الجمهورية الجزائرية الديمقراطية الشعبية République Algérienne Démocratique et Populaire
وزارة التعليم العالي والبحث العلمي
Ministère de l'Enseignement Supérieur et de la Recherche Scientifique
اللجنة البيداغوجية الوطنية لميدان العلوم و التكنولوجيا
Comité Pédagogique National du domaine Sciences et Technologies

MASTER ACADEMIQUE HARMONISE

Programme national

Mise à jour 2022

Domaine	Filière	Spécialité
Sciences et Technologies	Electrotechnique	Machines Electriques

الجمهورية الجزائرية الديمقراطية الشعبية République Algérienne Démocratique et Populaire
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عرض تكوين
ل. م . د

ماستر أكاديمية

تحديث 2022

الميدان	الفرع	التخصص
علوم و تكنولوجيا	كهروتقني	ماكنات كهربائية

I – Fiche d'identité du Master

Conditions d'accès

(Indiquer les spécialités de licence qui peuvent donner accès au Master)

Filière	Master harmonisé	Licences ouvrant accès au master	Classement selon la compatibilité de la licence	Coefficient affecté à la licence
Electrotechnique	Machines électriques	Electrotechnique	1	1.00
		Electromécanique	2	0.80
		Maintenance Industrielle	2	0.80
		Electronique	3	0.70
		Automatique	3	0.70
		Autres licences du domaine ST	5	0.60

II – Fiches d'organisation semestrielles des enseignements de la spécialité

Semestre 1 Master : MachinesElectriques

Unité d'enseignement	Matières	Credits	Coefficient	Volume horaire hebdomadaire			Volume Horaire Semestriel (15 semaines)	Travail Complémentaire en Consultation (15 semaines)	Mode d'évaluation	
	Intitulé			Cours	TD	TP			Contrôle Continu	Examen
UE Fondamentale Code : UEF 1.1.1 Crédits : 10 Coefficients : 5	Réseaux de transport et de distribution d'énergie électrique	4	2	1h30	1h30		45h00	55h00	40%	60%
	Electronique de puissance avancée	4	2	1h30	1h30		45h00	55h00	40%	60%
	µ-processeurs et µ-contrôleurs	2	1	1h30			22h30	27h30		100%
UE Fondamentale Code : UEF 1.1.2 Crédits : 8 Coefficients : 4	Machines électriques approfondies	4	2	1h30	1h30		45h00	55h00	40%	60%
	Méthodes numériques appliquées et optimisation	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Méthodologique Code : UEM 1.1 Crédits : 9 Coefficients : 5	TP : - µ-processeurs et µ-contrôleurs	1	1			1h00	15h00	10h00	100%	
	TP : - Réseaux de transport et de distribution d'énergie électrique	2	1			1h30	22h30	27h30	100%	
	TP : - Electronique de puissance avancée	2	1			1h30	22h30	27h30	100%	
	TP : Méthodes numériques appliquées et optimisation	2	1			1h30	22h30	27h30	100%	
	TP : - machines électriques approfondies	2	1			1h30	22h30	27h30	100%	
UE Découverte Code : UED 1.1 Crédits : 2 Coefficients : 2	Les tramways ou panier au choix	1	1	1h30			22h30	02h30		100%
	Panier au choix	1	1	1h30			22h30	02h30		100%
UE Transversale Code : UET 1.1 Crédits : 1 Coefficients : 1	Anglais technique et terminologie	1	1	1h30			22h30	02h30		100%
Total semestre 1		30	17	12h00	6h00	7h00	375h00	375h00		

Semestre 2 Master : Machines Electriques

Unité d'enseignement	Matières Intitulé	Credits	Coefficient	Volume horaire hebdomadaire Cours	TD	TP	Volume Horaire Semestriel (15 semaines)	Travail Complémentaire en Consultation (15 semaines)	Mode d'évaluation Contrôle Continu	Examen
UE Fondamentale Code : UEF 1.2.1 Crédits : 8 Coefficients : 4	Modélisation des machines électriques	4	2	1h30	1h30		45h0	55h00	40%	60%
	Champ magnétique dans les machines électriques	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Fondamentale Code : UEF 1.2.2 Crédits : 10 Coefficients : 5	Asservissements échantillonnés et Régulation numérique	4	2	1h30	1h30		45h00	55h00	40%	60%
	Construction des machines électriques	4	2	1h30	1h30		45h00	55h00	40%	60%
	Matériaux en électrotechnique et technique de haute tension	2	1	1h30			22h30	27h30		100%
UE Méthodologique Code : UEM 1.2 Crédits : 9 Coefficients : 5	TP : -Modélisation des machines électriques	2	1			1h30	22h30	27h30	100%	
	TP Asservissements échantillonnés et Régulation numérique	2	1			1h30	22h30	27h30	100%	
	TP Champ magnétique dans les machines électriques	1	1			1h00	15h00	10h00	100%	
	Association machines-convertisseurs	4	2	1h30		1h30	45h00	55h00	40%	60%
UE Découverte Code : UED 1.2 Crédits : 2 Coefficients : 2	Dessin technique ou panier au choix	1	1	1h30			22h30	02h30		100%
	Machines électriques en régime dynamique ou panier au choix	1	1	1h30			22h30	02h30		100%
UE Transversale Code : UET 1.2 Crédits : 1 Coefficients : 1	Respect des normes et des règles d'éthique et d'intégrité	1	1	1h30			22h30	02h30		100%
Total semestre 2		30	17	13h30	6h00	5h30	375h00	375h00		

Semestre 3 Master : Machines Electriques

Unité d'enseignement	Matières Intitulé	Credits	Coefficient	Volume horaire hebdomadaire Cours	TD	TP	Volume Horaire Semestriel (15 semaines)	Travail Complémentaire en Consultation (15 semaines)	Mode d'évaluation Contrôle Continu	Examen
UE Fondamentale Code : UEF 2.1.1 Crédits : 10 Coefficients : 5	Machines électriques spéciales	4	2	1h30	1h30		45h00	55h00	40%	60%
	Régimes transitoires des machines Electriques	4	2	1h30	1h30		45h00	55h00	40%	60%
	Computer-aided design of electrical machines	2	1	1h30			10:30 p.m.	27:30		100%
EU Fundamental Code: UEF 2.1.2 Credits: 8 Coefficients: 4	Identification and diagnosis of electrical machines	2	1	1h30			10:30 p.m.	27:30		100%
	Heating and cooling of electromechanical actuators	2	1	1h30			10:30 p.m.	27:30		100%
	Control of electrical machines	4	2	1h30	1h30		45h00	55h00	40%	60%
EU Methodological Code: UEM 2.1 Credits: 9 Coefficients: 5	Practical work: - Special electrical machines	2	1			1h30	10:30 p.m.	27:30	100%	
	Practical work: - Transient regimes of electrical machines	2	1			1h30	10:30 p.m.	27:30	100%	
	Practical work: - Identification and diagnosis of electrical machines	2	1			1h30	10:30 p.m.	27:30	100%	
	Practical work: Computer-aided design electrical machines	1	1			1 hour	3:00 p.m.	10:00 a.m.	100%	
	TP Control of electrical machines	2	1			1h30	10:30 p.m.	27:30	100%	
EU Discovery Code: UED 2.1 Credits: 2 Coefficients: 2	Basket of your choice	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
	Basket of your choice	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
Transversal EU Code: UET 2.1 Credits: 1 Coefficients: 1	Documentary research and dissertation design	1	1	1h30			10:30 p.m.	2:30 a.m.		100%

Total semester 3		30	17	12:00 p.m.	6:00 a.m.	7:00 a.m.	375 hours	375 hours		

EU Discovery(S1, S2 and S3)

1- Centralized and decentralized production of electrical energy
2- Renewable energies
3- Electrical energy quality Maintenance
4- and operational safety Industrial
5- computing
6- Implementation of real-time digital control Electrical
7- engineering materials and their applications Artificial
8- intelligence techniques
9- Standards and legislation in Electrotechnics
10-Industrial security and authorization
11-Industrial Ecology and Sustainable Development
12-The trams
13-Technical drawing
14-Electrical machines in dynamic mode 1-
Others...

Semester 4

Internship in a company leading to a dissertation and a defense.

	VHS	Coefficient	Credits
Personal Work	550	09	18
Internship in a company	100	04	06
Seminars	50	02	03
Other (Supervision)	50	02	03
Total Semester 4	750	17	30

This table is given for information purposes only.

Evaluation of the End of Master's Cycle Project

- Scientific value (Jury assessment) /6
- Writing the Dissertation (Jury Assessment) /4
- Presentation and answer to questions (Jury assessment) /4
- Supervisor's assessment /3
- Presentation of the internship report (Jury assessment) /3

III - Detailed program by subject for semester S1

Semester: 1

Fundamental EU Code: UEF 1.1.1

Subject:Electric energy transmission and distribution networks

VHS: 45h (Class: 1h30, Tutorial: 1h30)

Credits: 4

Coefficient: 2

Teaching objectives:

The objective of this course can be divided into two: on the one hand, the expansion of the knowledge acquired during the 'Electrical Networks' course in the Bachelor's degree, and on the other hand, introducing the necessary knowledge on the management and operation of electrical networks.

Recommended prior knowledge:

Fundamental laws of electrical engineering (Ohm's Law, Kirchhoff's Laws, etc.), Analysis of alternating current electrical circuits, complex calculations. Modeling of electrical lines (Electrical network course in Bachelor's degree).

Content of the material:

Chapter 1. Electrical substation architectures (2 weeks)

Overall architecture of the electrical network, equipment and architecture of substations (busbar coupling substations, circuit breaker coupling substations), topologies of energy transmission and distribution networks.

Chapter 2. Organization of electrical energy transmission 2.1.

Power transmission lines (3 weeks)

Calculation of transmission lines: Selection of conductor cross-section, insulation, mechanical calculation of lines, Operation of transmission lines in steady state. Operation of transmission lines in transient state. Direct current energy transmission (HVDC).

2.2. Distribution networks (2 weeks)

Introduction to electrical power distribution, primary distribution, secondary distribution, distribution transformers, reactive energy compensation in distribution networks, distribution reliability.

Chapter 3. Operation of MV and LV electrical networks (3 weeks)

Protection of HV/MV substations against overcurrents and overvoltages). Models of electrical network elements. Voltage adjustment, Voltage adjustment devices, - Control of reactive power on an electrical network

Chapter 4. Neutral Regimes (2 weeks)

Neutral systems (insulated, grounded, impedant), artificial neutral.

Chapter 5. Voltage Adjustment (3 weeks)

Voltage drop in electrical networks, voltage adjustment method (automatic voltage adjustment at generator terminals, AVR, reactive energy compensation by classical and modern means, voltage adjustment by autotransformer), introduction to voltage stability.

