وزارة التعليم العالي والبحث العلمي
Ministry of Higher Education and Scientific Research
اللجنة البيداغوجية الوطنية لميدان العلوم و التكنولوجيا
National Educational Committee for the Science and Technology sector

ACADEMIC MASTER HARMONIZE

National program

Updated 2022

Domain	Sector	Speciality
Sciences And Technologies	***Electrical engineering***	***Renewable Energies in Electrotechnics***

الجمهورية الجزائرية الديمقراطية الشعبية Democratic and Popular Republic of Algeria
وزارة التعليم العالي والبحث العلمي
Ministry of Higher Education and Scientific Research
اللجنة البيداغوجية الوطنية لميدان العلوم و التكنولوجيا
National Educational Committee for the Science and Technology sector

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ماستر أكاديمية

تــحديــث2022

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II – Half-yearly teaching organization sheets of the specialty

Semester 1 Master: Renewable Energies in Electrotechnics

Teaching unit	Materials Titled	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment method	
				Course	**TD**	**TP**			**Continuous Assessment**	**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	40%	60%
	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	Power transformer **or basket of your choice**	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
	The turbines **(proposed chapter program)**	1	1	1h30			10:30 p.m.	2:30 a.m.		100%

Transversal EU Code: UET 1.1 Credits: Coeff.: 1	Technical English and Terminology	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
Total semester 1		**30**	**17**	**12:00 p.m.**	**6:00 a.m.**	**7:00 a.m.**	**375 hours**	**375 hours**		

Semester 2 Master: Renewable Energies in Electrotechnics

Teaching unit	Materials	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment method	
	Titled			**Course**	**TD**	**TP**			**Continuous Assessment**	**Exam**
Fundamental EU Code: UEF 1.2.1 Credits: 8 Coefficients: 4	Photovoltaic energy conversion systems	4	2	1h30	1h30		45h00	55h00	40%	60%
	Wind energy conversion systems	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental EU Code: UEF 1.2.2 Credits: 10 Coefficients: 5	Electrical power quality	4	2	1h30	1h30		45h00	55h00	40%	60%
	Solar and wind energy resources	6	3	3:00 a.m.	1h30		67h30	82h30	40%	60%
Methodological EU Code: UEM 1.2 Credits: 9 Coefficients: 5	TP Wind Energy Conversion Systems	2	1			1h30	10:30 p.m.	27:30	100%	
	TPRenewable energy sources	1	1			1 hour			100%	
	TPPhotovoltaic energy conversion systems	2	1			1h30	10:30 p.m.	27:30	100%	
	Solar thermal energy	4	2	1h30	1h30		60h00	65h00	40%	60%

EU Discovery Code: UED 1.2 Credits: 2 Coefficients: 2	Power optimization and control techniques (Change'ddiscovery' at 'UEF Fundamentals')	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	Compliance with standards and rules of ethics and integrity	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
Total semester 2		**30**	**17**	**1:30 p.m.**	**7:30 a.m.**	**4:00 a.m.**	**375 hours**	**375 hours**		

Semester 3 Master: Renewable Energies in Electrotechnics

Teaching unit	Materials	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment method	
	Titled			**Course**	**TD**	**TP**			**Continuous Assessment**	**Exam**
Fundamental EU Code: UEF 2.1.1 Credits: 10 Coefficients: 5	Applications and sizing of renewable energy systems	4	2	1h30	1h30		45h00	55h00	40%	60%
	Energy storageand fuel cell	2	1	1h30			10:30 p.m.	27:30		100%
	Control of systems atrenewable energies	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental EU Code: UEF 2.1.2 Credits: 8 Coefficients: 4	Multi-source renewable energy systems	4	2	1h30	1h30		45h00	55h00	40%	60%
	Integration of renewable energies into networks	4	2	1h30	1h30		45h00	55h00	40%	60%

Methodological EU Code: UEM 2.1 Credits: 9 Coefficients: 5	TPApplications and sizing of ER systems	2	1			1h30	10:30 p.m.	27:30	100%	
	TP Energy Storage	1	1			1 hour	3:00 p.m.	10:00 a.m.	100%	
	TP Control of systems atrenewable energies	2	1			1h30	10:30 p.m.	27:30	100%	
	Maintenance and reliability of renewable energy systems	4	2	1h30		1h30	45h00	55h00	40%	60%
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.**	**7:30 a.m.**	**5:30 a.m.**	**375 hours**	**375 hours**		

EU Discovery (S1, S2 and S3) of your choice

1. Renewable Energies
2. Energy Audit
3. Photovoltaic materials
4. Political, economic and social aspects of renewable energies
5. Management and Management of ER projects
6. ER Regulations and Standards
7. Power optimization and control techniques
8. Industrial Ecology and Sustainable Development
9. Entrepreneurship and Business Management,
10. Thermal and energy efficiency
11. Communication and project management
12. Sensors and measurements dedicated to ER systems
13. Implementation of real-time digital control
14. Others

III - Detailed program by subject for semester S1

Semester: 1
Fundamental EU Code: UEF 1.1.1
Matter:Electric power 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:

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 the transport of electrical energy

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: Adjusting the Voltage **(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
Matter: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 **(02 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 **(02 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 **(03 weeks)**

- PWM inverter
- Sinusoidal absorption rectifier
- PWM dimmer
- Switching power supplies

Chapter 5: Multi-level inverter **(03 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 **(03 weeks)**

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

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
Matter: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 **(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 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:

Final exam: 100%.

Bibliographic references

1. *R. Zaks and A. Wolfe. From Component to System – Introduction to Microprocessors.*
2. *Sybex, Paris, 1988.*
3. *M. Tischer and B. Jennrich. The PC Bible – System Programming. Micro Application,*
4. *Paris, 1997.*
5. *R. Tourki. The PC Computer – Architecture and Programming – Courses and Exercises.*
6. *University Publication Center, Tunis, 2002.*
7. *H. Schakel. Programming in assembler on PC. Micro Application, Paris, 1995.*
8. *E. Pissaloux. Practical I80x86 assembler – Course and exercises. Hermès, Paris,*
9. *1994*

Semester: 1
Fundamental EU Code: UEF 1.1.2
Matter:In-depth 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. Ddifferent 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 andParallel coupling.Synchronous motors, starting…

Chapter 3: 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 4: Direct current machines **(4 weeks)**

Structure of DC machines. Equations of DC machines. Mstarting, braking and speed adjustment modes of 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.*

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
Fundamental EU Code: UEF 1.1.2
Matter:Applied numerical methods and optimization
VHS: 45h (Class: 1h30, tutorial 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

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

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; Runge-Kutta methods; Adams method.
- System ResolutionEDO.

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 aoptimization problems.
-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, J.N. Martin. Introduction to Numerical Analysis: Application in Matlab, Dunod, 2003.*
12. *Quarteroni, F. Saleri, P. Gervasio. Scientific computing, Springer, 2008.*

Semester 1
Methodological EUCode: UEM 1.1
Matter:TP 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 (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%.

