ÿÿÿÿÿÿÿÿÿ ÿÿÿÿÿÿÿÿÿÿÿ ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
ÿÿÿÿÿ ÿÿÿÿÿÿÿ ÿÿÿÿÿÿ ÿÿÿÿÿÿ ÿÿÿÿÿÿ

Algerian Democratic Republic and Popular
Ministry of Higher Education and Scientific Research

Compliance framework

TRAINING OFFER LMD

MASTER'S DEGREE IN INDUSTRIAL ELECTROTECHNOLOGY

2016 - 2017

Establishment	Faculty / Institute	Department

Domain	Sector	Speciality
Sciences And Technologies	***Electrical engineering***	***Electrical engineering***

CPND

ÿÿÿÿÿÿÿÿÿ ÿÿÿÿÿÿÿÿÿ ÿÿÿÿÿÿÿÿÿÿÿ ÿÿÿÿÿÿÿ
Democratic and Popular Republic of Algeria
ÿÿÿÿÿ ÿÿÿÿÿÿÿ ÿÿÿÿÿÿ ÿÿÿÿÿÿ ÿÿÿÿÿÿ
Ministry of Higher Education and Scientific Research

The whole world

The Lord

a No. No.

The Great Apostle

2017-2016

Al-Qaeda	Al-Qaeda/Al-Qaeda	Al-Qaeda

The	Allah	Allah
ÿÿÿÿÿÿ ÿÿÿÿÿ ÿÿÿÿÿÿ	ÿÿÿÿÿÿÿÿ	ÿÿÿÿ ÿ ÿÿÿÿÿÿÿÿÿ

CPNDS

Title: Master of Industrial Electrotechnics

Year: 2016-2017

I – Master’s identity card

Access conditions

(Indicate the bachelor's degree specializations that can provide access to the Master's degree)

Sector	Harmonized Master	Licenses providing access at the master's level	Ranking by license compatibility	Coefficient assigned to the license
Electrical engineering	Industrial electrical engineering	Electrical engineering	**1**	**1.00**
		Electromechanics	**2**	**0.80**
		Industrial Maintenance	**2**	**0.80**
		Automatic	**3**	**0.70**
		Electronic	**3**	**0.70**
		Other licenses in the ST domain	**5**	**0.60**

II – Half-yearly teaching organization sheets of the specialty

Semester 1 Master: Industrial Electrotechnics

Teaching unit	Materials / Titled	Credits	Coefficients	Hourly volume weekly Hourly Volume: Course	TD TP		Biannual (15 weeks)	Work Complementary in consultation (15 weeks)	Assessment method: Control Continuous	Exam
Fundamental EU Code: UEF 1.1.1 Credits: 10 Coefficients: 5	Electric power transmission and distribution networks	4 2	1h30	1h30			45h00	55h00	40%	60%
	Advanced power electronics	4 2	1h30	1h30			45h00	55h00		
	µ-processors and µ-controllers	2 1	1h30				10:30 p.m.	27:30		100%
Fundamental EU Code: UEF 1.1.2 Credits: 8 Coefficients: 4	In-depth electrical machines	4 2	1h30	1h30			45h00	55h00	40%	60%
	Applied numerical methods and optimization	4 2	1h30	1h30			45h00	55h00	40%	60%
Methodological EU Code: UEM 1.1 Credits: 9 Coefficients: 5	Practical work: - µ-processors and µ-controllers	1	1			1 hour	3:00 p.m.	10:00 a.m.	100%	
	Practical work: - Electrical energy transport and distribution networks	2 1				1h30	10:30 p.m.	27:30	100%	
	Practical work: - Advanced power electronics	2 1				1h30	10:30 p.m.	27:30	100%	
	Practical work: Applied numerical methods and optimization	2 1				1h30	10:30 p.m.	27:30	100%	
	Practical work: - in-depth electrical machines	2 1				1h30	10:30 p.m.	27:30	100%	
EU Discovery Code: UED 1.1 Credits: 2 Coefficients: 2	Basket of your choice	1	1 1	h30			10:30 p.m.	2:30 a.m.		100%
	Basket of your choice	1	1 1	h30			10:30 p.m.	2:30 a.m.		100%
Transversal EU Code: UET 1.1 Credits: 1 Coefficients: 1	Technical English and Terminology	1	1 1	h30			10:30 p.m.	2:30 a.m.		100%
Total semester 1		**30 1**	**7 12:**	**00 6:00 7**	**:00**		**375 hours**	**375 hours**		

CPNDST

Semester 2 Master: Industrial Electrotechnics

Unit teaching	Materials / Titled	Credits	Coefficient	Hourly volume weekly: Course	TD	TP	Volume Hourly Biannual (15 weeks)	Work Complementary in consultation (15 weeks)	Assessment method: Control Continuous	Exam
Fundamental EU Code: UEF 1.2.1 Credits: 10 Coefficients: 5	Industrial electricity	4	2	1h30	1h30		45h00	55h00	40%	60%
	Sampled Servo Systems and Regulation Digital	4	2	1h30	1h30		45h00	55h00	40%	60%
	Technology in Automation Industrialists	2	1	1h30			10:30 p.m.	27:30		100%
Fundamental EU Code: UEF 1.2.2 Credits: 8 Coefficients: 4	Modeling and Identification of Electrical Systems	4	2	1h30	1h30		45h00	55h00	40%	60%
	Electric drives	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological EU Code: UEM 1.2 Credits: 9 Coefficients: 5	TP Sampled servo systems and regulation Digital	2	1			1h30	10:30 p.m.	27:30	100%	
	Industrial Electricity/Public Works Modeling & Identification electrical systems	2	1			1h30	10:30 p.m.	27:30	100%	
	Electrical Drives TP	2	1			1h30	10:30 p.m.	27:30	100%	
	High Voltage Techniques 3		2	1h30		1 hour	37h30	37h30	40%	60%
EU Discovery Code: UED 1.2 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 1.2 Credits: 1 Coefficients: 1	Ethics, professional conduct and intellectual property	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
Total semester 2		30	17	1:30 p.m.	6:00 a.m.	5:30 a.m.	375 hours	375 hours		

