الجمهورية الجزائرية الديمقراطية الشعبية
Democratic Republic of Algeria
and Popular
وزارة التعليم العالي والبحث العلمي
Ministry of Higher Education
and Scientific Research

OTRAINING OFFER
STATE ENGINEER

Specifically for TM baccalaureate holders

2025/2026

Establishment	Faculty / Institute	Department
U. Bordj Bou Arreridj		

Domain	Sector	Speciality
Science and Technologies	***Electrotechnics***	***Industrial Electricity***

Title: Industrial Electricity
Academic Year

Establishment:

الجمهورية الجزائرية الديمقراطية الشعبية
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اللجنة البيداغوجية الوطنية
لميدان العلوم و التكنولوجيا
Pedagogical Committee
National Domain
Science and Technology

عرض تكوين
مهندسدولة

المؤسسة	الكلية/ المعهد	القسم

الميدان	الفرع	التخصص
علوم وتكنولوجيا	الهندسة الكهربائية	

Title: Industrial Electricity
Academic Year

Establishment:

Semester-based course organization sheets for the specialty.

Semester 5:

Half	Unit teaching	Intsubject titles	Code	Credits	Coefficients	Hourly Volume Weekly			VHS	Evaluation method	
						Course	TD	TP		Continuous assessment	Exam
5	Fundamental EU Code: UEF5.1 Credits: 10 Coefficients: 6	Electrical Machines	IGE 5.1	6	4	1 hour 30 minutes	3:00	1 hour 30 minutes	90:00	40% (20% TD + 20% TP)	60%
		Field theory Electromagnetic	IGE 5.2	4	2	1 hour 30 minutes	1 hour 30 minutes		45h00	40%	60%
	Fundamental EU Code: UEF5.2 Credits: 10 Coefficients: 6	Continuous linear control systems	IGE 5.3	5	3	1 hour 30 minutes	1 hour 30 minutes	1 hour 30 minutes	67h30	40% (20% TD + 20% TP)	60%
		Advanced Sequential Logic	IGE 5.4	5	3	1 hour 30 minutes	1 hour 30 minutes	1 hour 30 minutes	67h30	40% (20% TD + 20% TP)	60%
	Methodological Unit Code: UEM 5.1 Credits: 7 Coefficients: 4	Industrial Electrical Diagrams	IGE 5.5	3	2	1 hour 30 minutes		1 hour 30 minutes	45h00	40%	60%
		Applied Numerical Methods - Python		4	2	1 hour 30 minutes		1 hour 30 minutes	45 hours	40%	60%
	EU Discovery Code: UED 5.1 Credits: 1 Coefficients: 1	Electricity generation	IGE 5.7	1	1	1 hour 30 minutes			10:30 PM		100%
	EU Transversal Code: UET 5.1 Credits: 2 Coefficients: 2	Industrial maintenance		**1**	**1**	**1 hour 30 minutes**					
		Technical English related to the specialty	IGE 5.8	1	1	1 hour 30 minutes			10:30 PM		100%
Total Hourly Volume				30	19	1:30 PM	7:30 a.m.	7:30 a.m.	427h30		

Semester 6

Half	Unit teaching	Subject Titles	Code	Credits	Coefficients	Hourly Volume Weekly			VHS	Evaluation method	
						Course	TD	TP		Continuous assessment	Exa
6	Fundamental EU Code: UEF 6.1 Credits: 11 Coefficients: 7	Electrical networks	IGE 6.1	6	4	1 hour 30 minutes	3:00	1 hour 30 minutes	90:00	40% (20% TD + 20% TP)	60%
		Power Electronics I	IGE 6.2	5	3	1 hour 30 minutes	1 hour 30 minutes	1 hour 30 minutes	67h30	40% (20% TD + 20% TP)	60%
	Fundamental EU Code: UEF 6.2 Credits: 14 Coefficients: 8	Industrial regulation	IGE 6.3	5	3	1 hour 30 minutes	1 hour 30 minutes	1 hour 30 minutes	67h30	40% (20% TD + 20% TP)	60%
		Microprocessors and Microcontrollers	IGE 6.4	4	2	1h30		1 hour 30 minutes	45h00	40%	60%
		High-voltage technology	IGE 6.5	5	3	1 hour 30 minutes	1 hour 30 minutes	1 hour 30 minutes	67h30	40% (20% TD + 20% TP)	60%
	Methodological Unit Code: UEM 6.1 Credits: 4 Coefficients: 3	Sensors and measurement chains	IGE 6.6	3	2	1 hour 30 minutes		1 hour 30 minutes	45h00	40%	60%
		Company internship	IGE 6.7	1	1	Hourly volume outside the quota, Tutoring 1h30 TP				100%	
	EU Transversal Code: UET 6.1 Credits: 1 Coefficient: 1	Entrepreneurship and start-ups	IGE 6.8	1	1	1 hour 30 minutes			10:30 PM		100%
Total Hourly Volume				30	19	10:30	7:30	10:30	405h00		

Semester 7

Half	Unit teaching	Subject Titles	Code	Credits	Coefficients	Hourly Volume Weekly			VHS	Evaluation method	
						Course	TD	TP		Continuous assessment	Exam final
7	Fundamental EU Code: UEF 6.1 Credits: 9 Coefficients: 5	Electrical control	IGE 7.1	5	3	1 hour 30 minutes	1 hour 30 minutes	1 hour 30 minutes	67h30	40% (20% TD + 20% TP)	60%
		Electricity transmission and distribution networks	IGE 7.2	4	2	1 hour 30 minutes	1 hour 30 minutes		45h00	40%	60%
	Fundamental EU Code: UEF 6.2 Credits: 13 Coefficients: 8	Power Electronics II	IGE 7.3	5	3	1 hour 30 minutes	1 hour 30 minutes	1 hour 30 minutes	67h30	40% (20% TD + 20% TP)	60%
		Electrical machines in-depth	IGE 7.4	5	3	1 hour 30 minutes	1 hour 30 minutes	1 hour 30 minutes	67h30	40% (20% TD + 20% TP)	60%
		Industrial Automation.1	IGE 7.5	3	2	1 hour 30 minutes		1 hour 30 minutes	45h00	40%	60%
	Methodological Unit Code: UEM 6.1 Credits: 7 Coefficients: 5	Advanced Programming in Python	IGE 7.6	2	2	1 hour 30 minutes		1 hour 30 minutes	45h00	40%	60%
		Protection of electrical networks	IGE 7.7	3	2	1 hour 30 minutes		1 hour 30 minutes	45h00	40%	60%
		Personal Professional Project	IGE 7.8	2	1	Hourly volume outside the quota, Tutoring 1h30 TP				100%	
	EU Transversal Code: UET1.2 Credits: 1 Coefficients: 1	Standards in electrical engineering	IGE 7.9	1	1	1 hour 30 minutes			10:30 PM		100%
Total Hourly Volume				30	19	12:00	6 a.m.	10:30	427h30		

Semester 8

Half	Unit teaching	Subject Titles	Code	Credits	Coefficients	Hourly Volume Weekly			VHS	Evaluation method	
						Course	TD	TP		Continuous assessment	Exam final
8	Fundamental EU Code: UEF 8.1 Credits: 13 Coefficients: 7	Modeling and optimization of electrical networks	IGE 8.1	4	2	1 hour 30 minutes		1 hour 30 minutes	45 hours	40%	60%
		Modeling and identification of electrical machines	IGE 8.2	4	2	1 hour 30 minutes		1 hour 30 minutes	45h00	40%	60%
		Sampled servo systems	IGE 8.3	5	3	1 hour 30 minutes	1 hour 30 minutes	1 hour 30 minutes	67h30	40% (20% TD + 20% TP)	60%
	Fundamental EU Code: UEF 8.2 Credits: 7 Coefficients: 4	Industrial automation.2	IGE 8.4	4	2	1 hour 30 minutes		1 hour 30 minutes	45 hours	40%	60%
		Energy Quality and EMC		3	2	1 hour 30 minutes	1 hour 30 minutes				
	Methodological Unit Code: UEM 8.1 Credits: 7 Coefficients: 5	Industrial Computing	IGE 8.5	3	2	1 hour 30 minutes		1 hour 30 minutes	45 hours	40%	60%
		Sizing of industrial facilities	IGE 8.6	3	2	1 hour 30 minutes		1 hour 30 minutes	45 hours	40%	60%
		Company internship	IGE 8.7	1	1	Hourly volume outside the quota, Tutoring 1h30 TP				100%	
	EU Transversal Code: UET 8.1 Credits: 3 Coefficients: 3	Elements of Applied AI		2	2	1 hour 30 minutes	1 hour 30 minutes		45 hours	40%	60%
		Adherence to ethical standards and rules of integrity	IGE 8.9	1	1	1 hour 30 minutes			10:30 PM		100%
Total Hourly Volume				30	19	1:30 PM	3 hours	12pm	427h30		