Bibliographic references

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

Semester: 1
Methodological EUCode: UEM 1.1
Matter:TP: 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: 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 of Analysis of 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 EUCode: UEM 1.1
Matter:Advanced Power Electronics TP
VHS: 10:30 p.m. (TP: 1:30 p.m.)
Credits: 2
Coefficient: 1

Teaching objectives

Allow the studentto 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%;

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, problems*
4. *corrected", , : ELLIPSES MARKETING*

Semester: 1
Methodological EUCode: UEM 1.1
Matter: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 using the various Euler, Runge-Kutta methods of order 2 and 4(02 weeks)
  - ❖ Solve systems of linear and non-linear equations: Jacobi; Gauss-Seidel; Newton - Raphson; (1 week)
  - ❖ Solve PDEs using MDF and MEF for the three (03) types of equations (Elliptic, parabolic and elliptic); (06 weeks)
  - ❖ Minimize a multivariable function without constraints (2 weeks)
  - ❖ Minimize a multivariate function with constraints (inequalities and equalities). (2 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 EUCode: UEM 1.1
Matter:TPIn-depth electrical machines
VHS: 10:30 p.m. (TP: 1:30 p.m.)
Credits: 2
Coefficient: 1

Teaching objectives

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Recommended prior knowledge:

Content of the material

- Electromechanical characteristics of the asynchronous machine;
- Circle diagram;
- Asynchronous generator operating autonomously;
- Coupling an alternator to the network and its operation with the synchronous motor;
- 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.
4R. Abdessemed "Modeling and simulation of electrical machines" ellipses, 2011.

Semester: 1
Teaching unit: UET 1.1
Subject 1:Technical English and Terminology
VHS: 10:30 p.m. (Class: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:

Introduce the student to technical vocabulary. Strengthen their knowledge of the language. Help themunderstand and synthesize a technical document. Enable him 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, summarizing and presenting 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, internship or job application letters.

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*

III - Detailed program by subject for semester 2

Semester 2:
Fundamental EU Code: UEF 1.2.1
Matter:Photovoltaic energy conversion systems
VHS: 67.30h (Lecture: 3h00, Tutorial 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:
The aim of this teaching is to present theprinciples of photovoltaic conversion of solar energy, its implementation and the method of producing electricity using photovoltaic solar cells.

Recommended prior knowledge:
Basic concepts on: Electrical circuits, semiconductor physics.

Chapter 1 Photovoltaic (PV) Conversion
1.1 Historical
1.2 Concept of PV conversion
1.3 Principle of a solar cell and reduction of reflection losses
1.4 Solar cell technologies
1.5 Equivalent diagram of the PV cell
1.6 IV and PV characteristics
1.7 Classical architecture of different photovoltaic conversion chains
-Autonomous systems
1- Direct connection between the photovoltaic panel and the load
2-Connection between the photovoltaic panel and the load via an adaptation stage
- Grid-connected conversion systems.

Chapter 2 Photovoltaic Systems
2.1 Definition of PV systems
2.2 Classification of PV systems
2.2.1 Autonomous Systems
2.2.1.1 Sun-based systems
2.2.1.2 Systems with storage
2.2.2 Network Injection Systems
2.2.2.1 Decentralized systems
2.2.2.2 Centralized systems
2.3 Constitution of PV fields
2.3.1 Modules, Panels and PV Fields
2.3.2 IV and PV characteristics
2.3.3 Effects of illumination, temperature, series resistances and shunt resistance.
2.3.4 Connecting the modules
2.3.5 PV Field Locations
2.4 Modeling of photovoltaic systems

Chapter 3 Static converters used
3.1 Definition and types of converters
3.2 DC/DC converters (choppers)
3.2.1 Definition and types
3.2.2 Principle of an impedance adapter
3.2.3 Algorithm ofMaximum Power Point Tracking of an MPPT System
3.4 DC/AC converters (inverters)
3.4.1Classification of Inverters
3.4.2 Stand-alone inverters
3.4.3 Grid-connected inverters
3.4.4Grid-tied inverter topologies

Chapter 4 Storage Systems
4.1 Necessity and definition
4.2 Type of storage
4.3 Lead-acid batteries
4.4 Charge and discharge characteristics
4.5 Coupling a battery to the PV generator
Chapter 5: Charge Regulators
5.1 Charge regulator functions
5.2 Low voltage disconnect
5.3 Charge regulators and overload protection
5.4 Charge regulators and connections
5.5 Other functions of charge regulators and load management devices
5.6 Choice of charge regulator
5.7 Management of an installation not including a charge regulator
Chapter 6 Sizing PV Systems
6.1 Systems without storage
6.2 Systems with storage
Chapter 7: Applications
Pumping, cold, desalination….

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

References:

- Anne Labouret, Michel Villoz, Photovoltaic solar energy, Dunod edition, 2005.
- Rekioua, D.,Matagne, E.,Optimization of photovoltaic power systems: Modelization, Simulation and Control2012 Series: Green Energy and Technology. Ed Springerhttp://www.springer.com/gp/book/9781447123484.
- T. Markvart and L. Caslaner. Practical hand book of photovoltaics: fundamentals and applications. Elsevier, UK, 2003.
- Luis Castaner and Tom Markvart, Practical Handbook of Photovoltaics: Fundamentals and Applications, , Edition: Elsevier Science Ltd, 2003.
- M. Tissot, "The guide to solar and photovoltaic energy", Eyrolles, 2008.
- L. Protin, S. Astier, "Photovoltaic converters", Engineering Technique, Electrical Engineering Treatise, 1997.
- Alain Ricaud, Photovoltaic converters, 2007.
- Leon Freris, David Infield, Renewable energies for electricity production, Dunod edition, 2009.
- Pierre Odru, Energy Storage, Dunod edition, 2010.
- GN Tiwari and Swapnil Dubey, Fundamentals of Photovoltaic Modules and Their Applications, RSC Publishing, New Delhi, India, 2010.
- Antonio Luque and Steven Hegedus, Handbook of Photovoltaic Science and Engineering, John Wiley & Sons Ltd, 2003.
- W. Palz and P. Chartier. Energy from biomass in Europe. Applied science Publishers, Ltd, London, 1980.
- IT Cabirol, A. Pelisson and D. Roux. Solar water heating. Edisud, Aix-en Provence, 1976.
- A. Laugier, JA Roger, Solar photocells, Techniques and documentation, 1981.
- R. Patel Mukund, Wind and solar power systems, Taylor & Francis, 2006.
- BentSorensen. Renewable Energy. Elsevier, UK, 2004.
- J. Royer et al. Photovoltaic pumping. Canada, 1998.

Semester 2
Fundamental EU Code: UEF 1.2.1
Matter:Wind energy conversion systems
VHS: 45h00 (Lecture: 1h30, Tutorial 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:
To enable students to acquire in-depth theoretical and practical knowledge of the constituent elements of wind turbines for generating electricity (wind generators).

