الجمهورية الجزائرية الديمقراطية الشعبية People's Democratic 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 field of Science and Technology

ACADEMIC MASTER HARMONIZE

National program

2022 update

Domain	Sector	Speciality
Science And Technologies	***Electrical engineering***	***Renewable Energies in Electrical Engineering***

الجمهورية الجزائرية الديمقراطية الشعبية People's Democratic Republic of Algeria
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National Educational Committee for the field of Science and Technology

ماستر أكاديمي
مواءم

برنامج وطني

تـحديـث 2022

الميدان	الفرع	التخصص
علوم و تكنولوجيا	كهروتقني	طاقاتمتجددة في الكهرو تقني

II – Half-yearly teaching organization sheets of the specialty

Semester 1 Master: Renewable Energies in Electrotechnics

Teaching unit	Modules	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Evaluation mode	
	Titled			**Course**	**T.D.**	**TP**			**Continuous monitoring**	**Exam**
Fundamental EU Code: UEF 1.1.1 Credits: 10 Coefficients: 5	Electric energy transmission and distribution networks	4	2	1h30	1h30		45:00	55:00	40%	60%
	Advanced power electronics	4	2	1h30	1h30		45:00	55:00	40%	60%
	µ-processors and µ-controllers	2	1	1h30			10:30	27:30		100%
Fundamental EU Code: UEF 1.1.2 Credits: 8 Coefficients: 4	In-depth electrical machines	4	2	1h30	1h30		45:00	55:00	40%	60%
	Applied numerical methods and optimization	4	2	1h30	1h30		45:00	55:00	40%	60%
Methodological EU Code: UEM 1.1 Credits: 9 Coefficients: 5	TP: - µ-processors and µ-controllers	1	1			1h00	3:00	10:00	100%	
	TP: - Electric energy transport and distribution networks	2	1			1h30	10:30	27:30	100%	
	TP: - Advanced power electronics	2	1			1h30	10:30	27:30	100%	
	TP: Applied numerical methods and optimization	2	1			1h30	10:30	27:30	100%	
	TP: - in-depth electrical machines	2	1			1h30	10:30	27:30	100%	
EU Discovery Code: UED 1.1 Credits: 2 Coefficients: 2	Material of your choice	1	1	1h30			10:30	02:30		100%
	Material of your choice	1	1	1h30			10:30	02:30		100%
Transversal EU Code: UET 1.1 Credits: Coeff. : 1	Technical English and terminology	1	1	1h30			10:30.	02:30		100%
Total semester 1		**30**	**17**	**12:00**	**6:00**	**7:00**	**375h00**	**375h00**		

Semester 2 Master: Renewable Energies in Electrotechnics

Teaching unit	Modules	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Evaluation mode	
	Titled			**Course**	**T.D.**	**TP**			**Continuous monitoring**	**Exam**
Fundamental EU Code: UEF 1.2.1 Credits: 8 Coefficients: 4	Photovoltaic energy conversion systems	4	2	1h30	1h30		45:00	55:00	40%	60%
	Wind energy conversion systems	4	2	1h30	1h30		45:00	55:00	40%	60%
Fundamental EU Code: UEF 1.2.2 Credits: 10 Coefficients: 5	Quality of electrical energy	4	2	1h30	1h30		45:00	55:00	40%	60%
	Solar and wind energy resources	6	3	3:00	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	27:30	100%	
	TPRenewable energy sources	1	1			1h00	3:00	10:00	100%	
	TPPhotovoltaic energy conversion systems	2	1			1h30	10:30.	27:30	100%	
	Solar thermal energy	4	2	1h30	1h30		45:00	55:00	40%	60%
EU Discovery Code: UED 1.2 Credits: 2 Coefficients: 2	Material of your choice	1	1	1h30			10:30	02:30		100%
	Material of your choice	1	1	1h30			10:30	02:30		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	02:30		100%