Semester 9

Half	Unit teaching nt	Subject Titles	Code	Credits	Coefficients	Hourly Volume Weekly			VHS	Evaluation method	
						Course	TD	TP		Control continuous	Exam final
9	Fundamental EU Code: UEF19.1 Credits: 14 Coefficients: 8	Adjustable electric drives	IGE 9.1	5	3	1 hour 30 minutes	1 hour 30 minutes	1 hour 30 minutes	90:00	40% (20%TD + 20%TP)	60%
		Electrical network management	IGE 9.2	5	3	1 hour 30 minutes	1 hour 30 minutes	1 hour 30 minutes	45h00	40%	60%
		Design of electric drive systems		4	2	1 hour 30 minutes		1 hour 30 minutes		40%	~~60%~~
	Fundamental EU Code: UEF 9.2 Credits: 9 Coefficients: 5	Power Electronics Design	IGE 9.3	5	3	1 hour 30 minutes	1 hour 30 minutes	1 hour 30 minutes	67h30	40% (20%TD + 20%TP)	60%
		Monitoring and diagnostics of electrical systems	IGE 9.4	4	2	1 hour 30 minutes		1 hour 30 minutes	45 hours	40%	60%
	Methodological Unit Code: UEM 9.1 Credits: 3 Coefficients: 2	Smart Grids	IGE 9.5	3	2	1 hour 30 minutes		1 hour 30 minutes	45 hours	40%	60%
	EU Transversal Code: UET9.1 Credits: 4 Coefficients: 4	Industrial Hygiene and Safety	IGE 9.8	1	1	1 hour 30 minutes			10:30 PM		100%
		Reverse engineering		2	2	1 hour 30 minutes		1 hour 30 minutes	45 hours	40%	60%
		Bibliographic research and dissertation writing	IGE 9.9	1	1	1 hour 30 minutes			10:30 PM		100%
Total Hourly Volume				30	19	1:30 PM	4:30	10:30	427h30		

Semester 10:

The Final Year Project (FYP)necessarily related to the industrial sector or within a company or within the framework of decree 1275 (start-up) isvalidated by a dissertation and an oral defense

	VHS	Coeff	Credits
Personal Work			
Company internship			
Seminars			
Other (Management)			
Total Semester 10			

This table is provided for informational purposes only.

Evaluation of the Engineering Final Year Project

- Scientific value (Jury's assessment) /6
- Dissertation Writing (Jury Assessment) /4
- Presentation and answering questions (Jury's assessment) /4
- Supervisor's assessment /3
- Presentation of the internship report (Jury's assessment) /3

Detailed syllabi for the subjects of 5thhalf

HALF	Subject Title		Coefficient	Credits	Code
S 5	Electrical Machines		4	6	
VHS	Course	Tutorials	Practical Exercises		
45h00	1 hour 30 minutes	3 hours	1 hour 30 minutes		

Weekly Hourly Volume (HHV):

Prerequisites:

- General electricity and fundamental laws applied to electrical circuits.

Course content:

Chapter 1: Magnetostatics and Magnetic Circuits*(2 weeks)*

- Fundamental Laws and Theorems
- Direct current excited magnetic circuits: Role
- of an air gap
- Circuits excited by permanent magnets or alternating currents.
- Production of a field in the air gap of a cylindrical armature.
- Electromagnetic analogy.

Chapter 2: Transformers*(3 weeks)*

- General information and operating principle (single-phase)
- Ideal and real transformer
- Induced electromotive force, impedance matching, Kapp
- model, voltage drop, efficiency. Three-phase transformers:
- coupling types and clock hour index.

Chapter 3: Direct Current Machines*(4 weeks)*

- General information and operating principle;
- Construction, DC generator; Characteristic equations,
- electromotive force, torque; Excitation modes
-
- DC motor: operation, energy balance and efficiency

Chapter 4: Synchronous Machines*(3 weeks)*

- Concept of a rotating field, principle and structure.
- Operation as an alternator.
- Magnetic reaction of the armature,
- Behn-Eschenburg diagram, energy
- balance and efficiency

Chapter 5: Asynchronous Machines*(3 weeks)*

- Principle and constitution

- Equation formulation, equivalent single-phase circuit,
- torque and mechanical characteristics
- Energy balance, efficiency
- Simplified circle diagram

Practical Exercise Content:

1.Practical exercise #1:Magnetic circuits
2.Practical exercise #2:No-load, load, and short-circuit tests of a single-phase transformer
3.Practical exercise #3:Load test of a three-phase transformer
4.Practical exercise #4:Characteristics of a DC generator (shunt excitation, separate excitation, self-ignition)
5.Practical exercise #5:Characteristics of a DC motor (shunt excitation, series excitation, starting rheostat)
6.Practical exercise #6:Load characteristics of an asynchronous motor
7.Practical exercise #7:Determining the circular diagram of an asynchronous machine
8.Practical exercise #8:Alternator – operating diagram

Evaluation method:

- Continuous assessment (TP+CC):
- 40% Final exam:60%

Bibliographical references:

1. Jacques Lesenne, Francis Notelet, Guy Seguier –*Introduction to Advanced Electrical Engineering*Technical and Documentation, 1981
2. Pierre Mayé –*Industrial electric motors*Dunod, 2005
3. R. Annequin & J. Boutigny –*Physics course, Electricity 3*, Vuibert
4. Mr. Kuznetsov –*Foundations of electrical engineering*
5. H. Lumbroso –*Problems solved on electrical circuits*Dunod
6. J.-P. Perez, R. Carles, R. Fleekinger –*Electromagnetism: Fundamentals and Applications*, 6th ed., 1997
7. A. Searched –*Electrical engineering for engineers*Dunod, 1963
8. M. Kostenko, L. Piotrovsky –*Electrical machines*, Volumes 1 & 2, MIR, Moscow, 1979
9. Marcel Jufer –*Electromechanical*Presses polytechniques et universitaires romandes, Lausanne, 2004
10. AE Fitzgerald, Charles Kingsley Jr., Stephen D. Umans –*Electric Machinery*McGraw-Hill, 2003

11. Edminster –*Theory and applications of electrical circuits*McGraw-Hill

HALF	Subject Title		Coefficient	Credits	Code
S 5	**Field theory**		2	4	
VHS	Course	Tutorials	Practical Exercises		
45h00	1 hour 30 minutes	1 hour 30 minutes			

Prerequisites

Concepts about:
- the sources of electric and magnetic fields.
- the electric field and potential produced by a charge distribution.
- the magnetic field produced by an electric current.

Goals

This subject allows the student to acquire advanced knowledge in electromagnetism.

Content of the material:

Chapter 1 Math review (1 week)

-Vector analysis and coordinate systems.

Chapter 2. Electrostatics (3 weeks)

-Electrostatic fields in a vacuum and in dielectric media.

Chapter 3. Magnetostatic (3 weeks)

-Magnetic field and induction, magnetization of material media and electrodynamic forces.

Chapter 4. Electromagnetic induction phenomenon. (3 weeks)

- Quasi-stationary hypothesis; electromagnetic induction phenomenon. Induced currents. Lenz's law.

Chapter 5. Electromagnetic fields in varying regimes (4 weeks)

- Maxwell's equations (local and integral formulation); Poyting vector and energy.
- Electromagnetic waves in a vacuum and in material media.

Assessment method: (type of assessment and weighting) Continuous Assessment: (TC+TP) 40%, Exam 60%

Bibliographical references

[1].Joseph A. Edminister,Electromagnetism, lectures and problems - Schaum Series.

[2]. Emile Durand: Electrostatics Volume 1: Distributions; Volume 2: General problems of conductors.

[3]. Emile Durand: Magnetostatics

[4].Paul Lorrain, Dale Corson, and François Lorrain, "Electromagnetic Phenomena: Course, exercises and solved problems", 2002.

[5].Garing, "Electromagnetic waves in vacuum and conducting media: Exercises and solved problems", 1998.

[6].Michel Hulin, "Nicole Hulin, and Denise Perrin, Maxwell's Equations: Electromagnetic Waves. Course, Exercises and Solved Problems", 1998.

HALF	Subject Title	Coefficient	Credits	Code
S5	Control systems [Linear and continuous control systems]	3	5	

VHS	Course	Tutorials	Practical Exercises
45 hours	1 hour 30 minutes	01:30	1 hour 30 minutes

Prerequisites:
Basic mathematics (Algebra, Integral and differential calculus, Analysis, complex numbers, etc.). Fundamental concepts of signal processing, basic electronics (linear circuits).

Goals :
- Review the properties of control structures for continuous linear systems,
- To address the models of basic dynamic systems.
- Explore the time and frequency analysis tools of basic systems.