Recommended prior knowledge:
M1 course (UEF1: Renewable Energies)

Content of the subject:

Chapter 1 Characteristics of the Wind
Wind meteorology, distribution, vvariation of wind speed

Chapter 2Wind energy conversion systems (WEC)
Definition, operating principle, types of wind turbines (Autonomous, connected to networks), Architectures,the mechanical part of the turbine

Chapter 3 Wind Energy Conversion
Transformation of kinetic energy into mechanical energy, power coefficient, Betz limit, specific speed (TSR), ...

Chapter 4 Modeling and simulation of the wind turbine mechanical system
Electrodynamic conversion, turbine model, power characteristic, maximum power extraction techniques with and without speed control, power limitation in the overspeed zone (Pitch control).

Chapter 5 Wind System Topologies
State of the art of wind systems, the different machines used in wind conversion systems (modeling and simulation): MAS, MSAP, MADA, GRV, etc.,
converters used in wind conversion systems (modeling and simulation):AC/DC converter, DC/AC converter, DC/DC converters for impedance matching, principle of connecting the wind turbine to the electrical network.

Chapter6 Applications

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

References:

- Multon et al., “Electric Wind Turbines,” Engineering Techniques, Electrical Engineering Treatises, 2004.
- **Rekioua, Djamila,**Wind Power Electric Systems: Modeling, Simulation and Control 2014 Series:Green Energy and Technology,EdSpringer,http://www.springer.com/energy/renewable+and+green+energy/book/978-1-4471-6424-1
- . Hau, Wind-Turbines, Springer, 2000.
- J.F. Manwell, J.G. McGowan and A,L. Rogers, Wind energy explained theory, design and application, University of Massachusetts, Amherst, USA
- Gary L. Johnson, Wind energy systems, 2006
- Hills, R.L. (1994) Power from Wind. Cambridge University Press, Cambridge, UK
- Nelson, V. (1996) Wind Energy and Wind Turbines. Alternative Energy Institute, Canyon, TX.
- Freris, LL (1990) Wind Energy Conversion Systems, Prentice Hall, London.

- Jamil, M. (1994) Wind Power Statistics and Evaluation of Wind Energy Density. Wind Engineering
- R. Patel Mukund, Wind and solar power systems, Taylor & Francis, 2006.
- Pierre Le Chapellier. Wind, Wind Turbines, and Housing. Ed. Eyrolles, 1981.
- P Gipe. Wind energy comes of age. Wiley & sons Inc. New York, 1995.
- Tony Burton et al. Wind Energy, Handbook,JOHN WILEY & SONS, LTD, 2001.
- Leon Freris, David Infield, Renewable Energy in Power Systems, 2008, John Wiley & Sons, Ltd.
- Bent Sørensen, Renewable Energy Its physics, engineering, use, environmental impacts, economics and planning aspects, 2004, Elsevier Inc.

Semester 2:
Fundamental EU Code: UEF 1.2.2
Matter: Renewable energy sources
VHS: 45h (Class: 1h30, tutorial 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:
Allow the student to learn how to evaluate different energies and measurements in order to characterize sites that can be used in ER

Recommended prior knowledge:

Content of the subject:

Chapter 1 Introduction to Renewable Energy Sources
1.1 Importance and history of energy (World energy consumption,Energy Consumption Distribution, Energy History).
1.2 Electricity production
1.3 Sources of renewable energy resources
1.4 Radio-thermal measurement

Chapter 2 Solar deposit
2.1 Source
Geometric position of the sun, - Geographic parameters, Astronomical parameters, - Emission of the sun.
2.2 Solar radiation
Solar radiation outside the atmosphere, Structure and composition of the atmosphere, -Effect of the atmosphere on solar radiation, Incidence of different atmospheric parameters on radiation, etc.
2.3 Measuring devices
2.4 Models for calculating solar radiation
2.5 Solar deposit in Algeria
Chapter 3 Wind Energy Resources
3.1 General information on wind potential
Definitions, - Origin of wind, - Types of wind, - Parametrization of wind, - Kinetic energy and wind energy, - Aerodynamic conversion, etc.
3.2 Wind modeling and site characterization
Wind speed average curves, - speed-altitude characteristic, - wind speed distribution characteristic, identification of wind farm sites by Weibull distribution, etc.
3.3 Wind speed prediction method
Statistical methods, - Intelligent methods.
3.4 Measuring devices
3.5 Wind energy resources in Algeria
Chapter 4 Applications
Software

References:

1. Pierre-Henri Communay,Heliothermics: The solar deposit, methods and calculations,GRE Edition, 2002.
2. Jacques Bernard,, Solar energy. Calculation and optimization - Energy engineering, Edition:Ellipses, 2004.

3. Christian Perrin de Brichambaut, The solar deposit: evaluation of the energy resource, Edition: Tech. & Doc. / Lavoisier, 1999.
4. Alain Chiron de la Casinière,Solar radiation in the terrestrial environment, Edition: Publibook, 2003.
5. Soteris A. Kalogirou,Solar Energy Engineering: Processes and Systems,, Edition: Academic Press Inc 2009.
6. T. Markvart and L. Caslaner. Practical hand book of photovoltaics: fundamentals and applications. Elsevier, UK, 2003.
7. GN Tiwari and Swapnil Dubey, Fundamentals of Photovoltaic Modules and Their Applications, RSC Publishing, New Delhi, India, 2010.
8. John A. Duffie, William A. Beckman, Solar Engineering of thermal processes, John Wiley & sons, INC., 1980.
9. Bent Sørensen, Renewable Energy Its physics, engineering, use, environmental impacts, economics and planning aspects, 2004, Elsevier Inc.

10. Paltridge GW, and CMR Platt, 1976: Radiative Processes in Meteorology and Climatology, Elsevier Scientific Publishing Company, 1976.
11. Mokhtaria MERAD MESRI, 'Introduction to the Algerian solar deposit, Theory and applications, ISBN, : 978-9947-957-84-4, DL: 2011-4960.

Semester 2:
Fundamental EU Code:UEF 1.2.2
Matter:Electrical power quality
VHS: 45h (Course: 1h30, 1h30)
Credits: 4
Coefficient: 2

Teaching objectives

The objective of the subject is to study the quality of electrical energy in an electrical network through the degradation of voltage and/or current, and disturbances on electrical networks. It is also a question of understanding how non-linear loads can be incriminated. Study solutions to improve the quality of electrical energy by remedying disturbances by preventing them from occurring when possible or by mitigating them when they are unavoidable.

Recommended prior knowledge:

Fundamental electrical engineering. Power electronics

Content of the material

Chapter 1: Introduction: Definition, Classification, Electrical disturbances, Measurement and standards relating to the quality of electrical energy, Risks linked to electrical disturbances

Chapter 2: Source of electrical disturbances: Loads causing power quality problems, Power quality problems related to PV systems, Power quality problems related to hybrid systems

Chapter 3: Identifying Energy Quality: Electrical disturbance analysis methods, Waveform analysis, Harmonic decomposition

Chapter 4: Improving Power Quality: Passive filtering, Harmonic compensation, Active filtering, CompensatorsStatic reactive power (SVC), STATCOM, Advanced methods and algorithms for improving power quality.