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1. F. Kiessling et al, 'Overhead Power Lines, Planning, design, construction'. Springer, 2003.
2. T. Gonen et al, 'Power distribution', book chapter in Electrical Engineering Handbook. Elsevier Academic Press, London, 2004.
3. E. Acha and VG Agelidis, 'Power Electronic Control in Power Systems', Newns, London 2002.
4. TuranGönen: Electric power distribution system engineering. McGraw-Hill, 1986
5. TuränGonen: Electric power transmission system engineering. Analysis and Design. John Wiley & Sons, 1988

Semester: 1

Fundamental EU Code: UEF 1.1.1 Subject:

Advanced power electronics

VHS: 45h (Class: 1h30, Tutorial: 1h30)

Credits: 4

Coefficient: 2

Teaching objectives:

To provide the electrical circuit concepts behind the different operating modes of inverters to enable deep understanding of their operation
To equip with the necessary skills to obtain the criteria for the design of power converters for UPS, Drives etc.,
Ability to analyze and understand the different operating modes of different power converter configurations.
Ability to design different single-phase and three-phase inverters

Recommended prior knowledge:

Power components, basic power electronics,

Content of the material:

Chapter 1:Modeling and simulation methods of power semiconductors Idealized characteristics of different types of semiconductors, logic equations of semiconductors, simulation methods of static converters(2 weeks)
Chapter 2:Switching mechanisms in static converters Natural switching principle, forced switching principle, calculation of switching losses.
(3 weeks)
Chapter 3:Design methods for naturally commutated static converters Commutation rules, definition of the commutation cell, different types of sources, power exchange rules, direct and indirect converters example: study of a cyclo converter. (2 weeks)

Chapter 4:Design methods for forced-commutated static converters
- PWM inverter
- Sinusoidal absorption rectifier
- PWM dimmer
- Switching power supplies(3 weeks)

Chapter 5:Multi-level inverter (3 weeks)
Multi-level concept, topologies, Comparison of multi-level inverters. PWM control techniques for PWM inverters - single-phase and three-phase impedance source. Chapter 6:Power quality of static converters (2 weeks)
- Harmonic pollution due to static converters (Case study: rectifier, dimmer).
- Study of harmonics in voltage inverters.
- Introduction to pollution control techniques

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1. Power electronics, from the switching cell to industrial applications. Courses and exercises, A. Cunière, G. Feld, M. Lavabre, Casteilla editions, 544 p. 2012.
2. - Technical Encyclopedia “Engineering Techniques”, treatise on Electrical Engineering, vol. D4 articles D3000 to D3300.

Semester: 1

Fundamental EU Code: UEF 1.1.1

Subject: μ-processors and μ-controllers

VHS: 10:30 p.m. (Class: 1.5 hours)

Credits: 2

Coefficient: 1

Teaching objectives

Understand the structure of a microprocessor and its purpose. Differentiate between a microprocessor, a microcontroller, and a computer. Understand how memory is organized. Understand assembler programming. Understand the use of I/O interfaces and interrupts. Understand how to use a microcontroller (programming, system control).

Recommended prior knowledge

Combinational and sequential logic, industrial automation

Content of the subject:

Chapter 1: Architecture and operation of a microprocessor (2 weeks) Structure of a calculator, Circulation of information in a calculator, Hardware description of a microprocessor, Operation of a microprocessor, memories

Example: The Intel 8086 microprocessor

Chapter 2: Assembly Programming (2 weeks) Generalities,
The instruction set, Programming method.

Chapter 3: Interrupts and Input/Output Interfaces (3 weeks)
Definition of an interrupt, Support for an interrupt by the microprocessor, Addressing of interrupt subroutines,
I/O Port Addressing, I/O Port Management

Chapter 4: Architecture and operation of a microcontroller (3 weeks) Hardware description of a μ-controller and its operation. Programming the μ-controller Example: The PIC μ-controller

Chapter 5: Applications of Microprocessors and Microcontrollers (4 weeks) LCD Interface - Keyboard Interface - Signal Generation from Ports Gate for Converters - Motor- Control - Control of DC / AC Devices - Frequency Measurement - Data Acquisition System

Assessment method:

100% exam.

Bibliographic references:

1. M. Tischer and B. Jennrich. The PC Bible – System Programming. Micro Application, Paris, 1997.
2. R. Tourki. The PC Computer – Architecture and Programming – Courses and Exercises. University Publication Center, Tunis, 2002.
3. H. Schakel. Programming in assembler on PC. Micro Application, Paris, 1995.
4. E. Pissaloux. Practical use of the I80x86 assembler – Course and exercises. Hermès, Paris, 1994
5. R. Zaks and A. Wolfe. From Component to System – Introduction to Microprocessors. Sybex, Paris, 1988.

Semester: 1
Fundamental EU Code: UEF 1.1.2 Subject:
Advanced electrical machines
VHS: 45h (Class: 1h30, tutorial 1h30)
Credits: 4
Coefficient: 2

Teaching objectives

At the end of this course, the student will be able to establish the general equations for electromechanical energy conversion applied to synchronous, asynchronous and direct current machines and will be able to determine their characteristics in static or variable regimes. This allows in particular to take into account the association of machines with static converters.

Recommended prior knowledge

- Three-phase electrical circuits, alternating current, power. Magnetic circuits, single-phase and three-phase transformers, direct and alternating current electrical machines (motor and generator operation).

Content of the subject:

Chapter 1: General Principles (3 weeks)

Principle of electromechanical energy conversion. Principle of stator/rotor coupling: the primitive machine. Windings of electrical machines. Calculation of magnetomotive forces. Mechanical equation;

Chapter 2: Synchronous Machines (4 weeks)Generalities and equations of the smooth-pole synchronous machine. Study of the operation of the synchronous machine. Different excitation systems. Armature reactions. Elements on the salient-pole synchronous machine without and with dampers. Potier diagrams, two-reactance diagram and Blondel diagram. Elements on permanent magnet machines. Alternators and parallel coupling. Synchronous motors, starting...

Chapter 3: Asynchronous Machines (4 weeks)General information. Setting in equation. Equivalent diagrams. Torque of the asynchronous machine. Characteristics and diagram of the asynchronous machine. Motor/generator operation, starting, braking. Deep slot and double cage motors, Single-phase asynchronous motors.

Chapter 4: Direct Current Machines (4 weeks)

Structure of DC machines. Equations of DC machines. Starting, braking, and speed control methods for DC motors. Commutation phenomena. Armature saturation and reaction. Auxiliary commutation poles. Motor/generator operation.

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1. J.-P. Caron, JP Hautier: Modeling and control of the asynchronous machine, Technip, 1995.
2. G. Grellet, G. Clerc: Electric actuators, Principles, Models, Controls, Eyrolles, 1996.

Semester: 1

Fundamental EU Code: UEF 1.1.2 Subject:

Advanced electrical machines

VHS: 45h (Class: 1h30, tutorial 1h30)

Credits: 4

Coefficient: 2

Teaching objectives

At the end of this course, the student will be able to establish the general equations for electromechanical energy conversion applied to synchronous, asynchronous and direct current machines and will be able to determine their characteristics in static or variable regimes. This allows in particular to take into account the association of machines with static converters.

Recommended prior knowledge

Three-phase alternating current electrical circuits. Magnetic circuits. Single-phase and three-phase transformers.

Content of the subject:

Chapter 1: General Principles (3 weeks)

Principle of electromechanical energy conversion. Principle of stator/rotor coupling: the primitive machine. Windings of electrical machines. Calculation of magnetomotive forces. Mechanical equation;

Chapter 2: Synchronous Machines (4 weeks)

General information and equations of the smooth-pole synchronous machine. Study of the operation of the synchronous machine. Different excitation systems. Armature reactions. Elements on the salient-pole synchronous machine without and with dampers. Potier diagrams, two-reactance diagram and Blondel diagram. Elements on permanent magnet machines. Alternators and parallel coupling. Synchronous motors, starting...

Chapter 3: Asynchronous Machines (4 weeks)

General information. Equation. Equivalent diagrams. Torque of the asynchronous machine. Characteristics and asynchronous machine diagram. Motor/generator operation, starting, braking. Deep slot and double cage motors, single-phase asynchronous motors.

Chapter 4: Direct Current Machines (4 weeks)

Structure of DC machines. Equations of DC machines. Starting, braking, and speed control methods for DC motors. Commutation phenomena. Armature saturation and reaction. Auxiliary commutation poles. Motor/generator operation.

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1. J.-P. Caron, JP Hautier: Modeling and control of the asynchronous machine, Technip, 1995.
2. G. Grellet, G. Clerc: Electric actuators, Principles, Models, Controls, Eyrolles, 1996.
3. J. Lesenne, F. Notelet, G. Séguier: Introduction to advanced electrical engineering, Technique et Documentation, 1981.
4. Paul C. Krause, Oleg Wasyzczuk, Scott S, Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley, Second Edition, 2010.
   PS Bimbhra, "Generalized Theory of Electrical Machines", Khanna Publishers, 2008
5. AE, Fitzgerald, Charles Kingsley, Jr, and Stephan D, Umanx, "Electric Machinery", Tata McGraw Hill, 5th Edition, 1992

Semester: 1

Fundamental EU Code: UEF 1.1.2

Subject: Applied numerical methods and optimization

VHS: 45h (Class: 1h30, tutorial 1h30)

Credits: 4

Coefficient: 2

Teaching objectives:

The objective of this course is to present the tools necessary for numerical analysis and optimization, with or without constraints, of physical systems, in the field of engineering.

Recommended prior knowledge:

Mathematics, programming, mastery of the MATLAB environment.

Content of the material:

Chapter I: Reminders on some numerical methods (3 weeks)

- Resolution of nonlinear systems of equations by iterative methods.
- Digital integration and differentiation.
- Methods for solving ordinary differential equations (ODE): Euler methods; Methods Runge-Kutta; Adams method.
- Solving EDO systems.

Chapter II: Partial Differential Equations (PDE) (6 weeks)

- Introduction and classifications of partial differential problems and boundary conditions;
- Methods for solving PDEs: Finite Difference Method (FDM); Finite Volume Method (FVM); Finite Element Method (FEM).

Chapter III: Optimization Techniques (6 weeks)

- Definition and formulation of an optimization problem.
- Single and multiple optimization with or without constraints.
- Unconstrained optimization algorithms (Deterministic methods, Stochastic methods).
- Constraint processing (Transformation methods, Direct methods).

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1. G. Allaire, Numerical Analysis and Optimization, Edition of the Polytechnic School, 2012
2. SS Rao, 'Optimization – Theory and Applications', Wiley-Eastern Limited, 1984
3. A. Fortin, Numerical Analysis for Engineers, International Polytechnic Press, 2011.
4. J. Bastien, JN Martin, Introduction to numerical analysis: Application under Matlab, Dunod, 2003.
5. A. Quarteroni, F. Saleri, P. Gervasio, Scientific computing, Springer, 2008.
6. TA Miloud, Numerical methods: Finite difference method, integral and variational method, Office of University Publications, 2013.
7. JP Pelletier, Numerical techniques applied to scientific computing, Masson, 1982.
8. F. Jedrzejewski, Introduction to Numerical Methods, Springer, 2001.
9. P. Faurre, Numerical analysis, optimization notes, Ecole polytechnique, 1988.
10. Fortin.Numerical analysis for engineers,International Polytechnic Press, 2011.
11. J. Bastien, JN Martin.Introduction to numerical analysis: Application in Matlab,Dunod, 2003.
12. Quarteroni, F. Saleri, P. Gervasio.Scientific calculation,Springer,2008.

Semester 1

Methodological UE Code: UEM 1.1 Subject: Practical work - μ-processors and μ-controllers

VHS: 3 p.m. (Course: 1 hour)

Credits: 1

Coefficient: 1

Teaching objectives

Understand assembly programming. Understand the principle and execution steps of each instruction. Understand the use of I/O interfaces and interrupts. Understand the use of microcontrollers (programming, system control).

Recommended prior knowledge

Combinatorial and sequential logic, industrial automation, algorithms.