Total semester 2		**30**	**17**	**1:30**	**7:30**	**4:00**	**375h00**	**375h00**		

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)	Evaluation mode	
	Titled			**Course**	**T.D.**	**TP**			**Continuous monitoring**	**Exam**
Fundamental EU Code: UEF 2.1.1 Credits: 10 Coefficients: 5	Applications and sizing of renewable energy systems	4	2	1h30	1h30		45:00	55:00	40%	60%
	Energy storageand fuel cell	2	1	1h30			10:30 p.m.	27:30		100%
	Control of systemsrenewable energies	4	2	1h30	1h30		45:00	55:00	40%	60%
Fundamental EU Code: UEF 2.1.2 Credits: 8 Coefficients: 4	Multi-source renewable energy systems	4	2	1h30	1h30		45:00	55:00	40%	60%
	Integration of renewable energies into networks	4	2	1h30	1h30		45:00	55:00	40%	60%
Methodological EU Code: UEM 2.1 Credits: 9 Coefficients: 5	TPApplications and sizing of RE systems	2	1			1h30	10:30	27:30	100%	
	TP Energy storage	1	1			1h00	3:00	10:00	100%	
	TP Control of systemsrenewable energies	2	1			1h30	10:30	27:30	100%	

	Maintenance and reliability of renewable energy systems	4	2	1h30		1h30	45:00	55:00	40%	60%
EU Discovery Code: UED 2.1 Credits: 2 Coefficients: 2	Material of your choice	1	1	1h30			10:30	02:30		100%
	Material of your choice	1	1	1h30			10:30	02:30		100%
Transversal EU Code: UET 2.1 Credits: 1, Coeff: 1	Documentary research and dissertation design	1	1	1h30			10:30	02:30		100%
Total semester 3		**30**	**17**	**1:30**	**6:00**	**5:30**	**375h00**	**375h00**		

Baskets of choice of materials from Discovery Units (S1, S2 and S3):

1. Renewable Energies
2. Energetic audience
3. Photovoltaic materials
4. Political, economic and social aspects of renewable energies
5. Management and management of RE projects
6. RE Regulations and Standards
7. Optimization and power control techniques
8. Industrial Ecology and Sustainable Development
9. Entrepreneurship and Business Management,
10. Thermal and energy efficiency
11. Sensors and measurements dedicated to RE systems

Semester 4

Internship in a company or in a research laboratory culminating in a dissertation and a defense.

Personal work	**550**	**09**	**18**
Internship in a company or laboratory	100	04	06
Seminars	50	02	03
Other (Framing)	50	02	03
Total Semester 4	750	17	30

This table is given for information purposes only.

Evaluation of the End of Master Cycle Project

- Scientific value (jury assessment) /6
- Writing of the dissertation (jury assessment) /4
- Presentation and response to questions (Jury assessment) /4
- Appreciation of the supervisor /3
- Presentation of the internship report (Jury assessment) /3

III - Detailed program by subject of the S1 semester

Semester: 1
Fundamental EU Code: UEF 1.1.1
Matter: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 broadening of the knowledge acquired during the 'Electric Networks' course in License, 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 calculation. Modeling of electrical lines (Bachelor's Electrical Networks Course).

Content of the material:

Chapter 1: Architectures of electrical substations **(2 weeks)**

Overall architecture of the electrical network, equipment and architecture of substations (bar-coupled substations, circuit breaker-coupled substations), topologies of energy transport and distribution networks.

Chapter 2: Organization of electric energy transport

2.1.*Power transmission lines* **(3 weeks)**

Calculation of transmission lines: Choice of conductor section, insulation, mechanical calculation of lines, Operation of transmission lines in steady state. Operation of transmission lines in transitional regime. Direct current (HVDC) energy transport.

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 electricity networks **(3 weeks)**

Protection of HT/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 regimes (insulated, earthed, impedant), artificial neutral.

Chapter 5: Adjusting the tension **(3 weeks)**

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

Evaluation method:

Continuous control: 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 modes of operation of inverters to enable the 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 modes of operation of different power converter configurations.
Ability to design different single-phase and three-phase inverters

Recommended prior knowledge

Power components, basic power electronics,

Content of the material:

Chapter 1: Methods for modeling and simulation of power semiconductors **(02 weeks)**

Idealized characteristic of different types of semiconductors, logical equations of semiconductors, simulation methods of static converters

Chapter 2: Switching mechanisms in static converters (03 weeks)

Natural switching principle, forced switching principle, calculation of switching losses.

Chapter 3: Design methods for static converters with natural switching **(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 switching 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 inverter - single phase and three phase impedance source.