CPNDST

Title: Master of Industrial Electrotechnics *Year: 2016-2017*

Semester 3 Master: Industrial Electrotechnics

Unit teaching	Materials Titled	Credits	Coefficient	Hourly volume weekly Course	TD	TP	Volume Hourly Biannual (15 weeks)	Work Complementary in consultation (15 weeks)	Assessment method Control Continuous	Exam
Fundamental EU Code: UEF 1.3.1 Credits: 10 Coefficients: 5	Transient regimes of electrical systems	6	3	3h00	1h30		67h30	82h30	40%	60%
	Electrical systems control	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental EU Code: UEF 1.3.2 Credits: 8 Coefficients: 4	Diagnosis of faults in electrical installations	2	1	1h30			10:30 p.m.	27:30		100%
	Energy quality and Electromagnetic compatibility	4	2	1h30	1h30		45h00	55h00	40%	60%
	Artificial intelligence techniques	2	1	1h30			10:30 p.m.	27:30		100%
Methodological EU Code: UEM 1.3 Credits: 9 Coefficients: 5	Practical work on artificial intelligence techniques	2	1			1h30	10:30 p.m.	27:30	100%	
	TP Electrical Systems Control	2	1			1h30	10:30 p.m.	27:30	100%	
	Sizing of industrial systems	5	3	1h30	1h30	1h	60h00	65h00	40%	60%
EU Discovery Code: UED 1.3 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 1.3 Credits: 1 Coefficients: 1	Documentary research and memory design	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
Total semester 3		30	17	3:00 p.m.	6:00 a.m.	4:00 a.m.	375 hours	375 hours		

CPNDST

Title: Master of Industrial Electrotechnics *Year: 2016-2017*

Discovery EU *(S1, S2 and S3)*

1- Centralized and decentralized production of electrical energy 2- Renewable energies
3- Maintenance and operational
safety *4*- Industrial computing *5*- Implementation of real-time
digital control *6*- Electrotechnical
materials and their applications 7- Maintenance of electrical networks 8- Standards
and legislation in Electrotechnical engineering 9- Industrial ecology and
sustainable development 10- 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's Assessment) /4
- Presentation and answer to questions (Jury assessment) /4
- Assessment of the supervisor /3
- Presentation of the internship report (Jury assessment) /3

III - Detailed program by subject for semester S1

Semester 1 Master: Industrial Electrotechnics

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 course 'Electrical Networks' in 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 subject:

I. 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.

II. Organization of the transport of electrical energy

II.1. Energy 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).

II.2. Distribution networks (2 weeks)

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

III. 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

IV. Neutral diets (2 weeks)

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

V. Tension 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 Master: Industrial Electrotechnics

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 subject:

Chapter 1 : Modeling and simulation methods for power semiconductors (2 weeks)

Idealized characteristics of different types of semiconductors, logic equations of semiconductors, simulation methods of static converters

Chapter 2 : Switching mechanisms in static converters (3 weeks)

Principle of natural switching, principle of forced switching, calculation of switching losses.

Chapter 3 : Design methods for naturally commutated static converters (2 weeks)

Switching rules, definition of the switching cell, different types of sources, power exchange rules, direct and indirect converters example: study of a cyclo converter.

Chapter 4 : Design methods for forced-commutation static converters (3 weeks)

- PWM inverter
- Sinusoidal absorption rectifier
- PWM dimmer

- Switching power supplies

Chapter 5 : Multi-Level Inverter (0-3 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 (3 weeks)

- Harmonic pollution due to static converters (Case study: rectifier, dimmer).
- Study of harmonics in voltage inverters.
- Introduction to pollution control techniques

Bibliography:

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

Semester 1 Master: Industrial Electrotechnics

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 the organization of memory. Understand assembler programming. Understand the use of I/O interfaces and interrupts.

Use of microcontroller (programming, system control).

Recommended prior knowledge

Combinational and sequential logic, industrial automation

Subject content: Chapter 1:

Architecture and operation of a microprocessor (3 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 interrupt subroutines, Addressing I/O ports, Managing I/O ports **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 - Port Signal Generation Gate for Converters –

Motor- Control - DC/AC Device Control - Frequency Measurement - Data Acquisition System

Assessment method: Final exam: 100%.

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] R. Tourki. The PC computer – Architecture and programming – Course 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 I80x86 assembler – Course and exercises. Hermès, Paris, 1994

Semester 1 Master: Industrial Electrotechnics

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 I : 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 II : 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 Connection. Synchronous Motors, Starting…

Chapter III : Asynchronous Machines (4 weeks)

Generalities. 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 IV : Direct Current Machines (4 weeks)

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

Assessment method : Continuous assessment: 40%; Exam (60%)

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.
5) PS Bimbhra, “Generalized Theory of Electrical Machines”, Khanna Publishers, 2008.
6) AE, Fitzgerald, Charles Kingsley, Jr, and Stephan D, Umanx, “Electric Machinery”, Tata McGraw Hill, 5th Edition, 1992

Semester 1 Master: Industrial Electrotechnics

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 necessary numerical analysis and optimization tools to achieve this triple goal. The course will combine theoretical mathematical concepts with practical implementation on examples of concrete applications.
Recommended prior knowledge: Mathematics,
mastery of the MATLAB environment

Content of the subject:

Chapter I: Reminders on some numerical methods (3 weeks)
Resolution of systems of linear and nonlinear equations by iterative methods; Integration and differentiation, etc.
Ordinary Differential Equations (ODE)
- Introduction and canonical formulation of ordinary differential equations and systems of equations;

- Resolution methods: Euler methods; Runge-Kutta methods; Adams method.

Chapter II: Partial Differential Equations (PDE) (6 weeks)
- Introduction and classification of partial differential problems and boundary conditions;

- Resolution methods:

ÿ Finite Difference Method (FDM);

ÿ Finite element method (FEM).

Chapter III: Optimization Techniques (6 weeks)

Definition and formulation: optimization problems. Classical optimization techniques.
Single and multiple optimization with and without constraints.
Optimization algorithms: Linear programming, mathematical model, solution technique, duality, nonlinear programming.

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.

SS Rao, 'Optimization – Theory and Applications', Wiley-Eastern Limited, 1984

Semester 1 Master: Industrial Electrotechnics

Semester: 1

Methodological EU 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. Use of the microcontroller (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 (1 week)
TP2: Programming arithmetic and logical operations in a µ-processor (1 week)
TP3: Use of video memory in a µ-processor (1 week)
TP4: Managing the memory of the µ-processor. (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: 40%; Final exam: 60%.

