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 Pedagogical Committee for the Field of Science and Technology

HARMONIZED ACADEMIC MASTER'S PROGRAM

NATIONAL CURRICULUM

— Updated 2025 —

Domain	Field of Study	Major
Technology	***Electromechanics***	***Electromechanics***

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مواءمة
ماستر أكاديمي

تحيين 2025

الميدان	الفرع	التخصص
تكنولوجيا	كهروميكانيك	كهروميكانيك

I – Master's Program Overview

Admission Requirements

(Bachelor's degree majors that provide access to the Master's program)

Field of Study	Harmonized Master's Degree	Master's Degree Licenses	Classification according to License compatibility	Coefficient assigned to the license
Electromechanics	Electromechanics	Electromechanics	**1**	**1.00**
		Industrial Maintenance	**2**	**0.80**
		Electrotechnical	**3**	**0.70**
		Electronic	**3**	**0.70**
		Mechanical engineering	**3**	**0.70**
		Energy	**3**	**0.70**
		Other Technology Domain Licenses	**5**	**0.60**

II – Semester organisation sheets for the major's courses

Semester 1 – Master's Degree: Electromechanics

Teaching Unit (TU)	Module Title	Credits	Coefficient	Weekly Hourly Volume			Semester Hourly Volume (15 weeks)	Supplementary Research and Consultation (15 weeks)	Evaluation Methods	
				Course	**TD**	**PW**			**Continuous Assessment**	**Exam**
Fundamental (TU) Code : TUC 1.1.1 Credits : 10 Coefficients : 5	Modeling and Simulation of Electric Machines	4	2	1h30	1h30		45h00	55h00	40%	60%
	Advanced Power Electronics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Industrial Electrical Grids	2	1	1h30			22h30	27h30		100%
Fundamental (TU) Code : TUC 1.1.2 Credits : 8 Coefficients : 4	Industrial Mechanisms and Power Transmission	4	2	1h30	1h30		45h00	55h00	40%	60%
	Hydraulic and Pneumatic Machines	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological (TU) Code : TUM 1.1 Credits : 11 Coefficients : 7	PW Modeling and Simulation of Electric Machines	2	1			1h30	22h30	27h30	100%	
	PW Advanced Power Electronics	2	1			1h30	22h30	27h30	100%	
	PW Industrial Electrical Grids	2	1			1h30	22h30	27h30	100%	
	PW Industrial Mechanisms and Power Transmission	2	1			1h30	22h30	27h30	100%	
	PW Hydraulic and Pneumatic Machines	1	1			1h30	22h30	2h30	100%	
	Advanced Python Programming	2	2	1h30		1h30	45h00	5h00	40%	60%
Discovery (TU) Code : TUD 1.1 Credits : 1 Coefficients : 1	Elective Subject	1	1	1h30			22h30	02h30		100%
Semester 1 Total		**30**	**17**	**10h30**	**6h00**	**9h00**	**382h30**	**367h30**		

Semester 2 – Master's Degree: Electromechanics

Teaching Unit (TU)	Module Title	Credits	Coefficient	Weekly Hourly Volume Course	TD	PW	Semester Hourly Volume (15 weeks)	Supplementary Research and Consultation (15 weeks)	Evaluation Methods Title	Examen
Fundamental (TU) Code : TUF 1.2.1 Credits : 8 Coefficients : 4	Control of Electric Machines	4	2	1h30	1h30		45h00	55h00	40%	60%
	Hydraulic and Pneumatic Control	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental (TU) Code : TUF 1.2.2 Credits : 10 Coefficients : 5	Applied Thermodynamics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Applied Fluid Mechanics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Diagnostics and Condition Monitoring	2	1	1h30			22h30	27h30		100%
Methodological (TU) Code : TUM 1.2 Credits : 9 Coefficients : 5	pw Control of Electric Machines	2	1			1h30	22h30	27h30	100%	
	pw Hydraulic and Pneumatic Control	2	1			1h30	22h30	27h30	100%	
	pw Applied Thermodynamics	2	1			1h30	22h30	27h30	100%	
	Applied Numerical Methods	3	2	1h30		1h30	45h00	30h00	40%	60%
Transversale (TU) Code : TUT 1.2 Credits : 3 Coefficients : 3	Elements of Applied AI	2	2	1h30	1h30		45h00	5h00	40%	60%
	Compliance with Standards, Ethics, and Integrity Rules	1	1	1h30			22h30	02h30		100%
Semester 2 Total		**30**	**17**	**12h00**	**6h00**	**7h30**	**382h30**	**367h30**		

Semester 3 – Master's Degree: Electromechanics

Teaching Unit (TU)	Module Title	Credits	Coefficient	Weekly Hourly Volume Course	 TD	 PW	Semester Hourly Volume (15 weeks)	Supplementary Research and Consultation (15 weeks)	Evaluation Methods Title	 Examen
Fondamentale (TU) Code : TUF 2.1.1 Credits : 10 Coefficients : 5	Modeling and Simulation of Electromechanical Systems	6	3	3h00	1h30		67h30	82h30	40%	60%
	Advanced Control Techniques	4	2	1h30	1h30		45h00	55h00	40%	60%
Fondamentale (TU) Code : TUF 2.1.2 Credits : 8 Coefficients : 4	Microprocessors and PLCs	4	2	1h30	1h30		45h00	55h00	40%	60%
	Organization and Management of Industrial Maintenance	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological (TU) Code : TUM 2.1 Credits : 9 Coefficients : 5	PW Modeling and Simulation of Electromechanical Systems	2	1			1h30	22h30	27h30	100%	
	PW Advanced Control Techniques	2	1			1h30	22h30	27h30	100%	
	PW Microprocessors and PLCs	2	1			1h30	22h30	27h30	100%	
	CAD/CAM (Computer-Aided Design / Computer-Aided Manufacturing)	3	2	1h30		1h00	37h30	37h30	40%	60%
Transversale (TU) Code : TUT 2.1 Credits : 3 Coefficients : 3	Reverse Engineering	2	2	1h30	1h30 Atelier		45h00	5h00	40%	60%
	استرجاع المعلومات وتصميم الرسالة العلمية	1	1	1h30			22h30	02h30		100%
Semester 3 Total		**30**	**17**	**13h30**	**6h00**	**5h30**	**382h30**	**367h30**		

Semester 4

Industrial or Research Internship followed by a Thesis and Defense.

	Total Semester Hours	Coeff	Credits
Independent Study	550	09	18
Industrial or Laboratory Internship	100	04	06
Seminars	50	02	03
Other (Supervision)	50	02	03
Total Semester 4	750	17	30

This table is for information purposes only

Master's Thesis Evaluation

- Scientific Value (Jury Evaluation) /6
- Thesis Writing (Jury Evaluation) /4
- Presentation and Q&A (Jury Evaluation) /4
- Supervisor's Evaluation /3
- Internship Report Presentation (Jury Evaluation) /3

III - Detailed Program by Subject - Semester 1

Semester: 1
Teaching Unit: TUF 1.1.1
Course 1: Modeling and Simulation of Electric Machines
Total Hours: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

Establish the mathematical models necessary for the modeling and simulation of electric machines. These models provide, for the considered machine, the instantaneous and steady-state equations, performance, and control laws.

Recommended Prior Knowledge:

The student should have the following knowledge:

- Three-phase electrical circuits, magnetic circuits, single-phase and three-phase transformers.
- DC and AC electric machines.

Course Content:

Chapter 1: General Modeling of Machines (3 weeks)
Chapter 2: Modeling of Machines for Dynamic Regimes (3 weeks)
Chapter 3: Modeling and Simulation of DC Machines (3 weeks)
Chapter 4: Modeling and Simulation of Synchronous Machines (3 weeks)
Chapter 5: Modeling and Simulation of Squirrel-Cage Induction Machines (3 weeks)

Assessment Method:

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

Bibliographic References:

1. P. Barret, "Régimes transitoires des machines tournantes électriques", Edition Eyrolles, 1997. ISBN10 : 2-212-01574-7.
2. M. Kostenko, L. Piotroviski, "Machines électriques, Tome 2 : Machines à courant alternatif ", Edition Moscou.
3. J. P. Fanton, "Electrotechnique, Machines et réseaux, génie électrique",EditionEllipses, 2002. ISBN 10 : 2729811133.
4. R Abdessemed, ''Modélisation et simulation des machines électriques'', Edition Ellipses 2011. ISBN10 : 2-7298-6495-4.
5. J. P. Caron, J.P. Hautier, "Modélisation et commande de la machine asynchrone", Edition Technip 1995. ISBN : 9782710806837.
6. J. Chatelain, ''Machines Electriques'', T1 & T2,Edition Dunod, 1989.
7. D. Hanselman, ''Brushlesspermenent magnet motor design'', Magna physicspublishing 2006. ISBN: 1-881855-15-5.