Content of the material

TP1: Getting to grips with a programming environment on a μ-processor (2 weeks)
TP2: Programming arithmetic and logical operations in a μ-processor (2 weeks)
TP3: Using video memory in a μ-processor (2 weeks) TP4: Managing μ-processor memory. (2 weeks)
TP5: Control of a stepper motor by a μ-processor (2 weeks) TP6: Screen management (1 week)
TP7: Programming the PIC μ-microcontroller (2 weeks)
TP8: Control of a stepper motor by a PIC μ-microcontroller (2 weeks)

Assessment method:

Continuous assessment: 100%.

Bibliographic references:

1. R. Zaks and A. Wolfe. From Component to System – Introduction to Microprocessors. Sybex, Paris, 1988.
2. M. Tischer and B. Jennrich. The PC Bible – System Programming. Micro Application, Paris, 1997.
3. [3] R. Tourki. The PC computer – Architecture and programming – Courses and exercises. University Publication Center, Tunis, 2002.
4. H. Schakel. Programming in assembler on PC. Micro Application, Paris, 1995.
5. E. Pissaloux. Practical use of the 180x86 assembler – Course and exercises. Hermès, Paris, 1994

Semester: 1

Methodological EU Code: UEM 1.1

Subject: Practical work on electrical energy transmission and distribution networks

VHS: 10:30 p.m. (TP: 1:30 p.m.)

Credits: 2

Coefficient: 1

Teaching objectives:

To enable the student to have all the tools necessary to manage, design and operate electro-energy systems and more specifically electrical networks

Recommended prior knowledge:

General information on electrical transmission and distribution networks

Content of the subject: TP No. 1:Voltage adjustment by synchronous motor

TP No. 2:Power distribution and voltage drop calculation TP No.
3:Voltage adjustment by reactive energy compensation TP No. 4:
Neutral regime TP No. 5:Interconnected Networks

Assessment method:

Continuous assessment: 100%.

Bibliographic references:

1. Sabonnadière, Jean Claude, Electrical Lines and Networks, Vol. 1, Electrical Power Lines, 2007.
2. Sabonnadière, Jean Claude, Electrical Lines and Networks, Vol. 2, Methods for Analyzing Electrical Networks, 2007.
3. Lasne, Luc, Exercises and problems in electrical engineering: basic concepts, networks and electrical machines, 2011.
4. J. Grainger, Power system analysis, McGraw Hill, 2003
5. WD Stevenson, Elements of Power System Analysis, McGraw Hill, 1998.

Semester: 1

Methodological UE Code: UEM 1.1 Subject:

Advanced power electronics practical work

VHS: 10:30 p.m. (TP: 1:30 p.m.)

Credits: 2

Coefficient: 1

Teaching objectives:

To enable the student to understand the operating principles of new power electronic converter structures.

Recommended prior knowledge:

Basic principle of power electronics

Content of the material:

TP1: New converter structures Improved
TP2: power factor; Elimination of
TP3: harmonics
TP4: Static reactive power compensators

Assessment method:

Continuous assessment: 100%;

Bibliographic references:

1. GuySéguier and Francis Labrique, “Power electronics converters - volumes 1 to 4”
2. Ed. Lavoisier Tec and very rich documentation available in the library. - Website: “Courses and Documentation”
3. Valérie Léger, Alain Jameau Energy conversion, electrical engineering, power electronics. Course summary, corrected problems », , : ELLIPSES MARKETING

Semester: 1
Methodological UE Code: UEM 1.1 Subject: Practical work Applied numerical methods and optimization
VHS: 10:30 p.m. (TP: 1:30 p.m.)
Credits: 2
Coefficient: 1

Teaching objectives:

Program numerical resolution methods and those associated with optimization problems.

Recommended prior knowledge:

Algorithms and programming.

Content of the material:

- Initialization to the MATLAB environment (Introduction, Elementary Aspects, Comments, Vectors and Matrices, M-Files or Scripts, Functions, Loops and Control, Graphics, etc.). (01 week)

- Write a program to:
  - Calculate the integral by the following methods: Trapezoid, Simpson and general; (01 week)
  - Solve ordinary differential equations and systems of equations by the different Euler, Runge-Kutta methods of order 2 and 4 (02 weeks)
  - Solve systems of linear and nonlinear equations: Jacobi; Gauss-Seidel; Newton - Raphson; (01 week)
  - Solve PDEs using MDF and MEF for the three (03) types of equations (Elliptic, parabolic and elliptic); (06 weeks)
  - Minimize a multivariate function without constraints (02 weeks)
  - Minimize a multivariate function with constraints (inequalities and equalities). (02 weeks)

Assessment method:Continuous assessment: 100%;

Bibliographic references:

1. G. Allaire, Numerical Analysis and Optimization, Edition of the Polytechnic School, 2012
2. Computational methods in Optimization, Polak, Academic Press, 1971.
3. Optimization Theory with applications, Pierre DA, Wiley Publications, 1969.
4. Taha, HA, Operations Research: An Introduction, Seventh Edition, Pearson Education Edition, Asia, New Delhi, 2002.
5. SS Rao,"Optimization – Theory and Applications", Wiley-Eastern Limited,1984.

Semester: 1

Methodological EU Code: UEM 1.1 Subject: Advanced practical work on electrical machines

VHS: 10:30 p.m. (TP: 1:30 p.m.)

Credits: 2

Coefficient: 1

Recommended prior knowledge:

Good command of IT tools and MATLAB-SIMULINK software.

Content of the material:

1. Electromechanical characteristics of the asynchronous machine;
2. Circle diagram;
3. Asynchronous generator autonomous operation;
4. Coupling an alternator to the network and its operation with the synchronous motor;
5. Determination of the parameters of a synchronous machine;

Assessment method:

Continuous assessment: 100%

Bibliographic references:

1. Th. Wildi, G. Sybille "electrotechnics", 2005.
2. J. Lesenne, F. Noielet, G. Seguier, "Introduction to Advanced Electrical Engineering" Univ. Lille. 1981.
3. MRetif "Vector Control of Asynchronous and Synchronous Machines" INSA, Pedg course. 2008.
4. R. Abdessemed "Modeling and simulation of electrical machines" ellipses, 2011.

Semester: 1
Teaching unit: UED 1.1 Subject:
Subject 1 of your choice VHS:
22h30 (lesson: 1h30) Credits: 1

Coefficient: 1

Semester: 1
Teaching unit: UED 1.1 Subject:
Subject 2 of your choice VHS:
22h30 (lesson: 1h30) Credits: 1

Coefficient: 1

Noticed :
The specialist team can freely choose the discovery subjects offered or those offered in the basket according to the means, needs and interest of the training.

Semester: 1
Teaching unit: UET 1.1 Subject: Technical English and terminology VHS: 22h30 (lesson: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

Introduce students to technical vocabulary. Strengthen their language skills. Help them understand and summarize a technical document. Enable them to understand a conversation in English held in a scientific setting.

Recommended prior knowledge:

Basic English Vocabulary and Grammar

Content of the material:

- Written comprehension: Reading and analysis of texts relating to the specialty.

- Oral comprehension: Based on authentic popular science video documents, note-taking, summary and presentation of the document.

- Oral expression: Presentation of a scientific or technical subject, development and exchange of oral messages (ideas and data), Telephone communication, Gestural expression.

- Written expression: Extracting ideas from a scientific document, Writing a scientific message, Exchanging information in writing, writing CVs, letters of application for internships or jobs.

Recommendation : The subject manager is strongly recommended to present and explain at the end of each session (at most) around ten technical words of the specialty in the three languages (if possible) English, French and Arabic.

Assessment method:

Review: 100%.

Bibliographic references:

1. PT Danison, Practical guide to writing in English: usages and rules, practical advice, Editions d'Organisation 2007
2. A.Chamberlain, R. Steele, Practical Guide to Communication: English, Didier 1992
3. R. Ernst, Dictionary of applied techniques and sciences: French-English, Dunod 2002.
4. J. Comfort, S. Hick, and A. Savage, Basic Technical English, Oxford University Press, 1980
5. EH Glendinning and N. Glendinning, Oxford English for Electrical and Mechanical Engineering, Oxford University Press 1995
6. TN Huckin, and AL Olsen, Technical writing and professional communication for nonnative speakers of English, McGraw-Hill 1991
7. J. Orasanu, Reading Comprehension from Research to Practice, Erlbaum Associates 1986

IV - Detailed program by subject for semester S2

Semester: 2
Fundamental EU Code: UEF 1.2.1
Subject: Modeling of electrical machines
VHS: 45h (Class: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives

The main objective is to deepen students' knowledge of the different mathematical models dedicated to the study of the dynamic behavior of electrical machines.

Recommended prior knowledge

Basics of electrical machines.

Content of the subject:

I: Physical and mathematical study processes (2 weeks).
- Reminders on magnetically coupled circuits
- electromechanical conversion of energy
- Machine inductance
- Symmetrical and relative components

II: Theory of the generalized electrical machine (4 weeks).
- Idealized electric machine
- Idealized electric machine in the natural frame of reference
- Three-phase model of the generalized electric machine
- generalized electric machine in complex form
- Transition from a three-phase system to a two-phase system and vice versa
- Equation of motion of the electric machine

III: Modeling of direct current electrical machines (03 weeks).
- Model of the direct current machine on the d, q axes
- Application of the generalized theory to the various modes of excitation
- Generator operation
- Engine operation

IV: Modeling of asynchronous machines (3 weeks).
- Model of the linear three-phase asynchronous machine
- Model of the saturated three-phase asynchronous machine
- Model of single-phase asynchronous motors with permanent capacitor

V: Modeling of synchronous machines (03 weeks).
- Modeling of synchronous motors without and with dampers
- Modeling of synchronous generators without dampers

Assessment method:40%, exam: 60%

Bibliographic References

1.R. Abdessemed, “Modeling and simulation of electrical machines”, Ellipses, Collection, 2011.
2.M. Jufer, "Electric drives: Design methodology", Hermès, Lavoisier, 2010.
3.G. Guihéneuf, "Electric motors explained to electronics engineers, Projects: starting, speed variation, braking", Publitronic, Elektor, 2014.
4.P. Mayé, "Industrial electric motors, Bachelor's, Master's, engineering schools", Dunod, Collection: Sciences sup, 2011.

5.S. Smigel, "Modeling and control of three-phase motors. Vector control of synchronous motors", 2000.
6.J. Bonal, G. Séguier, "Variable Speed Electric Drives". Vol. 2, Vol.3.

Semester: 2
Fundamental EU Code: UEF 1.2.1
Subject:Magnetic field in electrical machines
VHS: 45h (Class: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

At the end of this course, the student will be able to determine, via a two-dimensional model, the characteristics of conventional electrical machines by solving the equations of the electromagnetic field: analytically, by using the method of separated variables, for simple geometries and numerically, by the finite element method, the finite difference method or the boundary integral method, for complex geometries,

Recommended prior knowledge

Basic Electromagnetism. Basic Electrical Engineering: Direct and alternating current electrical machines (motor and generator operation). Magnetic materials. Electrical and magnetic circuits. Basic Mathematics: Solving partial differential equations, differential analysis and geometry, matrix calculus. Numerical Analysis: Finite Difference Method and Finite Elements. Computer Programming.

Content of the subject:

CHAPTER I: Basic Electromagnetism Complements. (2 Weeks)

I.1. Reminders of electrostatics and magnetostatics
I.2. Reminders of electromagnetic induction.
I.3. Maxwell's equations: differential and integral forms (Gauss's theorems, Ampere's theorem and Faraday's law).
I.4. Interface relations, boundary conditions, and gauge conditions.
I.5. Constitutive laws of media (electric, magnetic and dielectric).

