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

-Updated 2022-

Domain	Sector	Speciality
Science And Technologies	***Electromechanics***	***Electromechanics***

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National Educational Committee for the field of Science and Technology

مواءمة
ماستر أكاديمي

تحيين 2022

الميدان	الفرع	التخصص
علوم و تكنولوجيا	كهروميكانيك	كهروميكانيك

I–Master's identity sheet

Access conditions

(Indicate the license specialties which can give access to the Master)

Sector	Harmonized Master	Access licenses to the master's degree	Ranking according to license compatibility	Coefficient assigned to the license
Electromechanics	Electromechanics	Electromechanics	**1**	**1.00**
		Industrial maintenance	**2**	**0.80**
		Electrical engineering	**3**	**0.70**
		Electronic	**3**	**0.70**
		Mechanical construction	**3**	**0.70**
		Energy	**3**	**0.70**
		Other licenses in the ST domain	**5**	**0.60**

II – Half-yearly teaching organization sheets of the specialty

Semester 1 Master: Electromechanics

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	Modeling and simulation of electrical machines	4	2	1h30	1h30		45:00	55:00	40%	60%
	Advanced power electronics	4	2	1h30	1h30		45:00	55:00	40%	60%
	Industrial electrical networks	2	1	1h30			10:30	27:30		100%
Fundamental EU Code: UEF 1.1.2 Credits: 8 Coefficients: 4	Industrial mechanisms and power transmission	4	2	1h30	1h30		45:00	55:00	40%	60%
	Hydraulic and pneumatic machines	4	2	1h30	1h30		45:00	55:00	40%	60%
Methodological EU Code: UEM 1.1 Credits: 9 Coefficients: 5	TP Modeling and simulation of electrical machines	2	1			1h30	10:30	27:30	100%	
	Advanced power electronics TP	2	1			1h30	10:30	27:30	100%	
	TP Industrial electrical networks	2	1			1h30	10:30	27:30	100%	
	TP Industrial mechanisms and power transmission	2	1			1h30	10:30	27:30	100%	
	TP Hydraulic and pneumatic machines	1	1			1h00	3:00	10:00	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: 1 Coefficients: 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: Electromechanics

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	Control of electrical machines	4	2	1h30	1h30		45:00	55:00	40%	60%
	Hydraulic and pneumatic control	4	2	1h30	1h30		45:00	55:00	40%	60%
Fundamental EU Code: UEF 1.2.2 Credits: 10 Coefficients: 5	Applied thermodynamics	4	2	1h30	1h30		45:00	55:00	40%	60%
	Applied fluid mechanics	4	2	1h30	1h30		45:00	55:00	40%	60%
	Diagnosis and monitoring	2	1	1h30			10:30	27:30		100%
Methodological EU Code: UEM 1.2 Credits: 9 Coefficients: 5	TP Control of electrical machines	2	1			1h30	10:30.	27:30	100%	
	TP Hydraulic and pneumatic control	2	1			1h30	10:30	27:30	100%	
	Practical thermodynamics applied	2	1			1h30	10:30.	27:30	100%	
	Applied numerical methods	3	2	1h30		1h00	37:30	37:30	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**	**6:00**	**7:00**	**375h00**	**375h00**		

Semester 3 Master: Electromechanics

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 2.1.1 Credits: 10 Coefficients: 5	Modeling and simulation of electromechanical systems	6	3	3:00	1h30		67h30	82h30	40%	60%
	Advanced control techniques	4	2	1h30	1h30		45:00	55:00	40%	60%
Fundamental EU Code: UEF 2.1.2 Credits: 8 Coefficients: 4	Microprocessors and APIs	4	2	1h30	1h30		45:00	55:00	40%	60%
	Organization and management of industrial maintenance	4	2	1h30	1h30		45:00	55:00	40%	60%
Methodological EU Code: UEM 2.1 Credits: 9 Coefficients: 5	TP Modeling and simulation of electromechanical systems	2	1			1h30	10:30	27:30	100%	
	TP Advanced control techniques	2	1			1h30	10:30	27:30	100%	
	TP Microprocessors and API	2	1			1h30	10:30	27:30	100%	
	Computer Aided Manufacturing Design CAD/CAM	3	2	1h30		1h00	37:30	37:30	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 Coefficients: 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**		

Discovery Unit (S1, S2 and S3)

1- Sensors and instrumentation
2- Cold and air conditioning
3- Exploitation of Renewable Energy
4- System reliability
5- Special electrical machines
6- Industrial security and authorization
7- Signal processing
8- Servo systems
9- Industry standards and legislation
10- Maintenance and operational safety
11- Industrial data
12- Others...

Semester 4

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

	VHS	coefficient	Credits
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 values (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 for the S1 semester

Semester:1
Teaching unit: UEF 1.1.1
Subject 1:Modeling and simulation of electrical machines
VHS: 45h00 (Class: 1h30, tutorial: 1h30)
Credits:4
Coefficient:2

Teaching objectives:

Establish the mathematical models necessary for the modeling and simulation of electrical machines. These modelsprovide, for the machine considered, the instantaneous equations and in steady state, theperformance and control laws.

Recommended prior knowledge:

The student must have the following knowledge:

- Three-phase electrical circuits,magnetic circuits,single-phase and three-phase transformers.
- Direct and alternating current electrical machines

Material content:

Chapter 1.General machine modeling (03 weeks)
Machine structures,rpresentation of magnetic phenomena, sequivalent scheme,fmagnetomotive orce,pwanderings,rinduction distribution,fwinding lux,vsoulages,fdispersion lux, vsas sinusoidal distributions, vscalculation of the couple by the method of virtual works.

Chapter 2.Machine modeling for dynamic regimes (03 weeks)
Transformation matrices,PAR transformationK,uuse of the method for calculations of transient regimes,vschoice of benchmark.

Chapter 3.Modeling and simulation of direct current machines(MCC) (03 weeks)
Equations of direct current machines,model of the direct current machine on the axes d, q, taking into account the various types of excitation in an MCC,transitional regimes.

Chapter 4.Modeling and simulation of synchronous machines (03 weeks)
Modeling and simulation of a synchronous machine with and without shock absorbers,study of transient regimes, expressions of torque,modeling and simulation of a permanent magnet synchronous machine,d,q diagrams, magnet, reluctance motors.

Chapter 5.Modeling and simulation of asynchronous squirrel cage machines (03 weeks)
Modeling and simulation of an asynchronous squirrel cage motor/generator, wound rotor motor,study of transient regimes, expressions of torque.

Evaluation method:

Continuous control: 40%; Exam: 60%.

Bibliographic references:

1. P. Barret, “Transient regimes of rotating electrical machines”, Edition Eyrolles, 1997.ISBN10: 2-212-01574-7.
2. M. Kostenko, L. Piotroviski, “Electric machines, Volume 2: Alternating current machines”, Moscow Edition.
3.JP Fanton, “Electrotechnics, Machines and networks, electrical engineering”, EditionEllipses, 2002. ISBN 10: 2729811133.
4. R Abdessemed, ''Modeling and simulation of electrical machines'', Edition Ellipses 2011. ISBN10: 2-7298-6495-4.

5. JP Caron,JP Hautier, “Modeling and control of the asynchronous machine”, Edition Technip 1995.ISBN: 9782710806837.
6. J. Chatelain, ''Machines Electriques'', T1 & T2, Edition Dunod, 1989.
7. D. Hanselman, ''Brushlesspermenent magnet motor design'', Magna physics publishing 2006. ISBN: 1-881855-15-5.

Semester:1
Teaching unit: UEF 1.1.1
Subject 1:Advanced power electronics
VHS: 45h00 (Class: 1h30, tutorial: 1h30)
Credits:4
Coefficient:2

Teaching objectives:

Allow the student to deepen their knowledge of energy conversion and quality and give them certain concepts about modern converters and their control.