Semester: 1
Teaching Unit: UEF 1.1.1
Course 1: Advanced Power Electronics
Total Hours: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

Enable the student to deepen their knowledge in energy conversion and quality, and provide them with certain concepts on modern converters and their control.

Recommended Prior Knowledge:

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

Course Content:

- Chapter 1: Choppers (3 weeks)
- Chapter 2: Control Techniques of Static Converters (3 weeks)
- Chapter 3: New Topologies of Converters (3 weeks)
- Chapter 4: Energy Quality of Static Converters (3 weeks)
- Chapter 5: Applications of Converters (3 weeks)

Assessment Method:

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

Bibliographic References:

1. G. Seguier, ''Les convertisseurs de l'électronique de puissance. Tome 1 : La conversion alternatif–continu'', Édition Lavoisier - Tec& Doc1992.
2. C. Rombaut, G. Seguier, ''Les convertisseurs de l'électronique de puissance. Tome 2 : La conversion alternatif–alternatif'', Édition Lavoisier - Tec & Doc1991.
3. R. Bausiere. F. Labrique, G.Seguier, ''Les convertisseurs de l'électronique de puissance. Tome 3 : La conversion continu–continu'', Édition Lavoisier - Tec & Doc1997.
4. F. Labrique, G. Seguier, R. Bausiere,''Les convertisseurs de l'électronique de puissance. Tome 4 : La conversion continu-alternatif'', Édition Lavoisier - Tec & Doc1995.
5. H. Bühler, ''Convertisseurs statiques'', Édition Presses polytechniques et universitaires romandes 1991.

Semester: 1
Teaching Unit: UEF 1.1.1
Course 1: Industrial Electrical Grids
Total Hours: 22h30 (Lecture: 1h30)
Credits: 2
Coefficient: 1

Teaching Objectives:

This course aims to provide students first with an overview of industrial electrical grids (architectures, diagrams, and plans), and then the necessary information to assess an electrical installation and the principles to follow to work on an installation safely.

Recommended Prior Knowledge:

Basic knowledge of electrical networks and equipment.

Course Content:

- Chapter 1: Generalities (1 week)
- Chapter 2: Industrial Electrical Grids (2 weeks)
- Chapter 3: Industrial Electrical Installations (Installations and Panels) (3 weeks)
- Chapter 4: Grounding and Safety in an Installation (3 weeks)
- Chapter 5: Installation Calculations (3 weeks)
- Chapter 6: Wiring and Maintenance (3 weeks)

Assessment Method:

Final exam: 100%.

Bibliographic References:

1. J. M. Broust, ''Appareillages et installations électriques industriels : conception, coordination, mise en œuvre et maintenance'', Dunod, Paris 2008.
2.C.Prévé et R. Jeannot, ''Guide de conception des réseaux électriques industriels'', Schneider Electric, n° 6883 427/A 1997.
3.D.Fedullo, T.Gallauziaux, ''Le grand livre de l'électricité'', Ed Broché, Eyrolles 2009.

Semester: 1
Teaching Unit: UEF 1.1.2
Course 1: Industrial Mechanisms and Power Transmission
Total Hours: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

Develop in the student the concepts of designing and implementing motion transmission systems for certain mechanisms and machine components (bearings, gear reducers, etc.).

Recommended Prior Knowledge:

The student should have knowledge of:

- Applied Mechanics
- Mechanical Manufacturing

Course Content:

- Chapter 1: Generalities (2 weeks)
- Chapter 2: Implementation of Joints (2 weeks)
- Chapter 3: Rotational Guidance (3 weeks)
- Chapter 4: Translational Guidance (3 weeks)
- Chapter 5: Motion and Power Transmission Components (5 weeks)

Assessment Method:

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

Bibliographic References:

1. E. Francis,''Construction mécanique: transmission de puissance'',Tome 1, ISBN: 2-10-049125-12006.
2. E. Francis,''Construction mécanique: transmission de puissance'',Tome 2, ISBN: 2-10-049750-2 2006.
3. E. Francis,''Construction mécanique: transmission de puissance'',Tome 3, ISBN: 2-10-049749-32006.

Semester: 1
Teaching Unit: UEF 1.1.2
Course 1: Hydraulic and Pneumatic Machines
Total Hours: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

The program aims to familiarize the student with the different types of hydraulic and pneumatic machines. Aerodynamic and thermodynamic concepts are applied to establish 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 should have knowledge of:

- Fluid Mechanics
- Applied Thermodynamics

Course Content:

- Chapter 1: Introduction (3 weeks)
- Chapter 2: One-Dimensional Theory of Hydraulic and Pneumatic Machines (5 weeks)
- Chapter 3: Axial and Radial Hydraulic and Pneumatic Machines (4 weeks)
- Chapter 4: Hydraulic Turbines (3 weeks)

Assessment Method:

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

Bibliographic References:

1. J. Faisandeur,''Mécanismes hydrauliques et pneumatiques'', Dunod 2006.
2. ''Industrial hydraulic Systems, an introduction'', Englwoodcliffs(new jersy), Prentice hall 1988.
3. R.Affouard, J. Diez, ''Les installations hydrauliques conception et réalisation pratique'', Paris, entreprise moderne d'édition 1972.
4. S. L.Dixon, ''Fluid Mechanics and Thermodynamics of Turbomachinery'', Fourth edition, Butterworth-Heinemann, Woburn, MA, USA 1998, ISBN 0-7506-7059-2.
5. H.Cohen, ,G.F.C.Rogers, H.I.H.Saravanamuttoo, ''Gas Turbine Theory'', Fourth edition, Longman group, Harlow, UK 1996, ISBN 0-582-23632-0.

Semester: 1
Teaching Unit: UEM 1.1
Course 1: Practical Work – Modeling and Simulation of Electric Machines
Total Hours: 22h30 (Practical: 1h30)
Credits: 2
Coefficient: 1

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

Recommended Prior Knowledge:
Good mastery of computer tools and MATLAB-SIMULINK software.

Course Content:

- TP1: Introduction to MATLAB-SIMULINK
- TP2: Modeling and Simulation of DC Machines
- TP3: Modeling and Simulation of Synchronous Machines
- TP4: Modeling and Simulation of a Permanent Magnet Synchronous Machine
- TP5: Modeling and Simulation of Squirrel-Cage Induction Machines

Assessment Method:
Continuous assessment: 100%.

Bibliographic References:
Course Notes and Laboratory Manuals

Semester: 1
Teaching Unit: UEM 1.1
Course 1: Practical Work – Advanced Power Electronics
Total Hours: 22h30 (Practical: 1h30)
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.

Course Content:

TP1: One-Quadrant and Four-Quadrant Chopper
TP2: Triangular-Sinusoidal PWM of a Voltage Inverter
TP3: Vector PWM of a Voltage Inverter
TP4: Simulation of a Multilevel Converter
TP5: Simulation of a Multicell Converter
TP6: Simulation of a Matrix Converter
TP7: Power Factor Correction

Assessment Method:
Continuous assessment: 100%

Bibliographic References:
Course Notes and Laboratory Manuals

Semester: 1
Teaching Unit: UEM 1.1
Course 1: Practical Work – Industrial Electrical Grids
Total Hours: 22h30 (Practical: 1h30)
Credits: 2
Coefficient: 1

Teaching Objectives:

This course aims to introduce students to the main indicators of energy quality in an industrial installation and to enable them to assess this quality.