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] R. Tourki. The PC computer – Architecture and programming – Course 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 I80x86 assembler – Course and exercises. Hermès, Paris, 1994

Semester: 1

Methodological EU Code: UEM 1.1

Subject: Practical work : 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 material

TP No. 1 : Adjusting the voltage using a 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, Network Analysis Methods electric, 2007.
3. Lasne, Luc, Exercises and problems in electrical engineering: basic concepts, networks and machines electric, 2011.
4. J. Grainger, Power system analysis, McGraw Hill 5. , 2003

WD Stevenson, Elements of Power System Analysis, McGraw Hill, 1998.

Semester 1 Master: Industrial Electrotechnics

Semester: 1

Methodological EU Code: UEM 1.1

Subject: Advanced Power Electronics TP

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
TP2 : Improvement of the power factor;
TP3 : Elimination of harmonics
TP4 : Static reactive power compensators

Assessment method: Continuous assessment: 100%;

References:

GuySéguier and Francis Labrique, “Power electronics converters - volumes 1 to 4” ,
Ed. Lavoisier Tec and very rich documentation available in the library. - Website: “Courses and Documentation”

Valérie Léger, Alain Jameau Energy conversion, electrical engineering, power electronics.
Course summary, corrected
problems”, , : ELLIPSES MARKETING

Semester 1 Master: Industrial Electrotechnics

Semester: 1
Methodological EU 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 To
familiarize students with the calculus of variations and solving problems using optimization techniques associated with engineering applications.

Recommended prior knowledge:
Ability to apply concepts of linear programming theory in electrical engineering problems

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 **session)**

- Write the following programs for:

- ÿ Calculate the integral by the following methods: Trapezoid, Simpson and general; **(01 session)**
- ÿ Resolution of ordinary differential equations and systems of equations by the different Euler methods, RK-4; (01 **session)**
- ÿ Solve systems of linear and non-linear equations: Jacobi; Gauss-Seidel; Newton - Raphson; **(01 session)**
- ÿ Solve PDEs using MDF and MEF for the three (03) types of equations (Elliptic, parabolic and elliptic); **(06 sessions)**
- ÿ Minimize a function with several variables without constraints by the methods: of gradient, conjugate gradient, Newton and quasi-Newton ; **(2 sessions)**
- ÿ Minimize a multivariate function with constraints (inequalities and equalities) using the methods: projected gradient and Lagrange-Newton. (2 **sessions)**

Note : The first 3 sessions can be done as personal work

Assessment method: Continuous assessment: 100%;

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 Master: Industrial Electrotechnics

Semester: 1
Methodological EU Code: UEM 1.1
Subject: Advanced electrical machinery
VHS: 10:30 p.m. (TP: 1:30 p.m.)
Credits: 2
Coefficient: 1

Teaching objectives
.

Recommended prior knowledge:

Content of the material

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

Assessment method: Continuous assessment: 100%;

Bibliography

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.
4R. Abdessemed "Modeling and simulation of electrical machines" ellipses, 2011.

Semester 1 Master: Industrial Electrotechnics

Semester: 1
EU Discovery Code: UED 1.1
Subject: Renewable Energies
VHS: 45h (Class: 1h30, tutorial 1h30)
Credits: 2
Coefficient: 2

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: Continuous assessment: 40%; Exam: 60%.

References

1. Sabonnadière Jean Claude. 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 1 Master: Industrial Electrotechnics

Semester: 1
EU Discovery Code: UET 1.1
Subject: Entrepreneurship and Business Management,
VHS: 10:30 p.m. (Class: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives Understand
how a company works and the achievement of the strategic objectives of the whole
,Adopt an appropriate management approach.Introduction of the concept of marketing.

Recommended prior knowledge:

Content of the subject:

Introduction

I. Raising awareness of entrepreneurship and entrepreneurial culture
I.1 Business, entrepreneur and entrepreneurship, I. 2 Culture, business culture and entrepreneurial culture, *I.3* The promotion of entrepreneurial culture and its values, *I.3.1 The reasons, I.3.2 The foundations, I.3.3 The means, I.3.4 Entrepreneurial values*

II. Knowledge of entrepreneurship and its forms
II.1 The need for entrepreneurship in a changing world examples, *II.2.1* , II.2 Forms of entrepreneurship: typology and *Individual vs. collective, II.2.2 Forms of entrepreneurship: some examples,* II.2.2.1 Creation of a new business, II.2.2.2 Creation of a business by spin-off, II.2.2.3 Creation of a business by franchise II.2.2.4 Takeover, sale and transfer of businesses, II.2.2.5 Organizational entrepreneurship , or entrepreneurship, II.2.2.6 Cooperative or collective entrepreneurship: cooperative or collective and social enterprise , II.2.2.7 Solidarity entrepreneurship

III. Knowledge and awareness of oneself and one's potential
III.1 Motivations to undertake, III.2 The qualities and defects of the individual who wants to undertake, III.3 The development of his entrepreneurial profile, III.4 The profession of the entrepreneur: components and key activities

IV. Knowledge of the socio-economic environment
IV.1 Family and close environment, IV.2 Professional, trade and profession environment, IV.3 Business support environment, IV.4 Associative environment

V. Knowledge of the entrepreneurial project
V.1 The entrepreneurial project: definition, V.2 The fundamental conditions of the project, V.3 The foundations of an entrepreneurial project, V.4 The stages and components of an entrepreneurial project,

Assessment method: Exam: 100%.

References

Brilman Jean, HérardJacques, 2006, *Best management practices,* Paris, Ed. Organization -
Leban Raymond, 2005, *business management,* Paris, Ed. Organization - Lispe, 2005, *Strategor,* Paris, Ed. Dunod - Buttrick Robert,
2006, *project management,* Paris, Ed. Village mondial - Muller Jean-Louis, 2005, *project management,* Paris, Ed. AFNOR

Semester 1 Master: Industrial Electrotechnics

Semester: 1

EU Discovery Code: UET 1.1

Subject: Industrial Ecology and Sustainable Development

VHS: 10:30 p.m. (Class: 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 in the world • Industrial symbiosis (eco-industrial parks/networks) • Gaseous, liquid and solid waste • Recycling

IV - Detailed program by subject for semester S2

Semester: 2

Fundamental EU Code: UEF 1.2.1

Subject: Industrial electricity

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

Credits: 4

Coefficient: 2

Teaching objectives The subject aims to give students the necessary knowledge on industrial electrical networks (architectures, diagrams and plans), the calculation of the power balance, energy minimization, choice of electrical conduits, calculation of faults, protection and safety

Recommended prior knowledge Basic notions of electrical networks

Contents of the subject: I.