Course content:

Chapter 1 Introduction to servo systems (2 weeks)
- History of automatic control systems,
- Terminology and definition, System concept,
- Dynamic behavior, Static behavior, Static systems, Dynamic systems, Linear systems,
- Introductory examples, Open-loop systems, Closed-loop systems, Main elements of a
- control chain, Reasoning for a control system, Performance of controlled systems.
-

Chapter 2 Systems modeling: (2 weeks)
- Representation of systems by their differential equations, Laplace
- transform, from differential equation to transfer function, Functional
- blocks and subsystems, Simplification rules,
- Representation of dynamic systems by fluence graphs, Masson's rule, Calculation
- of transfer functions of closed-loop systems.

Chapter 3 Time responses of linear systems: (2 weeks)
- Definition of a system's response, Transient regime, Steady-state regime, Concepts of stability,
- Static speed and accuracy, Impulse response (1st and 2nd order),
- Temporal characteristics,
- Index response (1erand 2emeorder) of first- and second-order systems based on the time response,
- Higher-order systems, Influence of poles and zeros on the response of a system

Chapter 4 Frequency responses of linear systems (3 weeks)
- Definition, Bode and Nyquist diagrams
- Frequency characteristics of basic dynamic systems (1erand 2emeorder), Phase and gain margins.

Chapter 5 Stability and precision of servo systems (3 weeks)
-Definition, Stability conditions,

- Routh-Herwitz algebraic criterion, Reverse criteria in Nyquist and Bode designs, Stability margins,
- Accuracy of servo systems, Static accuracy, Calculation of static error,
- Dynamic accuracy, Characterization of transient response

Chapter 6 State representation of servo systems (3 weeks)

State of a system and state variables, Solving state equations, Controllability of a system, Observability of the state of a system, Relationship between the state representation and the transfer function of a system, State representation of systems, Correction of servo systems in state space. Synthesis of state observers.

Practical Exercises

Practical Exercise 1: Study of System Behavior 1er2thand 3thorder

Analog and computer simulation, measuring the parameters that characterize the different responses: rise time; response time; maximum first overshoot, peak time and accuracy; observing the response of an unstable system

Lab 2: Frequency Responses and System Identification

Determining the frequency characteristics of a control system, with the aim of identifying the transfer function of a system. Application to a motor.

TP 3: Position control of a DC motor, difference between position and speed.

The influence of the gain on the stability and steady-state error of the system. The influence of the velocity feedback on the behavior of the system.

Lab 4: Speed control of a DC motor

The operation of the elements and the closed-loop closed-loop system, The influence of the gain on the stability of the system, The influence of the gain and the load on the static error of the system, The influence of the current feedback on the dynamic behavior of the system.

Evaluation methods:Continuous assessment: (20%; Practical work: 20%; Final exam: 60%.

Bibliographical references:

1. Norman, S Nise, Control Systems Engineering; John Wiley & Sons; 8th EMEA edition (May 17, 2019)
2. Katsuhiko Ogata, Modern Control Engineering: Fifth Edition Kindle Edition; 2020
3. EK Boukas, Servo Systems, Editions de l'école polytechnique de Montreal, 1995.
4. P. Clerc. Continuous, Sampled Automatic Control: IUT Electrical Engineering-Computer Science
5. Industrial, BTS Electronics-Mechanics-Computer Science, Masson Editions (198p), 1997.
6. Ph. de Larminat, Automatic, Editions Hermes 2000.
7. P. Codron and S. Leballois, Automatic Control: Continuous Linear Systems, Dunod Editions 1998.
8. Y. Granjon, Automatic Control: Linear, non-linear, continuous-time, discrete-time systems, state representation, Editions Dunod 2001.
9. M. Rivoire and J.-L. Ferrier, Course in Automation, Volume 2: Servomechanism, Regulation, Analog Control, Editions Eyrolles 1996.
10. Y. Thomas, Signals and linear systems: solved exercises, Editions Masson 1993.

HALF	Subject Title		Coefficient	Credits	Code
S 5	Advanced Sequential Logic		2	3	
VHS	Course	Tutorials	Practical Exercises		
45h00	1 hour 30 minutes		1 hour 30 minutes		

Content of the material

Chapter I: Numbering Systems and Information Coding*(2 weeks)* Number

- representation: binary, hexadecimal, BCD, signed and unsigned binary. Base
- conversion.
- Unweighted codes: Gray code, ASCII code
- Introduction to error-detecting and error-correcting codes (parity code, Hamming code)
- Elementary arithmetic operations in binary (addition, subtraction, multiplication)

Chapter II: Boolean Algebra and Simplification of Logical Functions*(2 weeks)* Logical

- variables, basic operators: AND, OR, NOT, NAND, NOR, XOR. Fundamental laws of Boolean
- algebra and theorems (including De Morgan's theorem). Complete and incomplete logical
- functions.
- Function representation: truth tables, algebraic expressions, Karnaugh maps.
- Simplification by algebraic method and by Karnaugh map (2 to 4 variables).

Chapter III: Integrated Logic Circuit Technology*(3 weeks)*

- Characteristics of logic signals: conventions, thresholds, voltage levels. Introduction to
- logic families: TTL, CMOS (comparison, advantages/disadvantages). Study of logic gates:
- totem-pole output, open collector, three states.
- Integration concepts: SSI, MSI, LSI circuits
- Physical limitations: propagation delay, consumption, noise immunity

Chapter IV: Combinational Circuits*(3 weeks)*

- General overview of combinational circuits and distinction from sequential circuits.
- Detailed study:
  - Decoders and encoders (including priority encoders)
  - Multiplexers and demultiplexers
  - Comparison tools
  - Parity generators and checkers
  - Arithmetic circuits: adders, subtractors, full adder
- Implementation of complex combinational logic functions from standard
- modules. Cascade and hierarchy techniques.

Chapter V: Basic Sequential Circuits – Flip-Flops*(3 weeks)*

- Combinational → sequential transition: introduction to memory and synchronization.
- In-depth study of flip-flops:
  - RS, RST, D, JK, T, Master-slave toggle
  - Truth table, timing diagrams, operating conditions, prohibited states
- Practical applications:
  - Frequency divider
  - Pulse train generator, one-bit
  - memory

- Analysis of limitations: metastability, propagation time, setup/hold time

Chapter VI: Complex Sequential Circuits – Counters *(3 weeks)* General

- concepts: clock, synchronism, initial state, feedback. Classification:
-
    - Synchronous vs. asynchronous counters;
    - Regular vs. irregular counters; Complete vs.
    - incomplete counters, modulo-n
- Designing counters using JK, D, or RS flip-flops
- Programmable counters, parallel loading, reset, bidirectional counting. Analysis and
- drawing of associated timing diagrams.
- Introduction to shift registers and finite state machines (FSMs – overview)

Practical Exercises (Recommended)

Practical exercise #1: Representation and manipulation of digital codes

- Goals :
    - Manipulating number systems (binary, hexadecimal, decimal, BCD)
    - Performing inter-base conversions
    - Encode/decode using ASCII, Gray, and parity codes
- Tools: digital simulator, spreadsheet, simulation software such as Logisim or Proteus

Practical exercise #2: Simplification and implementation of logical functions

- Goals :
    - Establish the truth table of a logical function.
    - Simplify a function using Karnaugh maps.
    - Implement the function using logic gates (TTL or simulation)
- Completion of a mini-project: 3-input coded alarm

Practical exercise #3: Study of standard combinational circuits

- Goals :
    - Use 1-bit decoders, multiplexers, and adders
    - Assembling multiple components for a complex function (e.g., 4-bit adder, comparator)
- Cascading and practical applications

Lab #4: Study and simulation of flip-flops (RS, D, JK, T)

- Goals :
    - Experiment with the operation of different flip-flops. Observe the timing
    - diagrams on a simulator or logic oscilloscope. Study the phenomena of
    - rebound, metastability, and their solutions.
- Applications: state memorization, frequency divider

Lab #5: Design of simple sequential circuits based on flip-flops

- Goals :
    - Build circuits with state transitions (simple FSM type).
    - Create a pulse generator, a flasher, or a sequencer.
    - Identify the impact of the clock signal.
- Project approach: creating a traffic light sequencer

Lab #6: Asynchronous and Synchronous Binary Counters

- Goals :
    - Implementing synchronous and asynchronous counters using flip-flops

- Study the propagation of the clock signal (delays). Measure the
- division frequency and observe the timing diagrams.

