The conversion of energy in electrical form, control of its collection from the sources (hydro, wind, photovoltaic) and storage;
* Power systems and their management; Applications: Embedded networks (transport: air, rail and car) and autonomous;
* The processes implementing a variety of forms of energy, focusing on electricity (eg in housing, electricity, gas, heat ...)
* Electrical energy conversion processes: static conversion, electromechanical conversion, mechatronic and their applications in all industry branches related to Electrical Engineering.
* Ability to manage and monitor energy systems, modeling techniques, optimization, acquisition and processing of data

Professional profiles: engineer, researcher, teacher

Organizational unit

École Nationale Supérieure d'Électrotechnique d'Électronique d'Informatique d'Hydraulique et des Télécommunications

Administrative contact(s)

Contact master EES
master-EES @ univ-toulouse.fr

MASTER ELECTRICAL ENERGY SYSTEMS M1

MORE INFO

ECTS credits : 60

Organization

- **M1 Electrical Energy Systems**
  - **M1 EES Semestre 7**
    - **Parcours Standard sem 7 EES**
      - **Teaching Unit Machines électriques : structures et modélisation**
        - **Subject Mécatronique 1**
        - **Subject Mach. 2 : modélisation électromag. et élect. des machines**
      - **Teaching Unit Synthèse et Conception des CVS**
        - **Subject Static Converters Design**
        - **Subject Static Converters Project**
      - **Teaching Unit Automatique des Systèmes Non linéaires/Echantillonnés(ASNLE)**
        - **Subject Regulation Structures**
        - **Subject Non linear Systems**
        - **Subject Sampled Linear Systems : Z transform**
      - **Teaching Unit Modélisation et Développelement des Systèmes Industriels**

· Subject Oriented Object Design and Programming

Pre-requisites

Algorithms, Data Types and Data Structures, Programming in C

Objectives

Introduction to the basic concepts of object-oriented design and programming, illustration of these notions with the C++ language, specification analysis, abstract view of a problem, classification and reuse. Quick overview of other languages (Java) and object-oriented design methods (UML).

Targeted skills

System specification analysis

Object-oriented design

Implementation of a solution in C++

Validation of the program (unit and integration testing).

Description

The course is divided into five chapters

- Introduction to the basic concepts of object -oriented design and programming

- Main characteristics of object-oriented languages (encapsulation, classification, inheritance, polymorphism, dynamic linking, etc.)

- Basic elements of the C ++ programming language(typing, structuring of programs, references, etc.)

- The specificities of the object-oriented in C ++ (classification and inheritance, input-output, exceptions, templates)

- Basic concepts of other languages and object methods (quick introduction to Java and UML).

The practical classes give the student the opportunity to understand these concepts and development techniques and master them. The proposed project is focusing more on the design and classification aspect than on complex algorithms.

Number of hours
10h lecture, 10h practical classes

Teaching method
En présence

Teaching language
French (english can be used to interact with teaching staff during practical classes)

Bibliography

Handouts ENSEEIHT, slides presented by M. Fabre;

« *Object-Oriented Software Construction* », Bertand Meyer, Prentice Hall, Inc. Eds. (Second edition – 1997) ;

« *The C++ Programming Language*», B. Stoustrup, Addison-Wesley ISBN 978-0321563842. May 2013. (4th edition) ;

« *UML 2 for Dummies* », Michael Jesse Chonoles, James A. Schardt, Wiley Publishing, Inc. (2003).

· Subject Control industrial systems

- **Subject BE Prog. Conc. Orient.Obj**

- **Teaching Unit Mathématiques 2**
  - **Subject Optimisation**
  - **Subject Optimisation Project**
  - **Subject Probabilities and Statistics**
  - **Subject Probabilities and Statistics Project**

- **Teaching Unit Sciences Humaines et Sociales**
  - **Subject PPP et Techniques de Recherche d'Emploi**
  - **Subject Langue 1 2GEA semestre 7**
  - **Subject Langue 2 2GEA semestre 7**
  - **Subject Sport sem C**
  - **Subject Expression Ecrite et Orale, soutenance stage 1A**

- **Teaching Unit Applications**
  - **Subject Projet Scientifique avec Tutorat**

- **M1 EES Semestre 8**

Choice: 1 Among 1 :

- **Parcours EMEC**
  - **Teaching Unit Static Converters, Machines and Control**

- **Subject Association Static Converters machines**
- **Subject Modulation, Filtering and Sizing of Inverters**
- **Subject Electric Machines Conception**
- **Subject Introduction to Machines Control**
- **Subject Modeling and Control of Static Converters**
- **Subject MASAP, MAS v/f**

- **Teaching Unit Numerical command**
  - **Subject real time digital control project**
  - **Subject real time digital control**