Chapter 6: Energy quality of static converters **(03 weeks)**

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

Bibliographic references

1. *Power electronics, from switching cells 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 items D3000 to D3300.*

Semester: 1
Fundamental EU Code: UEF 1.1.1
Matter:µ-processors and µ-controllers
VHS: 10:30 p.m. (Class: 1h30)
Credits: 2

Coefficient: 1

Teaching objectives

Know the structure of a microprocessor and its usefulness. Differentiate between microprocessor, microcontroller and calculator. Know the organization of a memory. Know assembly programming. Understand the use of I/O interfaces and interrupts. Use of the micro controller (programming, system control).

Recommended prior knowledge

Combinatorial and sequential logic, industrial automation

Content of the material:

Chapter 1 : Architecture and operation of a microprocessor **(3 weeks)**

Structure of a computer, Circulation of information in a computer, Hardware description of a microprocessor, Operation of a microprocessor, memories
Example: The Intel 8086 microprocessor

Chapter 2: Assembler programming **(2 weeks)**

General, The instruction set, Programming method.

Chapter 3: Interrupts and I/O 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 - Keypad Interface - Port Signal Generation Gate for Converters - Motor - Control - Control of DC/AC Devices - Frequency Measurement - Data Acquisition System

Evaluation mode:

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. Practice of the I80x86 assembler – Courses and exercises. Hermes, 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 electromechanical energy conversion equations applied to synchronous, asynchronous and direct current machines and will be able to determine their characteristics in static or variable regimes. This makes it possible 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 material:

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 synchronous machine with smooth poles. Study of the operation of the synchronous machine. Ddifferent excitation systems.Induce reactions. Elements on the salient pole synchronous machine without and with shock absorbers. Potier diagrams, two reactance diagrams and Blondel diagrams. Elements on permanent magnet machines. Alternators andParallel coupling.Synchronous motors, starting…

Chapter 3: Asynchronous machines **(4 weeks)**

General. Equation. Equivalent schemes. Torque of the asynchronous machine. Characteristics and diagram of the asynchronous machine. Engine/generator operation, starting, braking. Deep slot and double cage motors, Single-phase asynchronous motors;

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

Structure of direct current machines. Equations of DC machines. Modes for starting, braking and speed adjustment of DC motors.Switching phenomena. Saturation and armature reaction. Auxiliary switching poles. Engine/generator operation.

Evaluation mode:

Continuous control: 40%; Examination (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 in-depth electrical engineering, Technique and 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 course is to present the tools necessary for 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.

Material content:

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.
- Optimization algorithms without constraints (deterministic methods, stochastic methods).
- Treatment of constraints (Transformation methods, Direct methods).

Evaluation method:

Continuous monitoring: 40%; Examination: 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, Presses Internationales Polytechnique, 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, University Publications Office, 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. *Fort. Numerical analysis for engineers, international polytechnic presses, 2011.*
11. *J. Bastien, JN 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: 15h (Class: 1h)
Credits: 1
Coefficient: 1

Teaching objectives

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

Recommended prior knowledge

Combinatorial and sequential logic, industrial automation, algorithms.

Content of the subject

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

Evaluation mode:

Continuous monitoring: 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. Practice of the I80x86 assembler – Courses and exercises. Hermès, Paris, 1994*

Semester: 1
Methodological EUCode: UEM 1.1
Matter:TP: Electric energy transport and distribution networks
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives

Allow the student to have all the necessary tools to manage, design and operate electro-energy systems and more particularly electrical networks

Recommended prior knowledge:

General information on electrical transmission and distribution networks

Content of the subject

TP No. 1: Voltage adjustment by synchronous motor
TP No. 2: Power distribution and calculation of voltage drops
TP No. 3: Voltage adjustment by reactive energy compensation
TP No. 4: Neutral regime
TP No. 5: Interconnected Networks

Evaluation mode:

Continuous control: 100%;

Bibliographic references

1. *Sabonnadière, Jean Claude, Electric lines and networks, Vol. 1, Electric Power Lines, 2007.*
2. *Sabonnadière, Jean Claude, Electric lines and networks, Vol. 2, Methods for analyzing electrical networks, 2007.*
3. *Lasne, Luc, Exercises and problems in electrical engineering: basic notions, 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 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives

Allow the studentto understand the operating principles of new power electronics converter structures.

Recommended prior knowledge:

Basic principle of power electronics

Content of the subject

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

Evaluation mode:

Continuous control: 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, electrotechnics, power electronics. Course summary, problems*
4 *corrected", ,: MARKETING ELLIPSES*

Semester: 1
Methodological EUCode: UEM 1.1
Matter:TP Applied numerical methods and optimization
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives:

Program numerical solution methods and those associated with optimization problems.