Recommended Prior Knowledge:

Basic knowledge of networks, machines, and signals.

Course Content:

TP1: Loads and Their Supply Constraints
TP2: Reactive Power Compensation
TP3: Harmonics in an Industrial Network
TP4: Sizing an Industrial Installation

Assessment Method:

Continuous assessment: 100%

Bibliographic References:

Course Notes and Laboratory Manuals

Semester: 1
Teaching Unit: UEM 1.1
Course 1: Practical Work – Industrial Mechanisms and Power Transmission
Total Hours: 22h30 (Practical: 1h30)
Credits: 2
Coefficient: 1

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

Recommended Prior Knowledge:
Applied Mechanics and Mechanical Manufacturing.

Course Content:

TP1: Fixed Joint and Gear Reducer

TP2: Alignment of Couplings

TP3: Bearing Adjustments

TP4: Geometric Inspection of the Rotor

Assessment Method:
Continuous assessment: 100%

Bibliographic References:
Course Notes and Laboratory Manuals

Semester: 1
Teaching Unit: UEM 1.1
Course 1: Practical Work – Hydraulic and Pneumatic Machines
Total Hours: 22h30 (Practical: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:
The objective is to develop in the student the skills to analyze hydraulic and pneumatic circuits.

Recommended Prior Knowledge:
Thermodynamics and Fluid Mechanics (MDF).

Course Content:
- TP1: Study of a Venturi
- TP2: Test of a Centrifugal Pump and Cavitation Phenomenon
- TP3: Hydraulic Turbines
- TP4: Test of a Compressible Fluid Machine

Assessment Method:
Continuous assessment: 100%

Bibliographic References:
Course Notes and Laboratory Manuals

Semester: S1
Teaching Unit: UEM 1.1
Course: Advanced Python Programming
Total Hours: 45h00 (Lecture: 1h30, Practical: 1h30)
Credits: 2
Coefficient: 2

Targeted Skills:

Use of computer tools for information acquisition, processing, production, and dissemination

Python programming and project management skills

Automation and data visualization skills

Objectives:

Deepen mastery of Python and introduce students to data analysis and artificial intelligence basics

Acquire solid computer science foundations

Learn programming in Python and Excel

Master task automation

Master project management software

Required Materials:

A computer with Python installed

Python libraries:

NumPy, Pandas, Scikit-learn, Matplotlib, os.listdir, os.path.exists, os.mkdir, os.rmdir, Seaborn, Plotly, Request, Beautiful Soup, Tkinter, PyQT, …

TensorFlow, PyTorch, …

Prerequisites: Python programming

Course Content:

Chapter 1: Python Programming Review (2 weeks)

Chapter 2: Programming and Automation (4 weeks)

Chapter 3: Advanced Excel Learning (2 weeks)

Chapter 4: Learning GanttProject (2 weeks)

Chapter 5: Advanced Object-Oriented Programming (3 weeks)

Chapter 6: Introduction to Data for AI (2 weeks)

Practical Work:

TP01: Mastering Python Programming Basics

TP02: Create a project specification for a mini-task automation project in Python to automatically identify and send reports via email

TP03: Advanced Excel for Automated Dashboards and Macros

TP04: Organize a meeting in GanttProject

TP05: Advanced Structures and Code Organization

TP06: Advanced Object-Oriented Programming in Python

TP07: File Manipulation and Data Analysis

TP08: Data Preparation and Processing for Artificial Intelligence

Final Project:
Title: Data Analysis and Visualization + Simple Predictive Model
Skills Used: Data reading, OOP, advanced structures, Pandas, Scikit-learn (Oral presentation + written report)

Assessment Method:
Final Exam: 60%; Continuous Assessment (CC): 40%

Bibliography:

[1] . E.Schultz et M.Bussonnier (2020) : Python pour les SHS. Introduction à la programmation de données. Presses Universitaires de Rennes.
[2] . C.Paroissin, (2021) : Pratique de la data science avec R : arranger, visualiser, analyser et présenter des données. Paris : Ellipses, DL 2021.
[3] . S.Balech et C.Benavent : NLP texte minig V4.0, (Paris Dauphine – 12/2019) : lien : https://www.researchgate.net/publication/337744581_NLP_text_mining_V40_-_une_introduction_-_cours_programme_doctoral
[4] . Allen B. Downey Think Python: How to Think Like a Computer Scientist, O'Reilly Media, 2015;
[5] . Ramalho, L.. Fluent Python. " O'Reilly Media, Inc.", 2022;
[6] . Swinnen, G.. Apprendre à programmer avec Python 3. Editions Eyrolles, 2012;
[7] . Matthes, E. Python crash course: A hands-on, project-based introduction to programming. no starch press, 2019
[8] . Cyrille, H. (2018). Apprendre à programmer avec Python 3. Eyrolles, 6ème édition. ISBN: 978-2212675214
[9] . Daniel, I. (2024). Apprendre à coder en Python, J'ai lu
[10] . Nicolas, B. (2024). Python, du grand débutant à la programmation objet Cours et exercices corrigés, 3eme édition, Ellipses
[11] . Ludivine, C. (2024). Selenium Maîtrisez vos tests fonctionnels avec Python, Eni

Online Resources:

- Official Python Documentation: docs.python.org
- Python Exercises on Codecademy: codecademy.com/learn/learn-python-3
- W3Schools Python Tutorial: w3schools.com/python/

III - Detailed Program by Subject - Semester 2

Semester: 2
Teaching Unit: UEF 1.2.1
Course 1: Control of Electric Machines
Total Hours: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

Enable the student to acquire knowledge in the field of power electronics and in the control of the most commonly used electric machines.

Recommended Prior Knowledge:

Basics of control systems and regulation; Electric machines and static converters.

Course Content:

- Chapter 1: Introduction (2 weeks)
- Chapter 2: Control of DC Machines (2 weeks)
- Chapter 3: Control of Asynchronous Machines (7 weeks)
- Chapter 4: Control of Synchronous Machines (4 weeks)

Assessment Method:

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

Bibliographic References:

1. Course Notes
2. Entraînements électriques à vitesse variable; Jean Bonal, Guy Séguier, 1998
3. Commande électronique des moteurs électriques; Michel Pinard; Dunod, 2004
4. Commandes des systèmes électriques ; Loron Luc, Lavoisier, 2004
5. Modélisation et commande de la machine asynchrone, J.P.Hautier et J.P.Caron, Technip, 1995
6. Electrotechnique Theodore WILDI De BEOCK UNIVERSITE.

Semester: 2
Teaching Unit: UEF 1.2.1
Course 1: Hydraulic and Pneumatic Control
Total Hours: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

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

Recommended Prior Knowledge:

Logic circuits, fluid mechanics, hydraulic and pneumatic machines.

Course Content:

- Chapter 1: Hydraulic and Pneumatic Energy in the Functional Chain of a System (2 weeks)
- Chapter 2: Industrial Hydraulic Circuits (5 weeks)
- Chapter 3: Pneumatic Automation Circuits (4 weeks)
- Chapter 4: Automated Production Systems (APS) (4 weeks)

Assessment Method:

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

Bibliographic References:

1. J. Faisandeur, ''Mécanismes hydrauliques et pneumatiques'', Dunod 2006.
2. S.Moreno, ''Pneumatiques dans les systèmes automatisés'', Eyrolle 2001.
3. ''Industrial hydraulic Systems, an introduction'', Englwood cliffs (new jersy), Prentice hall 1988.
4. R. Affouard, J. Diez, ''Les installations hydrauliques conception et réalisation pratique'', Paris, entreprise moderne d'édition 1972.

Semester: 2
Teaching Unit: UEF 1.2.2
Course 1: Applied Thermodynamics
Total Hours: 22h30 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:
Refresh the student's understanding of fundamental thermodynamics concepts and the physical interpretation of these concepts to understand thermodynamic cycles as energy conversion systems.

Recommended Prior Knowledge:
Basic laws of thermodynamics and fluid mechanics acquired during the undergraduate program.