- **Teaching Unit Automatic Control and Systems**
  - **Subject Discrete polynomial command**
  - **Subject State Space**
  - **Subject Graphs, Algorithms and Applications (AII and EMEC)**
  - **Subject Auto (Pendule, Susp. Magn., Ordonancement, Str reg)(EMEC)**

- **Teaching Unit functional materials**
  - **Subject Mechanical Properties**
  - **Subject Dielectric Properties**
  - **Subject Magnetic properties**
  - **Subject Materials**

· Teaching Unit Macatronic Conception

· Subject Mechatronics 2: innovative actuators

· Subject Optimization Design

· Subject Thermal and fluid mechanics

· Subject Mach. 4: sizing

· Subject sensors

· Subject GE (Vibration, Piezo Engine, Optimag., Autopilot MS)

· Teaching Unit Soft and Human Skills

Person(s) in charge
HULL ALEXANDRA

· Subject Professional English 2.2 : Debates

Pre-requisites

None

Objectives

Perform key oral and written workplace tasks in English.

Targeted skills

1) Develop interactional communication and argumentation skills by actively participating in debates in English.

2) Write an reaction paper effectively in English.

3) Present your professional project convincingly during a job interview in English.

Description

A semester of 12 interactive weekly sessions to develop English intercultural communication competencies for professional purposes.

Number of hours
21 hours

Person(s) in charge
LAKE PETER

Teaching method
En présence

Teaching language
English

Bibliography

* *Heinrichs, J. (2017). Thank you for arguing: What Aristotle, Lincoln, and Homer Simpson can teach us about the art of persuasion.* Three Rivers Press (CA).
* Turabian, K. L. (2010). *Student's guide to writing college papers*. University of Chicago Press.
* Kelley, T. (2017). *Get That Job!: The Quick and Complete Guide to a Winning Interview.* Plovercrest Press.

· Second language

Person(s) in charge
BLANCO ANDRE

Choice: 1 Among 1 :

· Subject Spanish

· Subject Spanish

· Subject Chinese

· Subject Italian

· Subject Japanese

· Subject Russian

· Subject German

· Subject french (as a foreign language)

· Subject Sports

· Subject Leadership & Management

Person(s) in charge
HULL ALEXANDRA

· Parcours ENP

· Teaching Unit Static Converters, Machines and Control

· Subject Association Static Converters machines

· Subject Modulation, Filtering and Sizing of Inverters

- **Subject Electric Machines Conception**
- **Subject Introduction to Machines Control**
- **Subject Modeling and Control of Static Converters**
- **Subject MASAP, MAS v/f**

Teaching Unit Numerical command

- **Subject real time digital control project**
- **Subject real time digital control**

Teaching Unit Automatic Control and Systems

- **Subject Discrete polynomial command**
- **Subject State Space**
- **Subject Non linear Control (All and EMEC)**
- **Subject Auto (Pendule, Susp. Magn.) (ENP)**

Teaching Unit Switching implementation

- **Subject Switching Mechanism in Static Converters**
- **Subject Thermics**
- **Subject Static Converters Control**

Teaching Unit Electric Systems and Networks

- **Subject Introduction to Flexible AC Transmission System**
- **Subject Renewable Energies and Photovoltaic Systems**

· Subject Bond Graph Modeling

· Subject Inverters Filtering

· Subject Flexible AC Transmission System Labs

· Teaching Unit Soft and Human Skills

Person(s) in charge
HULL ALEXANDRA

· Subject Professional English 2.2 : Debates

Pre-requisites

None

Objectives

Perform key oral and written workplace tasks in English.

Targeted skills

1) Develop interactional communication and argumentation skills by actively participating in debates in English.

2) Write an reaction paper effectively in English.

3) Present your professional project convincingly during a job interview in English.

Description

A semester of 12 interactive weekly sessions to develop English intercultural communication competencies for professional purposes.

Number of hours
21 hours

Person(s) in charge
LAKE PETER

Teaching method
En présence

Teaching language
English

Bibliography

* *Heinrichs, J. (2017). Thank you for arguing: What Aristotle, Lincoln, and Homer Simpson can teach us about the art of persuasion.* Three Rivers Press (CA).
* Turabian, K. L. (2010). *Student's guide to writing college papers*. University of Chicago Press.
* Kelley, T. (2017). *Get That Job!: The Quick and Complete Guide to a Winning Interview.* Plovercrest Press.