Assessment method: Controlcontinuous: 40% exam 60%

References *(Booksand handouts, websites, etc.).*

1. GJ WAKILEH, 'Power system harmonics-Fundamental Analysis and Filter Design', Springer-Verlag, 2001.
2. Roger C. Dugan, Mark F. Granaghan, 'Electrical Power system Quality', McGraw Hill, 2001
3. Delphine RIU, Course on Energy Quality — INP Grenoble
4.WDJ Stevenson, "Element of power system analysis", Singapore, 1985
5.GT Stagg and AH El-Abiad, "Computer method in power system analysis", MC Graw-Hill, New York, 1968
6.PM Anderson and AA Fouad, "Power system control and stability", IEEE Press, New York, 1994
7.Olle I. Elgerd, "Electric energy systems theory"
8.Yao-nan Yu, "Electric power system dynamics", Academic press, New York, 1983
9.Prévé C, 'Industrial electrical networks', Volumes 1 and 2, Ed. Hermès
10. RogerC. Dugan, “Electrical Power Systems Quality”, McGraw Hill, 2012
11. E.Félice, P.Révilla, “Quality of electrical networks and energy efficiency”, Dunod, 2009.
12 Engineering Techniques Dedicated to Voltage Quality.

Semester 2:
EU Methodological Code:UEM 1.2
Matter:Solar thermal energy
VHS: 60 hours (class: 1h30, tutorial 1h, practical work 1h30)
Credits: 5
Coefficient: 3

Teaching objectives:

Recommended prior knowledge:

Content of the subject:

Chapter 1: General: Modes of heat transfer (conduction, convection, radiation), energy balance of a system, Expression of energy flows in a system (conduction, convection, radiation, Heat flow linked to a mass flow, Energy storage, Energy generation).

Chapter 2: Calculates heat losses: heat losses through walls, heat losses from closed enclosures.
Chapter 3**:**Radiation devices and solar collectors

***Chapter 4**:**Solar Collectors**:*general information on solar collectors, Description of the flat collector, Different types of solar collectors (Flat solar collectors, Vacuum tube collector, Concentrated solar collectors)

Chapter 5**:**Calculate solar collectors: Overall thermal balance of the flat collector, Slice method (Step-by-step method, Overall method.

Assessment method:

Continuous assessment: 40%; Exam (60%)

References:

1- Beckman, WA, Klein, SA, Duffie, JA, 1977, Solar Heating Design by the f-Chart Method, Wiley Interscience, NY
2- Duffie, JA Beckman, WA, 2006, Solar Engineering and Thermal Process, John Wiley & Sons, third Ed., NY
3- John A. Duffie and William A. Beckman, 2013. Solar Engineering of Thermal Processes, 5th edition. John Wiley & Sons, Inc., Hoboken, New Jersey

Semester 2:
EU Methodological Code:UEM 1.2

Matter:TP Photovoltaic energy conversion systems
VHS: 10:30 p.m. (TP 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:
This subject aims to allow the student to simulate using software (such as Matlab, Dspace, LabVIEW, SILVACO, etc.), or experiment with PV electrical characterization and the behavior of a solar cell as a function of physical and dimensional parameters, and on the other hand, this subject also aims to allow the student to be able to measure the characteristics of the components of a photovoltaic system under different climatic conditions and in different practical situations.

Recommended prior knowledge:
Photovoltaic conversion, Solar cell, PV module

TP1: Determination of the spectral response of a mono-junction solar cell.
TP2: Electrical characterization of photovoltaic modules under normal climatic conditions (fully illuminated module) (simulation and/or experimental)
TP3: Electrical characterization of photovoltaic modules under the effect of shading and understanding of the role of bypass diodes (simulation and/or experimental)
TP4: Study of a photovoltaic system with storage and without storage (simulation and/or experimental)
TP5: Study of a photovoltaic pumping system (using the sun, and/or with storage. (Simulation and/or experimental)
TP6: Connection of the photovoltaic panel to a load with adaptation

Assessment method:
Continuous assessment: 100%

Bibliographic references:
Practical work brochure, course notes, lab documentation.

Semester 2:
EU Methodological Code:UEM 1.2
Subject: Practical workWind energy conversion systems
VHS: 10:30 p.m. (TP 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:
The objective of this subject is to enable the student to model and simulate using software (such as: Matlab/Simulink, PSpice, PSIM, etc.), the elements constituting the wind conversion chain (wind generator)

Recommended prior knowledge:

Content of the subject:

Choose from the following 6 TPs:
TP1: Wind modeling and simulation
TP2: Modeling and simulation of a wind turbine
TP3: Modeling and simulation of power converters used in wind power (inverter, rectifier).
TP4:Modeling and simulation of a wind conversion chain
TP5: Power control and energy quality
TP 6: Optimization of the aerodynamic efficiency of a wind turbine (Power coefficient: (Cp) as a function of the specific speed and the pitch angle.

Assessment method:
Continuous assessment: 100%.

References:

1. Lecture notes onwind energy conversion systems, power electronics and control.
2. Matlab software
3. Practical work brochure, course notes, lab documentation.

Semester: 2
Teaching unit: UED 1.2
Matter :Subject 3 of your choice
VHS: 10:30 p.m. (lesson: 1.5 hours)
Credits: 2
Coefficient: 1

Semester: 2
Teaching unit: UED 1.2
Matter :Subject 4 of your choice
VHS: 10:30 p.m. (lesson: 1.5 hours)
Credits: 1
Coefficient: 1

Semester: 2
Teaching unit: UET 1.2
Subject: Respect forstandards and rules of ethics and integrity.
VHS: 10:30 p.m. (Class: 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. To raise awareness of the need to respect and value intellectual property. To explain the risks of moral evils such as corruption and how to combat them, and to 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 rulesof 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 andbondsof the student,of 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. Loyalty to the company. Responsibility within the company, Conflicts of interest. Integrity (corruption in work, its forms, its 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 in a congress, theses, dissertations, etc.)

II- Copyright

1. **Copyright in the digital environment**
   Introduction. Copyrightdatabases, 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. Rightsin a patent. Usefulness of a patent. Thepatentability. Patent applicationin Algeria and around the world.