Recommended prior knowledge:

Algorithmic and programming.

Material content:

- Initialization to the MATLAB environment (Introduction, Basic aspects, comments, vectors and matrices, M-Files or scripts, functions, loops and control, graphics, etc.). (01 week)

- Write a program for:

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

Evaluation method: Continuous control: 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 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives

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Recommended prior knowledge:

Content of the subject

- Electromechanical characteristics of the asynchronous machine;
- Circle diagram;
- Asynchronous generator autonomous operation;
- Coupling of an alternator to the network and its operation with the synchronous motor;
- Determination of the parameters of a synchronous machine;

Evaluation method:

Continuous control: 100%;

Bibliographic references

1 Th. Wildi, G. Sybille "electrotechnics", 2005.
2 J. Lesenne, F. Noielet, G. Seguier, "Introduction to in-depth electrical engineering" Univ. Lille. nineteen eighty one.
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: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

Introduce the student to technical vocabulary. Strengthen your knowledge of the language. Help him atunderstand and synthesize a technical document. Allow him to understand a conversation in English held in a scientific framework.

Recommended prior knowledge:

Basic English vocabulary and grammar

Material content:

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

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

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

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

Recommendation :It is strongly recommended that the person responsible for the subject presents and explains 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.

Evaluation method:

Review: 100%.

Bibliographic references:

1. *PT Danison, Practical guide to writing in English: uses and rules, practical advice, Editions d'Organization 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 (Class: 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 notions of: Electric circuit, physics of semiconductors.

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 Classic 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 life an adaptation stage
-Conversion systems connected to the network.

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 Solar-powered 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 modules
2.3.5 Locations of PV fields
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 AlgorithmTracking the maximum power point of an MPPT system
3.4 DC/AC converters (inverters)
3.4.1Classification of Inverters
3.4.2 Stand-alone inverters
3.4.3 Inverters connected to networks
3.4.4Grid-tied inverter topologies

Chapter 4 Storage Systems
4.1 Necessity and definition
4.2 Storage type
4.3 Lead-acid batteries
4.4 Charging and discharging characteristic
4.5 Coupling a battery to the PV generator
Chapter 5: Charge regulators
5.1 Charge controller functions
5.2 Low voltage disconnection
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 installation not including a charge regulator
Chapter 6 Sizing of PV systems
6.1 Systems without storage
6.2 Systems with storage
Chapter 7: Applications
Pumping, cold, desalination….

Evaluation method:
Continuous assessment: 40%, Examination: 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 Technology, Electrical Engineering Treatise, 1997.
- Alain Ricaud, Photovoltaic converters, 2007.
- LeonFreris, 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 photopiles, 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 (Class: 1h30, tutorial 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:
Allow students to acquire in-depth theoretical and practical knowledge on the constituent elements of wind power generation machines (wind turbines).

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

Content of the material:

Chapter 1Wind Characteristics
Wind meteorology, distribution, vwind speed variation

Chapter 2Wind conversion systems (CCE)
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 power 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 Topologies of wind energy systems
State of the art of wind energy systems, the different machines used in wind conversion systems (modeling and simulation): MAS, MSAP, MADA, GRV,….,
converters used in wind conversion systems (modeling and simulation):AC/DC converter, DC/AC converter, DC/DC converters for impedance adaptation, principle of connecting the wind chain to the electrical network.

Chapter6 Applications

Evaluation method:
Continuous assessment: 40%, Examination: 60%.

References :

- Multon et al., Electric wind generators", 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 habitat. 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 to evaluate the different energies and measurements in order to characterize the sites exploitable in RE

Recommended prior knowledge:

Content of the material:

Chapter 1 Introduction to Renewable Energy Resources
1.1 Importance and history of energy (World energy consumption,Distribution of energy consumption, Energy history).
1.2 Electricity production
1.3 Sources of renewable energy deposits
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, Impact of different atmospheric parameters on radiation, etc.
2.3 Measuring devices
2.4 Models for calculating solar radiation
2.5 Solar resources in Algeria
Chapter 3 Wind power
3.1 General information on wind potential
Definitions, - Origin of wind, - Types of wind, - Wind measurement, - 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 sites by the Weibull distribution, etc.
3.3 Wind speed prediction method
Statistical methods, - Intelligent methods.
3.4 Measuring devices
3.5 Wind power in Algeria
Chapter 4 Applications
Software

References :

1. Pierre-Henri Communay,Heliothermal: 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:
EU Fundamental Code:UEF 1.2.2
Matter:Quality of electrical energy
VHS: 45h (Class: 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, 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 subject

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

Chapter 2: Source of electrical disturbances: Loads Causing Power Quality Issues, Power Quality Issues Related to PV Systems, Power Quality Issues Related to Hybrid Systems

Chapter 3: Identification of power quality: Methods for analyzing electrical disturbances, 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 energy quality.