· Second language

Person(s) in charge
BLANCO ANDRE

Choice: 1 Among 1 :

- **Subject Spanish**
- **Subject Spanish**
- **Subject Chinese**
- **Subject Italian**
- **Subject Japanese**
- **Subject Russian**
- **Subject German**
- **Subject french (as a foreign language)**

- **Subject Sports**
- **Subject Leadership & Management**

Person(s) in charge
HULL ALEXANDRA

- **Parcours All**
  - **Teaching Unit Static Converters, Machines and Control**
    - **Subject Association Static Converters machines**
    - **Subject Modulation, Filtering and Sizing of Inverters**
    - **Subject Electric Machines Conception**
    - **Subject Introduction to Machines Control**
    - **Subject Modeling and Control of Static Converters**

· Subject MASAP, MAS v/f

· Teaching Unit Real Time Systems Software Development

· Subject Introduction to Modeling - Petri Networks

· Subject Introduction to Computer Networks Architectures

· Subject Real Time Programming

Pre-requisites

Operating systems principles, C / C++ programming

Objectives

Introduction to the basic concepts and architecture of real-time kernels (notion of thread and scheduling, critical sections and synchronisation). Illustration of fixed priority based scheduling algorithms, basic principles of scheduling analysis.

Targeted skills

Mastering synchronisation techniques

Fixed priority based scheduling

Scheduling analysis

Using a real-time kernel and application

Description

This module includes a lecture (10h) and a personal work as practical classes (10h). The lecture addresses the following topics

– Introduction to basic concepts of real-time kernels (memory management, threads and scheduling, synchronisation, time management)

– Main characteristics of synchronisation mechanisms and basic primitives (critical sections, mutual exclusion, semaphores, models)

– Principles of scheduling and deadlines (fixed priority based scheduling algorithms, Rate Monotonic Scheduling, introduction to schedulability analysis and Worst Case Execution Time evaluation)

– Examples and use of real-time kernels.

The practical work is done in groups of students and focuses on the analysis and the use of real-time kernels in industrial applications.

Number of hours
10 hours lecture, 10h practical classes

Person(s) in charge
FABRE Jean-charles
Jean-Charles.Fabre@laas.fr
Phone 2354

Teaching method
En présence

Teaching language

French (english can be used to interact with teaching staff during practical classes)

Bibliography

ENSEEIHT lecture slides presented by M. Fabre, M. Roy, M. Lauer ;

« *Scheduling in Real-Time Systems* », F. Cottet, J. Delacroix, C Kaiser et Z. Mammeri, Wiley Eds. (2002).

« *Hard Real Time Computing Systems* », G. Buttazzo, Springer Eds, 3rd edition, ISBN 9781461406754, 1997.

· Teaching Unit Signal Processing and Identification

· Subject Identification

· Subject Signal Processing

· Teaching Unit Numerical command

· Subject real time digital control project

· Subject real time digital control

· Teaching Unit Control and Systems

· Subject Control

· Subject Discrete polynomial command

· Subject State Space

· Subject Graphs, Algorithms and Applications (AII and EMEC)

· Subject Non linear Control (All and EMEC)

· Teaching Unit Soft and Human Skills

Person(s) in charge
HULL ALEXANDRA

· Subject Professional English 2.2 : Debates

Pre-requisites

None

Objectives

Perform key oral and written workplace tasks in English.

Targeted skills

1) Develop interactional communication and argumentation skills by actively participating in debates in English.

2) Write an reaction paper effectively in English.

3) Present your professional project convincingly during a job interview in English.

Description

A semester of 12 interactive weekly sessions to develop English intercultural communication competencies for professional purposes.

Number of hours
21 hours

Person(s) in charge
LAKE PETER

Teaching method
En présence

Teaching language
English

Bibliography

* *Heinrichs, J. (2017). Thank you for arguing: What Aristotle, Lincoln, and Homer Simpson can teach us about the art of persuasion.* Three Rivers Press (CA).
* Turabian, K. L. (2010). *Student's guide to writing college papers*. University of Chicago Press.
* Kelley, T. (2017). *Get That Job!: The Quick and Complete Guide to a Winning Interview.* Plovercrest Press.

· Second language

Person(s) in charge
BLANCO ANDRE

Choice: 1 Among 1 :

· Subject Spanish

· Subject Spanish

· Subject Chinese

· Subject Italian

· Subject Japanese

· Subject Russian

· Subject German

· Subject french (as a foreign language)

· Subject Sports

· Subject Leadership & Management

Person(s) in charge
HULL ALEXANDRA

Organizational unit

École Nationale Supérieure d'Électrotechnique d'Électronique d'Informatique d'Hydraulique et des Télécommunications

MASTER ELECTRICAL ENERGY SYSTEMS M2

MORE INFO

ECTS credits : 60

Organization

· M2 Electrical Energy Systems

· M2 EES Semestre 9

Choice: 1 Among 1 :