III- Protection and promotion of intellectual property

How to protect intellectual property. Rights infringement and legal tools. Vintellectual property protection. Intellectual property protectionin 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,

Assessment method:

Exam: 100%

Bibliographic references:

1. Charter of University Ethics and Professional Conduct,https://www.mesrs.dz/documents/12221/26200/Charte+fran ais+d f.pdf/50d6de61-aabd-4829-84b3-8302b790bdce
2. Order No. 933 of July 28, 2016 establishing the rules relating to the prevention and fight against plagiarism
3. The ABCs of Copyright, United Nations Educational, Scientific and Cultural Organization (UNESCO)
4. E. Prairat, On teaching ethics. Paris, PUF, 2009.
5. Racine L., Legault GA, Bégin, L., Ethics and engineering, Montreal, McGraw Hill, 1991.
6. Siroux, D., Deontology: Dictionary of Ethics and Moral Philosophy, Paris, Quadrige, 2004, pp. 474-477.
7. Medina Y., Ethics, what will change in the company, Editions d'Organisation, 2003.
8. Didier Ch., Thinking about the ethics of engineers, Presses Universitaires de France, 2008.
9. Gavarini L. and Ottavi D., Editorial. of professional ethics in training and research, Research and training, 52 | 2006, 5-11.
10. Caré C., Morality, Ethics, Deontology. Administration and Education, 2nd quarter 2002, no. 94.
11. Jacquet-Francillon, François. Concept: professional ethics. Letélémaque, May 2000, no. 17
12. Carr, D. Professionalism and Ethics in Teaching. New York, NY Routledge. 2000.
13. Galloux, JC, Industrial Property Law. Dalloz 2003.
14. Wagret F. and JM., Patents, trademarks and industrial property. PUF 2001
15. Dekermadec, Y., Innovating through patents: a revolution with the internet. Insep 1999
16. AEUTBM. The engineer at the heart of innovation. Belfort-Montbéliard University of Technology
17. Fanny Rinck and Leda Mansour, Literacy in the Digital Age: Copy and Paste Among Students, Grenoble 3 University and Paris-Ouest Nanterre La Défense University, Nanterre, France
18. Didier DUGUEST IEMN, Citing your sources, IAE Nantes 2008
19. Similarity Detection Software: A Solution to Electronic Plagiarism? Report of the Working Group on Electronic Plagiarism Presented to the CREPUQ Subcommittee on Pedagogy and ICT
20. Emanuela Chiriac, Monique Filiatrault and André Régimbald, Student Guide: Intellectual Integrity, Plagiarism, Cheating and Fraud... Avoiding Them and, Above All, How to Properly Cite Your Sources, 2014.
21. Publication of the University of Montreal, Strategies for preventing plagiarism, Integrity, fraud and plagiarism, 2010.
22. Pierrick Malissard, Intellectual Property: Origin and Evolution, 2010.
23. The World Intellectual Property Organization websitewww.wipo.int

24. http://www.app.asso.fr/

III - Detailed program by subject for semester S3

Semester: 3
Fundamental EU Code:UEF2.1.1
Subject: Applications and sizing of renewable energy systems
VHS: 45h (Class: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:
At the end of this course, the student should be able to design and size an ER system.

Recommended prior knowledge:
Photovoltaic conversion & wind conversion.

Content of the subject:
Chapter 1. Estimation of energy needs and climatic parameters
- Estimation of electricity needs, Estimation of solar radiation, Estimation of wind energy potential.

Chapter 2: Sizing Methods and Methodology to Follow
Chapter 3: Application to photovoltaic electrical energy conversion systems
Chapter 4: Application to Photovoltaic Pumping Systems
Chapter 5: Application to Wind Electric Energy Conversion Systems
Chapter 6: Application to photovoltaic/wind hybrid systems
Chapter 7: Economic aspects.

Assessment method:
Continuous assessment: 40%, Exam: 60%.
Bibliographic references:

[1]Rekioua, D.,Matagne, E.,Optimization of photovoltaic power systems: Modelization, Simulation and Control2012 Series: Green Energy and Technology. Ed Springerhttp://www.springer.com/gp/book/9781447123484.
[2]T. Markvart and L. Caslaner. Practical hand book of photovoltaics: fundamentals and applications. Elsevier, UK, 2003.
[3]Luis Castaner and Tom Markvart, Practical Handbook of Photovoltaics: Fundamentals and Applications, , Edition: Elsevier Science Ltd, 2003.
[4]Rekioua, Djamila, Wind Power Electric Systems: Modeling, Simulation and Control 2014 Series:Green Energy and Technology,EdSpringer,http://www.springer.com/energy/renewable+and+green+energy/book/978-1-4471-6424-1
[5]Hau, Wind-Turbines, Springer, 2000.
[6]J.F. Manwell, J.G. McGowan and A,L. Rogers, Wind energy explained theory, design and application, University of Massachusetts, Amherst, USA
[7]Gary L. Johnson, Wind energy systems, 2006
[8]Hills, R.L. (1994) Power from Wind. Cambridge University Press, Cambridge, UK
[9]Nelson, V. (1996) Wind Energy and Wind Turbines. Alternative Energy Institute, Canyon, TX.
[10]Freris, LL (1990) Wind Energy Conversion Systems, Prentice Hall, London.
[11]Falk Antony, Christian Dürschner&Karl-HeinzRemmers, Photovoltaics for all, edition: Observer'ER, Solarpraxis and Le Moniteur, 2010.
[12] Terry Galloway, Solar house: A guide for the solar designer, Architectural Press, 2004.
[13]R. Mosdale, Fuel Cells Applied to Vehicles, Engineering Techniques

Semester: 3
Fundamental EU Code:UEF2.1.1
Subject: Energy storage and fuel cell
VHS: 10:30 p.m. (Course: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives:
Acquire the operating principles of converting H2 into electricity using fuel cells (FCs) and the different types of electrical energy storage.

Recommended prior knowledge:
Introduction to ER

Content of the subject:
Chapter 1. Energy storage systems
- The different modes of energy storage
- Mechanical energy (potential or kinetic): pumped-storage gravity storage (PSGST), compressed air storage (CAES), flywheels
- Electrochemical storage
- Lead acid, Cadmium Nickel accumulator battery
- Super capacitors

Chapter 2. Electrochemical storage
- Solar battery: Battery technology, characteristics of a lead acid accumulator, parameters indicating the state of charge of a battery, battery charging modes, equivalent electrical circuit, battery modeling, etc.).
- Supercapacitors: Reminder on capacitors, presentation of a supercapacitor, applications of supercapacitors, different families, characterization and modeling, aging, use of supercapacitors, etc.

Chapter 3. Fuel Cells (FC)
- Historical
- Operating principle:principle,kinetics and performance, structure of PACs
- The different types of batteries: AFC, PEMFC, DMFC, SOFC, MCFC, PAFC…
- Production and storage of hydrogen
- ER systems using fuel cells
- Applications in the automotive field.

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

Bibliographic references:

[1] MézianeBoudellal, The Fuel Cell - 2nd ed.
- Hydrogen and its applications Paperback – January 11, 2012, Dunod Edition.
[2]Achaibou Nadia, Optimization of Renewable Energy Storage, editionAcademics, 2014.
[3] Antonio Luque and Steven Hegedus, Hand book of photovoltaic science and Engineering, John Wiley and Sons Ltd, 2003.
[4] Krishnan Rajeshwar, Robert McConnell and Stuart Licht, Solar Hydrogen generation toward a renewable energy future, Springer Science, 2008.