Receptors 2 weeks

Nature of the receiver; Characteristics of the receivers (current, voltage, power factor, operating regimes).

II. Power Sources **2 weeks**

Power supply by RDPs; Alternators (synchronous generators), asynchronous generators, Advantages and disadvantages; Uninterruptible power supplies (UPS), **III. Source-receiver interactions 2 weeks**

Disruptions in industrial networks (unbalanced operation, overloads, overvoltages, harmonics, etc.); Remedies;

IV. Methodology and sizing of electrical installations - Power balance; **6 weeks**

- Determination of conductor sections;
- Choice of protection devices and low voltage neutral systems;
- Calculation of interior lighting;
- Calculation of exterior lighting;

V. Reactive energy compensation Interests of ER compensation, ER compensation techniques. **2 weeks**

VI. Pricing of electrical energy **1 week**

Choice of tariff, Blue Tariff, "Yellow" Tariff, Green Tariff, Purchase tariffs; Connection and reinforcement costs for customer supply networks

Assessment method: Continuous assessment: 40%; Final exam: 60%.

References (Books and handouts, websites, etc.).

[1] Denis MARQUET, Didier Mignardot, Jacques SCHONEK, "Electrical Installation Guide 2010 - Standards international IEC and French national NF", Schneider Electric, 2010
[2] Jean Repérant, "Industrial electrical networks - Introduction", Tech. del'Ing., D5020, 2001
[3] Jean Repérant, "Industrial electrical networks - Engineering", Tech.del'Ing., D5022, 2001
[4] Dominique SERRE, "LV Electrical Installations - Electrical Protection", Tech. del'Ing., D5045, 2006
[5] SOLIGNAC (G.). – Guide to Electrical Engineering of Internal Factory Networks 1076 p.bibl. (30 ref.) lectra Tech & Doc Lavoisier, EDF. Paris, 1985.
[6] Catherine Le Trionnaire Vade-mecum electrotechnical networks production machines industrial systems Electrical Engineering Level A. Released: September 25, 2010.

Semester: 2
Fundamental EU Code: UEF 1.2.1
Subject: Sampled servocontrols and digital regulation
VHS: 45h (Class: 1h30, tutorial 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:
Understand sampling, the difference between continuous systems, sampled systems, and discrete systems. Understand and master the mathematical tool "z-transform." Understand discrete models. Analyze discrete systems and synthesize discrete PID, RST, and state feedback controllers. Understand how to implement digital (discrete) controllers.

Recommended prior knowledge:
The mathematical tool (polynomials, recurring equations, rational functions with complex variables) controls continuous linear systems.

Content of the material:

Chapter 1: Sampling and Reconstitution (1 week)
Chapter 2: Z-transform: properties and applications (1 week)
Chapter 3: Discrete systems, discrete transfer function, discrete systems analysis and stability (3 weeks)

Chapter 4: Digital regulation: principle and implementation (2 weeks)
Chapter 5: Control by digital PID regulator (03 weeks)
Chapter 6: Digital RST Command (03 weeks)
Chapter 7: Numerical control by state feedback (2 weeks)

Assessment method:
Continuous assessment: 40%; Exam: 60%

Reference:

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, INSA

Semester: 2

Fundamental EU Code: UEF 1.2.1

Subject: Industrial Automation Technology

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

Credits: 2

Coefficient: 1

Content of the subject:

I. General information on automation and industrial production systems

II. Pneumatic technology

Compressed air concepts; Compressors; Air conditioning; II.1
Pneumatic distributors II.2 Pneumatic
sensors:
- Mechanically operated presence detectors and push buttons -
Fluidic proximity detectors -
Pressure threshold proximity detectors -
Pressure detectors II.3
Pneumatic actuators:
Pneumatic cylinders; pneumatic motors; suction cups; vacuum generators
II.4 Logical functions

III. Hydraulic technology

II.1 Theory of hydraulics II.2
Pump families II.3 Hydraulic
receivers: - for translational
movement (cylinders) - for rotational
movement (hydraulic motors)
II.4 Connecting elements: distributors II.5 Accumulators
II.6 Protection and regulation
devices (pressure, flow, etc.)

IV. Electromechanical technology

IV.1 Communication devices (physical quantity conveyed, concept of electrical contact, etc.)
IV.2 Electrical contacts IV.3
Electromechanical sensors: position, pressure, temperature detectors;
buttons and selectors
IV.4 Electromechanical actuators (relays, contactors)

V. Electronic technology

Notions on the different electronic elements used in automation: sensors, preactuators and actuators.

Assessment method: Exam: 100%.

Semester: 2

Fundamental EU Code: UEF 1.2.2

Subject: Modeling and Identification of Electrical Systems

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

Credits: 4

Coefficient: 2

Program

Chapter 1: Systems and Experiments (2 weeks)

General information, types of models, models and simulation, how to obtain a model

Chapter 2: Mathematical model (2 weeks)

Block diagram of a system, characteristic variables, internal and external representations of a system

Chapter 3: Modeling of electrical systems (2 weeks)

Modeling of a passive component, an active component, basic electrical circuits

Chapter 4: Modeling Tools (2 weeks)

Bond graph (BG) or Causal Information Graph (CIG) (Application to electrical circuits)

Chapter 5: General information on identification (2 weeks)

Definitions, steps, SBPA generation, choice of model structure

Chapter 6: Graphic Identification Methods (2 weeks)

Strejc method, Broïda method…

Chapter 7: Digital Identification Methods (3 weeks)

Recursive methods, non-recursive methods.

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Handouts and books

Semester: 2
Fundamental EU Code: UEF 1.2.2
Subject: Electric Drives
VHS: 45h (Class: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:
The objective of this course is to provide students with the knowledge necessary to select components for an electric drive. It will also allow them to understand the challenges and solutions available in the field of electric drives in industrial electrical engineering.