· Parcours Commande Avancée des Systèmes sem 9-M2 EES

· Teaching Unit Commande et Diagnostic des Systèmes

· Subject System monitoring and diagnostics

Objectives

Have a global vision of what are monitoring and diagnostic

Know different monitoring and diagnostic methods and their fields of application

Identify the main functions involved in monitoring and diagnostic

· Subject Multidimensional systems

· Subject Multidimensionnels

· Surveillance - Diagnostic

· Teaching Unit Commande optimisée des systèmes

· Subject Advanced Control Project

· Subject Optimal Control

· Subject Continuous Optimisation

· Teaching Unit Commande et observation des actionneurs

· Subject Estimate Filtering

· Subject Control by flatness

· Subject Aeronautical Systems

· Subject Control of electrical systems

· Teaching Unit Analyse et Optimisation des systèmes discrets

· Subject Discrets Systems Analysis and Modeling

· Subject Combinatorial optimization

· Subject flexible workshop Project

· Optimisation combinatoire

· Teaching Unit Développement des systèmes informatiques

· Subject software engineering

Pre-requisites

Algorithmics and object oriented programming

Objectives

This course illustrates how to deploy a development process using the Unified Modeling Language (UML), focusing mainly on embedded systems.

Students are confronted with the semantics of language and the use of multiple diagrams for system design.

Targeted skills

Understanding and modeling of the functional and non-functional needs of an embedded application

Basic knowledge to use UML2.0 diagrams

Skills for modeling system requirements in UML

Development approach with UML models

Description

The course is composed of two parts, each one organised into chapers:

Part 1 – Embedded systems

Chapter 1 : Introduction to the development of embedded systems

Chapter 2 : Constraints and non-functional specifications

Chapter 3 : Hardware and software design elements

Part 2 – Object-Oriented Development

Chapter 4 : Generalities on software engineering

Chapter 5 : Unified Modeling Language (UML)

Chapter 6 : A light-weight object-oriented development process

Number of hours
10h lectures and 7h practical classes

Person(s) in charge
FABRE Jean-charles
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Phone 2354

Bibliography

Handouts ENSEEIHT, slides presented by J. Guiochet

P. A. MULLER et N. GAERTNER, Mode#lisation objet avec UML, Eyrolles, 2000

G. BOOCH, J. RUMBAUGH et Y. JACOBSON, Le guide de l'utilisateur UML , Eyrolles, 2000

E. GAMMA et al., Design Patterns, Thomson, 1996

· Subject Local Networks

· Génie Logiciel

· Réseaux Locaux

· Teaching Unit Commande Avancée des systèmes

· Subject Adaptive and Predictive Controls

· Subject Robust control

· Subject Modeling and control of complex systems

· Subject robotics

· Teaching Unit Métier d'ingénieur

· Subject BE industriel

· Subject Project management

· Subject English language

· Subject CV and professional Interview

· Parcours Commande Avancée des Systèmes (Desic) sem 9-M2 EES

· Teaching Unit Commande et Diagnostic des Systèmes

· Subject System monitoring and diagnostics

Objectives

Have a global vision of what are monitoring and diagnostic

Know different monitoring and diagnostic methods and their fields of application

Identify the main functions involved in monitoring and diagnostic

· Subject Multidimensional systems

· Subject Multidimensionnels

· Surveillance - Diagnostic

· Teaching Unit Commande optimisée des systèmes

· Subject Advanced Control Project

· Subject Optimal Control

· Subject Continuous Optimisation

· Teaching Unit Système Logiciel Critique

· Subject Estimate Filtering

· Subject Distributed computer systems

Pre-requisites

Algorithmics, C / C ++ programming, local area networks, operating system principles, Unix.

Objectives

Introduction to distributed programming based on a basic knowledge on local area networks and of TCP-UPD / IP protocols. Presentation of the client-server model. Introduction to causality, consensus and reliable broadcast.

Targeted skills

- Mastering of the client-server model (CS)

- Implementation of the CS model with BSD sockets on Linux

- Solution to the consensus problem

- Reliable broadcast protocols

Description

The course has two main parts:

- Introduction to the basic concepts of distributed programming, the client-server model, different server realization schemes (sequential, multiple inputs / polling, on-demand, multithreaded)

- Introduction to distributed algorithms, notion of logical clocks, notion of causal order, of total order, principle and solution of distributed consensus and atomic broadcast.

The practical classes enable the students to put into practice these concepts and development techniques, using BSD sockets on Linux. An messaging system (a chat) is first implemented with a client-server approach, a second solution is based on a peer-to-peer approach and implementated using a reliable broadcast protocol.