Semester: 3
Fundamental EU Code:UEF2.1.1
Subject: Control of renewable energy systems
VHS: 45h00 (Lecture: 1h30, Tutorial 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

- 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 servo-controls of energy production chains

Recommended prior knowledge:

- Power electronics
- Modeling of synchronous and asynchronous machines

Content of the subject:

- Chapter 1: Reminders on the modeling of alternating current machines (asynchronous and synchronous) in the Clark, Concordia and Park reference systems.
- Chapter 2:Variable speed drives based on asynchronous and synchronous machines.
- Chapter 3: Ordervector of permanent magnet synchronous machines
- Chapter 4:Direct torque control of asynchronous motors (DTC)
- Chapter 5: Applications to ER systems (vector and DTC controls of a wind turbine based on an asynchronous machine, etc.)

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

Bibliographic references:

[1] I. Boladea, SA Nasar. Vector control of AC drives, book, CRC Press, Boca Raton, Florida, 1992.
[2] I. Boladea, SA Nasar. Electric drives, book, CRC Press, Boca Raton, Florida, 199
[3] G. Grellet, G. Clerc. Electric shareholders. Ed. Eyrolles, France, 1996
[4] J. Chatelain. Electrical machines. . Ed. Presses Polytechniques Romandes, Lausanne, 1983.
[5]www.iai.heig-vd.ch/files/activities_IAI_V_2.pdf
[6]www.casidy.com/x331.html
[7] Michel Pinard. 'Electronic control of electric motors, 2004
[8] Paul Gipe, the great book of wind power, ER and Le Moniteur editions, 2007

Semester: 3
Fundamental EU Code:UEF2.1.2
Subject: Multi-source renewable energy systems
VHS: 45h (Class: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:
Become familiar with the different multi-source renewable energy systems with or without storage

Recommended prior knowledge:
Principles of renewable energy sources

Content of the subject:

Chapter 1. Preamble on multi-source systems
- Conventional and non-conventional (renewable energy) source systems
- State of the art of hybrid systems, advantages and disadvantages.
- The different configurations and architectures of hybrid renewable energy systems (DC, AC, mixed)

Chapter 2.-Examples of hybrid renewable energy systems
Chapter 3.-Multi-source system with hybrid storage (batteries/supercapacitors)
Chapter 4.Sizing and supervision of multi-source systems integrating renewable resources.

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

Bibliographic references:

Ben Ammar Mohsen, Optimal Management of Multi-Source Renewable Energy Systems, academic edition, 2014.
P. Poggi renewable energies, OMNISCRIPT edition, 2011.

Semester: 3
Fundamental EU Code:UEF2.1.2
Matter :Iintegration of renewable resources into electricity networks
VHS: 45h00 (Lecture: 1h30, Tutorial 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

Renewable resources have very interesting potential contributions in terms of energy and economy. However, depending on their penetration rate, these new energy sources could have significant consequences on the operation and security of electricity networks. For a massive insertion of renewable resources into the system, these impacts will not only be found at the level of the distribution network, where most renewable resources are connected, but they will affect the entire system. It is therefore necessary to seek, on the one hand, how to evolve the defense and recovery plans of the system in the new context, and on the other hand, how to effectively use the potential of renewable resources to support the system in critical situations. The objective is to understand the criteria for integrating ER systems into conventional electrical networks and the role of the power electronics interfacing devices used.

Recommended prior knowledge:

Renewable energies

Content of the subject:

Chapter 1: Introduction to Grid Integration

Why connect to the electricity grid?, expected functionalities of connecting a source to the grid, criteria for technical insertion of renewable energy into the electricity system, renewable energy system with injection into the grid, renewable energy system interchanging energy with the grid, choice of the interfacing converter(s), protection devices, energy management provided by MPPT, etc.

Chapter 2: Integration of photovoltaic solar energy into the electricity grid

Low-power PV system connected to the distributed network, building-integrated PV system (BIPV: Building Integrated Photovoltaic), PV plant with injection into the network, .

Chapter 3: Integration of wind energy into the electricity grid

Chapter 4: Integration of fuel cells into the electrical grid

Stack construction, sizing of the power source, choice of interface converter(s), control and command of the Fuel Cell system.

Chapter 5: Smart grid

Assessment method:

Final exam: 100%.

Bibliographic references:

1. B. Multon, "Production of Electrical Energy by Renewable Sources", Engineering Techniques, Electrical Engineering treatise, D 4, 2003.
2. D. Das, 'Electrical Power Systems', New Age International Publishers, 2006.
3. Mr.Crappe, S. Dupuis, 'stability and safeguarding of electrical networks', Hermès, 2003.
4. A. Maczulak,'Renewable Energy: Sources and Methods', Green technology, 2010.

Semester: 3
Fundamental EU Code:EMU2.1
Subject: Practical work Applications and sizing of renewable energy systems
VHS: 10:30 p.m. (TP: 1:30)
Credits: 2
Coefficient: 1

Teaching objectives:
Make applications of renewable energy systems by learning to choose the optimal sizing method to choose.Practical work sessions are necessary to consolidate the theoretical knowledge acquired.

Recommended prior knowledge:
Renewable energies

Content of the subject:
TP 1: Familiarization with sizing software (PVsyst, Homer, RETscreen, Psim, etc.)

TP 2: Sizing and simulation of a photovoltaic system (house, village, etc.) with storage.
TP 3: Sizing and simulation of a wind system with storage.
TP 4: Sizing and simulation of a photovoltaic pumping system
TP 5: Sizing and simulation of a hybrid photovoltaic/wind system with storage.

Assessment method:
Continuous assessment: 100%.

Bibliographic references:
Software user guides: PVsyst, PV-sol, RETscreen, Homer, Meteonorm
Lecture notes.

Semester: 3
Fundamental EU Code:EMU2.1
Matter :TP Energy Storage
VHS: 15h (TP: 1H)
Credits: 1
Coefficient: 1

Teaching objectives:

The aim of this subject is to provide an understanding of the modeling and simulation software (i.e. emulation) of the different energy storage elements at the level of an ER system (PV/Wind/PAC) using software such as:Matlab / Simulink, PSIM, PSpice…etc. Practical work sessions are necessary to consolidate the theoretical knowledge acquired.

Recommended prior knowledge:

Content of the subject:

TP1 Identification of a solar battery
TP2 Simulation of battery models
TP3 Simulation of super capacitor models
TP4 Simulation of inertial storage
TP5 Simulation of a heat pump

Assessment method:

Continuous assessment: 100%.

Bibliographic references:

Semester: 3
Fundamental EU Code:EMU2.1
Matter :TP Control of renewable energy systems
VHS: 10:30 p.m. (TP: 1 hour 30 minutes)
Credits: 2
Coefficient: 1

Teaching objectives:

- Power electronics
- Modeling of electrical machines

Recommended prior knowledge:

Content of the subject:

TP1 Self-piloting of a permanent magnet synchronous machine powered by PWM inverters
TP2 vector control of a permanent magnet synchronous machine
TP3 DTC control of an asynchronous machine

Assessment method:

Continuous assessment: 100%.