Recommended prior knowledge:

The student will have a basic understanding of power semiconductor components and knowledge of basic power converters.

Material content:

Chapter 1.Choppers (03 weeks)
Non-reversible choppers (series chopper, parallel chopper), current reversible chopper, voltage reversible chopper, current and voltage reversible chopper.

VSchapter 2.Static converter control techniques (03 weeks)
Full wave control, triangular PWM, calculated modulation, vector modulation, hysteresis control, etc.

Chapter 3.New converter topologies (03 weeks)
Multi-level converters, multi-cell converters, matrix converters…

Chapter 4. Energy quality of static converters (03 weeks)
Introduction to the problem of harmonic pollution of electrical networks, harmonic values and standards, disturbances due to harmonics, propagation of harmonics, reduction of harmonics.

Chapter 5. Converter Applications (03 weeks)
Active filtering, reactive energy compensation, power factor correction, variable speed electric drives, etc.

Evaluation method:

Continuous monitoring: 40%; Examination: 60%.

Bibliographic references:

1. G. Seguier,''Power electronics converters. Volume 1: The AC–DC conversion'', Edition Lavoisier - Tec& Doc1992.
2. C. Rombaut, G. Seguier,''Power electronics converters. Volume 2: The alternative–alternative conversion'', Edition Lavoisier - Tec & Doc1991.
3. R. Bausiere. F. Labrique, G. Seguier,''Power electronics converters. Volume 3: The continuous–continuous conversion'', Edition Lavoisier - Tec & Doc1997.
4. F. Labrique, G. Seguier, R. Bausiere,''Power electronics converters. Volume 4: The continuous-alternating conversion'', Edition Lavoisier - Tec & Doc1995.
5. H. Bühler,''Static converters'', Edition Presses Polytechniques et Universitaires Romandes 1991.

Semester:1
Teaching unit: UEF 1.1.1

Subject 1:Industrial electrical networks
VHS: 10:30 p.m. (Class: 1h30)
Credits:2
Coefficient:1

Teaching objectives:

This subject aims to give students first an overview of industrial electrical networks (architectures, diagrams and plans), then the information necessary to evaluate an electrical work and the principles to respect when intervening on a work in completely safe.

Recommended prior knowledge:

Basic notions of electrical networks and equipment.

Material content:

Chapter 1. General **(01 week)**
Standardization, voltage domains, equipment, graphic symbols of diagrams.

Chapter 2.Industrial electrical networks **(02 weeks)**
General structure of an industrial network, delivery stations, general panels and divisional panels, emergency power supply, uninterruptible power supply, Examples of industrial networks.

Chapter 3.Industrial electrical works (Installations and panels) **(03 weeks)**
Areas of voltages, environment, structures and pipes, power, lighting and special electrical installations, general problems with installations (disturbances and energy quality).

Chapter 4.Grounding and safety in an installation **(03 weeks)**
Origin of neutral regimes, usefulness of earthing, PE and PEN conductors, earthing of transformer stations.

Chapter 5.Installation calculations **(03 weeks)**
Minimum section of a pipe, voltage drop, short-circuit currents, heating in electrical cabinets.

Chapter 6.Wiring and maintenance **(03 weeks)**
Wire holding techniques (trunking, strands, combs), observations, measurements, control.

Evaluation method:

Review: 100%.

Bibliographic references:

1. JM Broust,''Industrial electrical equipment and installations: design, coordination, implementation and maintenance'', Dunod, Paris 2008.
2.C.Prévé and R. Jeannot,''Industrial electrical network design guide'', Schneider Electric, n° 6883 427/A 1997.
3.D.Fedullo, T.Gallauziaux,''The big book of electricity'', Ed Paperback, Eyrolles 2009.

Semester:1
Teaching unit: UEF 1.1.2
Subject 1:Industrial mechanisms and power transmission
VHS: 45h00 (Class: 1h30, tutorial: 1h30)
Credits:4
Coefficient:2

Teaching objectives:
Develop in the student the concepts of designing and creating a means of transmitting the movement of certain mechanisms and machine parts (bearings, reduction gears, etc.).

Recommended prior knowledge:
The student must have the following knowledge:
- Applied mechanics.
- Mechanical manufacturing.

Material content:

Chapter 1. general **(02 weeks)**
Standardization, kinematic connections between mechanical parts.

Chapter 2. Creating connections **(02 weeks)**
Functions to be performed and characterization of functions, removable assemblies, permanent assemblies.

Chapter 3. Rotation guidance **(03 weeks)**
Functions to be performed and characterization of functions, plain bearings, guidance by interposition of bearings, hydrostatic and hydrodynamic bearings.

Chapter 4. Translation guidance **(03 weeks)**
Function to be performed and characterization of functions, guidance by direct contact, guidance by interposition of rolling elements, sealing function and protection of connections

Chapter 5. Movement and power transmission organs **(05 weeks)**
Couplings, clutches, brakes, gear transmission, belt transmission, study and sizing of industrial devices (reducer, winch, overhead crane).

Evaluation method:
Continuous monitoring: 40%; Exam: 60%.

Bibliographic references:
1. E.Francis,''Mechanical construction: power transmission'',Volume 1, ISBN: 2-10-049125-12006.
2. E.Francis,''Mechanical construction: power transmission'',Volume 2, ISBN: 2-10-049750-2 2006.
3. E.Francis,''Mechanical construction: power transmission'',Volume 3, ISBN: 2-10-049749-32006.

Semester:1
Teaching unit: UEF 1.1.2
Subject 1:Hydraulic and pneumatic machines
VHS: 45h00 (Class: 1h30, tutorial: 1h30)
Credits:4
Coefficient:2

Teaching objectives:

The objective of the programaims to familiarize the student with the different types of hydraulic and pneumatic machines. The notions of aerodynamics and thermodynamics are applied to establish the modeling and understanding of the flow in a turbomachine and to develop basic elements for the design and selection of these machines.

Recommended prior knowledge:

The student must have the following knowledge:

- Fluid mechanics,
- Applied thermodynamics

Material content:

Chapter 1. Introduction (03 weeks)

General classification of hydraulic and pneumatic machines according to the direction of flow, historical aspects, machines operating with flows in incompressible regime and machines operating with flows in compressible regime, configuration of hydraulic and pneumatic machines, axial, radial and mixed turbomachines, machines hydraulics and thermal machines.

Chapter 2. One-dimensional theory of hydraulic and pneumatic machines (05 weeks)

Calculation hypothesis, revision of basic concepts of dynamics and energy transfer of a moving fluid, quantity of movement (principle of action and reaction), work of a wheel (Euler equation, application to hydraulic machines and tires which operate with compressible and incompressible fluids), transformation of kinetic energy into mechanical work, transformation of thermal energy into kinetic energy (Application of the fundamental laws of thermodynamics to thermal machines), definitions of efficiency.

Chapter 3. Axial and radial hydraulic and pneumatic machines (04 weeks)

Speed triangle, the normal triangle, characterization of speed triangles (load coefficient, flow coefficient, degree of reaction), radial hydraulic and pneumatic machines (energy transfer), slip factor, blade inclination, compressors and centrifugal pumps, dimensionless numbers (similarity of operating regimes, characteristic curves, specific speed and specific diameter).

Chapter 4. Hydraulic turbines (03 weeks)

Pelton, Francis and Kaplan turbines.

Evaluation method:

Continuous monitoring: 40%; Examination: 60%.

Bibliographic references:

1. J. Faisandeur,''Hydraulic and pneumatic mechanisms'', Dunod 2006.
2. ''Industrial hydraulic Systems, an introduction'', Englwoodcliffs(new jersey), Prentice hall 1988.
3. R. Affouard, J. Diez,''Hydraulic installations design and practical implementation'', Paris, modern publishing company 1972.
4. SLDixon,''Fluid Mechanics and Thermodynamics of Turbomachinery'', Fourth edition, Butterworth-Heinemann, Woburn, MA, USA 1998, ISBN 0-7506-7059-2.
5. H.Cohen, ,GFCRogers, HIHSaravanamuttoo,''Gas Turbine Theory'', Fourth edition, Longman group, Harlow, UK 1996, ISBN 0-582-23632-0.