CHAPTER II: Principles of Electromechanical Energy Conversion. (2 weeks)
II.1. The basics of electromechanical energy conversion.
II.2. Poynting vector, electrostatic energy, magnetic energy/co-energy, losses electric.
II.3. Methods for calculating electromagnetic magnetic force and torque: Approaches based on energies/co-energy and on the Maxwell tensor

CHAPTER III: Potential formulations of electromagnetic models. (4 weeks)
III.1. Electrostatic formulations in scalar potential or electric vector.
III.2. Magnetostatic formulations in magnetic potentials, vector and scalars
III.3. Electrokinetic formulation.
III.4. Magnetodynamic formulations in magnetic vector potential A, electric scalar potential V, electric vector potential T, magnetic scalar potential Ω.

CHAPTER IV: Methods for solving partial differential equations (PDE) (4 weeks)

IV.1. Approaches to solving (EDP) problems in Electrical Engineering.
IV.2. Finite Element (FE) formulation of static field models:
IV.3. EF formulation of dynamic models with induced currents in magnetic vector potential

CHAPTER V: Application to electrical machines (3 weeks)

Assessment method:Continuous assessment 40%, exam: 60%

Bibliographic references:

1. E. Durand: “Magnetostatics.”, Masson, Paris, 1968.
2. G. Fournet: “Electromagnetism from local equations”, Masson, Paris, 1985.
3. FORSYTHE and WASOW: “Finite difference methods for partial differential equations”, John Wiley and Sons.
4. Peter P. Silvester, MVK Chari: “Finite Elements in Electrical and Magnetic Field Problems.”John Wiley & Sons Inc, 1980
5. Peter P. Silvester, Ronald L. Ferrari: “Finite Elements for Electrical Engineer.” , 3ed,Cambridge University Press, 1996.
6. Nicola Bianchi:”Electrical Machine Analysis using Finite Elements.” ,Taylor & Francis Group, CRC Press 2005.
7. Sheppard J. Salon:”Finite Element Analysis of Electrical Machines.” ,Springer Science+Business Media New York, 1996.

Semester: 2

Fundamental EU Code: UEF 1.2.2 Subject:

Construction of electrical machines

VHS: 45 hours (Class: 1h30, tutorial: 1h30)

Credits: 4

Coefficient: 2

Teaching objectives:

The student will be able to calculate and size an electrical machine according to the requirements of precise specifications.

Recommended prior knowledge:

Electrical machines and programming software.

Content of the subject:

Chapter I:Materials used in electrical machines (01 Week)

- Magnetic materials;
- Conductive materials;
- Insulating materials;
- Winding wires;
- Building materials.

Chapter II:Magnetic circuit. Different parameters. Losses (2 Weeks)

- Magnetic circuit calculation;
- Calculation of the various parameters of electrical machines;
- Calculation of losses and yield.

Chapter III:Inductor windings (03 Weeks)

Types of winding of AC machines; Coil insulation; Utilization coefficient; Slot filling coefficient; Winding coefficient; Single-layer and double-layer windings; Types of winding of DC machines.

Chapter IV:Calculation of electrical machines

IV.1 - Asynchronous machines (03 Weeks)

Calculation of a cage and wound rotor machine, choice of winding, determination of parameters and losses, characteristics

IV.2 - Synchronous machines: (03 Weeks)

Calculation of a smooth-pole and salient-pole machine with dampers, choice of winding, determination of parameters and losses and characteristics.

IV.3 - Direct current machines (03 Weeks)

Calculation, choice of material, choice of winding, determination of losses and parameters and characteristics

Assessment method:Continuous assessment 40%, exam: 60%

Bibliographic references:

1. M. Kostenko, L. Piotrovsky, Electrical Machines, Volumes I and II, Mir Publishing, Moscow, 1979.

2. J.Pyrhönen, T.JokinenetV.Hrabovcovà “Design of rotating electrical Machines”, Wiley, 2008.

3. IP Kopilov “Calculation of electrical machines”, Energy Edition, Moscow, 1980.

Semester: 2
Fundamental EU Code: UEF 1.2.2
Subject: Materials in electrical engineering and high-voltage technology
VHS: 10:30 p.m. (Course: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives

The objective of this module is to introduce the main electrical and magnetic properties of materials. The student must be able to formulate the different parameters relating to the electrical and magnetic properties of materials and understand the phenomena and mechanisms related to them.

The teaching thus provided will allow the student to identify his area of specialization and to deal with the materials which are the seat and support of electromagnetic phenomena with a relatively developed formalism.

Recommended prior knowledge

Basic notions of electricity, magnetism and the structure of matter.

Content of the subject:

Chapter I: Dielectric materials (3 weeks).

I.1. Definitions: Electric dipole, Dipole moment, Polarization vector.
I.2. Representation of a polarization state
I.3. Electrical Induction (generalization of Gauss's law)
I.4. Dielectric permittivity
I.5. Boundary conditions in a dielectric
I.6. Local field
I.7. Polarization Factor
I.8. Types of Polarization: Electronic polarization; Ionic polarization; Dipolar (orientational) polarization and interfacial polarization.
I.9. Clausuis–mossotti relationship
I.10. Permittivity of a homogeneous mixture
I.11. Electronic polarization in variable regime: Simplified model; Improved model;
I.12. Dipole polarization in variable regime.
I.13. Study of conduction currents and displacement currents in a dielectric
I.14. Equivalent diagram of a dielectric in static mode
I.15. Transient currents in insulators: Absorption current; Resorption current.
I.16. Polarization Index
I.17. Equivalent diagram of a dielectric in variable regime
I.18. Dielectric losses
I.19. Dielectric dissipation factor
I.20. Effect of frequency on dielectric losses
I.21. Dielectric strengths and breakdown mechanisms
I.22. Degradation of dielectric strength
I.23. Constraints encountered by the isolation function
-Mechanical, electrical, climatic and radiation constraints...
I.24. Method of choosing an insulator

Chapter II: Magnetic Materials (4 weeks).
II.1. Definitions: Magnetic moment, magnetic dipole, Amperian currents;
II.2. Magnetization vector;
II.3. Magnetic vector potential;
II.4. Representation of a state of magnetization;
II.5. Generalization of Ampere's law;
II.6. Permeability and magnetic susceptibility;

II.7. Nature of Materials: Orbital magnetic moment, spin magnetic moment;
II.8. Classification of magnetic materials:

- Diamagnetic materials;
- Paramagnetic materials;
- Ferromagnetic materials;
- Antiferromagnetic materials;
- Ferrimagnetic materials.

II.9. Magnetic domains:
-The origin of the domain structure
II.10. Magnetization curve;
II.11. Hysteresis cycle and its dependence on frequency and temperature;
II.12. Soft magnetic materials:

- Examples and characteristics;
- Hysteresis and eddy current losses.

II.12. Hard magnetic materials:
-Examples and characteristics.
II.13. Measurement of magnetic characteristics
II.14. Magnetic circuits
Chapter III: - Conductive Materials (03 weeks).
III.1. Definitions and Physical Properties
III.2. Presentation of the different types of drivers
III.3. Modification of characteristics in relation to external phenomena (temperature, etc.).
- Semiconductor materials
III.4. Introduction of semiconductors.
III.5. Definition of semiconductors, types of semiconductors, pn junction and applications.
III.6. Modification of characteristics in relation to external phenomena (temperature, etc.).
Chapter IV: Superconductivity and superconducting materials (2 weeks).
IV.1. Definition of the superconducting state.
IV.2. BCS Theory.
IV.3. Applications and integration of superconductors in electrical engineering.

Chapter V: High Voltage Techniques (3 weeks).
V.1. High voltage source: (General; Continuous, alternating, and pulsed HV source)

V.2. Metrology in HV: (Measurement of alternating and continuous HV shock; Measurement of dielectric losses)
V.3. Electromagnetic compatibility element: (General information on disturbed systems; Practical rules for protection against electric and magnetic fields)
V.4. Electrical discharges: (Discharges in gases, in liquids, in solids; Protection against lightning; Corona effect)
V.5. Impact of HT on the environment

Assessment method:continuous assessment40%, exam: 60%

Bibliographic references:

1. P. Brissonneau: "Magnetism and Magnetic Materials for Electrical Engineering.", Hermes, Paris, 1997.
2. R. BOITE, J. Neirynck "Materials of Electrical Engineering", Treatise on Electricity, vol. II, Polytechnic and University Presses, Lausanne, 1989.

Semester: 2

Fundamental EU Code: UEF 1.2.2

Subject: Sampled servos and digital regulation

VHS: 45h (Class: 1h30, tutorial 1h30)

Credits: 4

Coefficient: 2

Teaching objectives

The main objective is to deepen students' knowledge of servo control and digital regulation techniques.

Recommended prior knowledge

Basics of enslavement.

Content of the subject:

Chapter 1: Modeling of Sampled Signals and Systems (03 weeks).

1.1 Introduction;
1.2 Fundamentals of signal sampling;
1.3 Examples of simple sampled signals;
1.4 Transformed intozsampled signals;
1.5 Transfer function in z;
1.6 Discrete-time Fourier transform;
1.7 Frequency behavior of sampled systems;
1.8 Relationships between continuous-time and discrete-time models.

Chapter 2: Stability and performance of sample-controlled systems(05 weeks).

2.1 Equation of sampled servocontrols;
2.2 Stability of sampled servocontrols;
2.3 Continuous servocontrols controlled or corrected in discrete time;
2.4 Accuracy of sampled servocontrols;
2.5 Dynamic performance of a sampled system.

Chapter 3: Correction of sampled-slave systems (04 weeks).

3.1 General principles;
3.2 Attempts at simple corrective actions;
3.3 Synthesis of a digital corrector by discretization of a continuous corrector;
3.4 Synthesis of a digital corrector by polynomial method.

Chapter 4: State Representation of Discrete-Time Systems(03 weeks).
4.1 General principle;
4.2 Resolution of state equations;
4.3 Controllability of a discrete-time system;
4.4 Observability of the state of a system;
4.5 Relationship between state representation and transfer function of a system;
4.6 Sampled control of a continuous-time system;

Assessment method:Continuous assessment 40%, exam: 60%

Bibliographic references:

1. P. Clerc. Continuous automatic, sampled: IUT Electrical Engineering-Industrial Computing, BTS, Electronics-Mechanics-Computer Science, Editions Masson (198p), 1997.

2.Ph. de Larminat, Automatique, Editions Hermes 2000.

3.P. Codron and S. Leballois, Automatics: continuous linear systems, Dunod Editions 1998.

4.Y. Granjon, Automatics: Linear, non-linear, continuous-time, discrete-time systems, state representation, Editions Dunod, 2001.

5.K. Ogata, Modern control engineering, Fourth edition, Prentice Hall International Editions 2001.

6.B. Pradin, Automation Course. INSA Toulouse, 3rd year GII specialty.

7.M. Rivoire and J.-L. Ferrier, Course in Automation, volume 2: servo-control, regulation, analog control, Editions Eyrolles 1996.

8.Y. Thomas, “Signals and linear systems: corrected exercises”, Editions Masson 1993.

9. Y. Thomas. “Signals and linear systems”, Editions Masson 1994.

Semester 2

Methodological UE Code: UEM 1.2 Subject: Practical work

Modeling of electrical machines

VHS: 10:30 p.m. (Class: 1 hour)

Credits: 2

Coefficient: 1

Teaching objectives

The main objective is to implement mathematical models of electrical machines with a view to numerical simulation of their behavior.