Bibliographic references:

Semester: 3
Fundamental EU Code:EMU2.1
Matter: Maintenance and reliability of renewable energy systems
VHS: 45h00 (Course 1H30 Practical work: 1H30)
Credits: 4
Coefficient: 2

Goals :
The student must be able to establish an operational inventory of an ER system, by mastering the different diagnostic methods and algorithms, industrialized or not, to detect and/or locate faults in an ER system, by taking the fewest possible measures to respect economic constraints.

Recommended prior knowledge:
Embedded systems, photovoltaic system and characterization, Sensors and measurements

Content of the subject:

1- **Chapter 1**: The quantities for the evaluation of renewable energies
2- **Chapter 2**: Study and analysis of the performance of ER systems

Recommended data according to international standards (IEC 61724, etc.) for the study of RES performance and RES performance indicators.

3- **Chapter 3**: Malfunction of ER systems (faults, etc.)
4- **Chapter 4**: Maintenance in ER systems
7- **Chapter 5**: Supervision of the operation of ER Systems
Recommendations for data measurement, transfer and analysis.
5- **Chapter 6**: Remote management and remote maintenance techniques.

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

Bibliographic references:

- Rabeh FELLOUAH, “Contributions to fault diagnosis for differentially flat systems”, doctoral thesis, University of Toulouse, 2007.
- Long BUN, “Detection and localization of faults for a photovoltaic system”, doctoral thesis, University of Grenoble, 2011.
- IEC, "photovoltaic system performance monitoring - guidelines for measurement, data exchange and analysis", international standard IEC 61724, ed 1998.
- R. Isermann, "Fault-Diagnosis Applications Model-based condition monitoring: Actuators, drives, machinery, plants, sensors, and fault-tolerant systems", Springer, 2011

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

Teaching objectives:
Provide the student with the necessary tools to research useful information to better use it in their final year project.Help him to go through the different stages leading to the writing of a scientific document. Inform himthe importance of communication and himlearn to present the work carried out 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:Select information sources (2 Weeks)
- Type of documents (Lbooks, 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:Locate documents (01 Week)
- Research techniques
- Search operators

Chapter I-4: Process 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 dissertation (2 Weeks)
- Identify and delimit the subject (Summary)
- Problems and objectives of the thesis
- Other useful sections (Acknowledgments, Table of abbreviations, etc.)
- The introduction (The writing of*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)**

- The shaping.Numbering of chapters, figures and tables.
- The cover page
- Typography and punctuation
- Writing. Scientific language: style, grammar, syntax.
- Spelling.Improvement of general language competence 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. *HAS.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. *Mr. Boeglin, Reading and Writing at University. From the Chaos of Ideas to Structured Text. L'Etudiant, 2005.*
6. *Mr. Beaud, the art of the thesis, Editions Casbah, 1999.*
7. *Mr. Beaud, the art of the thesis, La découverte, 2003.*
8. *Mr. Kalika, Master's thesis, Dunod, 2005.*

IV- Detailed programs by subject
Some Discovered EUs (S1, S2, S3)

Semester ...
EU Discovery Code:UED ...
Matter:Photovoltaic materials
VHS: 10:30 p.m. (Class: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:

Acquire in-depth theoretical knowledge on the sector of solar cells using crystalline and non-crystalline materials.

Recommended prior knowledge:

Content of the subject:

Chapter 1: Photovoltaic Technologies

a- Monocrystalline silicon
b- Multicrystalline (polycrystalline) cast silicon

Chapter 2: Ribbon and Foil Technologies

Chapter 3: Amorphous Silicon Thin Film Technology

Chapter 4: Silicon-Free Technologies

a- Cadmium telluride
b- Copper and Indium Diselide
c- Galium arsenide
d- Titanium Dioxide
e- Concentration cells

Chapter 5: Introduction to Organic Photovoltaic Technology

Assessment method:

Exam: 100%.

Bibliographic references:

- Rekioua, D.,Matagne, E., Chapter 1:Photovoltaic Applications Overview inOptimization of photovoltaic power systems: Modelization, Simulation and Control2012 Series: Green Energy and Technology. Ed Springerhttp://www.springer.com/gp/book/9781447123484
- C. Kittel: Solid State Physics, Dunod University Bordas (1983).
- W.KURZ, JP MERCIER and G. ZAMBELLI: Introduction to materials science, presses polytechniques romandes, (1987)
- Ashby Jones: Materials: 1- Properties and applications Dunod (1998).
- Ashby Jones: Materials: I1- Microstructure and implementation, Dunod (1991).
- Practical Handbook of Photovoltaics: Fundamentals and Applications, Luis Castaner and Tom Markvart, Edition: Elsevier Science Ltd, 2003.

Half...
EU Discovery Code: UED ...
Matter:Thermal and energy efficiency
VHS: 10:30 p.m. (Class: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives

Recommended prior knowledge

Content of the subject:

1. **Chapter 1: Reminders**
   1.1. Conduction, convection and thermal radiation
2. **Chapter 2: HVAC (heating, ventilation and air conditioning) systems, energy conversion systems, lighting, equipment.**
3. **Chapter 3: Energy efficiency of thermal processes**
   3.1. Energy efficiency of thermal processes in buildings
      3.1.1. Main energy parameters of buildings
      3.1.2. Simplified methods for calculating energy consumption: degree days, temperature bands
      3.1.3. Detailed methods for calculating energy consumption.
   3.2. Energy efficiency in energy systems (refrigeration systems, engines and combustion chambers, solar systems, etc.)
4. **Chapter 4: Solar Storage**

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

Bibliographic references:

- E.Félice, P.Révilla, “Quality of electrical networks and energy efficiency”, Dunod, 2009
- Engineering techniques dedicated to thermal engineering

Semester ...
EU Discovery Code:UED ...
Matter:Political, economic and social aspects of renewable energies
VHS: 10:30 p.m. (Class: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives

The objective of the subject is to introduce future graduates to the creation and management of renewable energy companies. This module will cover the essential political, economic and social aspects of renewable energy.

Recommended prior knowledge:

Fundamental electrical engineering, power electronics, concepts of management and economics.

Content of the material

Chapter 1: Global energy production and consumption, reserves and forecasts.
Chapter 2: Energy sources in Algeria
Chapter 3: Geopolitics of energy
Chapter 4: The different players in the energy sector
Chapter 5: Laws governing energies
Chapter 6: Socioeconomic impacts of renewable energies
Chapter 7: Renewable energy in the economy

Assessment method:

Exam: 100%.