Semester:1
Teaching unit: UEM1.1
Subject 1:TPModeling and simulation of electrical machines
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits:2
Coefficient:1

Teaching objectives:

Complete, consolidate and verify the knowledge already acquired in the course.

Recommended prior knowledge:
Good command of IT tools and MATLAB-SIMULINK software.

Material content:

TP1.Introduction to the softwareMATLAB-SIMULINK

TP2.Modeling and simulation of direct current machines(MCC)
Modeling and simulation of a DC machine with separate/shunt excitation.

TP3.Modeling and simulation of synchronous machines
Modeling and simulation of a synchronous machine with and without shock absorbers.

TP 4.Modeling and simulation of a synchronous machine with permanent magnets

TP5.Modeling and simulation of asynchronous squirrel cage machines
Modeling and simulation of an asynchronous squirrel cage motor.

Evaluation method:
Continuous control: 100%.

Bibliographic references:
Course notes and laboratory brochures.

Semester:1
Teaching unit: UEM1.1
Subject 1:TPAdvanced power electronics
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits:2
Coefficient:1

Teaching objectives:
Complete, consolidate and verify the knowledge already acquired in the course.

Recommended prior knowledge:

Power semiconductor components and basic power converters.

Content of the material:

TP 1. 1 quadrant and 4 quadrant chopper

TP 2. Triangulo-sinusoidal PWM of a voltage inverter

TP 3. Vector PWM of a voltage inverter

TP 4. Simulation of a multilevel converter

TP 5. Simulation of a multicell converter

TP6. Simulation of a matrix converter

TP7. Power factor correction

Evaluation method:
Continuous control: 100%

Bibliographic references:
Course notes and laboratory brochures.

Semester:1
Teaching unit: UEM1.1
Subject 1:TPIndustrial electrical networks
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits:2
Coefficient:1

Teaching objectives:
This subject aims to provide students with knowledge of the main indicators of energy quality in an industrial installation, and to be able to evaluate this quality.

Recommended prior knowledge:

Basic notions of networks, machines, signals.

Material content:

TP 1. Receivers and their power constraints

Disturbances in an industrial network (origins and evaluations), effects of disturbances on motors, effects on lighting (evaluations).

TP 2.Reactive energy compensation

Interest in compensation, determination of compensation power, location and choice of compensation equipment.

TP 3.Harmonics in an industrial network

Sources of harmonics, effects on equipment and receivers, means of protecting against their effects (filtering, confinement, low impedance source, etc.).

TP 4.Ddimensioning of an industrial installation

Evaluation method:

Continuous control: 100%.

Bibliographic references:

Course notes and laboratory brochures.

Semester:1
Teaching unit: UEM1.1
Subject 1:TPIndustrial mechanisms and power transmission
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits:2
Coefficient:1

Teaching objectives:

Complete, consolidate and verify the knowledge already acquired in the course.

Recommended prior knowledge:

Applied mechanicsand Fmechanical manufacturing.

Material content:

TP 1.Reducer embedding connections

TP 2. Coupling alignments

TP 3. Bearing adjustments

TP 4. Geometric rotor control

Evaluation method:
Continuous control: 100%.

Bibliographic references:
Course notes and laboratory brochures.

Semester:1
Teaching unit: UEM1.1
Subject 1:TPHydraulic and pneumatic machines
VHS: 3:00 p.m. (TP: 1:00 a.m.)
Credits:1
Coefficient:1

Teaching objectives:
The objective is to develop in students the means which will enable them to analyze hydraulic and pneumatic circuits.

Recommended prior knowledge:
Thermodynamics and MDF.

Material content:

TP 1. Study of a venturi

TP 2. Testing a centrifugal pump and Cavitation phenomenon

TP 3. Hydraulic turbines

TP 4. Testing a compressible fluid machine

Evaluation method:
Continuous control: 100%.

Bibliographic references:
Course notes and laboratory brochures.

Semester: 1
Teaching unit: UED 1.1
Subject 1:Basket of your choice
VHS: 10:30 p.m. (class: 1h30)
Credits: 1
Coefficient: 1

Semester: 1
Teaching unit: UED 1.1
Subject 2:Basket of your choice
VHS: 10:30 p.m. (class: 1h30)

Credits: 1
Coefficient: 1

Semester: 1
Teaching unit: UET 1.1
Matter :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 the S2 semester

Semester:2
Teaching unit: UEF 1.2.1
Subject 1: Control of electrical machines
VHS: 45h00 (Class: 1h30, tutorial: 1h30)
Credits:4
Coefficient:2

Teaching objectives:

Allow the student to acquire knowledge in the field of electronic power supply and control of the most used electrical machines.

Recommended prior knowledge:

Concepts of control and regulation; Electrical machines and static converters.

Material content:

Chapter 1.Introduction **(02 weeks)**

- Electromechanical properties of electrical machines
- Interest in variable speed
- Speed variators and their structures (for direct and alternating current machines)

Chapter 2.Control of direct current machines **(02 weeks)**

- Mathematical description of direct current machines (different excitation modes)
- Natural and artificial characteristics of DC machines
-Speed adjustment of DC motors (Control by armature voltage, Control by magnetic flux variation)
- Braking of direct current machines

Chapter 3.Control of asynchronous machines **(07 weeks)**

- Modeling of the asynchronous machine with a view to its control (torque-speed characteristic, operation at variable frequency and voltage, dynamic models of the machine in the two-phase frame)
- Principles, interest and methods of speed adjustment of asynchronous machines:
  - Electronic control and power supply by static converters of asynchronous machines
  - Scalar control (principle, model and control law)
  - FOC vector control (principle of vector control, rotor or stator flux orientation, expression of the control)
  - Direct torque control DTC (control strategy, torque control, power control)

Chapter 4.Control of synchronous machines **(04 weeks)**

- Types, structure and operation of synchronous machines
- Starting and autopiloting of synchronous machines
- Mathematical modeling for the control of a synchronous machine (synchronous machine with permanent magnet or others)
- Machine-converter and vector control association

Evaluation method:

Continuous monitoring: 40%; Examination: 60%.

Bibliographic references:

1. Course notes
2. Variable speed electric drives; Jean Bonal, Guy Séguier, 1998
3. Electronic control of electric motors; Michel Pinard; Dunod, 2004
4. Electrical system controls; Loron Luc, Lavoisier, 2004
5. Modeling and control of the asynchronous machine, JPHautier and JPCaron, Technip, 1995
6. Electrical engineering Theodore WILDI From BEOCK UNIVERSITY.

Semester:2
Teaching unit: UEF 1.2.1
Subject 1: Hydraulic and pneumatic control

VHS: 45h00 (Class: 1h30, tutorial: 1h30)
Credits:4
Coefficient:2

Teaching objectives:

Allow the student to acquire knowledge on the design, operation and calculation of the elements involved in industrial automated systems based on hydraulic and pneumatic energy.

Recommended prior knowledge:

Logic circuits, fluid mechanics, hydraulic and pneumatic machines.