I. General information on electric drives
Definition of electric drives, functional point of view, structure of an electric drive, methodology for studying an electric drive **(03 weeks)**
II. Characteristics of charges C(ÿ)
Fan load, lifting load, climbing load, traction load, etc. **(03 weeks)**
III. Operation of electric drives:
Speed variation, starting and braking processes for DC motors, asynchronous motors and synchronous motors **(9 weeks)**
- Principle of variation of the speed of DC motors;
- Variable speed drive by controlled rectifiers;
- Variable speed drive by choppers;
- Principle of speed adjustment of AC motors;
- Variable speed drive by voltage inverter;
- Variable speed drive by current inverter (without and with slip control)

Assessment method:
Continuous assessment: 40%; Exam: 60%.

Handouts and books

Semester: 2

Methodological UE Code: UEM 1.2

Subject: Practical work Sampled servocontrols and digital regulation

VHS: 22h30 (practical work: 1h30)

Credits: 2

Coefficient: 1

Teaching objectives: Know 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 material:

TP 1: Sampling and reconstitution (01 week)
TP 2: Sampled systems: time analysis and frequency analysis (2 weeks)
TP3: Control by digital PID regulator (4 weeks)
TP4: Digital RST control (4 weeks)
TP5: Digital control by status feedback (4 weeks)

Assessment method:

Continuous assessment: 100%

Reference:

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.
Automation of sampled systems, JM Retif, INSA

Semester: 2

Methodological EU Code: UEM 1.2

Subject: Industrial Electricity Practical Work / Electrical Systems Modeling & Identification Practical Work

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

Credits: 2

Coefficient: 1

Practical work in industrial electricity

TP n°1: Sizing of the different electrical protection boxes and cabinets

TP n°2: Sizing of protection devices and calculation of cable sections

TP n°3: Insulation measurement and earth fault protection devices

TP n°4: Industrial diagrams.

Note: The 1st and 2nd in the form of mini projects, the 3rd and 4th with preparation and completion in the laboratory.

Practical work on Identification & Modeling of Electrical Systems

TP n° 1: Modeling and simulation of passive or active electrical circuits.

TP n° 2: Modeling and simulation of electromechanical converters

TP n° 3 Direct measurement of the response of a system

TP n° 4: Parametric identification of an electrical system using the Strejc and Broïda methods

TP n° 5: Digital identification (online) of a DC Machine by the Recursive Least Squares Method MCR

TP n° 6: Digital identification (online) of an AC Machine by the Recursive Least Squares Method MCR

Assessment method:
Continuous assessment: 100%.

Semester: 2

Methodological EU Code: UEM 1.2

Subject: Electrical Drives Practical Work

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

Credits: 2

Coefficient: 1

TP1: Training a DC machine

TP2: Starting processes for an asynchronous motor
TP3: Association of static frequency converter - asynchronous motor - traction load TP4:
Association of voltage converter - asynchronous motor - fan load
TP5: Speed variator – asynchronous motor

Practical work that you cannot do practically (due to lack of equipment) can be done by simulation.

Assessment method:
Continuous assessment: 100%.

Semester: 2

Methodological EU Code: UEM 1.2

Subject: High voltage techniques

VHS: 37h30 (Lecture: 1h30, Practical work: 1h00)

Credits: 3

Coefficient: 2

Goals :

The subject aims to master electrical energy both in terms of understanding physical phenomena and in terms of design and dimensioning of insulation for high-voltage equipment. Also, at the end of this course, the student will be able to master the problems of insulation coordination in electrical networks.

Prerequisites: Basic knowledge of fundamental physics and fundamental electrical engineering.

Program

I. Familiarize yourself with the phenomena and techniques related to high voltage.

II. Production and measurement of high voltages in the laboratory: direct, alternating and impulse voltage.

III. Generation and measurement of currents: leakage current and high current.

III. Testing of high voltage equipment.

IV. Mastery of electric fields and applications to equipment design.

V. In-depth study of conduction mechanisms in insulators (solid, liquid and gas) application to the sizing of electrical networks.

VI. Statistical techniques for coordinating isolation

Practical work

- The high voltage transformer
- Dielectric strength of liquids, solids and gases at 50 Hz
- Capacity and loss factor, partial discharges and corona effect

Assessment method:
Continuous assessment: 40%; Exam: 60%.

References:

[1]- E.Kuffel, WS Zanegl, J.Kuffel “High Voltage engineering: Fundamentals”, 2nd edition, Edition Newnes, 2006 [2]- C.Gary “Dielectric properties
in air and very high voltage”, Editions Eyrolles, 1984

[3]- M.Aguet, M.Ianovic “Treatise on electricity, Volume XIII: High Voltage”, Edition GEORGI, 1982 [4]-
P.Bergounioux “High voltage”, Edition Willam blake & Co, 1997
[5] J. Arrillaga, “High Voltage Direct Current Transmission”, Peter Pregrinus, London, 1983

V - Detailed program by subject for semester S3

Semester 3 Master: Industrial Electrotechnics

Semester: 3
Fundamental EU Code: UEF 1.3.1
Subject: Transient regimes of electrical systems
VHS: 45h (Lecture: 3h00, Tutorial 1h30)
Credits: 6
Coefficient: 3

Teaching Objectives The objectives of this course are to enable the student to master the characteristics, performances and specificities of electrical engineering systems as well as to have the necessary bases in order to deal with transient regimes. Subsequently consider either their association with static converters in the case of electrical machines or with a view to the analysis of stability in the case of electrical networks.

Recommended prior knowledge: Electrical networks, electrical machines, mathematical tools, etc.

Contents of the subject: I.

Electromagnetic transients and electromechanical transients. (. Faults, overvoltage of maneuvers, lightning. Machine excitation systems, ...) **4 weeks**

II. Propagation of transient phenomena on power lines - Study of wave propagation in the frequency domain; **2 weeks**

- Propagation of surge waves in the presence of an injection or an internal disturbance in the system.

III. transient modeling of lines using the Laplace method and the moving wave method. 2 weeks

Disruptions in industrial networks (unbalanced operation, overloads, overvoltages, harmonics, etc.); Remedies;

IV. Modeling of electrical machines for dynamic regimes 7 weeks

- Park and Fortescue transformations, transformation matrices;
- Use of the method for transient regime calculations;
- Study of transient regimes and torque expressions;

Assessment method: Continuous assessment: 40%; Final exam: 60%.

References (Books and handouts, websites, etc.).

[1] M.Grappe “Stability and safeguarding of electrical networks”, Edition HERMES, 2003
[2] Yoshihide Hase, Power Systems engineering, British Library Cataloging in Publication Data, USA
[3] ARIEH L. SHENKMAN, Transient analysis of electric power circuit hand book, Holon Academic Institute of Technology, Springer revue, Netherlands, 2005.
[4] Electric Power Generation, Transmission, and Distribution, Leonard L. Grigsby, University of California, Davis, 2006.