Recommended prior knowledge

Electrical machines. Computer programming.

Content of the subject:

- Modeling and simulation of a separately excited direct current motor; Modeling
- and simulation of a three-phase asynchronous motor;
- Modeling and simulation of a permanent magnet synchronous generator.

Assessment method:Exam: 100%

Bibliographic references:

Practical work brochure; Lecture notes; Lab documentationo.

Semester: 2

Methodological EU Code: UEM 1.2

Subject: Practical work: Sampled servocontrols and digital regulation

VHS: 10:30 p.m. (TP: 1:30 p.m.)

Credits: 2

Coefficient: 1

Teaching objectives:

Learn how to model and simulate discrete systems. Understand sampling and reconstruction. Verify the dynamic behavior of discrete systems. Simulate and implement digital PID, RST, and state feedback controllers.

Recommended prior knowledge:

Know how to use simulation and programming software. Control of continuous linear systems.

Content of the subject:

TP 1: Sampling and reconstitution (1 week)

TP 2: Sampled systems: time analysis and frequency analysis (02 weeks) TP3: Control by digital PID regulator (04 weeks)

TP4: Digital RST control (4 weeks)

TP5: Digital control by status feedback (4 weeks)

Assessment method:

Continuous assessment: 100%

Bibliographic references:

1. Sampled settings (T1 and T2), H. Buhler, PPR
2. Industrial regulation, E. Godoy, Dunod
3. Computer controlled systems, KJ Astrom and B. Wittenmark, Prentice Hall
4. Automatic sampling systems, JM Retif, INSHAS

Semester: 2
Methodological EU Code: UEM 1.2
Subject: Practical work Magnetic field in electrical machines
VHS: 3 p.m. (TP: 1 hour)
Credits: 1
Coefficient: 1

Teaching objectives

To enable the student to become familiar with solving electromagnetic field equations. To be able to implement calculation programs for analytical cases or to use codes in the case of numerical resolutions.

Recommended prior knowledge

Mathematics. Electrical machines. Electromagnetic field theory. Numerical analysis. Computer programming.

Content of the subject:

- Writing a computer program for the analytical resolution of simple cases of 1D and 2D partial differential equations. (3 weeks)
- Writing a program to calculate the field in a linear electrical machine (linear MSAP, Linear MAS, Linear Reluctance Machine etc.); (04 weeks)
- Use of finite element calculation software to determine the overall quantities of a given electrical machine from local electromagnetic quantities. MSAP, MAS, MRV: linear/ nonlinear static regimes. (8 weeks)

Assessment method:100% continuous assessment

Reference :

1. E. Durand: “Magnetostatics. »,Masson, Paris, 1968.
2. G. Fournet: “Electromagnetism from local equations”,Masson, Paris, 1985.
3. Forsythe and Wasow: “Finite difference methods for partial differential equations”,John Wiley and Sons.
4.Peter P. Silvester, MVK Chari: “Finite Elements in Electrical and Magnetic Field Problems.”John Wiley & Sons Inc, 1980
5. Peter P. Silvester, Ronald L. Ferrari: “Finite Elements for Electrical Engineer.” , 3ed,Cambridge University Press, 1996.

6. JP Louis “Modeling of electrical machines with a view to their control”, Hermes – Sciences, Lavoisier, Paris 2004.

Semester: 2
Methodological UE Code: UEM 1.2 Subject:
Association of machines and converters
VHS: 45h (Course 1h30, Practical work: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

Mastery of the different possibilities of association between electrical machines and static converters.

Recommended prior knowledge:

Electrical machines, machine modeling, power electronics, concepts of mechanics, control and regulation.

Content of the subject:

Chapter 1: DC Motor Converter (3 weeks)

1.1.MCC – Three-phase rectifier (Operating mode and electromechanical equations, Determination of smoothing inductance, Insertion of armature voltage, bidirectional converter with and without circulating current, inversion of the excitation field).
1.2.MCC- Chopper (Rotation speed adjustment, Operating regime with independent motor, Operating regime with series motor, Regenerative braking technique, Rheostatic braking technique, Operation in the 4 quadrants, Chopper – series traction motor association).

Chapter 2: Asynchronous Machine – Static Converters (5 weeks)

2.1. Advantages of variable speed;
2.2. Speed variation processes (by acting on the voltage, variation of the rotor resistance by chopper, hyposynchronous cascade, braking modes, Operation in the 4 quadrants); 2.3. MAS – Three-phase dimmer (Soft start and speed variation, Reversal of the direction of rotation, Industrial application).
2.4. Speed variation of MAS by inverter (Current supply, voltage supply, introduction to multi-level structures)
2.5 Industrial frequency converters (AC/DC/AC converter combination –MAS))

Chapter 3: Synchronous machine - static converters (3 weeks)

3.1. Starting the synchronous motor (Current inverter – MS, Voltage inverter – MS)
Different types of controls, low speed operation and starting assistance circuits)

3.2. Synchronous Motor Autopilot

Chapter 4: Special machines – Static converters (2 weeks)
4.1. Voltage inverter – Brushless motor;
4.2. Resolver sensor;
4.3. Power supply for stepper motors.

Chapter 5: Converter-machine interactions (2 weeks)

Study the effects of harmonics generated by the CS on the machine (additional losses, torque pulsations, etc.).

Practical work program:

- Simulation of the direct current machine associated with a chopper;
- Simulation of the association: PWM voltage inverter sine triangle and vector - synchronous machine;
- Simulation of the inverter-asynchronous machine association.

Assessment method:

Continuous assessment 40%; Exam: 60%.

Semester: 2
Teaching unit: UED 1.2 Subject:
Subject 3 of your choice VHS:
22h30 (lesson: 1h30) Credits: 1

Coefficient: 1

Semester: 2
Teaching unit: UED 1.2 Subject:
Subject 4 of your choice VHS:
22h30 (lesson: 1h30) Credits: 1

Coefficient: 1

Noticed :
The specialist team can freely choose the discovery subjects offered or those offered in the basket according to the means, needs and interest of the training.

Semester: 2
Teaching unit: UET 1.2
Subject: Respect for standards and rules of ethics and integrity. VHS:
10:30 p.m. (Course: 1.5 hours)
Credit: 1
Coefficient: 1

Teaching objectives:

To raise student awareness of the ethical principles and rules that govern life at university and in the workplace. Raise awareness of the need to respect and value intellectual property. Explain the risks of moral evils such as corruption and how to combat them, and alert them to the ethical issues raised by new technologies and sustainable development.

Recommended prior knowledge:

Ethics and professional conduct (the foundations)

Content of the subject:

A. Respect for the rules of ethics and integrity,

1. Reminder of the MESRS Ethics and Professional Conduct Charter:Integrity and honesty. Academic freedom. Mutual respect. Demand for scientific truth, Objectivity and critical thinking. Fairness. Rights and obligations of the student, the teacher, administrative and technical staff,

2. Integrity and responsible research
- Respect for the principles of ethics in teaching and research
- Responsibilities in Teamwork: Professional equality of treatment. Conduct against discrimination. Pursuit of the public interest. Inappropriate conduct in teamwork.
- Adopting responsible conduct and combating abuses: Adopting responsible conduct in research. Scientific fraud. Conduct against fraud. Plagiarism (definition of plagiarism, different forms of plagiarism, procedures to avoid involuntary plagiarism, detection of plagiarism, sanctions against plagiarists, etc.). Falsification and fabrication of data.

3. Ethics and professional conduct in the world of work:
Legal confidentiality in business. Corporate loyalty. Corporate responsibility. Conflicts of interest. Integrity (corruption in the workplace, its forms, consequences, methods of combating and sanctions against corruption).

B- Intellectual property

I- Fundamentals of intellectual property
1- Industrial property. Literary and artistic property.
2- Rules for citing references (books, scientific articles, communications at a conference, theses, dissertations, etc.)

II- Copyright
1. Copyright in the digital environment

Introduction. Database copyright, software copyright. Specific case of free software.

2. Copyright in the Internet and e-commerce

Domain name law. Intellectual property on the internet. E-commerce website law. Intellectual property and social networks.

3. Patent

Definition. Rights in a patent. Usefulness of a patent. Patentability. Patent applications in Algeria and around the world.

III- Protection and promotion of intellectual property

How to protect intellectual property. Rights violations and legal tools. Valuing intellectual property. Protecting intellectual property in Algeria.

C. Ethics, sustainable development and new technologies

Link between ethics and sustainable development, energy saving, bioethics and new technologies (artificial intelligence, scientific progress, humanoids, robots, drones,

V - Detailed program by subject for semester S3

Semester: 3
Fundamental EU Code: UEF 2.1.1
Subject: Special electrical machines
VHS: 45h (Class: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

Become familiar with the various other types of machines after having studied classic machines (MCC and rotating symmetrical MCA). Be able to understand their operating principle, characterize them and also classify them according to the main categories already seen.

Recommended prior knowledge:

Electrical machines. Modeling of machines.

Content of the subject:

- Introduction to special machines (01 weeks).;
- Asynchronous machines: Single-phase motors (squirrel cage, commutator; with frigger ring, etc.); Linear motor; multi-phase (>3) and multi-star machines(03 weeks);
- Synchronous machines: Synchromachines; Variable reluctance machines; Permanent magnet machines; Stepper motors; Superconducting machines(04 weeks);
- Vernier machines (low speed and high torque in motor and generator operation) (03 weeks)
- Brushless DC machines (1 week)
- Micromachines: Synchromachines (selsynes); Hysteresis synchronous motors; DC tachometer generators; Resolvers(03 weeks)..

Assessment method:

- Continuous assessment 40%; Exam: 60%.

Bibliography:

Semester: 3

Fundamental EU Code: UEF 2.1.1 Subject: Transient regimes of electrical machines

VHS: 45h (Class: 1h30, Tutorial: 1h30)

Credits: 4

Coefficient: 2

Teaching objectives:

To be able to study transient regimes in electrical machines, whether they are regimes that are part of the operation of the machines such as start-up or sudden accidents. The interest is obviously in the sizing of the power supply and protection devices of its machines but also upstream their design.

Recommended prior knowledge:

Electrical circuits, electrical machines, machine modeling. Numerical analysis

Content of the subject:

I/ Transient regimes in linear electrical circuits. Direct current circuits. Alternating current circuits(02 weeks)..

II/ Transient conditions in transformers. Energizing a transformer. Sudden short-circuit of a transformer. Overvoltage in transformers. Electrodynamic forces in short-circuits(03 weeks)..

III/ Transient regimes in direct current machines. Starting a shunt motor. Transient regimes of a shunt generator(03 weeks)..

IV/ Transient regimes in synchronous machines. Sudden short circuit at the terminals of an alternator. Dynamic stability of an asynchronous motor(04 weeks)..

V/ Transient conditions in asynchronous machines. Starting an asynchronous motor. Tripping an asynchronous motor. Sudden short circuit at the terminals of an asynchronous motor(03 weeks)..

Assessment method:

- Continuous assessment 40%; Exam: 60%.

Bibliography:

Semester: 3
Fundamental EU Code: UEF 2.1.1
Subject:Computer-aided design of electrical machines
VHS: 10:30 p.m. (Class: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives

The aim of this course is to provide students with an overview of the stages of computer-aided design with objectives and constraints duly recorded in the specifications. The optimization of electrical machines is often an integral part of the design.