Material content:

Chapter 1. Ehydraulic and pneumatic energies in the functional chain of a system (02 weeks)

-Definitions of hydraulic and pneumatic energy
-Energy storage and supply: power systems, storage systems, conditioning systems (filters,driers, lubricators), safety systems (flow regulator), measuring systems
- Types of cenergy inverters (types of cylinders, pumps, etc.)
-Energy distributors (modulators) (presentation, types and designation of distributors)
-Sconventional chematization of hydraulic and pneumatic elements

Chapter 2.Industrial hydraulic circuits (05 weeks)

-General description
-Hydraulic circuit diagram
-Hydraulic power plant (Constitution)
-Positive displacement pumps and these gassociated hikers(calculations ofdisplacement, flow rates, dthe powers,he yields anddrive torque,'calculation example')
-Hydraulic receivers: Cylinders (sizing, pressure, section, speed, efficiency and power), Hydraulic motors (definition,types and calculations, 'calculation example')
-Protection and regulation devices(valves, pressure and flow limiters and reducers, valves, etc.)
-Oils, characteristics and choices

Chapter 3.Pneumatic automation circuits (04 weeks)

- Description
- Constitution and schematization of a compressed air installation (compressed air production elements, pneumatic cylinders, connections, compressed air conditioning modules)
- Pneumatic symbols
-Examples of circuits

Chapter 4. Theautomated production systems (SAP) (04 weeks)

-Definition and example of automated system.
-Description of an automated system:

- Operative parts: constitution, examples of sensors, examples of actuators (electric, hydraulic and pneumatic)
- Control parts: constitution, direct control mode (closed loop), control mode with execution report (or closed loop)
- Human Machine Interface

- The industrial programmable logic controller (PLC): principles, pPLC peripherals, modular design of the PLC (digital modules, communication modules)
-Representation tools: by GRAFCET (definition, GRAFCET standards and basic graphic elements, examples) or by programming flowchart.

Evaluation method:

Continuous monitoring: 40%; Examination: 60%.

Bibliographic references:

1. J. Faisandeur, ''Hydraulic and pneumatic mechanisms'', Dunod 2006.
2. S.Moreno,''Pneumatics in automated systems'', Eyrolle 2001.
3. ''Industrial hydraulic Systems, an introduction'', Englwood cliffs (new jersey), Prentice hall 1988.
4. R. Affouard, J. Diez, ''Hydraulic installations design and practical realization'', Paris, modern publishing company 1972.

Semester:2
Teaching unit: UEF 1.2.2
Subject 1:Applied thermodynamics
VHS: 10:30 p.m. (Class: 1h30, tutorial: 1h30)
Credits:4
Coefficient:2

Teaching objectives:

Remind the student of the fundamental concepts of thermodynamics,physical interpretation of the fundamental notions of thermodynamicsin order tounderstand thermodynamic cycles as an energy conversion system.

Recommended prior knowledge:

General laws of basic thermodynamicsand fluid mechanics acquired during the undergraduate course.

Material content:

Chapter 1. Principles of thermodynamics **(02 weeks)**

- The first law and the definition of internal energy in a closed system
- The second principle and the notion of yield in a cycle
- Ideal gases (The equation of state of ideal gases, The coefficients of expansion and compressibility, Analytical determination of entropy and enthalpy)
- Phase change

Chapter 2. Real cycles of thermal steam engines **(03 weeks)**

- Carnot cycle
- Rankine cycle
- Reheat cycle
- Regeneration cycle (withdrawal)
- Mixture and surface heaters
- Thermal power plant with two working fluids
- Ideal fluid for a steam power plant

Chapter 3. Theoretical cycles of internal combustion engines **(03 weeks)**

- Carnot cycle
- Otto Cycle
- Diesel cycle
- Mixed cycle
- Real cycles

Chapter 4.Theoretical cycles of gas turbines **(04 weeks)**

- Brayton cycle o Stirling cycle
- Ericsson cycle
- Cycle of the gas turbine equipped with a regenerator
- Staged compression with intercooling
- Staged expansion with intermediate reheating
- Theoretical cycle of jet, ramjet and turbojet propulsion
- Reverse Brayton cycle, refrigeration cycle

Chapter 5. Heat exchangers **(03 weeks)**

- Classification of heat exchangers
- Heat exchanger design method
- Calculation of heat exchangers
- Correlations of forced convection in heat exchangers
- Pumping power and pressure drop in heat exchangers
- Condensers and evaporators

Evaluation method:

Continuous monitoring: 40%; Examination: 60%.

Referencesbibliographic:

1. Thermodynamics and Energetics, Lucien BOREL
2. Energy Systems, Renaud GICQUEL

3. Thermodynamics applied to Energy, Francis-Emile MEUNIER
4. Applied Thermodynamics, Van-Wylen

Semester:2
Teaching unit: UEF 1.2.2
Subject 1: Applied fluid mechanics
VHS: 45h00 (Class: 1h30, tutorial: 1h30)
Credits:4
Coefficient:2

Teaching objectives:

The objectives of the teaching are to provide an operational understanding of the essential concepts of fluid mechanics andmaster the theory behind different flows in order to solve problemson case studies of practical interest.

Recommended prior knowledge:

- Rational mechanics
- The principles of thermodynamics

Material content:

Chapter 1. Reminders **(01 week)**

- Fluid viscosity
- Newtonian and non-Newtonian fluids
- The ideal gas equation of state

Chapter 2. Fluid Kinematics **(04 weeks)**

- Speed fields
- The different types of flow in 1D, 2D and 3D
- The trajectory and the current lines and tubes
- Streamline equation
- Acceleration and the notion of substantial derivative

Chapter 3. Fluid Dynamics **(04 weeks)**

- Study of a flow according to Lagrange
- Flow study according to Euler
- Reynolds theorem
- Deduction of conservation equations:
    - Conservation of mass (Continuity equation)
    - Conservation of momentum (Navier Stockes equation)
    - Conservation of energy (First law of thermodynamics)

Chapter 4. Application of the three Conservation Equations **(03 weeks)**

- Bernoulli equation for perfect and real fluids
- Applying the Bernoulli equation

Chapter 5.Energy balances **(03 weeks)**

- One-dimensional flows. Mechanical energy balance.
- Estimation of regular and singular load losses.
- Application example

Evaluation method:

Continuous monitoring: 40%; Examination: 60%.

Referencesbibliographic:

1. Course notes.
2.R.Benhamouda, ''Notions of Fluid Mechanics''.
3. S. Amirouche, J. Luc Battaglia, ''Fluid Mechanics Course and Corrected Exercises''.
5. Handouts, ''Solved Exercises with course in Fluid Mechanics''.

Semester:2
Teaching unit: UEF 1.2.2
Subject 1: Diagnosis and monitoring
VHS: 10:30 p.m. (Class: 1h30)
Credits:2
Coefficient:1

Teaching objectives:

Transmit to the student the basic concepts of diagnosing faults, monitoring installations and electromechanical systems.

Recommended prior knowledge:

Knowledge in subjects: electrical diagrams and equipment, maintenance of electromechanical systems, reliability and operational safety, electrical machines.

Material content:

Part 1: Monitoring **(07 weeks)**

Chapter 1. Failure mode analysis

General information on failures, Identification of the failure; Establishment of the failure. Functional analysis ; Qualitative analysis; Quantitative analysis

Chapter 2. Surveillance techniques

Systematic; Conditional; Forecast; Monitoring by vibrations, ultrasound, oil analysis, noise, thermal.

Chapter 3. Monitoring the operating status of a machine

Fault recognition; Setting up alarms; Monitoring of machine faults (bearings, bearings, pulleys, gears, etc.).

Part 2. Diagnosis **(08 weeks)**

Chapter 1. System Analysis Tools

SADT and FAST type functional analysis (block diagrams, functional chain, logical equations, chronogram).

Chapter 2. Overall approach to locating a fault

Phases of identifying the faulty chain; Identification of the faulty element; Self-diagnostic questionnaire

Evaluation method:

Continuous monitoring: 40%; Examination: 60%.