[5]SÉGUIER, G., Industrial Electrotechnics, Technique and Documentation, 1984.
[6]Fitzgerald, Electric machinery, McGraw-Hill, 5th Edition.
[7]CHATELAIN, J., Electrical Machines, Volumes 1 and 2, Treatise on electricity, Dunod, 1984.

Semester 3 Master: Industrial Electrotechnics

Semester: 3

Fundamental EU Code: UEF 1.3.1

Subject: Electrical systems control

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

Credits: 4

Coefficient: 2

Teaching objectives:

Learn how to choose the control elements and actuators of an electrical system.
Address the control of industrial systems such as pumps, overhead cranes, extractors, etc.

Recommended prior knowledge:

Electrical machines, system identification, control and regulation, etc.

Content of the material:

Chapter 1: Criteria for choosing an electric motor in an industrial environment

1.1 - Electric motors -
Use of electrical machines of normal construction
- Engines of specific construction

1.2- Choice of engines according to:
- of the industrial environment
- power - operating
speed

Chapter 2: Electrical Control and Automation of Pumps, Fans and compressors

2-1-Principles
2-2-Power at the end of the shaft
2-3-Starting the fan torque mechanisms
2-4- Electrical control of fans

Chapter 3: Power supply and automation of elevators and extractors

3-1- Principles
3-2- Accuracy of parking of lifting systems
3-3- Requirements in elevator control systems
3-4-Typical diagrams of controls for elevators
3-5-Automation of elevator speed controls

Chapter 4: Automation of overhead cranes

4-1- Principles
4-2- Loads of the motors of the mechanisms of the overhead cranes
4-3- Electromagnetic lifting systems
4-4-Electrical control systems for overhead cranes
4-5- Requirements for the mechanical characteristics of electrical controls for overhead cranes
4-6- Automation of overhead cranes using thyristor converters
4-7-Equipment of large overhead cranes
4-8-Remote control of overhead cranes
4-9-Power supply of overhead cranes

Assessment method:

Continuous assessment: 40%; Exam: 60%

Reference: Books and handouts.

Semester 3 Master: Industrial Electrotechnics

Semester: 3

Fundamental EU Code: UEF 1.3.1

Subject: Diagnosis of faults in electrical installations

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

Credits: 2

Coefficient: 1

Teaching objectives:

Diagnosis is the reasoning leading to the identification of the cause (origin) of a failure, problem or anomaly. This course allows students to become familiar with the tools for diagnosing industrial failures based on knowledge of the symptom(s) to determine the cause(s). The course is divided into a set of chapters that enhance the student's skills in the use of diagnostic techniques and analytical skills when faced with problem situations while providing the necessary tools for establishing a rigorous and effective approach. This subject will allow students to acquire essential knowledge for avoiding breakdowns in the interests of reliability and continuity of service in a

electrical installation.

Recommended prior knowledge:

Electrical machines, Electrical circuits, Signal theory, Numerical analysis

Content of the subject:

Chapter 1: Introduction to fault diagnosis (2 weeks)

Basic concepts: equipment, failure, breakdown, preventive maintenance, diagnosis and prognosis, tests and methods, test devices;

Pathological behavior of materials:

- Quantitative analyses of failures and their challenges;
- Qualitative post-failure analysis;
- Failure modes (mechanical, plastic, corrosion, control parts).

Chapter 2: Fault Diagnosis Tools (3 Weeks)

Basic tools for industrial diagnosis: Sensors, Acquisition and visualization of signals; Signal processing techniques: time analysis, frequency analysis (spectral analysis and envelope analysis), time-frequency analysis.

Chapter 3: Fault Diagnosis Techniques (3 Weeks)

Thermal analysis (temperature measurement), Current analysis, Vibration analysis, Lubricant analysis,

Chapter 4: Practical case studies: Electrical machines (3 weeks)

Machine failures and extension of their useful life: case of the asynchronous machine;
Testing of electrical machines;
Diagnosis by monitoring physical quantities: currents, vibration and temperature.

Chapter 5: Diverse practical case studies (04 Weeks)

Switches and circuit breakers: Overloads and faults;
Distribution panels: electrical contact, resistance formula, contact degradation and monitoring by thermal measurement;
Variable speed drive: overall protection and diagnostics, fault analysis of control circuits (defective capacitor, resistor or transformer, short-circuited or open diode, blown fuse);

Transformers: Causes of breakdowns, Maintenance in service and analysis of some problems;

Electrical cabinet: thermal analysis of the electrical cabinet (conduction, convection and radiation), installation of sensors and priority criteria, Indicator of crossing temperature thresholds.

Assessment method: Exam: 100%.

Reference:

[1] M. Brown, J. Rawtani and D., Electrotechnical Maintenance: electrical equipment and control circuits. Dunod Edition, Paris, 2012.

[2] EGEM treatise under the direction of JC. Trigeassou, Diagnostics of electrical machines, Lavoisier Edition, Paris 2011.

[3] Kahan N'Guessan. Methods and tools to assist in the diagnosis and maintenance of general electrical panels by monitoring characteristic physical quantities and their operation. Engineering sciences [physics]. National Polytechnic Institute of Grenoble - INPG, 2007.

[4] Gilles Zwingelstein. Fault diagnosis, theory and practice for systems industrialists. Ed. HERMES, 1995

[5] Ron Patton, Paul Frank and Robert Clark. Fault Diagnosis in Dynamic Systems. Theory and Applications. Prentice Hall Publishers, 1989.

[6] Rolf Isermann. Fault Diagnosis of Machines via Parameter Estimation and Knowledge Processing- Tutorial Paper. Automatica, Vol. 29, No. 4, p. 815-835, 1993.

Semester 3 Master: Industrial Electrotechnics

Semester: 3

Fundamental EU Code: UEF 1.3.2

Subject: Power Quality and Electromagnetic Compatibility

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

Credits: 4

Coefficient: 2

Teaching objectives The
objective of the course is on the one hand to master the qualitative aspects of electrical energy for good energy efficiency and on the other hand to understand electromagnetic disturbances from the source and victim point of view in order to provide solutions for adequate cohabitation of the different devices in an industrial installation.