Recommended prior knowledge

Electrical Machines (Operation, Topologies and Constructions). Basic Electromagnetic Modeling of Electrical Machines. Finite Element Method. Optimization Methods.

Content of the subject:

1. Principle and stages of designing an electrical machine(02 weeks)..

2. Design methods and tools(02 weeks)..

3. Specifications (performance specifications, constraints and operating limits)03 weeks)..

4. Characterization of an electrical machine (main relationships, electrical calculation, mechanical calculation and thermal calculation)(04 weeks).

5. Parametric example of design of electrical machines (MS, MAS, etc.)
   - Determination of the electromagnetic field using software based on FEM
   - Improving performance by applying an optimization method) (04 weeks).

Assessment method:

- Exam: 100%.

Bibliography:

Semester: 3
Fundamental EU Code: UEF 2.1.2
Subject: Identification and diagnosis of electrical machines
VHS: 10:30 p.m. (Class: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives:

The objective of this course is to determine by identifying the parameters of electrical machines for their simulation and control. It will also allow the student to acquire essential knowledge for avoiding breakdowns in the interest of continuity of service. The methods for diagnosing faults responsible for breakdowns are of two types: those based on a model and those that are free from it.

Recommended prior knowledge

Direct and alternating current electrical machines (Construction, modeling and operation of motor and generator), testing of electrical machines, equations of electrical circuits, signal theory and operational calculation, numerical analysis.

Content of the material

Part 1 (7 weeks)

Chapter I.Methodologies for identifying parameters of electrical machines. I.1. General information on identification. (4 weeks)
I.2. Classical test methods: measurement of resistance, self/mutual inductance of the stator and rotor, stator-rotor mutual inductance, mechanical parameters.
I.3. Special test method: (voltage attack index tests, symmetrical short-circuit test, frequency tests at standstill: SSFR method)

Chapter II.Parametric identification of electrical machines: (2 weeks) II.1. Parametric identification of the direct current machine.
II.2. Parametric identifications of the wound and cage asynchronous machine.
II.3. Parametric identifications of the synchronous machine.
II.4. Parametric identification of special electrical machines: MSAP, MRV.

Part 2 (8 weeks)
Chapter I. General information on faults in electrical machines and their diagnosis. (01 weeks)
I.1. Failures of electrical machines. Mechanical failures. Electrical failures.
I.2. Presentation of diagnostic methods.

Chapter II. Modeling of electrical faults in windings(04 weeks) II.1. State modeling of inter-turn short-circuit faults
II.2. State modeling of inter-coil and inter-phase short-circuit faults.
II.3. . Modeling of operation in unbalanced regime.
II.3 Applications, through projects, to electrical machines: MSAP, wound/cage MAS, MS, transformers, MRV.

Chapter III. Modeling of mechanical defects.(01 weeks)

Chapter IV. Model-free diagnostic methods:Signal processing approach. Parametric identification and state observation. Artificial intelligence methods (neural networks, fuzzy logic, etc.). (2nd week)s)

Assessment method:

- Exam: 100%.

Bibliography:

Semester 3 Master: Electrical Machines

Semester: 3
Fundamental EU Code: UEF 2.1.2
Subject: Heating and cooling of electromechanical actuators
VHS: 10:30 p.m. (Class: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives

The main objective of the course is to provide students with the basics and principles necessary to understand the various thermal aspects of electromechanical actuators. The course also introduces students to the thermal modeling of electrical machines.

Recommended prior knowledge

- Basics of mechanical construction of electrical machines
- Basics of fluid mechanics
- Basics of numerical methods

Content of the subject:

1. General information on heat transfer(02 weeks)
   1.1 Definitions: Temperature field, Temperature gradient, Heat flux
   1.2 Formulation of a heat transfer problem: Energy balance
2. Modes of heat transfer(6 weeks)
   2.1 Heat transmission by conduction
   - Fourier's law, Heat equation, Unidirectional transfer, Multidirectional transfer , The fins, Electrical analogy,
   -

   2.2 Heat transmission by convection
   - Convection exchange coefficient, Natural convection, Forced convection

   2.2 Heat transmission by radiation
   Laws of radiation, Reciprocal radiation of several surfaces, Electrical analogy

3. Thermal modeling of electrical machines(07 weeks)
3.1 Heat equation
- Space-time boundary conditions
- Analog method: Thermal networks
- Numerical methods: Finite differences, finite volumes, finite elements

3.2 Evaluation of the parameters of the heat equation
- Heat sources
- Evaluation of thermal conductivity
- Thermal contact and insulation

3.3 Thermal Contact Modeling Techniques
- Modeling using expanded domains
- Modeling in the case of the use of equivalent materials

4.3 Modeling of the different flow modes relating to electrical machines
- Air gap
- Convection in axial rotor and stator channels
- External cooling: fins

Assessment method:

- Exam: 100%.

Bibliography:

Semester: 3
Fundamental EU Code: UEF 2.1.2 Subject:
Control of electrical machines
VHS: 45h (Class: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Goals

• Know the different electrical systems of electric actuators (motor + mechanical loads and static converters)

• Be able to establish a simulation model of an electrical system including motor, power electronics and control

• Be able to simulate a model in the Matlab/Simulink environment

• Be able to size the correctors present in the motor controls using a suitable method

Content of the subject:

1. Reminders on the operation of motors associated with mechanical loads (02 weeks).
2. Speed variators based on asynchronous and synchronous machines(03 weeks).
3. Vector control of permanent magnet synchronous machines(04 weeks)
4. Direct torque control of asynchronous motors (DTC))(03 weeks).
5. Step-by-step moral order(03 weeks)

Assessment method:

- Continuous assessment: 40%, Exam: 60%.

Bibliography:

Bibliographic references:

1. Industrial Electrotechnics, Guy Séguier and Francis Notelet, Tech et Doc, 1994
2. Power Electronics, Guy Séguier, Dunod, 1990
3. Modeling and control of the asynchronous machine, JP Caron and JP Hautier, Technip, 1995
4. Control of Electrical Drives, W. Leonard, Springer-Verlag, 1996
5. Vector control of AC machines, Peter Vas, Oxford university press, 1990
6. Control of variable speed machines, Engineering Techniques, vol. D3.III, no. 3611, 1996
7. Electric actuators, Guy Grellet and Guy Clerc, Eyrolles, 1997
8. Vector control modeling and DTC, under the direction of C. Canudas de Wit, Hermes, 2000

Semester: 3

Methodological UE Code: UEM 2.1 Subject: Practical work - Special electrical machines

VHS: 10:30 p.m. (TP: 1:30 p.m.)

Credits: 2

Coefficient: 1

Teaching objectives

The main objective is to deepen students' knowledge of the construction and operating principles of special machines.

Recommended prior knowledge

Basics of traditional electrical machines.

Content of the subject:

1- Universal Motor (comparison between single-phase series-excited commutator motor and series-excited DC motor);
2- Single-phase asynchronous motor (study of characteristics and different starting modes); Isolated
3- asynchronous generator connected to the electrical network;
4- Permanent magnet synchronous machine;
5- Variable reluctance synchronous machine.
6- Brushless direct current machine

Assessment method:Exam: 100%

Bibliographic references:

Practical work brochure, course notes, lab documentationo.

Semester: 3

Methodological EU Code: UEM 2.1

Subject: Practical work - Transient regimes of electrical machines

VHS: 10:30 p.m. (TP: 1:30 p.m.)

Credits: 2

Coefficient: 1

Teaching objectives

The main objective is to study the different transient regimes in electrical machines by simulation.

Recommended prior knowledge

Electrical machines; Modeling of electrical machines; Programming and simulation.

Content of the subject:

1. Transient regimes in transformers;
2. Transient regimes in a direct current machine;
3. Transient regimes in an asynchronous machine;
4. Transient regimes in a synchronous machine.

Assessment method:Exam: 100%.

Bibliographic references:

1. J. Chatelain “Electrical Machines”, DUNOD Edition, 1982.
2. P. Barret “Transient regimes of rotating electrical machines”, Edition EYROLLES, 1982.
3. Practical work brochure, Course notes, Lab documentationo.

Semester: 3

Methodological EU Code: UEM 2.1 Subject:TP -

Control of electrical machines

VHS: 10:30 p.m. (TP: 1:30 p.m.)

Credits: 2

Coefficient: 1

Teaching objectives

The main objective is to deepen students' knowledge of the different control strategies of electrical machines.

Recommended prior knowledge:

Basics of electrical machines, servo control and simulation.

Content of the subject:

1- Simulation of a vector control of a squirrel cage asynchronous machine;

2- Simulation of a hypo-synchronous cascade;

3- Simulation of a vector control of a permanent magnet synchronous machine

Assessment method: Exam: 100%

Bibliographic references:

Practical work brochure, course notess.

Methodological EU Code: UEM 2.1

Subject: Practical work: Identification and diagnosis of electrical machines

VHS: 10:30 p.m. (TP: 1:30 p.m.)

Credits: 2

Coefficient: 1

Teaching objectives:

To enable the student to become familiar with the methods of identifying the electrical and mechanical parameters of electrical machines, and to become familiar with the diagnostic techniques of electrical machines through knowledge of the signatures of different faults.

Recommended prior knowledge

Electrical machines (operation, modeling, classical experiments); Electrical measurement; Signal theory/processing in a computer environment.

Content of the subject:

Part 1: Identification by experimentation and/or computer tool

- Identification of electrical parameters by conventional tests; Identification of
- electrical parameters of machines by index tests; Identification of
- mechanical parameters of electrical machines;

Part 2: Diagnosis and monitoring (IT tools)

- Fault diagnosis in permanent magnet synchronous machine Fault
- diagnosis in wound asynchronous machine; Fault diagnosis in
- synchronous machine.
- Diagnosis of bar/ring breakage faults in asynchronous machine

cage ;

Assessment method:

Continuous assessment: 100%

Bibliographic references:

1. TP brochure.

2. R. Abdessemed, "Modeling of electrical machines", Presses de l’Université de Batna, Algeria, 1997.

3. R. Abdessemed, "Modeling and simulation of electrical machines", Ellipses, Collection, 2011

Semester: 3

Methodological UE Code: UEM 2.1 Subject: Practical work - Design of electrical machines

VHS: 3 p.m. (TP: 1 hour)

Credits: 1

Coefficient: 1

Goals :

The main objective of this practical work is to deepen students' knowledge of the design and static/dynamic electromagnetic modeling of different electrical machines through the use of CAD software based on numerical calculation (Finite Element Method).

Recommended prior knowledge:

Electrical machines; Simulation software.

Content of practical work (Minimum 4 practical work):

TP N°1: Introduction to the software used for CAD of electrical machines;

TP N°2: CAD: Actuator, Transformer, simplified version of electrical machines; TP N°3: CAD of permanent magnet synchronous machine

TP No. 4: CAD of a synchronous machine (with excitation coil); TP No. 5: CAD of a wound/cage asynchronous machine;

TP N°6: CAD of a DC machine (classic, magnet, Brushless);

Assessment method:

Continuous assessment: 100%

Bibliographic references:

Practical work brochure, course notess.

Semester: 3
Teaching unit: UET 2.1
Subject 1: Documentary research and design of VHS dissertation:
10:30 p.m. (Course: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:
To give students the tools they need to research useful information and use it more effectively in their final year project. To help them navigate the various stages of writing a scientific document. To demonstrate the importance of communication and to teach them how to present their work in a rigorous and educational manner.

Recommended prior knowledge: Writing methodology,
Presentation methodology.