- Implementation of modulo-n counters (e.g., modulo-10 counter)

Practical exercise #7: Programmable and decremental counters

- Goals :
  - Design a parallel loading counter with a given initial state start. Up/down
  - counters.
  - Study of a regular/incomplete counter
- Project: Basic digital clock (HH:MM)

Lab #8: Introduction to shift registers and finite state machines

- Goals :
  - Study the operation of a shift register (SIPO, PISO). Create
  - a simple Moore or Mealy machine.
  - Applying the concept of sequencing with memory states
- Possible project: controlling a coded door lock

Assessment methods: Continuous Assessment 20%, Practical Work 20%Final exam:600%

Bibliographical references:

1. Letocha,*Introduction to logic circuits*McGraw Hill
2. JC Lafont,*Digital Electronics Courses and Problems*Ellipses
3. R. Delsol,*Digital electronics*Volumes 1 & 2, Berti
4. P. Cabanis,*Digital electronics*Dunod
5. Mr. Gindre,*Combinational logic*Ediscience
6. C. Brie,*Combinational and sequential logic*Ellipses
7. R. Katz,*Contemporary Logic Design*, 2nd ed., Prentice Hall, 2005
8. J.-P. Ginisti,*Combinatorial logic*, PUF, "Que sais-je?", no. 3205
9. H. Curry,*Combinatorial Logic II*North Holland, 1972
10. J.-L. Krivine,*Lambda calculus, types and models*Masson, 1990
11. Mr. Gindre,*Digital electronics: combinational logic and technology*McGraw Hill, 1987

HALF	Subject Title		Coefficient	Credits	Code
S5	**Electrical Diagrams and Equipment**		2	3	
VHS	Course	Tutorials	Practical Exercises		
45h00	1 hour 30 minutes		1 hour 30 minutes		

Prerequisites

Electricity, and fundamentals of electrical engineering.

Goals

Learn about the different types of electrical protection equipment and devices, monitoring and ordering of LV and HV electrical installations, and how to carry out an electrical installation.

Content of the material

Chapter 1 General information on electrical equipment

- Malfunctions and anomalies: role and
- classification of protection devices
- Basic functions of switchgear, isolation, control, protection, switchgear classification,
- switchgear selection, characteristics of electrical switchgear, switchgear protection, classes of electrical equipment.
- protective measures.

Chapter 2 Switching and control equipment

- Switches (definition, role and characteristics).
- Disconnectors (definition, role and characteristics).
- Switches (definition, role and characteristics).
- Contactors (definition, role and characteristics).

Chapter 3 Protective equipment

- Fuses (role and function, types). Relays (definition, role,
- types and characteristics). Circuit breakers (definition,
- role, types and characteristics).

Chapter 4 Development of electrical diagrams

- Standardized symbols for electrical equipment. Classification of
- diagrams according to the method of representation.
- Rules and standards for establishing an electrical diagram (example of control and power diagrams).
- Conventions and standardization.

Chapter 5 Lighting circuits

- Single ignition assembly, double ignition assembly, two-way switch assembly and assembly with remote switch and timer (connected in 03 and 04 wires).

Chapter 6 Starting and braking modes of three-phase asynchronous motors

- Selection of the starting and braking type for three-phase asynchronous motors.
- Direct starting of a three-phase asynchronous motor with a single direction of rotation (Operating principle, power and control diagram, protection and application
- range). Direct starting of a three-phase asynchronous motor with two directions of rotation (Operating principle, power and control diagram, protection and application range).

- Star-Delta Starting of a Three-Phase Asynchronous Motor (uses of star-delta starting, operating principle, power and control diagram; protection and areas of use).

- The different braking modes of three-phase asynchronous motors.

Practical Exercises
TP1:Lighting circuits (single, double and two-way switch installations, installations with remote switch and timer, power outlet installation).
TP2:Manual control of a disconnector by switch, by one or more push buttons. TP 3:Starting a three-phase squirrel cage asynchronous motor with one direction of travel and signal lamps (start and stop).
TP 4:Starting a three-phase asynchronous motor with two directions of rotation. TP 5:Star/ delta starting of a three-phase asynchronous motor. TP 6:A practical exercise on the braking mode of a three-phase asynchronous motor.

Evaluation method:Continuous assessment (20% tutorials + 20% practicals), Exam 60%

Bibliographical references

[1].http://www.yesss-fr.com/tech/symboles-electriques.php
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[3].Legrand, Electricity Guide, Legrand, 2021
[4]. “Electrical Diagrams Handbook”, Thierry Gallauziaux, David Fedullo, Eyrolles Publishing, collection: DIY Notebooks; 2009 (2nd edition)
[5]. "The Electrical Diagram", Hubert Largeaud, Eyrolles Publishing – 1991 (3rd Edition)
[6]. Christophe Prévé-, "Protection des réseaux électriques", Hermès, Paris, 1998.
[7].SH Horowitz, AG Phadke, "Power System Relaying", second edition, John Wiley & Sons, 1995.
[8]. Jacques Marie Broust, Industrial Electrical Equipment and Installations, Dunod, 2023
[9]. Schneider, Electrical Installation Guide, Schneider, 2017.
[10] L. Féchant, "Electrical equipment at LV, Distribution equipment", Techniques de l'Ingénieur, Electrical Engineering treatise, D 4 865.
[11]T. Wildi, Electrotechnics Third edition, Les presses de l'université de Laval, 2000.

HALF	Subject Title	Coefficient	Credits	Code
S5	Applied Numerical Methods - Python	2	3	

VHS	Course	Tutorials	Practical Exercises
45 hours	1 hour 30 minutes		1 hour 30 minutes

Prerequisites:
Subjects taught in TC-ST: Numerical Analysis 1 and 2; Computer Science 1, 2, 3, 4

Goals :
This course consolidates the knowledge acquired in semesters 1, 2, 3, and 4 in numerical analysis and computer science. After a review of Python programming and the numerical methods necessary for solving certain problems related to electrical engineering, students will develop Python programs to solve these problems as practical exercises.
The main objectives of this program are:

- Consolidate the knowledge already acquired during previous semesters in numerical analysis and computer science by developing programs in Python for solving problems in numerical analysis.
- Solving partial differential equations
- Programming and testing of some optimization methods

Content of the material:

Chapter 1. Review of Python programming (one week)
I.1 Introduction to Python
I.2 Data Types and Expressions
I.3 Conditional Instructions
I.3 Repetitive instructions (loops)
I.4 Functions and Procedures - Local Variables - Global Variables
I.5 Files (reading and writing)
I.6 Graphics
I.7 LibrariesNumPySciPymathplotlib ....

Chapter 2. Methods for solving systems of equations (3 weeks)
II.1 Methods for solving nonlinear equations
II.2 Methods for solving systems of linear equations
II.3 Methods for solving systems of nonlinear equations (Jordan, Gauss, Seidel, Newton methods and optimization methods)

Chapter 3. Methods for solving systems of differential equations (3 weeks)
II.4 Methods for solving ordinary differential equations of the 1erorder, application for solving systems of ordinary differential equations of order greater than 1. Chapter 4. Solving Partial Differential Equations (4 weeks)

Finite differences, finite elements

Chapter 5. Optimization Methods: Deterministic and Stochastic (4 weeks)

Practical Exercises :

- Lab 1: Solving Non-Linear Equations
- Lab 2: Solving Linear Systems: Direct Methods; Iterative Methods
- TP3 Solving ordinary differential equations and systems of equations
- Lab 4: Solving Partial Differential Equations
- TP5 Optimization Methods
- Project for solving a problem related to electrical engineering based on programming in Python.

These projects are assigned to students at the beginning of the semester so that they can prepare them for presentation before the end of the semester.

Bibliographical references:

[1] Michaël Baudin, Numerical Methods with Python: Theory, Algorithms, Implementation and Applications with Python, 3rd edition, Dunod 2023

[2] Q. Kong, T. Siauw, A Bayen, Python programming and numerical methods. https://pythonnumericalmethods.studentorg.berkeley.edu/notebooks/Index.html

[3] J. Kiusalaas, Numerical Methods in Engineering with Python 3, Cambridge university Press 2013

[4] André Fortin, numerical analysis for engineers, Presses internationales Polytechnique (2011).

Download site:https://www.python.org/downloads/

Official Python documentation site: docs.python.org

[5] G. Allaire, Numerical Analysis and Optimization, École Polytechnique Press, 2012

[6] Computational methods in Optimization, Polak, Academic Press, 1971.

[7] Optimization Theory with applications, Pierre DA, Wiley Publications, 1969.

[8] Taha, HA, Operations Research: An Introduction, Seventh Edition, Pearson Education Edition, Asia, New Delhi, 2002.

[9] SS Rao, “Optimization – Theory and Applications”, Wiley-Eastern Limited, 1984.

Evaluation methods:

Continuous assessment 40%, Examination 60%

HALF	Subject Title		Coefficient	Credits	Code
S 5	Industrial maintenance		1	1	
VHS	Course	Tutorials	Practical Exercises		
10:30 PM	1 hour 30 minutes				

Prerequisites

Statistics and probability, apparatus, measurements and instrumentation.