Recommended prior knowledge: Common
mathematical tools of electrical engineering, electromagnetism, electrical installations, power electronics, electrical control, transient regime of electrical systems.

Content of the subject:

I. Degradation of electrical energy quality: Origins, characteristics and consequences.

II. Concept of EMC: Terminology, context, issues and margin of compatibility.

III. EMC Actors: Sources, Victims and Couplings.

IV. Disturbances generated by power and digital electronic circuits: switching, voltage and current distortions, malfunction, clock signal.

V. Disturbances generated by electrostatic discharges: Static electricity, hygrometry, lightning, direct and indirect effects of lightning and models.

VI. Equivalent electrical models of electromagnetic effects: galvanic effect, magnetic effect self and mutual, dielectric effect and antenna effect.

VII. Study and reduction of couplings: Types of coupling (conduction, radiation and ionization), modes of coupling (common and differential), equivalent coupling circuit and methods of reducing couplings (arrangement of equipment, arrangement of cables and masses).

VIII. EMC measurement and protection techniques: Grounding, shielding, reducing effect, filtering and protection against overvoltages, clipping, measurement units and reference values, spectrum analyzer.

IX. Energy optimization and application to the industrial sector: Reduction of harmonics, time and frequency filtering, passive and active filtering, decoupling of power supplies, compensation of reactive energy.

X. Regulatory and normative provisions: Regulations in force

Assessment method:

Continuous assessment: 40%; Exam: 60%.

References

1. P. Degauque, A. Zeddam, **“Electromagnetic Compatibility: From Basic Concepts to Applications ”, Volumes** 1 and 2, Publisher **Hermès - Lavoisier, 2007.**
2. **Alain CHAROY , “EMC – Electronics Interference and Disturbances ”,** Volume 1: Sources, Couplings, Effects (2006), Volume 2: Earths, masses, wiring (2006), Volume 3: Shielding, filters, shielded cables (2007), Volume 4: Food, lightning, remedies (2007), 2nd edition DUNOD
3. **A. KOUYOUMDJIAN, “Harmonics and electrical installations ”,** Schneider Group Edition, 1998
4. **Jean-Louis COCQUERELLE, “EMC and power electronics”,** TECHNIP Edition, 1999.

Semester 3 Master: Industrial Electrotechnics

Semester: 3

Fundamental EU Code: UEF 1.3.2

Subject: Artificial Intelligence Techniques
VHS: 45h (Course: 1h30)

Credits: 2

Coefficient: 1

Teaching objectives:
Understand the basics of artificial intelligence techniques and their use in control, optimization, diagnostics, and decision support. The module covers the different topologies of neural networks and their learning algorithms, the various basic concepts of fuzzy logic and its applications, and finally, the principle of heuristic methods and their programming.

Recommended prior knowledge:
Dynamical systems. Optimization. Logic. Probability.

Content of the material:

Chapter 1: General information on "soft computing". (1 week)

Chapter 2: Fuzzy Logic and its Applications. (2 weeks)
- Basic concepts: fuzzy subsets and fuzzy logic. –Structure of a fuzzy system.
- Fuzzy reasoning model - Fuzzy identification and control

Chapter 3: Artificial Neural Networks. (2 weeks)
- Multi-layer networks and back-propagation algorithm – Recurrent neural networks
- RBF networks and learning

Chapter 4: Adaptive Networks and Fuzzy Neural Networks. (1 week)
- Associative memories and classification networks.
- Fuzzy neuro-networks

Chapter 5: Genetic Algorithms. (2 weeks)
-AGs - Differential Evolution - Firefly Algorithm

Chapter 6: Particle Swarm Optimization Technique…. (2 weeks)
-Local search -Advanced local search (simulated annealing, taboo search, etc.)
-Cooperative algorithms: ant colonies, etc.

Chapter 7: Probability and Probabilistic Reasoning (2 weeks)
-Probabilistic reasoning – Bayesian networks

Chapter 8: Expert systems and their applications (2 weeks)
-Expert systems -Fuzzy expert systems -Application to decision-making -Application to diagnosis

Assessment method:
Continuous assessment: 40% Exam: 60%

Reference:

1. PA Bisgambiglia, Fuzzy logic and its applications, Hermès-science
2. H. Buhler, Fuzzy Logic Control, PPR
3. Heikki Koivo, Soft computing 4.
DR Hush & BG *Horne,"Progress in Supervised Learning Neural Networks,"* IEEE signal proc. magazine, Vol.10, No.1, pp.8-39, Jan. 1993.
5. B. Kosko, *"Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence,"* Englewood Cliffs, NJ: Prentice-Hall, 1992.
6. LXWang, *"Adaptive Fuzzy Systems & Control: Design & Stability Analysis":* Prentice-Hall, 1994.
7. David E. Goldberg, *Genetic Algorithms,* Edit. Addison Wesley, 1994.

Semester: 3

Methodological EU Code: UEM 1.3

Subject: Practical work on artificial intelligence techniques

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

Credits: 2

Coefficient: 1

Teaching objectives:

Program and simulate control laws based on artificial intelligence techniques.

Recommended prior knowledge:

Simulation and programming software. Dynamic systems. Optimization. Logic. Probabilities.

Content of the material:

TP 1: Introduction to fuzzy logic. (3 weeks)
TP 2: Artificial neural networks. (3 weeks)
TP 3: Adaptive networks and neuro-fuzzy networks. (2 weeks)
TP 4: Genetic algorithms. (3 weeks)
TP 5: PSO. (2 weeks)
TP 6: Expert systems and probabilistic reasoning. (2 weeks)

Assessment method:

Continuous assessment: 100%

Reference:

1. PA Bisgambiglia, Fuzzy logic and its applications, Hermès-science
2. H. Buhler, Fuzzy Logic Control, PPR
3. Heikki Koivo, Soft computing 4.

DR Hush & BG *Horne,"Progress in Supervised Learning Neural Networks,"* IEEE signal proc. magazine, Vol.10, No.1, pp.8-39, Jan. 1993.

5. B. Kosko, *“Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence,"* Englewood Cliffs, NJ: Prentice-Hall, 1992.
6. LXWang, *“Adaptive Fuzzy Systems & Control: Design & Stability Analysis”:* Prentice-Hall, 1994.
7. David E. Goldberg, *Genetic Algorithms,* Edit. Addison Wesley, 1994.