Bibliographic references:

1-McKane, et al, 2007, UNIDO publication, Policies for Promoting Industrial Energy Efficiency in Developing Countries and Transitional Economies (Policies for Promoting Energy Efficiency in Developing Countries and Transitional Economies) v. 08-52434- April 2008.www.iso.org/iso/fr/focus_1105_sr_pinero.pdf*(retrieved on May 27, 2016)*
2-ISO/TC 242 Energy management,http://www.iso.org/iso/fr/iso_technical_committee?commid=558632(retrieved May 27, 2016)
3-Douglas F.Barnes; Kerry Krullilla and Wiliam F. Hyde; The urban household energy transition: social and environmental impacts; An AFF press book, published by resources of the future, USA 2004, ISBN:1-933115-07-6.
1- Rob Aldrich and Jon Parello; IP-Enabled energy management: a proven strategy for administering energy as a service, Wiley Publishing Inc, USA 2010; ISBN: 978-0-470-60725-1.
2- www.mem-algeria.org
3- Laws and decrees of Algerian law on energy
4- SmilVaclay, Energy, Miths and Realities, AEI Press, 2010

Semester ...
Fundamental EU Code: UED...
Matter:Energy audit
VHS: 10:30 p.m. (Class: 1 hour 300 minutes)
Credits: 1
Coefficient: 1

Chapter I:General information:

Sustainable development, Energy efficiency, Energy audit

Chapter II:Energy audit

I.Principle of energy audit
II.Types of energy audits
III.Main Objectives of the Energy Audit
IV.Audit methodology

Chapter III:Measuring companion

I.Concepts of electrical engineering
II.Measuring tools and instruments
III.Essential measurement methods and points

Chapter IV:Price analysis

I.Studies of different tariff systems
II.Comparison and choice of the best rate
III.Estimates of economic gains

Chapter V:Actions and solutions

I.Formulate advice and recommendations
II.Presentation of an energy audit report

Assessment method:

Exam: 100%.

Bibliographic references:

Semester ...
Teaching unit: UED ...
Matter:Communication and project management
VHS: 10:30 p.m. (Class: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:
The aim of this course is to provide students with the various concepts and notions useful for studying, carrying out and managing an industrial project.

Recommended prior knowledge:
Business economics, industrial systems.

Content of the material:

- General information
- Prerequisites for project management
  - Understanding the functional specifications
  - Complete and finalize the functional specifications
- Project management
  - Define one or more technical solutions that respond to the problem posed
  - Put into practice one of the possible solutions
  - Demonstrate the satisfaction of the proposed solution with the requirements of the specifications
  - Prepare and follow a project implementation schedule
  - Evaluate and optimize component costs
- Establishing the benchmark (prototype)
- Time management (operational planning)
- Cost control
- Quality control
- Risk management

Example on project management

Assessment method:
Exam: 100%.

Bibliographic references:

- "Project Management", Girard-ECONOMICA
- "Business Engineer's Manual", Fraysse-GARNIER ENTREPRISE
- "Project Analysis Techniques", Vallet/DUNOD

Semester ...
EU DiscoveryCode: UED ...
Matter:Renewable Energies
VHS: 10:30 p.m. (Class: 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 sensorsassociated with engineering applications.

Recommended prior knowledge:

Energy conversion devices and technologies -

Content of the material

Cchapter 1: Introduction to renewable energies (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… **(2 weeks)**
Chapter 5: Storage, fuel cells and hydrogen **(2 weeks)**

Assessment method:

Continuous assessment: 40%; Exam: 60%.

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. *Weigh Felix A. Solar thermal installations: design and implementation, Ed. Moniteur.*

Semester ...
EU DiscoveryCode: UED ...
Matter:Industrial Ecology and Sustainable Development
VHS:10:30 p.m.(Course: 1h30)
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
- Industrial ecology experiences 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, fromJunqua Guillaume, Brullot Sabrina*
1 *Towards an industrial ecology: how to put sustainable development into practice in a hyper-industrial society, 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: emergence, diffusion, translationsB Villalba - 2009*

Semester ...
EU DiscoveryCode: UED ...
Matter:Power optimization and control techniques
VHS:10:30 p.m.(Course: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:
To enable students to acquire knowledge of the elements (electronic devices) constituting an electrical power conditioner from an ER system and in particular PV/Wind/PAC as well as their control techniques.
Recommended prior knowledge:

Content of the subject:
1- Chapter 1: Control of the generated power via MPPT techniques.
2- Chapter 2: MPPT techniques in PV systems:
-Direct algorithms
   - ✓ the Perturb&Observ (P&O) method,
   - ✓ algorithm based on sliding mode,
   - ✓ algorithm based on fuzzy, adaptive logic
   - ✓ algorithm based on neural networks, neuro-fuzzy

-Indirect algorithms.-
   - ✓ the curve fitting method,
   - ✓ the method ("look-up table"),
   - ✓ the open circuit voltage method,
   - ✓ the short circuit method.

3- Chapter 3:optimization techniques in wind systems
-P&O methods,TSR, PSF, HCS, gradient, LF, adaptive, predictive
4- Chapter 4: Applications

Assessment method:
Exam: 100%.

Bibliographic references:
[1] H. Buhler. Fuzzy Logic Control. Ed. Presses Polytechniques Romandes, Lausanne, 1994.
[2] H. Buhler. Electronics for adjustment and control. Ed. Presses Polytechniques Romandes, Lausanne, 1983.
[3] H. Buhler. Sliding mode adjustment. Ed. Presses Polytechniques Romandes, Lausanne, 1986.
[4]G. Grellet, G. Clerc. Electric shareholders. Ed. Eyrolles, France, 1996
[5]J. Chatelain. Electrical machines. . Ed. Presses Polytechniques Romandes, Lausanne, 1983.
[6] D. Diankov, H. Hellendoorn, M. Reinfrank. An introduction to fuzzy control. Springer-Verlag, Berlin, Heidelberg, 1993.
[7] P. Born, JR Dieulot, J. Rozeinoer, L. Dubois. Introduction to fuzzy control. Ed. Technip, 1996.

Semester ...
EU DiscoveryCode: UED ...
Matter:Sensors and measurements dedicated to ER systems
VHS:10:30 p.m.(Course: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:
The aim is to enable students to acquire general notions concerning metrology, the different types of parameters (physical quantities) inherent in RE systems and more specifically PV, wind and PAC systems. For example: meteorological parameters, electrical parameters, energy parameters, as well as the types of sensors and measurement and characterization processes likely to be used by specialists in the field.

Recommended prior knowledge:
Electrical sensors and measurements

Content of the subject:

Chapter 1:Introduction to metrology.

Chapter 2:Physical quantities to be measured at the PV and wind system level And PAC.

- Solar radiation (global, direct, diffuse, albedo)
- Temperatures (ambient and cell)
- Wind speed and direction
- Humidity
- Current, voltage, power, energy, power factor
- Hydrogen flow rate, hydrogen pressure, etc.

Chapter 3:Sensors, devices and methods for measuring parameters.

Chapter 4:Calibration and calibration methods.

Assessment method:
Exam: 100%.

Bibliographic references:

- Muhammad Iqbal,Introduction to Solar Radiation. New York: Academic Press
- Pierre-André Paratte, Philippe Robert, Measurement systems
- National Renewable Energy Laboratory, http://www.nrel.gov

Semester ...
EU Discovery Code:UED ...
Matter:Implementation of real-time digital 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; (3 weeks)

Chapter 2: Numerical control of systems; (4 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.