Content of the material:

Part I-: Documentary research:

Chapter I-1: Definition of the subject (2 Weeks)
- Subject title
- List of keywords related to the subject
- Gather basic information (acquisition of specialized vocabulary, meaning of terms, linguistic definition)
- The information sought
- Take stock of your knowledge in the field

Chapter I-2: Selecting information sources (2 Weeks)
- Type of documents (Books, Theses, Dissertations, Periodical articles, Conference proceedings, Audiovisual documents, etc.)
- Type of resources (Libraries, Internet, etc.)
- Evaluate the quality and relevance of information sources

Chapter I-3: Locating documents (01 Week)
- Research techniques
- Search operators

Chapter I-4: Processing information (2 Weeks)
- Work organization
- The starting questions
- Summary of the documents selected
- Links between different parties
- Final plan of the documentary research

Chapter I-5: Presentation of the bibliography (01 Week)
- Bibliography presentation systems (The Harvard system, The Vancouver system, The mixed system, etc.)
- Presentation of documents.
- Citation of sources

Part II: Memory Design

Chapter II-1: Plan and stages of the report (2 Weeks)

- Identify and delimit the subject (Summary)
- Problems and objectives of the thesis
- Other useful sections (Acknowledgments, Table of abbreviations, etc.)
- The introduction (Writing the introduction last)
- State of the specialized literature
- Formulation of hypotheses
- Methodology
- Results
- Discussion
- Recommendations
- Conclusion and perspectives
- Table of Contents
- The bibliography
- The annexes

Chapter II-2: Writing techniques and standards (2 Weeks)

- Formatting. Numbering of chapters, figures and tables.
- The cover page
- Typography and punctuation
- Writing. Scientific language: style, grammar, syntax.
- Spelling. Improvement of general language skills in terms of comprehension and expression.
- Save, secure, archive your data.

Chapter II-3: Workshop:Critical study of a manuscript (01 Week)

Chapter II-4: Oral presentations and defenses (01 Week)

- How to present a poster
- How to present an oral communication.
- Defense of a dissertation

Chapter II-5: How to avoid plagiarism? (01 Week)

(Formulas, sentences, illustrations, graphs, data, statistics, etc.)

- The quote
- The paraphrase
- Indicate the full bibliographic reference

Assessment method:

Exam: 100%

Bibliographic references:

1. M. Griselin et al., Guide to Written Communication, 2nd edition, Dunod, 1999.
2. JL Lebrun, Practical guide to scientific writing: how to write for the international scientific reader, Les Ulis, EDP Sciences, 2007.
3. A. Mallender Tanner, ABC of technical writing: user guides, instructions, online help, Dunod, 2002.

4. M. Greuter, How to write your dissertation or internship report well, L'Etudiant, 2007.
5. M. Boeglin, Reading and Writing at University. From the Chaos of Ideas to Structured Text. L'Etudiant, 2005.
6. M. Beaud, the art of the thesis, Editions Casbah, 1999.
7. M. Beaud, the art of the thesis, La découverte, 2003.
8.Mr. Kalika, Master's thesis, Dunod, 2005.

Suggestion of some discovery subjects

Semester: ..
EU Discovery Code: UED .. Subject: Maintenance and operational safety

VHS: 10:30 p.m. (Class: 1.5 hours)

Credits: 1

Coefficient: 1

Content of the subject:

I-History,context and definitions of the SdF

II-Analysissystems with independent components (-Modeling of the logic of malfunction by fault trees, - Qualitative and quantitative Boolean exploitation, - Limits of the method)

III- Analysis of systems taking into account certain dependencies (-Modeling of systems, -Markovian by state graphs, - Quantitative exploitation of the model, - Limit of the method)

IV- Analysis of systems with generalized consideration of dependencies (-Modeling by Petrie nets (PNets), - Quantitative exploitation of the model: PNet: stochastic)

V- Application of operational safety methodologies (-reliability, -maintainability, -Availability, security)

VI- Reliability prediction methodology (-Predictive reliability calculations, -Analysis of modes of failure, -failure diagnosis and maintenance techniques)

Assessment method:

Exam: 100%

Bibliographic references:

1. Patrick Lyonnet, "Reliability Engineering, TEC & DOC Edition, Lavoisier, 2006.

2. Roger Serra, "Reliability and Industrial Maintenance", Course, ETS School of Advanced Technology, University of Quebec, 2013.

3. David Smith, Reliability, Maintenance and Risk, DUNOD, Paris 2006

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Semester: ..
Transversal EU Code: UED .. Subject:
Industrial safety and authorization
VHS: 10:30 p.m. (Class: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:

The subject aims to inform the future Master in High Voltage Technology about the nature of electrical accidents, the rescue methods for electrical accident victims and to give him sufficient knowledge to enable him to best size the protection devices for equipment and personnel working in industry and other areas of use of this equipment.

Recommended prior knowledge:

Electric power transmission and distribution networks.

Content of the subject:

1) Electrical risks (history, standards, statistics on electrical accidents);

2) Nature of electrical accidents and dangers of electric current;

3) Protective measures (protection of people and materials);

4) Safety measure against indirect effects of electric current (harmful materials, fire, explosions, etc.);

5) Relief measures and care.

Assessment method:Exam: 100%

Semester: ..
Transversal EU Code: UED ..
Subject: Standards and legislation in Electrotechnics
VHS: 10:30 p.m. (Class: 1.5 hours)
Credits: 1
Coefficient: 1

Content of the subject:

Part I:Management

I. Types of businesses to manage
- Traditional, profit-oriented businesses;
- Non-profit organizations: Administrations, Hospitals, International organizations

II. Business management tools
- Methods of analysis and understanding of socio-economic phenomena;
- Decision-making in a changing and complex economic environment

III. Examples of management policies and concepts
- Lean management;
- Benchmarking

Part II:Standard in electrical engineering
- Different standardization bodies
- French NFC Standard
- European standard EN
- IEC International Standard
- Standards and Symbols

Part III:Certification

I. Implementation of a quality management system (QMS)
- How to do it?
- Why do it?

II. Quality as a means of making the company prosper
- 2-1 Quality policy (QP);
- 2-2 Quality approach (DM);
- 2-3 Quality management manager (QM); 2-4 PCDA tool (Plan, Do, Check, Act)

III. Certification Process ISO9001
- Standard Certification, Steps to Follow,
- Awareness, diagnosis, actions, audit and technical certification file

Assessment method:
Exam: 100%.

Semester: ..
EU Discovery Code: UED .. Subject:
Industrial Computing VHS: 10:30 p.m.
(Course: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:

This subject allows students in this master's program to familiarize themselves with the field of industrial computing. They will acquire the concepts of communication protocols.

Recommended prior knowledge:

Combinational and sequential logic, µ-processors and µ-controllers, computer science.

Content of the material:

Chapter 1:Introduction to industrial computing;	(2 weeks)
Chapter 2:Connecting the hardware to a µP;	(2 weeks)
Chapter 3:Peripherals and interfaces (Ports, Timers, etc.); Chapter 4:	(04 weeks)
Serial communication bus (RS-232, DHCP, MODBUS, I2C); Chapter 5:	(05 weeks)
Data acquisition: CAN and DAC devices;	(2 weeks)

Assessment method:

Exam: 100%

Bibliographic references:

1. Baudoin, Geneviève & Virolleau, Férial, “The DSP family, TMS 320C54X [printed text]: application development”, Paris: Francis Lefebvre, 2000, ISBN: 2100046462.
2. Pinard, Michel, “DSPs, ADSP218x family [printed text]: principles and applications”, Paris: Francis Lefebvre, 2000, ISBN: 2100043439;
3. Tavernier, Ch., “PIC microcontrollers: applications”, Paris: Francis Lefebvre, 2000, ISBN: 2100059572;
4. Tavernier, Ch., “PIC microcontrollers: description and implementation”, Paris: Francis Lefebvre, 2004, ISBN: 2100067222;
5. Cazaubon, Christian, “HC11 microcontrollers and their programming”, Paris: Masson, [nd], ISBN: 2225855277;
6. Tavernier, Christian, “AVR microcontrollers: description and implementation”, Paris: Francis Lefebvre, 2001, ISBN: 2100055798;
7. Dumas, Patrick, “Industrial Computing: 28 practical problems with course reminders”, Paris: Francis Lefebvre, 2004, ISBN: 2100077074.

Semester ..:
EU Discovery Code: UED ...
Subject: Industrial Ecology and Sustainable Development VHS:
10:30 p.m. (Course: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives

Raise awareness of sustainable development, industrial ecology and recycling.

Recommended prior knowledge:

Content of the subject:

- Birth and evolution of the concept of industrial ecology Definition
- and principles of industrial ecology Experiences of industrial
- ecology in Algeria and around the world Industrial symbiosis (eco-
- industrial parks/networks)
- Gaseous, liquid and solid waste
- Recycling

Assessment method:

Review: 100%.

Bibliographic references:

1 Industrial and territorial ecology, COLEIT 2012, by Junqua Guillaume, Brullot Sabrina
1 Towards industrial ecology: how to put sustainable development into practice in a hyper-society industrial, SurenErkman 2004
2 Energy and its control. Montpellier Cedex 2: CRDP of Languedoc-Roussillon, 2004. ISBN 2-86626-190-9,
3 Appropriations of sustainable development: emergences, diffusions, translations B Villalba - 2009

Semester ..:
EU Discovery Code: UED ...
Subject: Renewable Energies
VHS: 10:30 p.m. (Course: 1.5 hours) Credits: 1
Coefficient: 1

Teaching objectives

To provide students with the scientific foundations enabling them to integrate the scientific research community in the field of renewable energies, batteries and sensors associated with engineering applications.

Recommended prior knowledge:

Energy conversion devices and technologies -

Content of the material

Chapter 1:Introduction to renewable energy (Renewable energy sources: deposits and materials (4 weeks)
Chapter 2:Solar energy (photovoltaic and thermal) (4 weeks)
Chapter 3:Wind energy (3 weeks)
Chapter 4:Other renewable sources: hydraulic, geothermal, biomass, etc. (2 weeks)
Chapter 5:Storage, fuel cells and hydrogen (2 weeks)

Assessment method:

Exam: 100%.

Bibliographic references:

1.Jean Claude Sabonnadière. New Energy Technologies 1: Renewable Energies, Ed. Hermès.
2.Gide Paul. The Great Book of Wind Power, Ed. Moniteur.
3.A. Labouret. Photovoltaic Solar Energy, Ed. Dunod.
4.Viollet Pierre Louis. History of hydraulic energy, Ed. Press ENP Chaussée.
5.Peser Felix A. Solar thermal installations: design and implementation, Ed. Moniteur.

Semester: ..
EU Discovery Code: UED .. Subject:
Materials in electrical engineering
VHS: 10:30 p.m. (Class: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:

The objective of this course is to provide the basic knowledge necessary for understanding the physical phenomena occurring in materials and for making appropriate choices for the design of electrical components and systems. The fundamental characteristics of different types of materials as well as their behavior in the presence of electric and magnetic fields are covered.

Recommended prior knowledge:

Fundamental physics and applied mathematics.

Content of the material

Chapter 1:Know and understand the functioning, constitution, technology and specification of electrical equipment used in electrical networks.(03 weeks)
Chapter 2:Magnetic materials: properties, losses, types, thermal and mechanical properties, characterization, magnets.(04 weeks)
Chapter 3:Conductive materials: properties, losses, insulation, testing and applications.(04 weeks)
Chapter 4:Dielectric materials: properties, losses, breakdown and performance, stresses, tests. (04 weeks)

Assessment method:

Review: 100%.