Goals

Upon completion of this course, the student will be able to assimilate the fundamental principles of industrial maintenance, its application to various service contexts, to all equipment technologies and to all types of industrial structures.

Content of the material

Chapter 1 Introduction to maintenance (1 week)

- History and evolution of maintenance; Definitions and types of maintenance.
- Levels of maintenance.

Chapter 2 The maintenance department within the company (3 weeks)

- Organizational chart of the maintenance department.
- The production/maintenance relationship.
- Maintenance functions (methods, scheduling and execution).
- Intervention management.
- The communication circuit (DT, OT, BT, etc.)

Chapter 3 Equipment and Technical Documentation Management (3 weeks)

- Nature and classification of the material.
- Inventory of equipment (functional breakdown, structural analysis, technical specifications, coding, etc.).
- Technical documentation; Warranties.

Chapter 4 Introduction to CMMS (4 weeks)

- History of the computerization of maintenance.
- *Smart*-maintenance.
- The basic modules of CMMS; Benefits of CMMS.

Chapter 5 Generalities on operational safety (4 weeks)

- Concepts and definitions.
- Reliability, maintainability, availability and safety.
- The challenges of operational safety.
- Contribution of maintenance to operational safety.

Evaluation methods:Final Exam: 100%

Bibliographical references:

[1] Monchy, François, and Claude Kojchen. Maintenance-5th ed.: Tools, methods and efficient organizations. Dunod, 2019.
[2] Heng, Jean. Practical preventive maintenance - 4th ed. Dunod, 2023.
[3] Procaccia, Henri, Eric Ferton, and Marc Procaccia. Reliability and maintenance of repairable and non-repairable industrial equipment. Lavoisier, 2011.
[4] Lasnier, Gilles. Operational safety of equipment and reliability calculations. Lavoisier, 2011.
[5] Lyonnet, Patrick. Maintenance planning: Methods and mathematics. Springer Science & Business Media, 2013.

HALF	Subject Title	Coefficient	Credits	Code
S5	Energy production	1	1	

VHS	Course	Tutorials	Practical Exercises
10:30 PM	1 hour 30 minutes		

Course content

Chapter 1 – General Information on Electricity Production

- Global and national (Algeria) history of electricity production. Energy
- transition: concepts of eco-design, sustainable development.
- Comparison between renewable and non-renewable energies.
- Economic, environmental and geopolitical issues related to energy.

Chapter 2 – Thermal Power Plants

- Steam power plants:
  - Operating principle: water-steam circuit, turbines, boilers, condensers. Study of
  - thermodynamic cycles: Carnot, Rankine, Hirn, reheating and drawdown. Overall
  - efficiency, loss factors, site selection criteria.
- Gas turbine power plants:
  - Operation, Joule cycle.
  - Combined cycle power plants: gas + steam turbines.

Chapter 3 – Generator Sets

- Definition and construction of a generator set.
- Types of generators (petrol, diesel).
- Applications (rescue, isolated sites).

Chapter 4 – Nuclear Power Plants

- Principle of nuclear fission, operation of a power plant.
- Types of reactors: PWR, CANDU, breeder reactors. Nuclear
- fuel, processing, vitrification, storage.
- Risks and safety: radiation protection, containment, accidents (Chernobyl,
- Fukushima). Environmental and regulatory issues.

Chapter 5 – Hydroelectric Power Plants

- Hydropower and tidal energy.
- Types: run-of-river, dam, pumped-storage. Main components:
- dam, penstock, turbine, generator. Calculation of available
- power and efficiency.

Chapter 6 – Wind Energy

- Introduction to wind turbines: operation, components (blades, generator, nacelle). Different
- types of wind turbines: horizontal / vertical axis.

- Calculation of power extracted from wind.
- Integration into the electrical grid.

Chapter 7 – Solar Energy

- Photovoltaic systems: principle, efficiency, architecture.
- Difference between off-grid and grid-connected systems.
- Comparison with solar thermal energy.
- Advantages/disadvantages, solar energy storage.

Chapter 8 – Fuel Cells

- Definition, operating principle (electrochemical reaction).
- Types of batteries: PEMFC, SOFC, PAFC, AFC.
- Applications: vehicles, stationary production.
- Yield, environmental impact.

HALF	Subject Title		Coefficient	Credits	Code
S5	Technical English related to the specialty		1	1	
VHS	Course	Tutorials	Practical Exercises		
10:30 PM	1 hour 30 minutes				

Recommended prior knowledge:

— Basic English vocabulary and grammar

— Fundamental knowledge of electrical systems

Course Objectives:

The objective of this course is to strengthen fundamental knowledge of the English language and to introduce and familiarize the student with technical vocabulary, particularly in the field of electrical engineering. At the end of this course, the student will have acquired the necessary knowledge that allows him to write and present a technical or scientific report in English.

Course content:

Chapter 1: Reminder on grammar: common tenses in academic writing (4 weeks)

- Present simple and present continuous.
- Past simple and past continuous.
- Present perfect and present perfect continuous.
- Past perfect and past perfect continuous.

Chapter 2: Remainder on English for mathematics (3 weeks)

-Equations writing and spelling

Chapter 3: Terminology of electrical engineering (3 weeks)

- Conductors/insulators/semiconductors.
- Circuit elements.
- Power electronics elements.
- Electric Machines elements.
- Control systems Elements.

Chapter 4: Technical writing and presentation (4 weeks)

- Electric system description. Technical report
- writing and presentation.

Evaluation method:Final Exam: 100%.

References:

1. PT Danison, Practical guide to writing in English: usages and rules, practical advice, Editions d'Organisation 2007.
2. A. Chamberlain, R. Steele, Practical Guide to Communication: English, Didier 1992.
3. R. Ernst, Dictionary of techniques and applied sciences: French-English, Dunod 2002.
4. PT Danison, Practical guide to writing in English: usages and rules, practical advice, Editions d'Organisation 2007.
5. A. Chamberlain, R. Steele, Practical Guide to Communication: English, Didier 1992.
6. R. Ernst, Dictionary of techniques and applied sciences: French-English, Dunod 2002.
7. J. Comfort, S. Hick, and A. Savage, Basic Technical English, Oxford University Press, 1980.
8. EH Glendinning and N. Glendinning, Oxford English for Electrical and Mechanical Engineering, Oxford University Press 1995.
9. TN Huckin, and AL Olsen, Technical writing and professional communication for non-native speakers of English, McGraw-Hill 1991.
10. J. Orasanu, Reading Comprehension from Research to Practice, Erlbaum Associates 1986.

Detailed syllabi for the subjects of 6thhalf

HALF	Subject Title		Coefficient	Credits	Code
S 6	Energy conversion		3	5	
VHS	Course	Tutorials	Practical Exercises		
67h30	1 hour 30 minutes	3 hours			

Content of the material

Chapter I: General Information on Electrical Networks

- Electrical grid organization.
- Power plants.
- Electrical substations: power transformers, measuring transformers (current and voltage), circuit breakers, disconnectors, other substation equipment.
- Other network elements: supports, conductor cables, overhead lines, underground lines, guard cables, busbars, insulators.
- Dispatching center.

Chapter II: Modes of transport, allocation and distribution of electrical energy

- Description of electrical networks (structure, voltage levels).
- Electrical network topology: HV/MV substations, MV networks, MV/LV substations, LV networks.

Chapter III: Modeling of Power Lines

- Longitudinal characteristics: resistance, longitudinal reactance, concept of geometric mean radius (GMR) and geometric mean distance (GMD).
- Transverse characteristics: transverse reactance, corona conductance. Electrical
- network calculations: general operating equations, equivalent circuits, voltage drop calculation, Ferranti effect.
- Transmitted power and power factor compensation in lines.

Chapter IV: Transformers and the system of relative units

- Review of single-phase and three-phase transformers: modeling, parameter determination, transformer coupling (types and choices).
- Parallel connection of three-phase transformers: advantages, conditions, clock hour index. Main types of
- transformers: current measuring transformers, voltage measuring transformers, on-load tap changers, phase shifters, three-winding transformers, autotransformers.
- Relative unit system: basic quantities (power, voltage, impedance), choice of base, change of base.

Chapter V: Calculation of short-circuit currents

- Calculation of short-circuit currents: causes, consequences, types, concept of symmetrical and asymmetrical short circuits.
- Calculation using symmetric components: method, construction of sequential networks.
- Equivalent impedances of network elements.