Number of hours
7h lecture, 7h practical classes

Person(s) in charge
FABRE Jean-charles
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Phone 2354

Teaching method
En présence

Teaching language
French (interaction with students in English possible)

Bibliography

Handouts , slides presented by M. Fabre;

Handouts , slides presented by M. Roy;

"Distributed Algorithms", Nancy A. Lynch, Morgan Kaufmann Publishers Inc. San Francisco, California, USA © 1996, ISBN: 9780080504704

· Subject Planning and scheduling

· Subject Simulation of discrete event systems

· Processus de développement de Systèmes Industriels

· Teaching Unit Système Informatique

· Subject IT security

Pre-requisites

Algorithmics, C / C++ programming

Objectives

Introduction to basic concepts of computer systems security, in particular symmetric and asymmetric ciphering techniques, and their application to the development of authentication protocols. Introduction and illustration of discretionary and mandatory security policies, but also to intrusion tolerance techniques.

Targeted skills

Basic knowledge in cryptography

Zero-knowledge authetication protocols

Discretionary and mandatory security policies

Description

The lecture is composed of four main sections:

– Introduction to basic concepts of computer security (classification of attacks, cryptography, evaluation)

– Illustration using basic examples (DES, RSA, Diffie-Hellmann, electronic signatures)

– Authentication and zero-knowledge authentication protocols (Needham-Schroeder, Fiat-Shamir, smartcards)

– Protection in computing systems (discretionary and mandatory security policies) and examples

The lecture concludes with notions of intrusion tolerance (Shamir threshold schemes, fragmentation-scattering).

Number of hours
10h lecture

Teaching method
En présence

Teaching language
French (interaction with students in English possible)

Bibliography

ENSEEIHT lecture slides presented by M. Fabre;

« *Applied Cryptography*», Bruce Schneider, John Wiley Eds (1994) ;

« *Practical Unix & Internet Security* », Simson Garfinkel & Gene Spafford, O'reilly Associates, Inc. (1996).

· Subject Dependability of Computer Systems

Pre-requisites

Algorithmics, operating systems principle, real-time computing, C/C++ programming, computer architecture

Objectives

Introduction to the basic concepts, assumptions and techniques for the design, the implementation and the evaluation of dependable computing systems, in general, and fault tolerant systems in particular. Illustration using several examples of dependable systems and experimental evaluation results.

Targeted skills

Knowledge of the development process of safety critical systems

Mastering assumptions and fault tolerant computing techniques

Characterisation techniques by fault injection and analysis

Description

The lecture is composed of five section:

– Introduction, definitions and basic notions (fault prevention, fault tolerance, fault removal, fault forecasting) and measures.

– Fault tolerance techniques (fault assumptions, basic techniques, replication strategies) and architectural solutions

– Validation techniques, in particular, by fault injection (principles, robustness analysis, examples of tools and experimental results)

– Examples of dependable systems (real-time micro-kernel based systems, A320, B777, ELEKTRA)

– Software testing and verification/validation

Number of hours
10h lecture, 6h tutored classes (followed by 10h of practical classes - see. BE Critical System)

Person(s) in charge
FABRE Jean-charles
Jean-Charles.Fabre@laas.fr
Phone 2354

Teaching method
En présence

Teaching language
French (interaction with students in English possible)

Bibliography

ENSEEIHT lecture slides (in English) presented by M. Fabre;

"Basic Concepts and Taxonomy of Dependable and Secure Computing"

Algirdas Avizienis, Jean-Claude Laprie, Brian Randell, and Carl Landwehr,

IEEE Transactions on Dependable ad Secure Computing, Vol. 1, No. 1, Jan. 2004.

· Subject System Dependability Evaluation

Pre-requisites

Basic concepts and techniques of dependable computing

Basic concepts in probabilities and statistics

Objectives

Knowledge of the principles and techniques for evaluating the dependability of computer systems. In the first part, we present the main dependability measures and methods for evaluating and comparing different system architectures. The second part presents techniques to follow the evolution and analyze the quality and reliability of software systems.

Targeted skills

Knowledge of modeling techniques and evaluation of the dependability of computer systems

Description

The lecture is divided into the following sections:

1) Introduction: Objectives and place of evaluation in the life cycle

2) Qualitative analysis (FMECA: Failure Modes Effects and Critical Analysis)

3) Dependability measures

4) Evaluation methods of system architectures: Reliability Diagrams, Fault Trees, Markov Chains

5) Evaluation of fault-tolerant architectures: Coverage factor

6) Software reliability analysis: Role in the development process

7) Characterization of reliability growth and trend tests

8) Case studies

Number of hours
10h lecture, 4h tutored classes

Teaching method
En présence

Teaching language
French (interaction with students in English possible)

Bibliography

Handouts provided by Mr. Kaâniche and Ms. Kanoun;

"Reliability and Availability Engineering: Modeling, Analysis and Applications", Kishor Trivedi, Andrea Bobbio (2017)

"Reliability of Systems", Gondran and Pagès (1980)

"Software Reliability Engineering Manual", Michael Lyu (1996)

· Subject Critical System Case Study

Pre-requisites

Algorithmics, C/C++ programming, real-time operating systems, dependable computing

Objectives

The objectives of this project / case study is to implement several fault tolerance techniques presented in the course "Dependable Computing". Fault injection experiments are carried out to validate the mechanisms implemented.