Semester: 3

Methodological EU Code: UEM 1.3

Subject: Practical work on electrical systems control

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

Credits: 2

Coefficient: 1

Titles of the practical work:

TP n° 01: Control of a centrifugal pump

TP n° 02: Study of an automated gate

TP n° 03: Study of a treadmill training

TP n° 04: Automation of a freight elevator

Assessment method:
Continuous assessment: 100%.

Reference:
Books and handouts.

Semester 3 Master: Industrial Electrotechnics

Semester: 3

Methodological UE Code: UEM 1.3

Subject: Sizing of industrial systems VHS: 22h30

(Lecture: 1h30; Tutorial: 1h30; Practical: 1h00)

Credits: 5

Coefficient: 3

Chapter I: Elements of industrial mechanism equipment I.1-General principles of industrial systems I.2- Criteria for choosing a motor I.3- Main quantities to take into account when choosing a drive motor: Speeds, torques, powers, moment of inertia, reducer/multiplication.

Chapter II: Types of service of electric motors

II.1-Main service types: S1…S9; II.2-Average values of power, torque and intensity; II.3-Power of an engine and types of service; II.4-Increase in power compared to S1; II.5-Mechanical limit capacity; II.6-Reduction in power compared to S1.

Chapter III: Characteristic torque curves

III.1-Load torques as a function of speed; III.2-Load torques as a function of distance; III.3-Load torques as a function of time; III.4 -Initial breakaway torque.

Chapter IV: Choice and sizing of electric motors

IV.1-Motor power; IV.2-Catalogue data and application parameters; IV.3-Determination of approved power; IV.4-Catalogue data; IV.5-Operating conditions; IV.6-Motor selection procedure; IV.7-Dimensioning using load torque; IV.8-Calculation using torque or acceleration time; IV.9- Acceleration time and torque; IV.10-Preliminary selection of the motor; IV.11- Motor verification; IV.12-Motor verification at start-up; IV.13- Motor verification according to heating; IV.14-Calculation using switching frequency; IV.15-Selection by consulting the catalogue.

IV.16-Life cycle cost.

Chapter V: Miscellaneous Applications

A-Choice and sizing of electric motors in the following cases: 1. Elevators, hoists, machine tools.

2. Low and high speed vehicles, 3. Compressors.

4. Centrifugal fans and pumps.

5. Crushers.

B- Industrial applications

1. Electric ovens;
2. Welding equipment; 3.
Electrolysis and coating of metals;
4. Metallurgical plants; 5.
Agro-food industry;
6. Oil drilling station;
7. Paper industry; 8. Cement
industry
9. Glass industry
10. Metal industry.

Practical work

TP01: Study of a freight elevator
TP02: Study of treadmill training
TP03: Study of a centrifugal pump

Note: For the practical work and the last part of the “industrial applications” course, it would be more useful to do them in the form of mini-projects and educational visits.

Assessment method:
Continuous assessment: 100%.

Reference:

Books and handouts.

Suggestion of some discovery subjects

Master: Industrial Electrotechnics

Semester: ..

EU Discovery Code: UED ..

Subject: Industrial Computing

VHS: 10:30 p.m. (Class: 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;	**(02 weeks)**
Chapter 2: Connecting the hardware to a µP;	**(02 weeks)**
Chapter 3: Peripherals and interfaces (Ports, Timers, etc.);	**(04 weeks)**
Chapter 4: Serial communication bus (RS-232, DHCP, MODBUS, I2C);	**(05 weeks)**
Chapter 5: Data Acquisition: CAN and DAC Devices;	**(02 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;

, Christian, "HC11 microcontrollers and their programming", Paris: Masson, [nd], ISBN: 5. Cazaubon 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.

Master: Industrial Electrotechnics

Semester ..:

EU Discovery Code: UED ...

Subject: Industrial Ecology and Sustainable Development

VHS: 10:30 p.m. (Class: 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 society hyper-industrial, Suren Erkman 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

Master: Industrial Electrotechnics Semester ..:

Discovery UE
Code: UED ...
Subject: Renewable Energies
VHS: 45h (Class: 1h30, tutorial 1h30)
Credits: 2
Coefficient: 2

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:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

6. *Sabonnadière Jean Claude. New Energy Technologies 1: Renewable Energies, Ed. Hermes.*
7. *Gide Paul. The Great Book of Wind Power, Ed. Moniteur.*
8. *A. Labouret. Photovoltaic Solar Energy, Ed. Dunod.*
9. *Viollet Pierre Louis. History of hydraulic energy, Ed. Press ENP Chaussée.*
10. *Peser Felix A. Solar thermal installations: design and implementation, Ed. Moniteur.*

Master: Industrial Electrotechnics

Semester: ..

EU Discovery Code: UED ..

Subject: Materials in electrical engineering

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

Credits: 2

Coefficient: 2

Goals :

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.

Prerequisites: Fundamental physics and applied mathematics.

Content :

I. Know and understand the operation, composition, technology and specification of electrical equipment used in electrical networks.

II. Magnetic materials: properties, losses, types, thermal and mechanical properties, characterization, magnets.

III. Conductive materials: properties, losses, insulation, testing and applications.

IV. Dielectric materials: properties, losses, breakdown and performance, stresses, tests.

Assessment method:
Continuous assessment: 40%; Exam: 60%.

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] M. Aguet and M. 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 2 Master: Industrial Electrotechnics

Semester: 2
EU Discovery Code: UED 1.2 Subject:
Standards and legislation in Electrical Engineering VHS:
10:30 p.m. (Course: 1:30 p.m.)
Credits: 1
Coefficient: 1

Part I: Management

I. Types of businesses to manage

Traditional, profit-oriented businesses; Non-profit organizations: Government agencies, 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 electrotechnics

Different standards 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: a means of making the company prosper

2-1 Quality policy (PQ); 2-2 Quality approach (DM); 2-3 Quality management manager (RMQ); 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%.

Master: Industrial Electrotechnics

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-Analysis of systems with independent components (-Modeling of malfunction logic 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 (PNet), - Quantitative exploitation of the model: PNet: stochastic)

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

VI- Reliability forecasting methodology (-Calculation of reliability forecasts, - Failure mode analysis, fault diagnosis and maintenance techniques)

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

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.

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

Master: Industrial Electrotechnics

Semester: ..

EU Discovery Code: UED …

Subject: Implementation of real-time numerical control

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

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: Numerical 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.