Practical Work (PW)

TP no.	Titled	Goals
TP1	Job analysis electric	Identify the components of a workstation and their role. Use simulation software to understand the overall operation.
TP2	Modeling a transport line	Calculate the parameters of a line (R, L, C) using geometric data. Implementation using calculation software (Matlab or equivalent).
TP3	Simulation of a network: distribution	Study a simulated HV/MV/LV architecture. Identify losses and voltage drops.
TP4	Study of a transformer: Measuring the parameters of a transformer (open-circuit voltage, three-phase short-circuit voltage)	circuit). Experiment with different couplings.
TP5	Fault analysis and short circuit calculation	Identify fault types and simulate short-circuit currents using simulation software (ETAP, Simulink, etc.).
TP6	Compensation for reactive power	Study of the effect of compensation on the power factor. Use of capacitor banks.

Bibliographical references

1. Debaprya Das, *Electrical Power System*, Indian Institute of Technology, New Delhi, 2006.
2. John J. Grainger, William D. Stevenson Jr., *Power System Analysis*, North Carolina State University, 1994.
3. J. Duncan Glover, Mulukutla S. Sarma, Thomas J. Overbye, *Power System Analysis and Design*, 5th Edition, SI, Cengage Learning, USA, 2008.
4. J. Lewis Blackburn, *Symmetrical Components for Power Systems*, Ohio State University, 1993.
5. Jean-Pierre Muratet, *Economic and planning elements for electricity transmission and distribution networks* ALSTOM, 1998.
6. Serge Pichot, *High-voltage transmission lines*, FCIS AAE Transmission, 1998.
7. Daniel Noel, *Medium/Low Voltage Substations* ALSTOM, 1998.
8. Schneider Electric, *T&D Industrial Electrical Network Design Guide: Electrical Network Architecture* Ref. 6 883 427/A.
9. Schneider Electric, *Low-voltage electrical network design guide: Transformer, definitions and characteristic parameters* Ref. B92.
10. *The GRTE: Organization and missions*, 10th National Conference on High Voltage (CNHT16), May 2016.

April 11, Charles *Construction of overhead high-voltage power lines*, Eyrolles Publishing, Paris, 1974.

12. Souad Chebbi, *Faults in electrical networks*, teaching material, Virtual University of Tunis.
13. *Electrotechnics*, 2nd edition, Presses internationales polytechniques, 1999.
14. JC Gianduzzo, *Electrotechnical lectures and tutorials* University of Bordeaux 1.
15. L. Lasne, *Electrical engineering for energy distribution* University of Bordeaux 1, 2004.
16. T. Wildi, *Electrotechnics*, 3rd edition, Presses de l'Université Laval, 2000.
17. N. Hadjsaid, JC Sabonnadière, *Electrical Lines and Networks 1: Electrical Power Lines*, Éditions Hermès - Lavoisier, 2007.
18. B. Demetz-Noblat, *Analysis of three-phase networks under disturbed conditions using symmetrical components* Schneider Technical Notebook No. 18, 2002.

HALF	Subject Title	Coefficient	Credits	Code
S5	Power Electronics	2	3	

VHS	Course	Tutorials	Practical Exercises
45 hours	01:30	01:30	

Prerequisites
General electricity, fundamental electrotechnics, power semiconductor components.

Goals
Understand the basic principles of power electronics. Understand the operating principles and uses of power semiconductor components. Master the operation of the main static converters. Acquire the basic knowledge for making a technical selection based on the application area of a static power converter.

Content of the material

Chapter 1. Introduction to Power Electronics 3 weeks
Introduction to power electronics and its role in electrical energy conversion systems. Classification of static converters (according to switching mode, according to conversion mode). Non-sinusoidal periodic quantities (RMS values, averages, form factor, ripple factor, THD, etc.). Study of the static and dynamic characteristics of various power semiconductor components. Definition of different switching modes.

Chapter 2. AC to DC Conversion 3 weeks
Single-phase controlled and uncontrolled rectifiers, load types R, RL, RLE. Three-phase controlled and uncontrolled rectifiers, load types R, RL, RLE. Analysis of the commutation (overlap) phenomenon in uncontrolled and controlled static rectifier converters.

Chapter 3. AC to AC Conversion (3 weeks)
Single-phase and three-phase dimmer with R and RL loads. Principle of the single-phase cycloconverter.

Chapter 4. DC-DC Conversion 3 weeks
Step-down and step-up chopper, with R, RL and RLE loads. Two-quadrant reversible chopper. Four-quadrant reversible chopper.

Chapter 5. DC-AC Conversion 3 weeks
Single-phase inverter, half-point and full-bridge configuration with R and RL loads. Full-wave and phase-shift control. Three-phase inverter with full-wave and phase-shift control.

Content of practical exercises

TP 01:Single-phase and three-phase uncontrolled rectifier (load R, L). TP 02: Single-phase and three-phase controlled rectifier (load R, L).

TP 03:Serial and parallel chopper.
TP 04:Single-phase dimmer (Load R, L). TP 05:Three-phase dimmer. TP 07:Single-phase inverter. TP 08:Three-phase inverter.

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

Bibliographical references

1.L. Lasne, "Power Electronics: Course, Case Studies and Solved Exercises", Dunod, 2011.
2.P. Agati et al. “Aide-mémoire: Electricity-Control and Power Electronics-Electrotechnics”, Dunod, 2006.
3.J. Laroche, “Power Electronics – Converters: Course and Solved Exercises”, Dunod, 2005.
4.G. Séguier et al. “Power Electronics: Course and Solved Exercises”, 8eedition; Dunod, 2004.
5.D. Jacob, “Power Electronics - Operating Principle, Dimensioning”, Ellipses Marketing, 2008.
6.G. Séguier, “Power electronics, basic functions and their main applications”, Tech et Doc.
7.H. Buhler, "Power Electronics", Dunod
8.CW Lander, "Power Electronics", McGraw-Hill, 1981
9.H. Buhler, "Electronics for Regulation and Control; Treatise on Electricity".
10.F. Mazda, “Power Electronics Handbook: Components, Circuits and Application”, 3rdEdition, Newness, 1997.
11.R. Chauprade, “Control of alternating current motors (Power electronics)”, 1987.
12.R. Chauprade, “Control of DC motors (Power electronics)”, 1984.

HALF	Subject Title	Coefficient	Credits	Code
S6	Industrial Regulation	2	3	

VHS	Course	Tutorials	Practical Exercises
45 hours	1 hour 30 minutes	1 hour 30 minutes	1 hour 30 minutes

Content of the material

Chapter 1 – Introduction to Industrial Regulation

- Concepts of industrial processes.
- Components of a control loop:
  - Process, actuators, sensors, controller, signal conditioner. Characteristic
  - quantities: setpoint, measurement, disturbance, controlled, controlling and disturbing quantities.
- Diagram of a regulated system.
- Components of a control loop. Symbols,
- functional diagrams.
- Performance criteria of a regulation system (stability, precision, speed, robustness...).

Chapter 2 – On/Off Regulator

- Operation of a simple on/off regulator. On/
- off regulator with threshold.
- On/off regulator with hysteresis.
- On/off regulator with combined threshold and hysteresis.

Chapter 3 – Standard controllers: P, PI, PD, PID

- Characteristics of proportional, integrator, and differentiator controllers.
- Structures of PID controllers:
  - Parallel, series, and mixed forms.
- Electronic and pneumatic designs.

Chapter 4 – Selection and sizing of regulators

- Criteria for choosing a
- regulator. Sizing methods:
  - Plateau criterion, symmetrical
  - criterion. Ziegler-Nichols method.
- Adjusting the regulators by tracking a reference model.

Chapter 5 – Industrial Applications

- Regulatory case studies:
  - Temperature
  - Speed
  - Pressure
  - Level
  - Engine speed

Practical Work (PW)

TP no.	Titled	Educational objectives
TP1	Frequency responses and system identification	Analyze the frequency responses of a linear system; model a process from experimental data.
TP2	Regulator characteristics	To study the effects of P, PI, PD and PID actions on a simulated process.
TP3	Analog (PID) control of a fluid level	Create a PID loop and analyze its behavior on a level control model.
TP4	Speed control of a direct current motor (DCM)	Tuning a PID to stabilize the speed of a motor in a closed loop.
TP5	Pressure regulation	Implementing pressure regulation on a training bench.
TP6	Temperature regulation	Implement PID temperature control and analyze performance (response time, overshoot, etc.).