Evaluation 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 material:

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, Storage of energy, Energy generation).

Chapter 2: Calculates thermal losses: thermal losses through the walls, thermal 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 (Plane solar collectors, The vacuum tube collector, Concentrated solar collectors)

Chapter 5*:*Calculate solar collectors: Overall thermal assessment of the flat sensor, Method by slices (Step by step method, Global method.

Evaluation method:

Continuous control: 40%; Examination (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 1:30 a.m.)
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 to experiment with PV electrical characterization and the behavior of a solar cell depending on the physical parameters and dimensional and on the other hand this subject also aims to enable 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 By-Pass 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

Evaluation method:
Continuous control: 100%

Bibliographic references:
Lab brochure, course notes, lab documentation.

Semester 2:
EU Methodological Code:UEM 1.2
Material: TPWind energy conversion systems
VHS: 10:30 p.m. (TP 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives:
This subject aims 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 turbine)

Recommended prior knowledge:

Content of the material:

Choose from these following 6TPs:
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 generator (Power coefficient: (Cp) as a function of the specific speed and the pitch angle.

Evaluation method:
Continuous control: 100%.

References :

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

Semester: 2
Teaching unit: UED 1.2
Matter :Subject 3 of your choice
VHS: 10:30 p.m. (class: 1h30)
Credits: 2
Coefficient: 1

Semester: 2
Teaching unit: UED 1.2
Matter :Subject 4 to choose from
VHS: 10:30 p.m. (class: 1h30)
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: 1h30)
Credit: 1
Coefficient: 1

Teaching objectives:

Develop students' awareness of respect for ethical principles and the rules that govern life at university and in the world of work. Raise awareness about respecting and valuing intellectual property. Explain to them the risks of moral evils such as corruption and how to combat them, 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 material:

A.The respect of the rulesethics and integrity,

1. **Reminder on the MESRS Charter of Ethics and Professional Conduct:**Integrity and honesty. Academic freedom. Mutual respect. Requirement for scientific truth, objectivity and critical thinking. Equity.Rights andobligationsof the student,the teacher, administrative and technical staff,

2. Integrity and responsible research

- Respect for ethical principles in teaching and research
- Responsibilities in teamwork: Professional equality of treatment. Conduct against discrimination. The search for the general interest. Inappropriate conduct in the context of collective work
- Adopt responsible conduct and combat abuses: Adopt responsible conduct in research. Scientific fraud. Conduct against fraud. Plagiarism (definition of plagiarism, different forms of plagiarism, procedures to avoid unintentional 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 the workplace, 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 site law. Intellectual property and social networks.

3. Patent

Definition. Rightsin a patent. Usefulness of a patent. Therepatentability. Patent applicationin Algeria and around the world.

III- Protection and valorization of intellectual property

How to protect intellectual property. Violation of rights and legal tool. Vvaluation of intellectual property. Protection of intellectual propertyin 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,

Evaluation method:

Review: 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. Orders No. 933 of July 28, 2016 setting 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, p. 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, n°94.
11. Jacquet-Francillon, François. Concept: professional ethics. Letélémaque, May 2000, n° 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., Patent of invention, 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 etléda Mansour, literacy in the digital age: copying and pasting among students, University of Grenoble 3 and University of Paris-Ouest Nanterre la Défense Nanterre, France
18. Didier DUGUEST IEMN, Cite 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. EmanuelaChiriac, 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, Plagiarism prevention strategies, Integrity, fraud and plagiarism, 2010.
22. Pierrick Malissard, Intellectual property: origin and evolution, 2010.
23. The website of the World Intellectual Property Organizationwww.wipo.int
24. http://www.app.asso.fr/

III - Detailed program by subject of the S3 semester

Semester: 3
EU Fundamental 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 will be able to design and size an ER system.