Bibliographic references:

1. J. LouiFeron, ''Maintenance diagnosis, availability of rotating machines'', Edition Masson, 1995.
2. J. Morel, ''Vibration of machines and diagnosis of their mechanical condition'', Edition Eyrolles, 1991.
3. G.Zwingelstein, ''Fault diagnosis: theory and practice for industrial systems'', Treatise on New Technologies from the Diagnostic and Maintenance series, Editions Hermes, Paris 1995.
4. R. Isermann, ''Fault Diagnosis of Machines via Parameter Estimation and Knowledge Processing'', Tutorial Paper, Automatica, Vol. 29, No. 4, p. 815-835, 1993.
5. JN Chatain, ''Diagnosis by expert systems'', Editions Hermes, Paris 1993.
6. R.Toscano, ''Control and Diagnostics of Dynamic Systems'', Technosup Series, Editions Ellipses, Paris 2005.
7. A.Boulenger and C.Pachaud, Memorandum Monitoring of machines by vibration analysis, Dunod, Paris 2009.
8. M.Ghozlane, Monitoring Techniques for Rotating Machines, Volume 1: Vibration Analysis, Higher Institute of Technological Studies of Radès, 2013 edition.
9. M.Ghozlane, Monitoring Techniques for Rotating Machines, Volume 1: Volume 2: Analysis of industrial oils, Higher Institute of Technological Studies of Radès, 2013 edition.
10. D.AUGEIX, Vibration analysis of rotating machines, engineering techniques BM5145, January 10, 2001.
11. D.PAJANI, L.AUDAIRE, Thermography - Technologies and applications, engineering techniques R2741, March 10, 2013.

Semester:2
Teaching unit: UEM1.2
Subject 1:TP Control of electrical machines
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits:2
Coefficient:1

Teaching objectives:
Know how to model and apply the control techniques studied on electrical machines. Check the dynamic behavior of controlled systems (machines with control loops). Implementation and calculation of PID regulators.

Recommended prior knowledge:
Concepts of control and regulation; modeling and control theories of electrical machines.

Material content:

TP1.Control of a direct current machine (01 session)

TP2.Scalar control (voltage/frequency) of the asynchronous machine (02 sessions)

TP3.Vector control (FOC) of the asynchronous machine (03 sessions)

TP4.Direct torque control (DTC) of the asynchronous machine (03 sessions)

TP5.Vector commands of a synchronous machine (exp: MSAP) (03 sessions)

Evaluation method:
Continuous control: 100%.

Bibliographic references:
Course notes and laboratory brochures.

Semester:2
Teaching unit: UEM1.2
Subject 1:TP Hydraulic and pneumatic control
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits:2
Coefficient:1

Teaching objectives:

Know how to choose and size elements involved in industrial hydraulic or pneumatic circuits in order to create simple diagrams with manual or automatic controls.

Recommended prior knowledge:
hydraulic and pneumatic control course.

Material content:

TP1.Creating a manual control (push button) of a single-acting cylinder (pneumatic or hydraulic) (02 sessions)

TP2.Creating a manual control (push button) of a double-acting cylinder (pneumatic or hydraulic) (02 sessions)

TP3.Carrying out automatic control (repeated cycle) of a double-acting cylinder (pneumatic or hydraulic) using an end-of-course sensor (03 sessions)

TP4.Carrying out an automatic control (cycle programmed on the PLC) of a double-acting cylinder (pneumatic or hydraulic) using an end-of-course sensor (03 sessions)

Evaluation method:
Continuous control: 100%.

Bibliographic references:
Course notes and laboratory brochures.

Semester:2
Teaching unit: UEM1.2
Subject 1:TP Applied thermodynamics
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits:2
Coefficient:1

Teaching objectives:

Complete, consolidate and verify the knowledge already acquired in the course of the Applied Thermodynamics subject.

Recommended prior knowledge:

Good mastery of materials: Thermodynamics, Heat transfer.

Material content:

TP1.Determination of the polytropic compression index "n"

TP2.Determination of the overall efficiency of the compression installation

TP3.Change of state of a pure body

TP4.Determination of the adiabatic index of air

TP5.Change of state of a binary system

TP6.Verifying the ideal gas equation of state

TP7.Measuring the saturation vapor pressure of water

Evaluation method:

Continuous control: 100%.

Bibliographic references:

Course notes and laboratory brochures.

Semester:2
Teaching unit: UEM1.2
Subject 1: Applied numerical methods
VHS: 37h30 (Class: 1h00, TP: 1h00)
Credits:3
Coefficient:2

Teaching objectives:

The applied numerical methods subject aims to provide the basic knowledge necessary for understanding and implementing the most commonly used algorithms for solving problems encountered during the processing of industrial systems.

Recommended prior knowledge:

Mathematics, basic notions of numerical analysis, mastery of the MATLAB environment.

Material content:

Chapter I. Reminders of some numerical methods (04 weeks)

- Resolution of linear and non-linear systems of equations using iterative methods (Jacobi Method, Gauss-Seidel Method, Newton Raphson Method)
- Interpolation and approximation (Lagrange method, Divided difference method)
- Numerical integration (Trapezium Method, Simpson Method, Composite Trapezoid Method, Simpson Composite Method)
- Solving ordinary differential equations (Euler method, Runge-Kutta method, Adams method)

Chapter II. Solving partial differential equations (06 weeks)

- Classifications of partial differential equations and boundary conditions
- Finite difference method
- Finite element method

Chapter III. Optimization techniques (05 weeks)

-Definition and wording
- Types of optimization
- Optimization algorithms
- Optimization without constraints (deterministic methods, stochastic methods)
- Treatment of constraints (Transformation methods, Direct methods)

Practical work:

-Introduction to the MATLAB environment
-Calculates integrals by the methods: Trapezoid, Simpson and general
- Solving ordinary differential equations using the methods: Euler, Runge-Kutta
-Interpolation and approximationby the method ofBarn
- Resolution of systems of linear and non-linear equations using methods: Jacobi; Gauss-Seidel; Newton-Raphson
- Resolution ofpartial differential equationsover therefinite difference method
- Resolution ofpartial differential equationsby the mfinite element method
-Minimization of a function with several variables without constraints by the methods: Gradient, Conjugate gradient, Quasi-Newton
- Minimization of a function with several variables with constraints by the methods: Projected gradient and Lagrange-Newton

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

Evaluation method:

Continuous control: 40%; Exam: 60%.

Referencesbibliographic:

1. A. Quarteroni, R. Sacco, F. Saleri, “Numerical Methods, Algorithms, analysis and applications”, Book published by Springer-Verlag, 2007.
2. S. Nicaise, “Numerical analysis and partial differential equations: Courses and solved problems”, Book published by Dunod, 2000.
3. JL Merrien, “Numerical analysis with Matlab: Exercises and problems”, Edition Dunod, 2007.

4. G. Allaire, “Numerical Analysis and Optimization”, Edition de l’école polytechnique, 2012.
5. SS Rao, "Optimization: Theory and Applications", Wiley-Eastern Limited, 1984.

Semester: 2
Teaching unit: UED 2.1
Subject 3:basket of your choice
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Semester: 2
Teaching unit: UED2.1
Subject 4:basket of your choice
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. The telemaque, 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 for the S3 semester

Semester:3
Teaching unit: UEF 2.1.1
Subject 1: Modeling and simulation of electromechanical systems
VHS: 67h30 (Class: 3h00, tutorial: 1h30)
Credits:6
Coefficient:3

Teaching objectives:

Allow the student to develop the methodology for establishing the elements of a physical model for various electromechanical systems.

Recommended prior knowledge:

Applied mathematics, electromechanical systems.