Targeted skills

- Implementation of fault tolerance replication techniques and temporal redundancy.

- Characterisation by fault injection (Software-Implemented Fault Injection - SWIFI) to simulate both crash and value faults.

- Multithreaded and distributed implementation on a network of Linux machines.

Description

A software service S acquires measurements using a set of sensors and computes a value on a sliding window of n numerical values.

An FMEA shows that this service S can lead to a catastrophic failure of the system in which it is used, in case of value error or absence of output value. This service S must therefore guarantee dependability properties, in the presence of permanent faults and transient faults.

The hardware architecture of the computer running this software a simulated bi-processor with stable storage on disk. Each processor also has its own local memory.

Each group of students must implement this service, develop mechanisms first to tolerate cash faults (duplex replication technique) and, secondly, accidental transient value faults (temporal redundancy technique). Tests by fault injection must be used to validate the various mechanisms.

Number of hours
10h of practical classes

Person(s) in charge
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Teaching method
En présence

Teaching language
French (interaction with students in English possible)

Bibliography

Handouts and bibliography of the course *"Dependable Computing.*

· Teaching Unit Analyse et Optimisation des systèmes discrets

· Subject Discrets Systems Analysis and Modeling

· Subject Combinatorial optimization

· Subject flexible workshop Project

· Optimisation combinatoire

· Teaching Unit Développement des systèmes informatiques

· Subject software engineering

Pre-requisites

Algorithmics and object oriented programming

Objectives

This course illustrates how to deploy a development process using the Unified Modeling Language (UML), focusing mainly on embedded systems.

Students are confronted with the semantics of language and the use of multiple diagrams for system design.

Targeted skills

Understanding and modeling of the functional and non-functional needs of an embedded application

Basic knowledge to use UML2.0 diagrams

Skills for modeling system requirements in UML

Development approach with UML models

Description

The course is composed of two parts, each one organised into chapers:

Part 1 – Embedded systems

Chapter 1 : Introduction to the development of embedded systems

Chapter 2 : Constraints and non-functional specifications

Chapter 3 : Hardware and software design elements

Part 2 – Object-Oriented Development

Chapter 4 : Generalities on software engineering

Chapter 5 : Unified Modeling Language (UML)

Chapter 6 : A light-weight object-oriented development process

Number of hours
10h lectures and 7h practical classes

Person(s) in charge
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Jean-Charles.Fabre@laas.fr
Phone 2354

Bibliography

Handouts ENSEEIHT, slides presented by J. Guiochet

P. A. MULLER et N. GAERTNER, Mode#lisation objet avec UML, Eyrolles, 2000

G. BOOCH, J. RUMBAUGH et Y. JACOBSON, Le guide de l'utilisateur UML , Eyrolles, 2000

E. GAMMA et al., Design Patterns, Thomson, 1996

- **Subject Local Networks**
- **Génie Logiciel**
- **Réseaux Locaux**

- **Teaching Unit Métier d'ingénieur**
  - **Subject BE industriel**
  - **Subject Project management**
  - **Subject English language**
  - **Subject CV and professional Interview**

- **Parcours Electrodynamique et Mécatronique - Sem. 9 M2 EES**
  - **Teaching Unit Commande et Observation des actionneurs**
    - **Subject Formation SABER**
    - **Subject TER Commande des actionneurs électriques**
    - **Subject Estimation filtrage**
    - **Subject Stratégie de commande des actionneurs électriques**
    - **Subject TER Commande avancée**
  - **Teaching Unit Physique des dispositifs électromagnétiques**
    - **Subject Plasmas**