Course Content:

Chapter 1: Principles of Thermodynamics (2 weeks)

Chapter 2: Real Cycles of Steam Power Machines (3 weeks)

Chapter 3: Theoretical Cycles of Internal Combustion Engines (3 weeks)

Chapter 4: Theoretical Cycles of Gas Turbines (4 weeks)

Chapter 5: Heat Exchangers (3 weeks)

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

Bibliographic References:
1. Thermodynamique et Energétique, Lucien BOREL
2. Systèmes Energétiques, Renaud GICQUEL
3. Thermodynamique appliquée à l'Energétique, Francis-Emile MEUNIER
4. Thermodynamique Appliquée, Van-Wylen

Semester: 2
Teaching Unit: UEF 1.2.2
Course 1: Applied Fluid Mechanics
Total Hours: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:
The course aims to provide an operational understanding of the essential concepts of fluid mechanics and mastery of the theory behind different flows to solve problems through practical case studies.

Recommended Prior Knowledge:

Rational Mechanics

Principles of Thermodynamics

Course Content:

Chapter 1: Review (1 week)

Chapter 2: Fluid Kinematics (4 weeks)

Chapter 3: Fluid Dynamics (4 weeks)

Chapter 4: Application of the Three Conservation Equations (3 weeks)

Chapter 5: Energy Balances (3 weeks)

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

Bibliographic References:
1. Course Notes.
2. R.Benhamouda,''Notions de Mécanique des Fluides''.
3. S. Amirouche, J. Luc Battaglia,''Mécanique des Fluides Cours et Exercices corrigés''.
5. Polycopiés, ''Exercices Résolus avec cours en Mécanique des fluides''.

Semester: 2
Teaching Unit: UEF 1.2.2
Course 1: Diagnostics and Condition Monitoring
Total Hours: 22h30 (Lecture: 1h30)
Credits: 2
Coefficient: 1

Teaching Objectives:

Provide the student with basic concepts for diagnosing faults and monitoring electromechanical installations and systems.

Recommended Prior Knowledge:

Knowledge in the following subjects: electrical schematics and devices, maintenance of electromechanical systems, reliability and operational safety, electric machines.

Course Content:

Part 1: Monitoring (7 weeks)

- Chapter 1: Analysis of Failure Modes
- Chapter 2: Monitoring Techniques
- Chapter 3: Monitoring the Operating Condition of a Machine

Part 2: Diagnostics (8 weeks)

- Chapter 1: System Analysis Tools
- Chapter 2: Overall Approach to Fault Localization

Assessment Method:

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

Bibliographic References:

1. J. LouiFeron,''Diagnostic maintenance, disponibilité des machines tournantes'', Edition Masson, 1995.
2. J. Morel, ''Vibration des machines et diagnostic de leur état mécanique'', Edition Eyrolles,1991.
3. G.Zwingelstein, ''Diagnostic des défaillances: théorie et pratique pour les systèmes industriels'', Traité des Nouvelles Technologies de la série Diagnostic et Maintenance, Editions Hermes, Paris 1995.
4. R. Isermann, ''Fault Diagnosis of Machines via Parameter Estimation and Knowledge Processing'', Tutorial Paper,Automatica, Vol. 29, No. 4, pp. 815-835, 1993.
5. J. N. Chatain, ''Diagnostic par systèmes experts'', Editions Hermes, Paris 1993.
6. R.Toscano, ''Commande et Diagnostic des Systèmes Dynamiques'', Série Technosup, Editions Ellipses, Paris 2005.
7. A.Boulenger et C.Pachaud, Aide-mémoire Surveillance des machines par analyse des vibrations, Dunod, Paris 2009.
8. M.Ghozlane, Techniques de Surveillance des Machines Tournantes, Tome 1 : Analyse Vibratoire, Institut Supérieur des Etudes Technologiques de Radès, édition 2013.
9. M.Ghozlane, Techniques de Surveillance des Machines Tournantes, Tome 1 : Tome 2 : Analyse des huiles industrielles, Institut Supérieur des Etudes Technologiques de Radès, édition 2013.
10. D.AUGEIX, Analyse vibratoire des machines tournantes, techniques de l'ingénieur BM5145, 10 janv. 2001.
11. D.PAJANI, L.AUDAIRE, Thermographie - Technologies et applications, techniques d'ingénieur R2741,10 mars 2013.

Semester: 2
Teaching Unit: UEM 1.2
Course 1: Practical Work – Control of Electric Machines
Total Hours: 22h30 (Practical: 1h30)
Credits: 2
Coefficient: 1

Teaching Objectives:
Learn to model and apply the control techniques studied on electric machines. Verify the dynamic behavior of controlled systems (machines with control loops). Implement and calculate PID controllers.

Recommended Prior Knowledge:
Basics of control systems and regulation; modeling and control theory of electric machines.

Course Content:

TP1: Control of a DC Machine (1 session)

TP2: Scalar Control (Voltage/Frequency) of an Asynchronous Machine (2 sessions)

TP3: Vector Control (FOC) of an Asynchronous Machine (3 sessions)

TP4: Direct Torque Control (DTC) of an Asynchronous Machine (3 sessions)

TP5: Vector Control of a Synchronous Machine (e.g., MSAP) (3 sessions)

Assessment Method:
Continuous assessment: 100%.

Bibliographic References:
Course Notes and Laboratory Manuals

Semester: 2
Teaching Unit: UEM 1.2
Course 1: Practical Work – Hydraulic and Pneumatic Control
Total Hours: 22h30 (Practical: 1h30)
Credits: 2
Coefficient: 1

Teaching Objectives:
Learn to select and size components used in industrial hydraulic or pneumatic circuits to implement simple manual or automatic control schemes.

Recommended Prior Knowledge:
Course on Hydraulic and Pneumatic Control.

Course Content:

TP1: Implementation of a Manual Control (Push Button) of a Single-Acting Cylinder (Pneumatic or Hydraulic) (2 sessions)

TP2: Implementation of a Manual Control (Push Button) of a Double-Acting Cylinder (Pneumatic or Hydraulic) (2 sessions)

TP3: Implementation of an Automatic Control (Repeated Cycle) of a Double-Acting Cylinder (Pneumatic or Hydraulic) Using an End-of-Stroke Sensor (3 sessions)

TP4: Implementation of an Automatic Control (Programmed Cycle on PLC) of a Double-Acting Cylinder (Pneumatic or Hydraulic) Using an End-of-Stroke Sensor (3 sessions)

Assessment Method:
Continuous assessment: 100%.

Bibliographic References:
Course Notes and Laboratory Manuals

Semester: 2
Teaching Unit: UEM 1.2
Course 1: Practical Work – Applied Thermodynamics
Total Hours: 22h30 (Practical: 1h30)
Credits: 2
Coefficient: 1

Teaching Objectives:
Complete, consolidate, and verify the knowledge already acquired in the Applied Thermodynamics course.

Recommended Prior Knowledge:
Good mastery of Thermodynamics and Heat Transfer.

Course Content:

TP1: Determination of the Polytropic Index "n" of Compression

TP2: Determination of the Overall Efficiency of the Compression System

TP3: Phase Change of a Pure Substance

TP4: Determination of the Adiabatic Index of Air

TP5: Phase Change of a Binary System

TP6: Verification of the Ideal Gas Equation of State

TP7: Measurement of the Saturation Vapor Pressure of Water

Assessment Method:
Continuous assessment: 100%.

Bibliographic References:
Course Notes and Laboratory Manuals

Semester: 2
Teaching Unit: UEM 1.2
Course 1: Applied Numerical Methods
Total Hours: 45h00 (Lecture: 1h30, Practical: 1h30)
Credits: 3
Coefficient: 2

Teaching Objectives:

The course on Applied Numerical Methods aims to provide the basic knowledge necessary to understand and implement the most commonly used algorithms for solving problems encountered in the processing of industrial systems.

Recommended Prior Knowledge:

Mathematics, basic notions of numerical analysis, proficiency in the MATLAB environment.