Assessment methods: Continuous assessment 20%, Practical work 20%, Examination 60%

Bibliographical references

1. E. Dieulesaint, D. Royer,*Automatic applied*, 2001.
2. P. de Larminat,*Automation: Control of linear systems*, Hermès, 1993.
3. KJ Åström, T. Hägglund,*PID Controllers: Theory, Design and Tuning*, Instrument Society of America, 1995.
4. A. Datta, MT Ho, SP Bhattacharyya,*Structure and Synthesis of PID Controllers*, Springer-Verlag, 2000.
5. Jean-Marie Flaus,*Industrial regulation*, Hermès Publishing, 1995.
6. P. Borne,*Analysis and regulation of industrial processes – Volume 1: Continuous regulation*, Technip Editions.
7. T. Hans, P. Guyenot,*Regulation and control*, Eyrolles Publishing.
8. R. Longchamp,*Digital control of dynamic systems*, Presses Polytechniques et Universitaires Romandes, 2006.
9. Online resource:www.technologuepro.com – Industrial Regulation

HALF	Subject Title	Coefficient	Credits	Code
S6	Microcontrollers and Microprocessors	2	4	

VHS	Course	Tutorials	Practical Exercises
45 hours	1 hour 30 minutes		1:30 AM

Prerequisites

Combinational and sequential logic.

Goals

Understand the structure and uses of a microcontroller. Be proficient in assembly language and high-level programming. Understand the use of I/O interfaces and interrupts. Learn to use microcontrollers for system control programming.

Content of the material

Chapter 1 Internal architecture and operation of a microcontroller (3 weeks)

- Introduction to the microprocessor, Transition from microprocessor to microcontroller,
- Clock and reset, Memory organization, Central processing unit registers, Interrupts
- Program memory, EEPROM data memory, WDT
- watchdog timer, and sleep mode.
- parallel input/output ports, timers 0, 1 and 2.

Chapter 2 Capture and Comparison (CCP) and Pulse Width Modulation (PWM) modules (2 weeks)

- Capture mode, Comparison mode, PWM mode, CCP
- module control registers.

Chapter 3 Analog-to-digital converters (2 weeks)

- Conversion process,
- Conversion time,
- Acquisition time,
- Numerical value obtained.

Chapter 4 The USART or SCI (Serial Communication Interface) serial communication interface (3 weeks)

- Presentation in asynchronous and synchronous
- modes, Transmission (Presentation and Operation),
- The reception (Presentation and Operation),
- The SCI registers.

Chapter 5 The MSSP (Master Synchronous Serial Port) module (2 weeks)

- The MSSP module in I2C (inter-integrated circuit) mode:
- Transmission of one byte, Reception of one byte.
- The MSSP module in SPI (Serial Peripheral Interface) mode,
- The MSSP registers.

Chapter 6 Instruction set and application development in Electrotechnics (3 weeks)

- Detailed description of instructions,
- Machine language programming,
- High-level language programming.

Practical exercises

Lab 1: Getting started with a microcontroller programming environment: lighting up an LED and sequentially lighting up all 8 LEDs

Lab 2: Programming a Timer and Interrupts

Lab 3: Control of electrical machines based on PIC microcontrollers (e.g., PIC16F877). Lab 4: Programming for analog-to-digital converters (e.g., PIC16F877).

Lab 5: Microcontroller applications: Serial interface circuits, transmission/reception synchronous, LCD interface - keyboard interface - data acquisition system.

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

Bibliographical references

[1].C. TAVERNIER, “PIC 10, 12, 16 Microcontrollers: Description and Implementation”, Dunod Edition 2000.

[2]. BIGONOFF, “The programming of PICs”, Course, first part, Revision 33.

[3].M. Tischer and B. Jennrich. The PC Bible – System Programming. Micro Application, Paris, 1997.

[4]. R. Tourki. The PC computer – Architecture and programming – Course and exercises. University Publishing Center, Tunis, 2002.

[5]. H. Schakel. Programming in assembly language on PC. Micro Application, Paris, 1995.

[6]. E. Pissaloux. I80x86 Assembler Practice – Course and Exercises. Hermès, Paris, 1994.

HALF	Subject Title		Coefficient	Credits	Code
S 6	High-voltage techniques		3	5	
VHS	Course	Tutorials	Practical Exercises		
45h00	1 hour 30 minutes	1 hour 30 minutes	1 hour 30 minutes		

Prerequisites :Concepts of fundamental physics, fundamental electrical engineering.

Goals : The aim of this course is to provide a comprehensive understanding of electrical energy, encompassing both the comprehension of physical phenomena and the design and dimensioning of insulation for high-voltage equipment. Upon completion of this course, students will be able to address insulation coordination issues within electrical networks. Mastery of this subject will enable engineers to design equipment capable of withstanding the stresses encountered during high-voltage operation.

Content of the material:

Chapter 1: Introduction to High Voltage (2 weeks)

General information on high voltage; Definition; History; Why use high voltage in the transmission of electrical energy; Problems related to high voltage; Examples of high voltage applications...

Chapter 2. Control of Electric Fields (2 weeks)

Electric field and shape dependence; Electric field control; Electric field evaluation methods; Peak power; Faraday cage; Equipotential surface....

Chapter 3. High Voltage Generators (2 weeks)

Electrostatic generators; High voltage alternating, direct and shock generators

Chapter 4. High Voltage Measurements (2 weeks)

Measurement of electric fields, measurement of high alternating, direct and shock voltages; measurement of currents.

Chapter 5. Ionization Phenomena in Gases (2 weeks)

Natural ionization of gases – ion movement – mobility – electron temperature. Disruption mechanisms: (Seed electrons – ionization – electron avalanches – secondary emissions)

Chapter 6. Gaseous Insulators (2 weeks)

Townsend Mechanisms - Streamer and Leader Mechanisms. Priming Conditions

Chapter 7: Impacts of high voltage on the environment and applications.
(2 weeks)

Impact of the corona effect in electrical networks on the environment; Industrial applications of corona discharge.

High-voltage practical exercises:

Lab 1+2: High Voltage Sources (AC, DC, Impulse) Lab 3:
High Voltage Measurements
TP4: Corona discharge
TP5: Partial discharges

Evaluation method: Continuous assessment: (40% practical work); Examination: 60%.

Bibliographical references:

[1] Michel Aguet, Michel Ianoz: "Treatise on electricity, volume 22 - High voltage -", Presses Polytechniques et Universitaires Romandes (PPUR), 436 pages, 1982.

[2] AFFOLTER Jean-François: "HAUTE TENSION", EIVD, 2000.

[3] E. Kuffel, WS Zaengl, J. Kuffel: "HighVoltageEngineering; Fundamentals", Second edition, Butterworth-Heinemann, 2000.

[4]- C. Gary "Dielectric properties in air and very high voltages", Editions Eyrolles, 1984

[5]- P. Bergounioux "High tension", Edition Willam Blake & Co, 1997

[6]-J. Arrillaga, "High Voltage Direct Current Transmission", Peter Pregrinus, London, 1983

HALF	Subject Title		Coefficient	Credits	Code
S 6	Sensors and measurement chains		2	3	
VHS	Course	Tutorials	Practical Exercises		
45 hours	1 hour 30 minutes		1 hour 30 minutes		

Course content

Chapter 1 – Concept of a measurement chain

- Definition of a measurement chain.
- Industrial control chain: synoptic representation. Active
- and passive sensors.
- Classification of sensors according to the nature of the quantity measured (temperature, pressure, displacement...) and the operating principle (resistive, inductive, capacitive, optical, etc.).

Chapter 2 – Metrological characteristics of sensors

- Definitions: accuracy, precision, resolution, threshold, hysteresis, drift.
- Sensor calibration.
- Static and dynamic sensitivity.
- Linearity, accuracy, bandwidth.

Chapter 3 – Sensor Conditioning Circuits

- Basic operational amplifier circuits:
  - Inverter, non-inverter, differential, summing.
- Instrumentation amplifier, isolation amplifier.
- Conditioning bridges (e.g., Wheatstone bridge).
- Linearization of static characteristics.

Chapter 4 – Temperature Measurement

- Introduction to thermometry.
- Temperature sensors:
  - Resistors (RTDs), thermocouples, thermistors (NTC, PTC), pyrometers (IR). Selection
- and characteristics of temperature sensors according to applications.

Chapter 5 – Pressure Measurement

- Definitions: absolute, relative, and differential pressure.
- Physical principles of pressure measurement.
- Piezoresistive, capacitive, strain gauge sensors.

Chapter 6 – Measurement of levels and flow rates

- Level sensors: float, ultrasonic, capacitive. Flow sensors:
- Doppler, turbine, electromagnetic.

Chapter 7 – Measuring Displacement and Speed

- Position sensors: potentiometric, inductive (LVDT), optical.
- Rotation speed sensors: tachometers, incremental encoders, Hall effect sensors.

Practical Work (PW)

TP no.	Title	Educational objectives
TP1	Packaging of sensors	Design and test conditioning circuits based on operational amplifiers.
TP2	Temperature measurement	Implement different temperature sensors (RTD, thermocouple) and analyze the output signals.
TP3	Pressure measurement	Manipulating a piezoresistive pressure sensor and studying its metrological performance.
TP4	Level and flow measurement	Use ultrasonic sensors to measure levels, implement a flow sensor.
TP5	Photometric measurement	To study the behavior of an optical sensor (photodiode or phototransistor).
TP6	Rotational speed measurement	Set up a speed measurement circuit using an optical or Hall effect sensor.