· **Subject Electrodynamics**

· **Subject Modélisation des phénomènes couplés; BE Modé des phén couplé**

· **Subject Couplage électromécanique et milieux fluides;BE**

· **Teaching Unit Cnv. électromec. syst méc**

· **Subject Conception des machines et des actionneurs électromécaniques**

· **Subject TER Modélisation Num. et Dimensionnement des Mach. Elect.**

· **Subject Conception mécanique des convertisseurs électromécaniques**

· **Subject Caractérisation d'un capteur de vitesse**

· **Subject Théorie et technique de bobinages des machines électriques**

· **Subject Propriétés fondamentales des convertisseurs statiques**

· **Subject Compatibilité électromagnétique**

· **Teaching Unit Métier d'Ingénieur**

· **Subject BE industriel**

· **Subject Project management**

· **Subject English language**

· **Subject CV and professional Interview**

· **Teaching Unit Commande et Diagnostic des systèmes**

· **Subject System monitoring and diagnostics**

Objectives

Have a global vision of what are monitoring and diagnostic

Know different monitoring and diagnostic methods and their fields of application

Identify the main functions involved in monitoring and diagnostic

· Subject Multidimensional systems

· Teaching Unit Commande Optimisée des systèmes

· Subject Optimisation statique : Conc. par optimi. des actionneurs

· Subject Optimal Control

· Subject Continuous Optimisation

· Subject TER Optimath

· Parcours Electronique de puissance Avancée - Sem 9 M2 EES

· Teaching Unit Commande et Diagnostic des systèmes

· Subject Fiabilité CVS

· Subject Mécanismes commutation et intégration fonctionnelle

· Subject Multidimensional systems

· Teaching Unit Commande optimisée des systèmes

· Subject Conception par optimisation et système

· Subject autonomous energy systems, hybridization, embedded systems

Objectives

At the end of the course, the student will be able to identify the architectures of the hybrid systems and to know the energy/ power characteristics of some sources and energy storage elements.

He will be able to analyze the mission of an energy system, to evaluate the relevance of its hybridization and to design a hybrid system.

The student will also be able to propose an energy management strategy of a multi-source energy system by respecting the intrinsic characteristics of the associated sources.

Description

In addition to the hybridization theorie and the energy management of multi-source systems, the course is based on several examples of hybrid energy systems from the Laplace laboratory experience feedback.These examples relate in particular to the transport field (aeronautics, rail and road).

Number of hours
10.5

Teaching method
En présence

· Conception système

· BE Conception syst (EHA)

· BE PAC

· Conception réseaux embarqués

· Teaching Unit Commande et Observation des actionneurs

· Subject Commande des actionneurs dans leur environnement

· Subject TER Commande actionneurs

· Subject Sources, reversibility, storage

Objectives

The course objective is to know and understand the operating principle of the main electrical energy sources and energy storage elements.

At the end of the course, the student will be able to determine the static and dynamic models of some electrochemical components: fuel cell and battery.

The student will also be able to identify the different architectures of wind energy conversion.

Description

This course allows the student to know the different electrical energy sources, the different elements of energy storage and clean energy vectors.

A modeling of the electrochemical components (fuel cell, battery) is proposed.

Concerning renewable energies, the student discovers through this course the different configurations of wind energy conversion.

The photovoltaic conversion is not treated in this course

Number of hours
8.75

Teaching method
En présence

Teaching language
French

- Subject Formation SABER

- Teaching Unit Conception des CVS
  - Subject Conception et associations de CVS
  - Subject Journées thématiques
  - Subject Modélisation, Commande avancée, Architecture
  - Associations de CVS
  - BE CVS (alim. Décharges)
  - TER Architecture et commande

- Teaching Unit Réseaux de puissance
  - Subject Conditionnement réseaux énergie
  - Subject CVS pour réseaux HVDC

- Teaching Unit CVS N-Niveaux, Cde MLI et CEM
  - Subject CEM
  - Subject CVS X niveaux, commande vectorielle

- Teaching Unit Métier d'Ingénieur
  - Subject BE industriel
  - Subject Project management
  - Subject English language

· Subject CV and professional Interview

· Parcours Nouvelle Technologie de l'Energie sem 9-M2 EES

· Teaching Unit Conception systémique et Eco-conception

· Subject Optimization design Project

· Subject Life cycle analysis Project

· Subject Process Designs Project

· Subject Process Design and Analysis

· Subject Systemic modeling in Bond Graph

· Subject Ecodesign, Life cycle analysis, project management

· Subject Optimization Design

· Teaching Unit Systèmes hybrides, Smart-grids et Stockage électrochimique

· Subject Hybrid energy systems Project

Objectives

- Develop a multiphysics system model using Bond Graph formalism;

- Analyze energy transfer and energy coupling in a multiphysics system;

- Analyze system power profile and evaluate the interest of its hybridization;

- Sizing the hybrid system sources (fuel cell and supercapacitor);

- Simulate a frequency energy management strategy.

Description

This project consists in applying the Bond Graph formalism for the modeling of an EHA (ElectroHydrostatic Actuator) of an Airbus 320.