Material content:

Chapter 1. Dynamic Properties of DC Machine (01 week)
- Direct and inverse models
- Causal model of the direct current machine

Chapter 2. Dynamic models of synchronous machines (02 weeks)
- General information on structures and models
- Transformation of Concordia and equivalent two-phase model
- Transformation of Park;
- Park equations of synchronous machines
- Analysis of models in steady state
- Models for ordering

Chapter 3. Extension of the Park transformation to synchronous motors with non-sinusoidal field distribution (02 weeks)
- Application of the Park transformation to non-sinusoidal flow distribution machines
- Park extension for constant air gap machines
- Analogies with state feedback linearization techniques
- Interpretation of the Park transformation from isocouple curves
- Implementation of extended vector control

Chapter 4. Modeling the converter-machine association (02 weeks)
- Reminders on the operation of a three-phase voltage inverter
- The different types of MLI order
- Vector modeling of the MLI control
- Classic vector control
- Sine-triangle control

Chapter 5. Dynamic modeling of asynchronous machines (02 weeks)
- Modeling of a two-phase asynchronous machine
- Modeling of a three-phase asynchronous machine
- Dynamic properties of the asynchronous machine
- Dynamic models linked to orders

Chapter 6. Static modeling of asynchronous machines with a view to their scalar controls. (02 weeks)- Sinusoidal steady state modeling
- Model with totalized magnetic leaks at the stator
- Model with totalized magnetic leaks at the rotor

- Scalar torque control

Chapter 7. Extension of the Park transformation to asynchronous machines in saturated mode (02 weeks)

- Inductances in saturated mode
- Influence of saturation on inductances
- Extended Park model

Chapter 8. Modeling of electromagnetic converters (02 weeks)

- Power transformer
- Mathematical Model of Power Transformers
- Special Transformers and Micro Transformers
- Mathematical Model and Simulation

Evaluation method:

Continuous monitoring: 40%; Examination: 60%.

Bibliographic references:

1.Course notes

2. Modeling and mathematical methods, Yves Cherruault,Ed. Eyrolles, 1998

3. Modeling and simulation for the analysis and optimization of industrial systems, Dolgui Alexandre,Ed. Lavoisier, 2004

4. Modeling and simulation: Computer science, mathematics, engineering sciences, biology, biochemistry,Cegielski Patrick,Ed. L'harmattan, 1998

5. Modeling and control of the asynchronous machine, JPHautier and JPCaron,Ed. Technip, 1995

Semester:3
Teaching unit: UEF 2.1.1
Subject 2: Advanced control techniques
VHS: 45h00 (Class: 1h30, tutorial: 1h30)
Credits:4
Coefficient:2

Teaching objectives:

Present to the student a utility synthesis on the different graphical and analytical models of advanced system controls necessary to understand the various aspects of their operation, to understand the formalism of identification techniques.

Recommended prior knowledge:

Dynamic models of electrical machines.

Material content:

Chapter 1. Optimal control(03 weeks)
-Introduction to command in state space
-Formulation of the control problem and optimality criterion
-Optimal control of stationary or non-stationary linear systems with quadratic criterion; LQ (infinite horizon and finite horizon), LQG.

Chapter 2. Adaptive control(03 weeks)
-Principle of adaptive control
-The different adaptive control techniques
-Synthesis of some adaptive control laws (direct adaptive control with MRAS reference model, adaptive control with self-adjusting regulator, etc.)

Chapter 3. Control by RST regulator (03 weeks)
- Principles of RST regulators
-Structure of RST regulators, presentation of the different polynomials
-Synthesis of RST regulators

Chapter 4. Robust order (03 weeks)
- Analysis of multivariable looped systems, transfer matrix and singular value
- Generalization of the Nyquist criterion, sensitivity function
- Robustness analysis and resolution method

Chapter 5. Predictive ordering (03 weeks)
- Principle of predictive control
- Prediction model
- Synthesis of the equivalent RST polynomial regulator and choice of adjustment parameters

Evaluation method:

Continuous monitoring: 40%; Examination: 60%.

Bibliographic references:

1. Course notes
2. State representation for modeling and control of systems, Luc JAULIN, Ed. Lavoisier, 2005
3. Systems control: Design, identification and implementation, ID LANDAU. Ed. Hermès-Lavoisier, 2002
4. Adaptive Control: Practical and Theoretical Aspects, IDLandau, L. Dugard, Ed.Masson, 1986

Semester:3

Teaching unit: UEF 2.1.2
Subject 1: Microprocessors and APIs
VHS: 45h00 (Class: 1h30, tutorial: 1h30)
Credits:4
Coefficient:2

Teaching objectives:

Know the operation and implementation of Microprocessors and Industrial Programmable Controllers (API) in order to develop control circuits.

Recommended prior knowledge:

Combinatorial and sequential logic, automation.

Material content:

Part 1. Microprocessors(07 weeks)

- Architecture
- General purpose microprocessors
- DSP digital signal processing processors
- Microcontrollers
- Memoirs
- Input/output devices
- Methods of information exchange

-Microcontrollers

- Digital signal processing processors
- Programming
- Examples of processors available on the market

Part 2. Industrial Programmable Controllers (PLC)(08 weeks)

- API architecture: Organization, input-output, memory, Bus.
- Choice and cabling of APIs: characteristics, environment, evaluation
- PLC programming software: GRAFCE, basic, calculation and sequential languages,
- Applications: Automation of elevators, pumps, ventilation systems, compressors, continuous transport mechanisms, machine tools.

Evaluation method:

Continuous monitoring: 40%; Examination: 60%.

Referencesbibliographic:

1. Course notes
2. Progress with PIC microcontrollers, Gérard Samblancat,Ed.Dunod, 2006
3. Programming PICs in C, Christian Tavernier,Ed.Dunod, 2006
4. AVR microcontrollers: Description and implementation, Christian Tavernier,Ed.Dunod, 2009
5. Advanced PIC microcontroller projects in C, Dogan Ibrahim,Ed.Elsevier, 2008
6. Microcontrollers in C, TV Sickle,Ed.LLH Publishing, 2001

Semester:3

Teaching unit: UEF 2.1.2
Subject 2: Organization and management of industrial maintenance
VHS: 45h00 (Class: 1h30, tutorial: 1h30)
Credits:4
Coefficient:2

Teaching objectives:

Transmit to the student the basic concepts of maintenance, its role, the organization and management of maintenance.

Recommended prior knowledge:

Probability and statistics.

Material content:

Chapter 1. Maintenance policy and organization (02 weeks)
- Objective, mission, developments
- Responsibilities of the maintenance function
- Organization, maintenance functions

Chapter 2. The different types of maintenance (03 weeks)
- Fix
- Preventive
-Systematic
-Conditional
-Predictive
- Improvement

Chapter 3. Resource management (02 weeks)
- Humans
- Techniques
- Procedures

Chapter 4. Maintenance tools (04 weeks)
- Documentation
- Stock management and procurement
- Work order
- Preventive maintenance and inspection visits
- Planning
- Dashboards
- Availability and reliability of equipment

Chapter 5. The maintenance environment (04 weeks)
- Environmental protection, personal safety, control of installations
- Centralized technical management, integrated production system
- Energy and fluid management

Evaluation method:

Continuous monitoring: 40%; Examination: 60%.

Referencesbibliographic:

1. Course notes
2. Practice of preventive maintenance, Jean Henq, Ed. Dunod, 2005

3. Practice of industrial maintenance, Raymond Magnan, Ed. Dunod, 2003
4. Industrial maintenance, Yves Lavina, Ed. Company function, 2005

Semester:3

Teaching unit: UEM2.1
Subject 1:TP Modeling and simulation of electromechanical systems
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits:2
Coefficient:1

Teaching objectives:
Know how to simulate through the application of modeling techniques studied on electromechanical systems. Simulate the behavior of the converter-machine association.

Recommended prior knowledge:
Concepts of control and regulation; modeling and control theories of electrical machines.

Material content:

TP 1. Simulation of direct current motors (01 session)

TP 2. Simulation of the DC motor converter association (01 session)

TP 3. Simulation of synchronous motors (01 session)

TP 4. Simulation of the converter-synchronous motor association (01 session)

TP 5. Simulation of asynchronous motors (01 session)

TP 6. Simulation of the converter-asynchronous motor association (01 session)

Evaluation method:
Continuous control: 100%.

Bibliographic references:
Course notes and laboratory brochures.