Recommended prior knowledge:
Photovoltaic conversion & wind conversion.

Content of the material:
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 hybrid photovoltaic/wind systems
Chapter 7: Economic aspects.

Evaluation method:
Continuous assessment: 40%, Examination: 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, editon: Observer'ER, Solarpraxis and The Monitor, 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
EU Fundamental Code:UEF2.1.1
Subject: Energy storage and fuel cell
VHS: 10:30 p.m. (Class: 1h30)
Credits: 2
Coefficient: 1

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

Recommended prior knowledge:
Introduction to RE

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

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

Chapter 3. Fuel Cells (PAC)
- Historical
- Working principle:principle,kinetics and efficiency, structure of PACs
- The different types of batteries: AFC, PEMFC, DMFC, SOFC, MCFC, PAFC…
- Hydrogen production and storage
- RE systems using fuel cells
- Applications in the automotive field.

Evaluation method:
Continuous assessment: 40%, Examination: 60%.
Bibliographic references:

[1] MézianeBoudellal, The fuel cell - 2nd ed.
- Hydrogen and its applications Paperback – January 11, 2012, Edition Dunod.
[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
EU Fundamental Code:UEF2.1.1
Subject: Control of renewable energy systems
VHS: 45h00 (Class: 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 controls of energy production chains

Recommended prior knowledge:

- Power electronics
- Modeling of synchronous and asynchronous machines

Content of the material:

- Chapter 1: Reminders on the modeling of alternating current machines (asynchronous and synchronous) in the Clark, Concordia and Park benchmarks.
- Chapter 2 :Speed variators 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 RE systems (vector controls and DTC of a wind turbine based on an asynchronous machine, etc.)

Evaluation method:

Continuous assessment: 40%, Examination: 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. Electric machine. . Ed. Presses Polytechniques Romandes, Lausane, 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, edition ER and Le Moniteur, 2007

Semester: 3
EU Fundamental 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 material:

Chapter 1. Preamble on multi-source systems
- Systems with conventional and non-conventional sources (renewable energy)
- 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
Chapter3.-Multi-source system with hybrid storage (batteries/supercapacitors)
Chapter4.Sizing and supervision of multi-source systems integrating renewable resources.

Evaluation method:
Continuous assessment: 40%, Examination: 60%.

Bibliographic references:

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

Semester: 3
EU Fundamental Code:UEF2.1.2
Matter :Iintegration of renewable resources into electricity networks
VHS: 45h00 (Class: 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 at the distribution network level, 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 reconstitution 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 the critical situations.

The objective is to know the criteria for integrating RE systems into conventional electrical networks and the role of the power electronics interfacing devices used.

Recommended prior knowledge:

Renewable energies

Content of the material:

Chapter 1: Introduction to power grid integration

Why connection to electrical networks?, expected functionalities of connecting a source to the network, criteria for technical insertion of ENR into the electrical system, RE system with injection into the network, ER system interchanging energy with the network , choice of 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, PV system integrated into the building (BIPV: Building InegratedPhotovoltaic), 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 electricity grid

Constitution of the stack, sizing of the power source, choice of interfacing converter(s), control of the Fuel Cell system.

Chapter 5: Smart grid

Evaluation method:

Final exam: 100%.

Bibliographic references:

1. B. Multon, “Production of Electric 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
EU Fundamental Code:EMU2.1
Subject: Practical work Applications and sizing of renewable energy systems
VHS: 10:30 p.m. (TP: 1:30 a.m.)
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 material:
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 power 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.

Evaluation method:
Continuous control: 100%.

Bibliographic references:

Software getting started guides: PVsyst, PV-sol, RETscreen, Homer, Meteonorm
Course notes.

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

Teaching objectives:

The aim of this subject is to understand the modeling and software simulation (ie 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 material:

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

Evaluation method:

Continuous control: 100%.

Bibliographic references:

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

Teaching objectives:

- Power electronics
- Modeling of electrical machines

Recommended prior knowledge:

Content of the material:

TP1 Autopilot 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

Evaluation method:

Continuous control: 100%.

Bibliographic references:

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

Goals :
The student must be able to establish an operating 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, in taking as few measures as possible to respect economic constraints.

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

Content of the material:

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

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

3- **Chapter3**: Malfunction of ER systems (faults, etc.)
4- **Chapter4**: Maintenance in RE systems

7-**Chapter 5**: Supervision of the operation of RE Systems
Recommendations for data measurement, transfer and analysis.