Course Content:

Chapter I: Review of Some Numerical Methods (4 weeks)

Chapter II: Solving Partial Differential Equations (6 weeks)

Chapter III: Optimization Techniques (5 weeks)

Practical Work:

Introduction to the MATLAB environment

Calculation of integrals using the Trapezoidal, Simpson, and General methods

Solving ordinary differential equations using Euler and Runge-Kutta methods

Interpolation and approximation using the Lagrange method

Solving linear and nonlinear systems of equations using Jacobi, Gauss-Seidel, and Newton-Raphson methods

Solving partial differential equations using the Finite Difference Method

Solving partial differential equations using the Finite Element Method

Minimization of a multivariable function without constraints using Gradient, Conjugate Gradient, and Quasi-Newton methods

Minimization of a multivariable function with constraints using Projected Gradient and Lagrange-Newton methods

Note: The first three sessions can be completed as personal work.

Assessment Method:

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

Bibliographic References:

1. A. Quarteroni, R. Sacco, F. Saleri, "Méthodes Numériques, Algorithmes, analyse et applications", Ouvrage de l'édition Springer-Verlag, 2007.

2. S. Nicaise, "Analyse numérique et équations aux dérivées partielles : Cours et problèmes résolus", Ouvrage de l'édition Dunod, 2000.
3. J. L. Merrien, "Analyse numérique avec Matlab : Exercices et problèmes", Edition Dunod, 2007.
4. G. Allaire, "Analyse Numérique et Optimisation", Edition de l'école polytechnique, 2012.
5. S. S. Rao, "Optimization: Theory and Applications", Wiley-Eastern Limited, 1984.

Semester: 2
Teaching Unit: UET 1.2.1
Course: Elements of Applied Artificial Intelligence
Total Hours: 45h00 (Lecture: 1h30, Practical: 1h30)
Credits: 2
Coefficient: 2

Targeted Competencies:

- Identify opportunities for artificial intelligence in engineering sciences
- Understand the ethical implications of AI and best practices for its use
- Ability to apply AI techniques to problem-solving

Objectives:

- Master AI algorithms
- Introduction to fundamental concepts, tools, and applications of modern artificial intelligence, with emphasis on practical work using Python and its libraries
- Deepen Python programming skills
- Understand AI approaches in problem-solving

Prerequisites:

Advanced Python Programming

Required Materials:

- A computer with Python installed
- Python libraries: NumPy, Pandas, Scikit-learn, Matplotlib, os.listdir, os.path.exists, os.mkdir, os.rmdir, Seaborn, Plotly, Requests, Beautiful Soup, Tkinter, PyQT, …
- TensorFlow, PyTorch, …

Course Content:

- Chapter 1: Introduction to Artificial Intelligence (AI) (1 week)
- Chapter 2: Basic Mathematics for AI (1 week)
- Chapter 3: Machine Learning (3 weeks)
- Chapter 4: Supervised Classification (3 weeks)
- Chapter 5: Unsupervised Learning
- Chapter 6: Neural Networks
- Chapter 7: Mini Project (Personal guided work outside class)

Practical Work:

- TP01: Initialization
- TP02:
    - Implement simple regression with Scikit-learn and visualize with Matplotlib
    - Visualize results using Matplotlib
- TP03:
    - Machine learning pipeline and data splitting
    - Deepen concepts covered in lectures

- TP04:
  - Use Scikit-learn to train a simple classification model
- TP05:
  - Implement a clustering algorithm on a dataset
  - Visualize clusters: Unsupervised clustering (K-means, DBSCAN)
- TP06:
  - Build a simple neural network with TensorFlow, PyTorch, or Keras
  - Build a simple CNN for image classification (e.g., MNIST dataset)

Assessment Method:

Exam: 60%; Continuous assessment: 40%

Bibliography:

- Ganascia, J.Gabriel (2024) : l'IA expliquée aux humains. Paris France- Edition le Seuil.
- Anglais, Lise, Dilhac, Antione, Dratwa, Jim et al. (2023) : L'éthique au coeur de l'IA. Quebec Obvia.
- J.Robert (2024) : Natural Language Processing (NLP) : définition et principes – Datasciences. Lien : https://datascientest.com/introduction-au-nlp-natural-language-processing
- Qu'est-ce que le traitement du langage naturel. Lien : https://aws.amazon.com/fr/what-is/nlp/
- M.Journe : Eléments de Mathématiques discrètes – Ellipses
- F.Challet : L'apprentisage profond avec Python – Eyrolles
- H.Bersini (2024) : L'intelligence artificielle en pratique avec Python – Eyrolles
- B.Prieur (2024) : Traitement automatique du langage naturel avec Python – Eyrolles
- V.Mathivet (2024) : Implémentation en Python avec Scikit-learn – Eyrolles
- G.Dubertret (2023) : Initiation à la cryptographie avec Python – Eyrolles
- S.Chazallet (2023) : Python 3 – Les fondamentaux du langage - Eyrolles
- H.Belhadef, I.Djemal : Méthode TALN – Cours de l'unievrsité de Msila - Algérie

Semester: 2
Teaching Unit: UET 1.2
Course: Compliance with Standards, Ethics, and Integrity Rules
Total Hours: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:
Develop students' awareness of ethical principles and rules governing university life and the workplace. Raise their awareness of respecting and valuing intellectual property. Explain the risks of moral wrongs such as corruption and ways to combat them, and alert them to ethical issues raised by new technologies and sustainable development.

Recommended Prior Knowledge:
Ethics and professional conduct (foundations)

Course Content:
A. Respect for Ethics and Integrity Rules

Overview of the Ethics and Professional Conduct Charter of the MESRS

Honest and responsible research

Ethics and professional conduct in the workplace

B. Intellectual Property
I. Fundamentals of Intellectual Property
II. Copyright
III. Protection and Valorization of Intellectual Property

C. Ethics, Sustainable Development, and New Technologies

Assessment Method:
Exam: 100%

Bibliographic References:

1. Charte d'éthique et de déontologie universitaires, https://www.mesrs.dz/documents/12221/26200/Charte+fran__ais+d__f.pdf/50d6de61-aabd-4829-84b3-8302b790bdce
2. Arrêtés N°933 du 28 Juillet 2016 fixant les règles relatives à la prévention et la lutte contre le plagiat
3. L'abc du droit d'auteur, organisation des nations unies pour l'éducation, la science et la culture(UNESCO)
4. E. Prairat, De la déontologie enseignante. Paris, PUF, 2009.
5. Racine L., Legault G. A., Bégin, L., Éthique et ingénierie, Montréal, McGraw Hill, 1991.
6. Siroux, D., Déontologie : Dictionnaire d'éthique et de philosophie morale, Paris, Quadrige, 2004, p. 474-477.
7. Medina Y., La déontologie, ce qui va changer dans l'entreprise, éditions d'Organisation, 2003.
8. Didier Ch., Penser l'éthique des ingénieurs, Presses Universitaires de France, 2008.
9. Gavarini L. et Ottavi D., Éditorial. de l'éthique professionnelle en formation et en recherche, Recherche et formation, 52 | 2006, 5-11.
10. Caré C., Morale, éthique, déontologie. Administration et éducation, 2e trimestre 2002, n°94.

11. Jacquet-Francillon, François. Notion : déontologie professionnelle. Le télémaque, mai 2000, n° 17
12. Carr, D. Professionalism and Ethics in Teaching. New York, NY Routledge. 2000.
13. Galloux, J.C., Droit de la propriété industrielle. Dalloz 2003.
14. Wagret F. et J-M., Brevet d'invention, marques et propriété industrielle. PUF 2001
15. Dekermadec, Y., Innover grâce au brevet: une révolution avec internet. Insep 1999
16. AEUTBM. L'ingénieur au cœur de l'innovation. Université de technologie Belfort-Montbéliard
17. Fanny Rinck etléda Mansour, littératie à l'ère du numérique : le copier-coller chez les étudiants, Université grenoble 3 et Université paris-Ouest Nanterre la défense Nanterre, France
18. Didier DUGUEST IEMN, Citer ses sources, IAE Nantes 2008
19. Les logiciels de détection de similitudes : une solution au plagiat électronique? Rapport du Groupe de travail sur le plagiat électronique présenté au Sous-comité sur la pédagogie et les TIC de la CREPUQ
20. EmanuelaChiriac, Monique Filiatrault et André Régimbald, Guide de l'étudiant: l'intégrité intellectuelle plagiat, tricherie et fraude… les éviter et, surtout, comment bien citer ses sources, 2014.
21. Publication de l'université de Montréal, Stratégies de prévention du plagiat, Intégrité, fraude et plagiat, 2010.
22. Pierrick Malissard, La propriété intellectuelle : origine et évolution, 2010.
23. Le site de l'Organisation Mondiale de la Propriété Intellectuelle www.wipo.int
24. http://www.app.asso.fr/

III - Detailed Program by Subject - Semester 3

Semester: 3
Teaching Unit: UEF 2.1.1
Course 1: Modeling and Simulation of Electromechanical Systems
Total Hours: 67h30 (Lecture: 3h00, Tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching Objectives:
Enable students to develop a methodological approach to establishing the elements of a physical model for various electromechanical systems.