Semester:3
Teaching unit: UEM2.1

Subject 2: TP Advanced control techniques
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits:2
Coefficient:1

Teaching objectives:

The student will be able, on the one hand, to make a good theoretical analysis of the different existing control methods and, on the other hand, to practice, through simulation, advanced techniques applied to electric motors.

Recommended prior knowledge:

Advanced control techniques course.

Material content:

TP1. Control by state feedback of an electric motor (02 sessions)

TP2. Simulation of an adaptive control with a reference model (02 sessions)

TP3.Simulation of an RST command (02 sessions)

TP4.Simulation of a robust or predictive control (02 sessions)

Evaluation method:

Continuous control: 100%.

Bibliographic references:

Course notes and laboratory brochures.

Semester:3
Teaching unit: UEM2.1

Subject 3:TP Microprocessors and API
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits:2
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 industrial programmable logic controllers (PLC).

Recommended prior knowledge:

Industrial automation, algorithms, programming languages.

Material content:

TP1. Getting started with a µ-processor programming environment(01 session)
TP2. Programming arithmetic and logic operations in a µ-processor (01 session)
TP4. µ-processor memory management(01 session)
TP5. Programming APIs in assembly language (01 session)
TP6. API programming in advanced language (01 session)
TP7. Programming APIs in Grafcet (01 session)

Evaluation method:

Continuous control: 100%.

Bibliographic references:

Course notes and laboratory brochures.

Semester:3
Teaching unit: UEM2.1
Subject 4: Computer-Aided Manufacturing Design CAD/CAM
VHS: 37h30 (Class: 1h30, TP: 1h00)

Credits:3
Coefficient:2

Teaching objectives:

The aim is to improve students' knowledge in the field of CAD/CAM. At the end of the semester, the student will have to acquire the following skills:
- Modeling of parts with complex shapes (molds, matrices, etc.).
- Simulation of the machining process.
- Interpretation and verification of the automatically generated machining program.

During the practical sessions, the student will have to master CAD/CAM software to design complex parts and assemblies as well as to simulate the machining of the designed parts. If existing resources allow it, the student must go to the workshop to execute the program generated on a numerically controlled machine tool (MOCN).

Recommended prior knowledge:

Mathematics, industrial design, mechanical construction, mechanical manufacturing.

Material content:

Chapter 1. General (01 Week)
(Definition of CAD/CAM, product development process, elements of a CAD system, elements of a CAM system, CAD/CAM software).
Chapter 2. Curve modeling (03 Weeks)
(Introduction, smoothing and interpolation, mathematical and geometric continuities, Bézier curves, B-spline curves, NURBS curves, examples).
Chapter 3. Surface modeling (03 Weeks)
(Introduction, Bézier tiles, continuity, B-spline tiles, NURBS tiles, examples).
Chapter 4. Modeling of solids (01 Week)
(Introduction, modeling by decomposition, Boolean operations, modeling by "B-Rep" boundaries, modeling by "CSG" construction tree, exchange formats).
Chapter 5. MOCN (01 Week)
(Introduction, main bodies, areas of use, standardized axes, origins, control of an axis, different architectures of MOCN).
Chapter 6. ISO Programming (04 Weeks)
(Introduction, structure of an NC program, main preparatory functions, main auxiliary functions, cutting parameters, predefined cycles, examples).
Chapter 7. Generation of machining trajectories (02 Weeks)
(Introduction, machining strategies, longitudinal and transverse pitch, tolerances, discontinuities and interferences).
The practical sessions: must take place in a room equipped with microcomputers on which either CAD/CAM software or CAD software and another CAM software are installed. The practical work must be divided into two parts:
CAD part: (07 weeks)
-Production of parts with complex shapes (use of splines and surface tools). Backup in a neutral format.
- Creation of an assembly.
- Determination of the mass characteristics of parts and assemblies.
- Production of mold and die impressions.
- Static simulation (rapid calculation of stresses and deformations).
-Drawing of parts and assemblies (cartridge, nomenclature, annotations).

- Kinematic and dynamic simulation (Position, speed, acceleration, trajectory, force, torque, power).

FAO part: (08 weeks)

Simulation of part machining by following the following steps:

- Modeling of the finished part (or opening of it, if it is already designed).
- Modeling of the stock (or opening of it, if it is already designed).
- Choice of the type of machining (turning, prismatic machining, surface machining, etc.).
-Choice of machine (horizontal lathe, vertical lathe, 3-axis milling machine, 5-axis milling machine, etc.).
- Repository selection.
- Selection of the finished part and the stock.
- Choice of a security plan.
- Choice of the type of machining (roughing, pocket machining, surfacing, contouring, following curves, sweeping, drilling, facing, turning, etc.).
- Choice of surfaces to machine (in the case of turning, this will be generators).
- Choice of tool.
- Determination of cutting conditions (cutting and feed speeds).
- Choice of machining strategy (Zig-zag, round trip, one way, etc.).
- Choice of axial and radial passes (optionally).
- Approach and retreat macro settings.
- Execution of the simulation (generation of tool paths).
- Viewing the generated video.
- Determination of machining times.
- Choice of post-processor.
- Generation of the machining program in G-code.
- Reading and checking the generated program.

For the CAM part, it is necessary to start with parts of simple shapes (prismatic and cylindrical) in order to experience the effect of the variation of the different parameters chosen (variation of cutting conditions, machining strategies, cutting tools , radial and axial passes, approach and retreat macros, etc.); checking the generated machining program will also be easier. Subsequently, parts with complex shapes can then be processed without difficulty. If available means allow it, it would be very beneficial to run the generated program on a MOCN.

The time allocated being very limited, a large part of the work will have to be carried out by the students outside of practical hours.

Evaluation method:

Continuous control: 40%; Exam: 60%.

Referencesbibliographic:

1. JEAN-CLAUDE LEON, “Modeling and construction of surfaces for CAD/CAM”,
2. Ed. Hermès, Paris, 1991.
3. GERALD FARIN, “Curves and Surfaces for CAGD”, Ed. Academic Press, 2002.
4. M. HOSAKA, “Modelling of Curves and Surfaces in CAD/CAM”, Ed. Springer Verlag, 1992.
5. DAVID F. ROGERS, "An Introduction to NURBS with Historical Perspective", Ed. Academic Press, 2001.
6. KUNWOO LEE, “Principles of CAD/CAM/CAE systems”, Ed. Addison Wesley, 1999.
7. IBRAHIM ZEID, “Mastering CAD/CAM”, Ed. McGraw-Hill, 2004.
8. MILTIADIS A. BOBOULOS, “CAD-CAM & Rapid Prototyping Application Evaluation”, Ed. Ventus Publishing Aps, 2010.
9. ALAIN BERNARD, “Computer-assisted manufacturing”, Ed. Lavoisier Hermès-science, Paris, 2003.
10. PETER SMID, “CNC Programming Handbook”, Ed. IndustrialPress Inc., 2007.
11. JEAN VERGNAS, “Operation of numerically controlled machine tools”, Ed. Pyc, 1985.

12. CLAUDE HAZARD, “Numerical control of machine tools”, Ed. Foucher, 1984.
13. CLAUDE MARTY, CLAUDE CASSAGNES, PHILIPPE MARIN, “The practice of numerical control of machine tools”, Ed. Tec & Doc, 1993.
14. A. CORNAND, F. KOLB, “Machining and numerical control”, Ed. Foucher, 1987.
15. P. GONZALEZ, “Numerical control by computer: turning, milling, machining center”, Ed. Casteilla, Paris, 1993.
16. CATIA software documentation, “Catia LatheMachining”, “Catia PrismaticMachining”, “Catia Advanced Machining”.

