21_ING_S05_UE_E
CS

Energie électrique et Commande des Systèmes
ELECTRICAL ENERGY AND SYSTEMS CONTROL

Director : Catherine MUSY

Introduction

The Electrical Energy and systems control teaching unit brings together lessons on systems control and the modern use of electrical energy. The wealth of these areas lies in the diversity of applications encountered (electric traction, renewable energies, distribution, lighting, communication ...) and in the constant updating of knowledge and know-how. In many fields (transport, energy ...) the main added value of modern devices lies in control systems and conversion of electrical energy to improve the performance and energy efficiency of the systems. All this makes these teachings a must-have brick in the basic knowledge of a generalist engineer.

Semester

S05

S06

Programme

ECS tc 0 : Autonomie
ECS tc 1 : Cours d'énergie électrique
ECS tc 2 : Cours d'automatique des procédés linéaires
ECS tc 3 : Régulation et entrainement électrique

Learning Outcomes

- To know how to use the recent technologies of the domains of the electrical energy and the control of the systems.
- To be able to apply basic concepts in automatic and electrical engineering.
- Know how to implement the tools of design and analysis of complex systems.
- To be able to design simple control laws for linear processes.

Employment Sectors

Requirements

Assesment

ECS tc0 : 15 %, ECS tc1 : 40 %, ECS tc2 : 40 %, ECS tc3 : 5%

Option Website

Additional Information

AUTONOMIE ECS

ACADEMIC SUPPORT ECS

Lecturers: Arnaud BREARD, Emmanuel BOUTLEUX

| Lecturers : 0.0 | TC : 2 | PW : 0.0 | Autonomy : 16 | 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

Auteur ouvrage 1, *TITRE OUVRAGE 1*, Editeur ouvrage 1, 2010
2011 *TITRE OUVRAGE 2*, Editeur ouvrage 2, 2012
Auteur ouvrage 3*TITRE OUVRAGE 3*, Editeur ouvrage 3, 2013

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: Christian VOLLAIRE, Arnaud BREARD

| 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 :

Méhodes :

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: Emmanuel BOUTLEUX, Eric BLANCO

| 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 :

Méhodes :

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