Recommended Prior Knowledge:
Applied Mathematics, Electromechanical Systems.

Course Content:

Chapter 1: Dynamic Properties of the DC Machine (1 week)

Chapter 2: Dynamic Models of Synchronous Machines (2 weeks)

Chapter 3: Extension of Park's Transformation to Synchronous Motors with Non-Sinusoidal Field Distribution (2 weeks)

Chapter 4: Modeling of Converter–Machine Association (2 weeks)

Chapter 5: Dynamic Modeling of Asynchronous Machines (2 weeks)

Chapter 6: Static Modeling of Asynchronous Machines for Scalar Control (2 weeks)

Chapter 7: Extension of Park's Transformation to Saturated Asynchronous Machines (2 weeks)

Chapter 8: Modeling of Electromagnetic Converters (2 weeks)

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

Bibliographic References:
1. Course Notes
2. Modélisation et méthodes mathématiques, Yves Cherruault, Ed. Eyrolles, 1998
3. Modélisation et simulation pour l'analyse et l'optimisation des systèmes industriels, Dolgui Alexandre, Ed. Lavoisier, 2004
4. Modélisation et simulation : Informatique, mathématiques, sciences pour l'ingénieur, biologie, biochimie, Cegielski Patrick, Ed. L'harmattan, 1998
5. Modélisation et commande de la machine asynchrone, J.P.Hautier et J.P.Caron, Ed. Technip, 1995

Semester: 3
Teaching Unit: UEF 2.1.1
Course 2: Advanced Control Techniques
Total Hours: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

Provide students with a practical synthesis of the different graphical and analytical models of advanced control systems necessary to understand various aspects of their operation, and to understand the formalism of identification techniques.

Recommended Prior Knowledge:

Dynamic models of electric machines.

Course Content:

- **Chapter 1:** Optimal Control (3 weeks)
- **Chapter 2:** Adaptive Control (3 weeks)
- **Chapter 3:** RST Controller-Based Control (3 weeks)
- **Chapter 4:** Robust Control (3 weeks)
- **Chapter 5:** Predictive Control (3 weeks)

Assessment Method:

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

Bibliographic References:

1. Course Notes .
2. Représentation d'état pour la modélisation et la commande des systèmes, Luc JAULIN, Ed. Lavoisier, 2005
3. Commande des systèmes : Conception, identification et mise en œuvre, I. D. LANDAU. Ed. Hermès-Lavoisier, 2002
4. Commande Adaptative : Aspects Pratiques Et Théoriques, I. D. Landau, L. Dugard, Ed. Masson, 1986

Teaching Unit: UEF 2.1.2
Course: Microprocessors and PLC (Programmable Logic Controllers)
Total Hours (VHS): 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:
To understand the operation and implementation of Microprocessors and Industrial Programmable Logic Controllers (PLCs) in order to develop controlcircuits.

Recommended Prerequisite Knowledge:
Combinational and sequential logic, automation systems.

Course Content:

Part 1: Microprocessors (07 weeks)

Part 2: Industrial Programmable Logic Controllers (PLCs) (08 weeks)

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

Bibliographic References:
1. Course Notes.
2. Progressez avec les microcontrôleurs PIC, Gérard Samblancat, Ed. Dunod, 2006
3. Programmation en C des PIC, Christian Tavernier, Ed. Dunod, 2006
4. Microcontrôleurs AVR : Description et mise en oeuvre, Christian Tavernier, Ed. Dunod, 2009
5. Advanced PIC microcontroller projects in C, Dogan Ibrahim,Ed. Elsevier, 2008
6. Microcontrollers in C, T. V. Sickle, Ed. LLH Publishing, 2001

Semester: 3
Teaching Unit: UEF 2.1.2
Course 2: Organization and Management of Industrial Maintenance
Total Hours (VHS): 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:
To introduce students to the basic concepts of maintenance, its role, and the organization and management of maintenance.

Recommended Prerequisite Knowledge:
Probability and statistics.

Course Content:

Chapter 1: Maintenance Policy and Organization (02 weeks)

Chapter 2: Different Types of Maintenance (03 weeks)

Chapter 3: Management of Resources (02 weeks)

Chapter 4: Maintenance Tools (04 weeks)

Chapter 5: Maintenance Environment (04 weeks)

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

Bibliographic References:

1. Course Notes.
2. Pratique de la maintenance préventive, Jean Henq, Ed. Dunod, 2005
3. Pratique de la maintenance industielle, Raymond Magnan, Ed. Dunod, 2003
4. Maintenance industrielle, Yves Lavina, Ed. Fonction de l'entreprise, 2005

Semester: 3
Teaching Unit: UEM 2.1
Course 1: Practical Work – Modeling and Simulation of Electromechanical Systems
Total Hours (VHS): 22h30 (Practical Work: 1h30)
Credits: 2
Coefficient: 1

Teaching Objectives:
To be able to simulate, using the studied modeling techniques, electromechanical systems. Simulate the behavior of the converter-machine association.

Recommended Prerequisite Knowledge:
Knowledge of control systems and regulation; modeling and control theory of electric machines.

Course Content:

TP 1: Simulation of DC Motors (01 session)
TP 2: Simulation of the Converter–DC Motor 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)

Assessment Method:
Continuous assessment: 100%.

Bibliographic References:
Lecture notes and laboratory manuals.

Semester: 3
Teaching Unit: UEM 2.1
Course 2: Practical Work – Advanced Control Techniques
Total Hours (VHS): 22h30 (Practical Work: 1h30)
Credits: 2
Coefficient: 1

Teaching Objectives:
The student will be able to theoretically analyze the different existing control methods and, on the practical side, simulate advanced techniques applied to electric motors.

Recommended Prerequisite Knowledge:
Course on Advanced Control Techniques.

Course Content:

TP1: State Feedback Control of an Electric Motor (02 sessions)
TP2: Simulation of Adaptive Control with Reference Model (02 sessions)
TP3: Simulation of RST Control (02 sessions)
TP4: Simulation of Robust or Predictive Control (02 sessions)

Assessment Method:
Continuous assessment: 100%.

Bibliographic References:
Lecture notes and laboratory manuals.

Semester: 3
Teaching Unit: UEM 2.1
Course 3: Practical Work – Microprocessors and PLCs
Total Hours (VHS): 22h30 (Practical Work: 1h30)
Credits: 2
Coefficient: 1

Teaching Objectives:
Understand assembly programming. Know the principle and execution steps of each instruction. Learn the use of I/O interfaces and interrupts. Use Industrial Programmable Logic Controllers (PLCs).

Recommended Prerequisite Knowledge:
Industrial automation, algorithms, programming languages.

Course Content:

TP1: Getting Started with a Microprocessor Programming Environment (01 session)
TP2: Programming Arithmetic and Logic Operations in a Microprocessor (01 session)
TP3: Memory Management of the Microprocessor (01 session)
TP4: PLC Programming in Assembly Language (01 session)
TP5: PLC Programming in High-Level Language (01 session)
TP6: PLC Programming using Grafcet (01 session)

Assessment Method:
Continuous assessment: 100%.

Bibliographic References:
Lecture notes and laboratory manuals.

Semester: 3
Teaching Unit: UEM 2.1
Course 4: Computer-Aided Design / Computer-Aided Manufacturing (CAD/CAM)
Total Hours (VHS): 45h00 (Lecture: 1h30, Practical Work: 1h30)
Credits: 3
Coefficient: 2

Teaching Objectives:
The aim is to enhance students' knowledge in the field of CAD/CAM. By the end of the semester, the student should acquire the following skills:

Modeling complex-shaped parts (molds, dies, etc.).