5- **Chapter 6**: Remote management and remote maintenance techniques.

Evaluation method:

Continuous assessment: 40%, Examination: 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: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:
Give the student the necessary tools to search for useful information to better use it in their end-of-studies project.Help them go through the different stages leading to the writing of a scientific document. Tell himthe importance of communication and itlearn to present the work carried out in a rigorous and educational manner.

Recommended prior knowledge:
Writing methodology, Presentation methodology.

Content of the subject:

Part I-: Documentary research:

Chapter I-1: Definition of the subject (02 Weeks)
- Subject title
- List of keywords relating 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 (02 Weeks)
- Type of documents (Ldrunk, Theses, Memoirs, 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: To process information (02 Weeks)
- Work organization
- Starting questions
- Summary of documents retained
- Links between different parties
- Final plan of the documentary research

Chapter I-5: Presentation of the bibliography (01 Week)
- Systems for presenting a bibliography (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 (02 Weeks)
- Identify and delimit the subject (Summary)
- Problem and objectives of the dissertation
- 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
- Annexes

Chapter II-2: Writing techniques and standards (02 Weeks)

- Formatting.Numbering of chapters, figures and tables.
- Cover Page
- Typography and punctuation
- Writing. Scientific language: style, grammar, syntax.
- Spelling.Improved general language skills in terms of comprehension and expression.
- Back up, 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,...)

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

Evaluation method:

Review: 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: instructions for use, user manuals, online help, Dunod, 2002.*
4. *M. Greuter, Write your dissertation or internship report well, L'Etudiant, 2007.*
5. *Mr. Boeglin, reading and writing in college. From the chaos of ideas to structured text. The Student, 2005.*
6. *M. Beaud, the art of the thesis, Editions Casbah, 1999.*
7. *M. Beaud, the art of the thesis, The discovery, 2003.*
8. *M. Kalika, Master's thesis, Dunod, 2005.*

IV- Detailed programs by subject
From Some Discoveries (S1, S2, S3)

Semester ...
EU Discovery Code:UED...
Matter:Photovoltaic materials
VHS: 10:30 p.m. (Class: 1h30)
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 material:
Chapter 1: Photovoltaic technologies
- a- Monocrystalline silicon
- b- Multi-crystalline molded silicon (polycrystalline)

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 diseleriide
- c- Galium arsenide
- d- Titanium Dioxide
- e- Concentration cells

Chapter 5: Introduction to organic photovoltaic technology

Evaluation method:
Review: 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 Bordas University (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.

Semester…
UE Discovery Code: UED …
Matter:**Thermal and energy efficiency**
VHS: 10:30 p.m. (Class: 1h30)
Credits:1
Coefficient: 1

Teaching objectives

Recommended prior knowledge

Content of the material:

1. **Chapter 1: Reminders**
   - 1.1. Conduction, convection and thermal radiation
2. **Chapter2: HVAC systems (heating, ventilation and air conditioning), 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: day degrees, temperature ranges
     - 3.1.3. Detailed methods of energy consumption calculations.
   - 3.2. Energy efficiency in energy systems (refrigeration systems, engines and combustion chambers, solar systems, etc.)
4. **Chapter4: Solar storage**

Evaluation method:
Continuous assessment: 40%, Examination: 60%.

Bibliographic references:

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

Semester …
EU Discovery Code:UED…
Matter:Political, economic and social aspects of renewable energies
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives
The objective of the subject is to introduce future graduates to the creation and management of renewable energy businesses. In this module the essential political, economic and social aspects of renewable energies will be given.

Recommended prior knowledge:
Fundamental electrical engineering, Power Electronics, Management and economics concepts.

Content of the subject

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

Evaluation method:
Review: 100%.