Semester: 3
Teaching unit: UED 2.1
Subject 5:basket of your choice
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1

Coefficient: 1

Semester: 3
Teaching unit: UED2.1
Material6:basket of your choice
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Semester: 3
Teaching unit: UET2.1
Matter :Documentary research and dissertation design
VHS: 10:30 p.m. (Class: 1h30)
Credit: 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.*

Proposal of some discovery materials

Semester: ..
Teaching unit: UED..
Subject 1:Smart sensor
VHS: 10:30 p.m. (Class: 1h30)
Credits:1
Coefficient:1

Teaching objectives:

Master the basic operating principle of a sensor, the metrological characteristics that must be taken into account when using and choosing a sensor as well as the different constituent elements of an excessive chain.

Recommended prior knowledge:

General electricity, electrical and electronic measurements, Sensor and conditioner and signal processing

Content of the material:

Chapter 1. General information and metrological characteristics of sensors (2 weeks)

Reminders on dimensional analysis and calculation of uncertainties, principles and classification of sensors, passive sensors, active sensors, Calibration, sensitivity, linearity, precision, etc.

Chapter 2. Introduction to intelligent and communicating systems (2 weeks)

Technological evolution and industrial needs, definitions of intelligent sensors and their functions, life cycle, applications.

Chapter 3. Smart sensors in industry 4.0 (4 weeks)

Industry 4.0, integration of smart sensors, role of smart sensors

Chapter 4. Mini-projects on smart sensors (workshops) (4 weeks)

In this chapter students will carry out mini-projects on smart sensors; pollution sensors, position, pressure.

Evaluation method:

-Continuous control 50%
-Personal work (workshops) 50% - Mini-projects on smart sensors; in this part the student has the option of choosing a mini project on the different types of intelligent sensors and carrying it out using the means available.

Bibliographic references:

1. J.Niard, ''Electrical measurements'', Nathan 1981.
2. JP Bentley, ''Principles of measurement systems'', Pearson education 2005.
3. P. Dassonvalle, ''The sensors'', Dunod 2013.
4. JM Broust, ''Industrial electrical equipment and installations: design, coordination, implementation and maintenance'', Dunod, Paris 2008.
5. M.BAYART, Intelligent sensors and actuators, engineering technique N°S 7 5202005.
6. George Ash et al, Sensors in industrial instrumentation, Dunod 2010.
7. Karim Bourouni, Measurement exercises and instrumentation with some corrections, the National School of Engineers of Tunis, 2011.
8. P. Dassonvalle, Sensors -70 exercises and corrected problems, Dunod 2019.

Semester: ..
Teaching unit: UED..
Subject 1:Cold and air conditioning
VHS: 10:30 p.m. (Class: 1h30)
Credits:1
Coefficient:1

Teaching objectives:

This subject allows the student: to acquire knowledge in the fieldair conditioning and air conditioning,master the basic operating principle of a refrigeration circuit,to address the technology of refrigeration installations.

Recommended prior knowledge:

Thermodynamics and heat transfer.

Content of the material:

Chapter 1. General **(02 weeks)**
Concept of comfort, refrigeration, humidification.

Chapter 2. Refrigeration circuit **(03 weeks)**
Constitution, operation, refrigerants.

Chapter 3. Enthalpy diagram **(04 weeks)**
Definition, refrigeration cycle, application and use of the diagram.

Chapter 4. Case study **(04 weeks)**
Thermal assessment, sizing of a refrigeration circuit, determination of the main components.

Chapter 5. Air humidifiers **(02 weeks)**
Necessity, applications.

Evaluation method:

Review: 100%.

Bibliographic references:

1. H. Noack and R. Seidel,''Practical refrigeration installations'', Editions PYC 1999.
2.P. Rapin,P.Jacquard,J.Desmons,''Refrigeration plant technology'', Editions PYC 2015.
3.J. Bouteloup,Mr. Le Guay,I Ligen,''Air conditioning - Air conditioning'', Volume 1: Air treatment,Parisian editions (EDIPA)1996.
4. F. Reinmuth, ''Modern air conditioning and air conditioning by example'', Volume 1: The calculations, Editions PYC Livres, Paris 1999.
5. F. Reinmuth, ''Modern air conditioning and air conditioning by example'', Volume 2: The choice of a system, Editions PYC Livres, Paris 1999.

Semester: ..
EU DiscoveryCode: UED..
Matter:Exploitation of 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

VSchapter1. Introduction to renewable energies (04 weeks)

Chapter 2. Exploitation of solar energy (04 weeks)

Chapter 3. Exploitation of wind energy (03 weeks)

Chapter 4. Exploitation of other renewable sources: hydraulic, geothermal, biomass... (02 weeks)

Chapter 5.Storage, fuel cells and hydrogen (02 weeks)

Evaluation method:

Review:100%.

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: Signal processing
VHS:10:30 p.m.(Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

This subject aims to provide students with basic tools on the analysis of signals and spectra for the purpose of use in maintenance and fault detection.

Recommended prior knowledge:

Mathematics, Algebra

Material content:

Chapter01. General **(03 weeks)**
Introduction; Definitions; Classification of signals; Special signals; Frequency representation

Chapter02. Analog signal processing **(04 weeks)**
Fourrier series; Fourier transform; Convolution; Filtering concept; Concept of modulation

Chapter03. Digitization **(04 weeks)**
Sampling;Quantification; Coding

Chapter04. Digital signal processing **(04 weeks)**
Fourier transform of a discrete signal; Discrete Fourier transform; Concept of fast Fourier transform

Evaluation method:

Review:100%.

Bibliographic references:

1. Dominique Placko, “Measurement and instrumentation: Volume 1. From the physics of the sensor to the electrical signal”, Publisher: Hermès – Lavoisier, October 1970.
2. MaïtineBergouniou, “Mathematics for signal processing - Course and corrected exercises”, SCIENCES SUP – Dunod, 2010.
3. M. Benidir, “Signal theory and processing: Volume 1 – representation of signals and systems”, Collection: Sciences Sup, Dunod, 2002.

Semester: ..
UE TransversaleCode: UED ..

Subject: Industrial security and authorization
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

The subject aims to inform the future master on the nature of electrical accidents, the methods of rescuing electrical accidents and to give him sufficient knowledge to enable him to best dimension the protection devices of the equipment and personnel involved in industry and other areas of use of this equipment.

Recommended prior knowledge:

Electric energy transport and distribution networks.

Material content:

Chapter 1. Electrical risks **(03 weeks)**
Historical; Standards; Electrical accident statistics

Chapter 2. Nature of electrical accidents and dangers of electric current **(03 weeks)**

Chapter 3. Protective measures **(03 weeks)**
Protection of people and equipment

Chapter 4. Safety measure against indirect effects of electric current **(04 weeks)**
Harmful materials; Fire; Explosions, etc.

Chapter 5. Relief measure and care **(02 weeks)**

Evaluation method:

Review: 100%.

Bibliographic references:

1. Detection, extinction and instruction plans, Editions CNPP-France, 15th edition, 2014, 224 pages.
2. Fire safety notice: instructions for use. Editions CSTB-France, 2013, 218 pages.
3. Nichan Margossian, Risks and major industrial accidents, The new factory, 2006, Dunod
4. CHOQUET. A. Electrical safety. Prevention techniques. DUNOD.
5. FOLLIOT. D. Electrical accidents and their prevention. MASSON.
6. VILLEMEUR A., “Operational safety of industrial systems”, Collection of the Department of Studies and Research of Electricity of France No. 67, Eyrolles, 1988.

Semester: ..
EU Discovery Code:UED..

Matter:Industrial data
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

This subject allows students of this master's degree to become familiar with the field of industrial computing. They will acquire the notions of communication protocols.

Recommended prior knowledge:

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

Material content:

Chapter 1. Introduction to industrial computing (02 weeks)

Chapter 2. Connecting hardware to a µP (02 weeks)

Chapter 3. Peripherals and interfaces (Ports, Timers, etc.) (04 weeks)

Chapter 4. Serial communication bus (RS-232, DHCP, MODBUS, I2C) (05 weeks)

Chapter 5. Data Acquisition: CAN and CNA Devices (02 weeks)

Evaluation method:

Review: 100%.

Bibliographic references:

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