Simulating the machining process.

Interpreting and verifying automatically generated machining programs.

During practical sessions, the student must master CAD/CAM software to design complex parts and assemblies and simulate the machining of designed parts. If resources allow, the student should proceed to the workshop to execute the generated program on a CNC machine.

Recommended Prerequisite Knowledge:
Mathematics, technical drawing, mechanical design, mechanical manufacturing.

Course Content:

Chapter 1: Generalities (01 week)
Chapter 2: Curve Modeling (03 weeks)
Chapter 3: Surface Modeling (03 weeks)
Chapter 4: Solid Modeling (01 week)
Chapter 5: CNC Machines (01 week)
Chapter 6: ISO Programming (04 weeks)
Chapter 7: Generation of Machining Trajectories (02 weeks)

Practical Work:
Should take place in a computer lab equipped with CAD/CAM software, or separate CAD and CAM software. Practical sessions are divided into two parts:

CAD Part: (07 weeks)
Advanced CAD Design: Complex Surfaces, Assemblies, Mass Properties, Mold Design, Static Simulation, Drafting, Kinematic/Dynamic Analysis

CAM Part: (08 weeks)
Simulation of machining operations following the defined steps.

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

Bibliographic References:
1. JEAN-CLAUDE LEON, "Modélisation et construction de surfaces pour la CFAO",
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, "Fabrication assistée par ordinateur", Ed. Lavoisier Hermès-science, Paris, 2003.
10. PETER SMID, "CNC Programming Handbook", Ed. IndustrialPress Inc., 2007.
11. JEAN VERGNAS, "Exploitation des machines-outils à commande numérique", Ed. Pyc, 1985.
12. CLAUDE HAZARD, "La commande numérique des machines-outils", Ed. Foucher, 1984.
13. CLAUDE MARTY, CLAUDE CASSAGNES, PHILIPPE MARIN, "La pratique de la commande numérique des machines-outils", Ed. Tec & Doc, 1993.
14. A. CORNAND, F. KOLB, "Usinage et commande numérique", Ed. Foucher, 1987.
15. P. GONZALEZ, "La commande numérique par calculateur : tournage, fraisage, centred'usinage", Ed. Casteilla, Paris, 1993.
16. Documentation du logiciel CATIA, "Catia LatheMachining", "Catia PrismaticMachining", "Catia Advanced Machining".

Teaching Unit: UET 2.1
Semester: 3
Course 1: Reverse Engineering
Total Hours (VHS): 45h00 (Lecture: 1h30, Workshop: 1h30)
Credits: 2
Coefficient: 2

Teaching Objectives:

Understand the principles and goals of Reverse Engineering (RE) in the field of Science and Technology (ST).

Get introduced to the tools and methods of RE in the relevant specialty.

Grasp the value and ethics of RE principles in design, manufacturing, and product quality assurance.

Encourage critical thinking, technical curiosity, reasoned reverse engineering, and innovation.

Learn to analyze, document, and model an existing system without initial documentation.

Targeted Skills:

Break down and analyze an existing system.

Faithfully reproduce a technical drawing or 3D model from an existing product.

Apply diagnostic and simulation tools.

Work in groups on exploratory projects.

Identify the legal limits of reverse engineering.

Adaptability to Science and Technology Specialties:

All ST specialties are relevant.

Example tasks: digital technical documentation, technology watch results, technical project management, collaboration on plans, report analysis, understanding industrial processes, monitoring production data, reporting techniques, prototyping, testing.

Prerequisites:

Fundamental knowledge in the specialty.

Course Content:

Introduction to Reverse Engineering

General Methodology

Hardware Reverse Engineering

Software Reverse Engineering

Mechanical Reverse Engineering

Security and Intrusion Detection

Real Case Studies

Practical Work Examples (Based on Four Engineering Fields):

Electrical Engineering

Mechanical Engineering

Civil Engineering

Process Engineering

Assessment Method:

Technical lab sessions

Mini reverse engineering project (report + presentation)

Final exam (MCQ + case study)

Exam: 60% and Lab/Continuous Assessment: 40%

References:

- Reverse Engineering for Beginners – Dennis Yurichev (gratuit en ligne)
- The IDA Pro Book – Chris Eagle (logiciels)
- Practical Reverse Engineering – Bruce Dang
- Documentation :
  - https://ghidra-sre.org
  - https://www.kicad.org
  - https://www.autodesk.com/products/fusion-360

Semester: 3
Teaching Unit: UET2.1
Subject: Information Retrieval and Thesis Design
Total Semester Hours: 22h30 (Lecture: 1h30)
Credit: 1
Coefficient: 1

Teaching Objectives:
Provide the student with the necessary tools to search for useful information and effectively utilize it in their graduation project. Assist them through the various stages of writing a scientific document. Emphasize the importance of communication and teach them to present their work in a rigorous and pedagogical manner.

Recommended Prior Knowledge:
Writing Methodology, Presentation Methodology.

Subject Content:
Part I: Information Retrieval
Chapter I-1: Topic Definition (02 Weeks)
Chapter I-2: Selecting Information Sources (02 Weeks)
Chapter I-3: Locating Documents (01 Week)
Chapter I-4: Information Processing (02 Weeks)
Chapter I-5: Bibliography Presentation (01 Week)

Part II: Thesis Design
Chapter II-1: Thesis Plan and Stages (02 Weeks)
Chapter II-2: Writing Techniques and Standards (02 Weeks)
Chapter II-3: Workshop: Critical Study of a Manuscript (01 Week)
Chapter II-4: Oral Presentations and Defenses (01 Week)
Chapter II-5: How to Avoid Plagiarism? (01 Week)

Assessment Method:
Exam: 100%

Bibliographic References:

1. *M. Griselin et al., Guide de la communication écrite, 2e édition, Dunod, 1999.*
2. *J.L. Lebrun, Guide pratique de rédaction scientifique : comment écrire pour le lecteur scientifique international, Les Ulis, EDP Sciences, 2007.*
3. *A. Mallender Tanner, ABC de la rédaction technique : modes d'emploi, notices d'utilisation, aides en ligne, Dunod, 2002.*
4. *M. Greuter, Bien rédiger son mémoire ou son rapport de stage, L'Etudiant, 2007.*
5. *M. Boeglin, lire et rédiger à la fac. Du chaos des idées au texte structuré. L'Etudiant, 2005.*
6. *M. Beaud, l'art de la thèse, Editions Casbah, 1999.*
7. *M. Beaud, l'art de la thèse, La découverte, 2003.*
8. *M. Kalika, Le mémoire de Master, Dunod, 2005.*

Proposition of some discovery subjects

Semester: ..
Teaching Unit: UED..
Subject 1: Smart Sensor
Total Semester Hours: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Learning Objectives:

Master the basic operating principles of a sensor, the metrological characteristics to consider during use and selection, as well as the various components of a measurement chain.

Recommended Prior Knowledge:

General Electricity, Electrical and Electronic Measurements, Sensors and Conditioners, and Signal Processing.

Subject Content:

Chapter 1: Overview and Metrological Characteristics of Sensors (2 weeks)

Chapter 2: Introduction to Smart and Communicating Systems (2 weeks)

Chapter 3: Smart Sensors in Industry 4.0 (4 weeks)

Chapter 4: Mini-projects on Smart Sensors (Workshops) (4 weeks)

Assessment Method:

Continuous Assessment: 50%

Personal Work (Workshops): *50%* - Mini-projects on smart sensors; in this part, the student chooses a mini-project based on different types of smart sensors and implements it using available resources.