Bibliographic references:
1-McKane, et al, 2007, UNIDO publication, Policies for PromotingIndustrialEnergyEfficiency in Developing Countries and Transitional Economiesv. 08-52434 - April 2008.www.iso.org/iso/fr/focus_1105_sr_pinero.pdf*(retrieved in May 27, 2016)*
2-ISO/TC 242 Energy management,http://www.iso.org/iso/fr/iso_technical_committee?commid=558632(retrievedin 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 for energy
4- SmilVaclay, Energy, Miths and Realities, AEI Press, 2010

Semester ...
Fundamental EU Code: UED...
Matter:Energetic audience
VHS: 10:30 p.m. (Class: 1h300)
Credits: 1
Coefficient: 1

Chapter I:General:
Sustainable development, Energy efficiency, Energy audit

Chapter II:Energetic audience
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.Basics of electrical engineering
II.Measuring tools and instruments
III.Methods and essential measurement points

Chapter IV:Pricing analysis
I.Studies of different pricing systems
II.Comparison and choice of the best price
III.Estimates of economic gains

Chapter V:Actions and solutions
I.Formulate advice and recommendations
II.Presentation of an energy audit report

Evaluation method:
Review: 100%.

Bibliographic references:

Semester ...
Teaching unit: UED ...
Matter:Communication and project management
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:
This course aims to offer students the different concepts and notions useful for studying, carrying out and managing an industrial project.

Recommended prior knowledge:
Business economics, industrial systems.

Material content:

- General
- Prerequisites for project management
  - Understanding the functional specifications
  - Complete and finalize the functional specifications
- Project management
  - Define one or more technical solutions responding to the problem posed
  - Put one of the possible solutions into practice
  - Demonstrate 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 repository (prototype)
- Managing deadlines (operational planning)
- Cost control
- Quality control
- Risk management

Example of project management

Evaluation method:
Review: 100%.

Bibliographic references:

- "ManagementProject", 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: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives

Provide students with the scientific foundations allowing 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 subject

VSchapter 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 power **(3 weeks)**
Chapter 4: Other renewable sources: hydraulic, geothermal, biomass… **(2 weeks)**
Chapter 5: Storage, fuel cells and hydrogen **(2 weeks)**

Evaluation method:

Continuous control: 40%; Exam: 60%.

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

Semester ...
EU DiscoveryCode: UED...
Matter:Industrial Ecology and Sustainable Development
VHS:10:30 p.m.(Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives

Raise awareness of sustainable development, industrial ecology and recycling.

Recommended prior knowledge:

Content of the material:

- 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

Evaluation 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, SurenErkman 2004*
2 *Energy and its control. Montpellier Cedex 2: CRDP of Languedoc-Roussillon, 2004. . ISBN 2-86626-190-9,*
3 *Appropriations of sustainable development: emergences, diffusions, translationsB Villalba - 2009*

Semester ...
EU DiscoveryCode: UED...
Matter:Optimization and power control techniques
VHS:10:30 p.m.(Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:
Allow students to acquire knowledge on 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 material:

1- Chapter1: Control of 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.-

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

3- Chapter3:optimization techniques in wind energy systems
-P&O methods,TSR, PSF, HCS, gradient, LF, adaptive, predictive
4- Chapter4: Applications

Evaluation method:
Review: 100%.

Bibliographic references:

[1] H. Buhler. Adjustment by fuzzy logic. Ed. Presses Polytechniques Romandes, Lausane, 1994.
[2] H. Buhler. Adjustment and control electronics. Ed. Presses Polytechniques Romandes, Lausane, 1983.
[3] H. Buhler. Adjustment by sliding mode. Ed. Presses Polytechniques Romandes, Lausane, 1986.
[4]G. Grellet, G. Clerc. Electric shareholders. Ed. Eyrolles, France, 1996
[5]J. Chatelain. Electric machine. . Ed. Presses Polytechniques Romandes, Lausane, 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. Technip, 1996.

Semester ...
EU DiscoveryCode: UED...
Matter:Sensors and measurements dedicated to RE systems
VHS:10:30 p.m.(Class: 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 to RE systems and more precisely PV, wind and heat pump 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 material:

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, hydrogen pressure, etc.

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

Chapter 4:Calibration and calibration methods.

Evaluation method:
Review: 100%.

Bibliographic references:

- Muhammad Iqbal,Introduction to Solar Radiation.new York: Academic Press
- Pierre-André Paratte, Philippe Robert, Measuring 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: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

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

Recommended prior knowledge:

µ-processors and µ-controllers, IT, Control, Electrical machines, Power converters.

Content of the material:

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

Chapter 2 : Digital control of systems; (04 weeks)

Chapter 3: Study of the implementation of MLI techniques on a digital processor;

(04 weeks)

Chapter 4: Examples of implementing machine controls: Direct Current Machine, Asynchronous Machine, Synchronous Machine.

(04 weeks)

Evaluation method:

Review: 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.