Bibliographic references:

1.AC Rose-Innes and EH Rhoderick, Introduction to Superconductivity, Pergamon Press.
2.P. Tixador, Superconductors, Editions Hermès, Materials Collection, 1995.
3.P. Brissonneau, Magnetism and Magnetic Materials Editions Hermès.
4.P. Robert, Materials of Electrotechnology, Volume II, Treatise on Electricity, Electronics and Electrotechnology of the Swiss Federal Institute of Technology in Lausanne, Dunod Edition.
5.Engineering Techniques.
6.R. Coelho and B. Aladenize, Dielectrics, Treatise on New Technologies, Materials series, Editions Hermès, 1993.
7.Mr. Aguet and Mr. Ianoz, High Voltage, Volume XXII, Treatise on Electricity, Electronics and Electrotechnics of the Swiss Federal Institute of Technology in Lausanne, Dunod Edition.
8.C. Gary et al, The dielectric properties of air and very high voltages, Collection of the Directorate of Studies and Research of Electricity of France, Edition Eyrolles, 1984.
9.Dielectric Materials for Electrical Engineering, Volumes 1 & 2, HERMES LAVOISIER, 2007.

Semester: ..
EU Discovery Code: UED...
Subject: Implementation of a real-time digital control VHS: 22h30
(Course: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

This teaching unit deals with the digital control of machine converter assemblies by programmable components (μControllers, DSP, ARM, FPGA).

Recommended prior knowledge:

μ-processors and μ-controllers, computing, control, electrical machines, power converters.

Content of the subject:

Chapter 1:Description of real-time systems;(03 weeks) Chapter 2:

Digital control of systems;(04 weeks)

Chapter 3:Study of the implementation of MLI techniques on a digital processor; (04 weeks)

Chapter 4:Examples of machine control implementation: Direct Current Machine, Asynchronous Machine, Synchronous Machine. (04 weeks)

Assessment method:

Exam: 100%.

Bibliographic references:

1. B. Bouchez “Digital Audio Applications of DSP: Theory and Practice of Digital Processing”, Elektor, 2003.
2. Baudoin, Geneviève & Virolleau, Férial, “The DSP family, TMS 320C54X [printed text]: application development”, Paris: Francis Lefebvre, 2000, ISBN: 2100046462.
3. Pinard, Michel, “DSPs, ADSP218x family [printed text]: principles and applications”, Paris: Francis Lefebvre, 2000, ISBN: 2100043439;
4. Tavernier, Ch., “PIC microcontrollers: applications”, Paris: Francis Lefebvre, 2000, ISBN: 2100059572.

Semester: ..
EU Discovery Code: UED .. Subject: Quality of electrical energy VHS: 10:30 p.m. (Course: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:

- Study the main phenomena that deteriorate the Quality of Electrical Energy (QEE), their origins and the consequences on equipment through the degradation of voltage and/or current and disturbances on the networks.
- Understand the implication of non-linear loads in the deterioration of power quality and learn about the main solutions to improve it by remedying disturbances by eliminating them or mitigating them when they are unavoidable.

Recommended prior knowledge:

Electrical networks, harmonics, filters, fundamental electrical engineering, power electronics.

Content of the material:

Chapter 1: Introduction to Power Quality (PQ) (03 weeks)
Background, definition and terminology of energy quality, Objectives of energy quality measurement.

Chapter 2: Degradation of Power Quality (05 weeks)
Most common power quality problems and effects on loads and processes
- Voltage dips and outages: Origins of voltage dips and overvoltages, Consequences on receivers, Concepts of Flicker.
- Harmonics and interharmonics: Origins of harmonics. Nonlinear loads, Impacts of harmonics on the network and receivers.
- Voltage variations and fluctuations: Internal/external origins of outages, Consequences on production and equipment.
- Transient phenomena: EMC concepts, Lightning strikes, Equipotentiality, PE protective conductor.
- Imbalances.

Chapter 3: Energy Quality Level - Standards (03 weeks)
Voltage characteristics. Terminology, Voltage parameter measurement strategy, standards, Network analyzers.

Chapter 4: Solutions to Improve Power Quality (04 weeks)
Reduction in the number of voltage dips and outages, Reduction in the duration and depth of voltage dips, Desensitization of installations, Use of uninterruptible power supplies (UPS), etc.

Reduction of generated harmonic currents: Modification of the installation, Passive filtering, Active filtering, Hybrid filtering, etc.
Remedies for protection against temporary overvoltages, operating overvoltages (shock reactor, static automatic compensator), atmospheric overvoltages (lightning), etc.
Voltage fluctuations: Changing lighting mode, changing motor starting mode, modifying the network, etc.
Imbalances: Balancing single-phase loads on the three phases, Increasing transformer power and cable cross-sections upstream of imbalance generators, Protecting machines, Using LC loads (Steinmetz assembly), etc.

Assessment method:

Exam: 100%

Bibliographic references:

1. Guide to Quality of Electrical Supply for Industrial Installations Part 2: Voltage Dips and Short Interruptions Working Group UIE Power Quality 1996.
2. GJ Wakileh, Power system harmonics-Fundamental Analysis and Filter Design, Springer-Verlag, 2001.
3. A. Kusko, MT. Thompson, Power Quality in Electrical Systems, McGraw Hill, 2007.
4. F. Ewald Fuchs, MAS Masoum, Power Quality in Power Systems and Electrical Machines, Elsevier Academic Press, 2008.
5. RC Dugan, Mark F. Granaghan, Electrical Power System Quality, McGraw Hill, 2001.
6. Scheider Technical Notebooks No. CT199, CT152, CT159, CT160 and CT1.
7. A. Robert, Supply Quality Issues at the Interphase between Power System and Industrial Consumers, PQA 1998.
8. Energy quality, Course by Delphine RIU, INP Grenoble.

Semester: ..
EU Discovery Code: UED… Subject: Artificial intelligence techniques VHS: 10:30 p.m. (Course: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:

The main motivation of this subject is the implementation of an introduction of the capabilities offered by Artificial Intelligence Techniques ''TIA'' as new and improved techniques, with a view to developing approaches for the study of electrical machines. At the end of the module, students should master the concepts related to TIA, know how to manipulate them with the theory of electrical machines, and use software toolboxes for the purpose of modeling, identification, design optimization, diagnosis and synthesis of simple, efficient and robust control laws). The results published in research works are used to draw some practical examples.

Recommended prior knowledge:

Mathematics, electrical engineering and systems theory. (Presentation of electrical systems, Fourier, Laplace and Z transforms, Electrical machines - types and theories).

Content of the subject:

Neural Network (NN) Optimization;

Fuzzy logic (FL) optimization;

Optimization by genetic algorithms (GA);

Particle swarm optimization (PSO).

HYBRID APPROACHES: Introduction - Neuro-fuzzy network (ANFIS, SANFIS) - Radial-fuzzy basis network - Optimization of fuzzy systems by genetic algorithms - Areas of application - Examples.

Semester: ..
EU Discovery Code: UED...
Subject: Technical drawing VHS:
10:30 p.m. (Course: 1:30 p.m.)
Credits: 1
Coefficient: 1

Teaching objectives:

With the aim of representing through drawings and designing structures such as electrical machines, transformers or others, this course will allow students to acquire the basic principles for the representation of parts in industrial drawing, to draw electrical machines while respecting standardized conventions to ensure the construction represented is as imagined by the designer.

Recommended prior knowledge:

Electrical machines.

Content of the subject:

CHAPTER I: GENERAL INFORMATION ON TECHNICAL DRAWING

1. Main types of industrial designs
2. formats
3. permanent elements
4. the scale
5. the cartouche
6. nomenclature
7. writing
8. the features

CHAPTER II: GEOMETRIC REPRESENTATION OF PARTS

1. cavalier perspective
2. projections and views
3. simple cuts – hatching
4. section

CHAPTER III: VOLUME REPRESENTATION

1. volume modeler
2. creation of elementary volumes
3. creation of a simple part
4. creating a simple assembly
5. creation of an assembly of rotating electrical machines

Assessment method:
Exam: 100%.

Bibliographic references:

1. Industrial designer's guide Chevalier A. Hachette Technique Edition;
2. Technical drawing 1st part descriptive geometry Felliachi d. and Bensaada s. Edition OPU Algiers;
3. Technical drawing 2nd part industrial drawing Felliachi d. and bensaada s. Edition OPU Algiers;
4. First notions of technical drawing Andre Ricordeau Edition AndreCasteillhas

Semester: ..
EU Discovery Code: UED...
Subject: Trams
VHS: 10:30 p.m. (Course: 1.5 hours) Credits: 1
Coefficient: 1

Teaching objectives:

Understanding the tram environment and its specificities.

Recommended prior knowledge:

General electromechanics, electrical circuits.

Content of the subject:

Chapter 1: General information on trams
· First generation trams
· New tram systems
· Presentation of equipment
· Trams around the world

Chapter 2: Electrical Installations of Tramways
· Power supply network structures
· Energy storage and on-board production
· Modern techniques for energy storage

Chapter 3: System Modeling and Control
· System modeling
· Control techniques used

Chapter 4: Signaling
· Signaling concepts

Assessment method:
Exam: 100%.

Semester: ..
EU Discovery Code: UED ..
Subject: Electrical machines in dynamic mode VHS: 10:30
p.m. (Course: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:

To enable the student to acquire knowledge concerning the modeling of synchronous and asynchronous machines in dynamic mode

Recommended prior knowledge:

Mathematics, operation of electrical machines in steady state.

Content of the subject:

Chapter 1: Model of the synchronous machine in dynamic mode

- Constitution of the synchronous machine and phenomena involved in its operation – simplifying hypotheses
- Equations for stator and rotor voltages in the real axis (salient pole machine)
- Flux equation - Calculation of inductances - case of the smooth pole machine - Mechanical equation and calculation of the electromagnetic torque - problem related to the resolution of the system
- Axis transformation – Concordia – Park
- Machine model in the Park frame – expression of the electromagnetic torque – advantage of the Park model – state model
- Limits of the obtained model

Chapter 2: Model of the asynchronous machine in dynamic mode

- Constitution of the asynchronous machine and phenomena occurring in it operation – simplifying assumptions
- Real-axis stator and rotor voltage equations - (wound rotor machine)
- Flux equation - Calculation of inductances - case of the cage rotor machine - Mechanical equation and expression of the electromagnetic torque
- Machine model in the Park frame - Different types of frame position - expression of the electromagnetic torque - state model
- Limits of the obtained model

Assessment method:

Exam: 100%.

Bibliographic references:

1. Modeling and control of the asynchronous machine, JP Caron and JP Hautier, Technip, 1995
2. Control of Electrical Drives, W. Leonard, Springer-Verlag, 1996
3. Vector control of AC machines, Peter Vas, Oxford University Press, 1990
4. Methods of controlling electrical machines, R. Husson, Hermès.
5. Power Electronics and AC Drives, Prentice-Hall, BK Bose, 1986
6. Modern Power Electronics and AC Drives, BK. Bose, Prentice-Hall International Edition, 2001.
7. Electric actuators, Guy Grellet and Guy Clerc, Eyrolles, 1997
8. Control of asynchronous motors, Modeling, Vector control and DTC, Volume 1, C. Canudas De 9. Wit, Edition Hermès Sciences, Lavoisier, Paris2004.