The project also aims to feed the EHA through a hybrid energy system.Indeed, the student must analyze the system power profile (here the EHA during a flight sequence) and conclude on the interest of its hybridization.The hybridization here consists in associating a PEM (Proton Exchange Membrane) fuel cell with a supercapacitor.The student has to size the sources and apply a frequency energy management strategy to respect the dynamic characteristics of

the hybrid system sources.

Number of hours
10.5

Teaching method
En présence

· Subject Fuel cells project

Objectives

- Evaluate two complementary methodologies for experimental characterization of an electrochemical component:

Dynamic plot of voltage-current curve.

Electrochemical impedance spectroscopy.

- Parameterize a dynamic model of PEM (Proton Exchange Membrane) fuel cell based on the performed experimental characterizations.

- Evaluate the dynamic behavior of the PEM fuel cell providing current ripples generated by the connection of DC/DC static converters (Buck, Boost).

Description

- Electrical and fluidic assembly of an energy conversion manipulation based on an electrolyzer and a fuel cell.

- Study of two electrochemical components characterization methodology: the dynamic tracing of the voltage-current curve and the electrochemical impedance spectroscopy.

- Parametric identification: obtain the model parameters of an electrochemical component from the experimental characterizations.

Number of hours
10.5

Teaching method
En présence

Teaching language
French

· Subject Decentralized and embedded electrical networks

Objectives

* Know the characteristic criteria (security, stability ...) of an embedded or decentralized electrical network compared to a conventional distribution network.
* Understand the main elements (storage ...) used in the design of such a network.
* Propose different network architectures in relation to a given specification.
* Be able to read a complete electrical diagram of a photovoltaic installation by being able to identify the various devices necessary as well as their function and sizing.

Description

1. Security and reliability

* Related concepts (fault isolation, reconfiguration, backup network, ...)
* Example of an aeronautical network

2. Mission Profile to be completed

* Interest of sources hybridization to optimize their use

* Using the Ragone plan in sizing storage units

3. Quality (AC and DC networks)

* Definition of quality standards (current, voltage)
* Quality Improvement Solutions

4. Stability (AC and DC networks)

* Architecture and operation of AC power grids
* Principles of frequency and voltage settings on networks (primary, secondary adjusments)
* Power limitation of transportation lines
* Instability related to filter - regulated system interactions

5. EMC issues

* Coupling types
* Disturbance measurements and means of protection
* EMC issues for power grids
* Problems associated with indirect lightning strike

6. Study of PV installations connected to the distribution network

* Definitions of electrical switchgears and classes of protection
* LV earth connection diagram
* Electrical surge protection
* Study of plant schematic examples

Person(s) in charge
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Teaching method
En présence

Teaching language
French

Bibliography

T. Christen et M. W. Carlen, « Theory of Ragone plots », Journal of Power Sources 91, pp. 210-216.

O. Gergaud, « Modélisation énergétique et optimisation économique d'un système de production éolien et photovoltaïque couplé au réseau et associé à un accumulateur », Thèse ENS Cachan, 2002.

· Subject Energy Hybridization of Systems

Objectives

At the end of the course, the student will be able to identify the architectures of the hybrid systems and to know the energy/ power characteristics of some sources and energy storage elements.

He will be able to analyze the mission of an energy system, to evaluate the relevance of its hybridization and to design a hybrid system.

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Description

In addition to the hybridization theorie and the energy management of multi-source systems, the course is based on several examples of hybrid energy systems from the Laplace laboratory experience feedback.These examples relate in particular to the transport field (aeronautics, rail and road).

Number of hours
8.75

Teaching method
En présence

Teaching language
French

· Subject Electrochemical components

· Subject Electrochemistry

· Subject Habitat project

· Subject Habitat

· Teaching Unit Energies renouvelables

· Subject BER Valo Bio HT

· Subject Agrofuels Project

· Subject Wind Energy Systems

· Subject Biofuel systems

· Subject High temperature biomass valorization

· Subject Photovoltaic Project

· Teaching Unit Formation générale

· Subject English language

· Subject Energy and Sustainable Dev Conferences

- **M2 EES Semestre 10**
  - **Parcours Standard sem 10-M2 EES**
    - **Teaching Unit UE Projet Long (M2 EES) Semestre 10**
      - **Subject Rapport Projet Long**
      - **Subject Exposé Projet Long**
      - **Subject Travail Projet Long**
    - **Teaching Unit UE Soutenance PFE (M2 EES) Semestre 10**
      - **Subject Rapport Projet de Fin d'Etudes**
      - **Subject Exposé Projet de Fin d'Etudes**
      - **Subject Travail Projet de Fin d'Etudes**

Organizational unit

École Nationale Supérieure d'Électrotechnique d'Électronique d'Informatique d'Hydraulique et des Télécommunications