Bibliographical References:

1. J.Niard,''Mesures électriques'', Nathan 1981.
2. J. P. Bentley, ''Principles of measurementsystems'', Pearson education 2005.
3. P. Dassonvalle, ''Les capteurs'', Dunod 2013.
4. J. M. Broust, ''Appareillages et installations électriques industriels : conception, coordination, mise en oeuvre et maintenance'', Dunod, Paris 2008.
5. M.BAYART, Capteurs et actionneurs intelligents, technique de l'ingénieur N°S 7 5202005.
6. George Ash et coll, Les capteurs en instrumentation industriel, Dunod 2010.
7. Karim Bourouni, Exercices de mesures et instrumentation avec quelques corriges, l'Ecole Nationale d'Ingénieurs de Tunis, 2011.
8. P. Dassonvalle, Les capteurs -70 exercices et problèmes corrigés, Dunod 2019.

Semester: ..
Teaching Unit: UED..
Subject 1: Refrigeration and Air Conditioning
Total Semester Hours: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Learning Objectives:

This subject enables the student to: acquire knowledge in the field of air conditioning and climate control, master the basic operating principles of a refrigeration circuit, and explore the technology of refrigeration installations.

Recommended Prior Knowledge:

Thermodynamics and Heat Transfer.

Subject Content:

Chapter 1: General Overview (02 weeks)

Chapter 2: Refrigeration Circuit (03 weeks)

Chapter 3: Enthalpy Diagram (04 weeks)

Chapter 4: Case Study (04 weeks)

Chapter 5: Air Humidifiers (02 weeks)

Assessment Method:

Exam: 100%

Bibliographical References:

1. H. Noack et R. Seidel, ''Pratique des installations frigorifiques'', Editions PYC 1999.
2. P. Rapin, P. Jacquard, J.Desmons,''Technologie des installations frigorifiques'', Editions PYC 2015.
3.J. Bouteloup, M. Le Guay, J.E. Ligen, **''**Climatisation - Conditionnement d'air**''**, Tome 1: Traitement de l'air, Editions parisiennes (EDIPA) 1996.
4. F. Reinmuth, ''Climatisation et conditionnement d'air modernes par l'exemple'', Tome 1: Les calculs, Editions PYC Livres, Paris 1999.
5. F. Reinmuth, ''Climatisation et conditionnement d'air modernes par l'exemple'', Tome 2: Le choix d'un système, Editions PYC Livres, Paris 1999.

Semester: ..
Discovery Teaching Unit Code: UED ..
Subject: Exploitation of Renewable Energies
Total Semester Hours: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Learning Objectives:
Provide students with the scientific foundations allowing them to join the scientific research community in the field of renewable energies, batteries, and sensors associated with engineering applications.

Recommended Prior Knowledge:
Energy conversion devices and technologies.

Subject Content:

Chapter 1: 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)

Assessment Method:
Exam: 100%

Bibliographical References:
1. Sabonnadière Jean Claude. Nouvelles technologies de l'énergie 1: Les énergies renouvelables, Ed. Hermès.
2. Gide Paul. Le grand livre de l'éolien, Ed. Moniteur.
3. A. Labouret. Énergie Solaire photo voltaïque, Ed. Dunod.
4. Viollet Pierre Louis. Histoire de l'énergie hydraulique, Ed. Press ENP Chaussée.
5. Peser Felix A. Installations solaires thermiques: conception et mise en œuvre, Ed. Moniteur.

Semester: ..
Discovery Teaching Unit Code: UED ..
Subject: Signal Processing
Total Semester Hours: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Learning Objectives:
This subject aims to provide students with the basic tools and concepts for signal and spectrum analysis, with the goal of applying them in maintenance and fault detection.

Recommended Prior Knowledge:
Mathematics, Algebra.

Subject Content:

Chapter 01: General Overview (03 weeks)
Introduction; Definitions; Signal Classification; Particular Signals; Frequency Representation.

Chapter 02: Analog Signal Processing (04 weeks)
Fourier Series; Fourier Transform; Convolution; Concept of Filtering; Concept of Modulation.

Chapter 03: Digitization (04 weeks)
Sampling; Quantization; Coding.

Chapter 04: Digital Signal Processing (04 weeks)
Fourier Transform of a Discrete Signal; Discrete Fourier Transform (DFT); Concept of Fast Fourier Transform (FFT).

Assessment Method:
Exam: 100%

Bibliographical References:
1. Dominique Placko, « Mesure et instrumentation : Volume 1. De la physique du capteur au signal électrique », Editeur : Hermès – Lavoisier, Octobre 1970.
2. MaïtineBergouniou, « Mathématiques pour le traitement du signal - Cours et exercices corrigés », SCIENCES SUP – Dunod, 2010.
3. M. Benidir, « Théorie et traitement du signal : Tome 1 - représentation des signaux et des systèmes », Collection: Sciences Sup, Dunod, 2002.

Semester: ..
Transversal Teaching Unit Code: UED ..
Subject: Industrial Safety and Accreditation
Total Semester Hours: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Learning Objectives:

The objective of this subject is to inform the future Master's graduate about the nature of electrical accidents and rescue methods for victims of electrical accidents. It also aims to provide sufficient knowledge to properly size protection devices for equipment and personnel working in industry and other fields where such equipment is used.

Recommended Prior Knowledge:

Electrical energy transmission and distribution networks.

Subject Content:

Chapter 1: Electrical Risks (03 weeks)

History; Standards; Statistics on electrical accidents.

Chapter 2: Nature of Electrical Accidents and Dangers of Electric Current (03 weeks)

Chapter 3: Protection Measures (03 weeks)

Protection of persons and equipment.

Chapter 4: Safety Measures Against Indirect Effects of Electric Current (04 weeks)

Harmful substances; Fire; Explosions, etc.

Chapter 5: Rescue Measures and First Aid (02 weeks)

Assessment Method:

Exam: 100%

Bibliographical References:

1. Détection, extinction et plans de consignes, Editions CNPP-France, 15ème édition, 2014, 224 pages.
2. Notice de sécurité incendie : mode d'emploi. Editions CSTB-France, 2013, 218 pages.
3. Nichan Margossian, Risques et accidents industriels majeurs, L'usine nouvelle, 2006, Dunod
4. CHOQUET. R. La sécurité électrique. Techniques de prévention. DUNOD.
5. FOLLIOT. D. Les accidents d'origine électrique et leur prévention. MASSON.
6. VILLEMEUR A., « Sûreté de fonctionnement des systèmes industriels », Collection de la Direction des Études et Recherches d'Électricité de France N° 67, Eyrolles, 1988.

Semester: ..
Discovery Teaching Unit Code: UED ..
Subject: Industrial Computing
Total Semester Hours: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Learning Objectives:
This subject allows Master's students to familiarize themselves with the field of industrial computing. They will acquire concepts related to communication protocols.

Recommended Prior Knowledge:
Combinational and sequential logic, microprocessors and microcontrollers, computer science.

Subject Content:

Chapter 1: Introduction to Industrial Computing (02 weeks)

Chapter 2: Connecting Hardware to a Microprocessor (02 weeks)

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

Chapter 4: Serial Communication Buses (RS-232, DHCP, MODBUS, I2C) (05 weeks)

Chapter 5: Data Acquisition: ADC and DAC Peripherals (02 weeks)

Assessment Method:
Exam: 100%

Bibliographical References:

1. Baudoin, Geneviève &Virolleau, Férial, « Les DSP famille, TMS 320C54X [texte imprimé] : développement d'applications », Paris : Francis Lefebvre, 2000, ISBN : 2100046462.
2. Pinard, Michel, « Les DSP, famille ADSP218x [texte imprimé] : principes et applications », Paris : Francis Lefebvre, 2000, ISBN : 2100043439.
3. Tavernier, Ch., « Les microcontrôleurs PIC : applications », Paris : Francis Lefebvre, 2000, ISBN : 2100059572.
4. Tavernier, Ch., « Les microcontrôleurs PIC : description et mise en œuvre », Paris : Francis Lefebvre, 2004, ISBN : 2100067222.
5. Cazaubon ,christian, « Les microcontrôleurs HC11 et leur programmation », Paris : Masson, [s.d], ISBN : 2225855277.
6. Tavernier, Christian, « Les microcontrôleurs AVR : description et mise en œuvre », Paris : Francis Lefebvre, 2001, ISBN : 2100055798.
7. Dumas, Patrick, « Informatique industrielle : 28 problèmes pratiques avec rappel de cours », Paris : Francis Lefebvre, 2004, ISBN : 2100077074.