Evaluation methods

- Final Exam 60%
- TP 40%

Bibliographical references

1. Georges Asch et al.,*Sensors in industrial instrumentation*, 6th ed., Dunod, 2006.
2. Pascal Dassonvalle,*Sensors – 50 exercises and solved problems*, Dunod, 2004.
3. G. Asch, P. Renard, P. Desqoutte, Z. Mammeri, E. Chambérod, J. Gunther,*Data acquisition*, 3rd ed., Dunod, 2011.
4. FéridBélaïd,*Introduction to sensors in industrial instrumentation*, CPU, 2006.
5. JP Bentley,*Principles of Measurement Systems*Pearson Education, 2005.
6. J. Niard et al.,*Electrical measurements*, Nathan, 1981.

HALF	Subject Title		Coefficient	Credits	Code
S6	Company Internship 1		1	1	
VHS	Course	Tutorials	Practical Exercises		
10:30 PM			1 hour 30 minutes		

Prerequisites:

- Basic knowledge of electrical engineering, including electrical circuits, electrical machines, sensors, actuators and control systems.
- Familiarity with electrical safety standards and work protocols in electrical environments.
- Computer science.

Teaching objectives

- Gain practical experience in implementing the theoretical concepts studied in class.
- Develop technical skills related to the repair, installation and maintenance of electrical equipment.
- Become familiar with electrical safety standards and best practices in an industrial environment.
- Learn to use electrical tools and equipment safely and efficiently.
- Strengthen skills in fault diagnosis and problem solving related to electrical systems.
- Collaborating with industry professionals to acquire knowledge and practical skills specific to the field of electrical engineering and systems

Evaluation method :

Continuous monitoring: 100%

HALF	Subject Title		Coefficient	Credits	Code
S6	Entrepreneurship and Start-ups		1	1	
VHS	Course	Tutorials	Practical Exercises		
10:30 PM	1 hour 30 minutes				

Teaching objectives:

This course aims to introduce students to the fundamentals of entrepreneurship, startup creation, and innovation processes. It will enable students to acquire the skills necessary to identify innovative opportunities, develop a viable business concept, and understand thethe essential steps to creating a start-up.

Content of the material:

Chapter 1: Introduction to Entrepreneurship (2 weeks)

- Definition and interrelationship between entrepreneurship and
- innovation: The entrepreneurial and innovation ecosystem in Algeria
- The different types of innovation (product, process, business model)
- Profile and skills of the innovative entrepreneur

From idea to project

- Identifying opportunities
- Creativity techniques (brainstorming, mind mapping, etc.)
- Case study: failure vs. success

Chapter 2: Identifying innovative opportunities (1 week)

- Methods for identifying innovation opportunities;
- Analysis of unmet needs in the Algerian market; Design
- thinking and user-centered approach; Creativity and
- ideation techniques

Chapter 3: Business Model Canvas (3 weeks)

- Components of the Business Model
- Canvas: Developing the value
- proposition, Customer segmentation
- Distribution channels and customer relations; Cost
- structure and revenue streams Development of
- disruptive business models

Chapter 4: Introduction to the Business Plan (2 weeks)

- Structure and key elements of the business
- plan; Simplified market study
- Marketing and sales strategy
- Fundamental Financial Aspects
- SWOT Analysis
- Marketing plan, operational plan

Chapter 5: Financing Startups (3 weeks)

- Sources of funding available in Algeria

- Public support schemes for entrepreneurship (ANSEJ, ,incubators, accelerators,CNAC, ANGEM)
- Venture capital and business angels;
- Crowdfunding Intellectual property
- protection
- Tax advantages and specific support for innovative start-ups

Chapter 6: Communication and leadership **(1 week)**

- Oral presentation techniques,
- teamwork, conflict management

Chapter 7: Legal and Administrative Aspects (1 week)

- Legal forms of businesses in Algeria;
- Administrative procedures for business
- creation; Protection of intellectual property;
- Taxation of start-ups

Chapter 8: From Concept to Realization - Implementation of the Innovative Project (2 (weeks)

- Development of a minimum viable product (MVP)
- Testing and validation of the innovation in the market
- Development of a growth strategy Effective
- presentation of an innovative project (pitch)

Evaluation method:100% exam

Bibliographical references:

1. Christensen, CM (2021).The innovator's dilemma: When new technologies lead to the failure of large companies.VALOR.
2. Nezha DA, Mouffok B. (2023). Startups and Entrepreneurship: The Future of Algeria Editions European academics.
3. Osterwalder, A., & Pigneur, Y. (2011).*Next Generation Business Model: A Guide for Visionaries, Revolutionaries, and Challengers*Pearson.

1. Fayolle, A. (2012).*Entrepreneurship: Learning to be an entrepreneur*Dunod.
2. Blank, S., &Dorf, B. (2013).*The Startup Creator's Handbook: Step by Step, Build a Great Business*. Diateino.
3. Ries, E. (2015).*Lean Startup: Embrace continuous innovation*Pearson.
5. Madoui, M. (2015).*North African entrepreneurs: Areas of development*Karthala.
6. Grim, N. (2012).*Entrepreneurs, Business Creation and Development*European University Editions.

Detailed syllabi for the subjects of 7thhalf

HALF	Subject Title		Coefficient	Credits	Code
S 7	Electrical control		4	6	
VHS	Course	Tutorials	Practical Exercises		
45 hours	1 hour 30 minutes	3 hours	1 hour 30 minutes		

Course content

Chapter 1 – Generalities on electrical control*(10%)*

- Fundamental definitions.
- Mechanical characteristics of production machines and electric motors.
- Characteristic curves and operating point.

Chapter 2 – Bypass-wound DC motor*(10%)*

- Engine speed.
- Engine start.
- Braking system.

Chapter 3 – Series-wound DC motor*(10%)*

- Engine speed.
- Engine start.
- Braking system.

Chapter 4 – Three-phase asynchronous motor*(15%)*

- Engine operation. Starting
- methods.
- Braking methods.

Chapter 5 – Adjusting the Speed of a DC Motor*(20%)*

- Adjustment indices.
- Adjustment zones.
- Action on magnetic flux.
- Rheostatic adjustment.
- Variation in supply voltage.

Chapter 6 – Speed Control of an Asynchronous Motor*(15%)*

- Action on the number of
- poles. Action on the sliding.
- Variation in supply frequency.

Chapter 7 – Concepts of Transient Regimes*(10%)*

- Response time, dynamics of a control system.
- Disturbances and stability.

Chapter 8 – Choosing Motor Power and Load Diagram*(10%)*

- Calculating power based on load. Energy
- assessment and motor selection. Reading and
- interpreting load diagrams.

Practical Work (PW)

TP no.	Title	Educational objectives
TP1	Study of the characteristics of a current motor independently excited continuous powered by a series chopper	Analyze the effect of chopper control on motor behavior.
TP2	Study of a series-wound DC motor powered by a mixed rectifier bridge	Implement a rectified control and analyze performance in steady state.
TP3	Study of the characteristics of a universal motor powered by a dimmer	Observe the effects of voltage variation on the dynamic performance of the universal motor.
TP4	Study of the characteristics of an engine three-phase asynchronous motor powered by a variable frequency drive frequency	Perform speed adjustment tests by varying the frequency, analyze the characteristic curves.

Evaluation methods

- Continuous assessment:40%
  - TD: 20%
  - TP: 20%
- Final exam:60%

Bibliographical references

1. Mutrel, *The asynchronous motor – Static and dynamic regimes* Electrotechnics, 2000.
2. Sturtzer, Smigel, *Modeling and control of three-phase motors – Vector control of synchronous motors*, 2000.
3. Jean Bonal, Guy Séguier, *Variable speed electric drives*, Vol. 2 & 3.
4. Michel Pinard, *Electronic control of electric motors*, 2004.

HALF	Subject Title		Coefficient	Credits	Code
S7	Power Electronics II		3	5	
VHS	Course	Tutorials	Practical Exercises		
67h30	3:00	1 hour 30 minutes	1 hour 30 minutes		

Prerequisites:

Power semiconductor components, basic power electronics.

Teaching objectives:

Study of the actual characteristics and dynamic behavior of power switches in switching operation. In-depth study of static converters. Study and design of new static converter structures, as well as their modeling and control. Simulation and practical implementation of static converters.

Content of the material:

Chapter 01: Power Semiconductor Components (Week 2)
Ideal and actual characteristics, calculation of switching losses, protection of semiconductor components. Close-range control circuits for semiconductor components.

Chapter 02: Switching Mechanism and Converter Synthesis (Week 2) Concept of sources and connection rules, Concept of segments, Switching modes and elementary switching cell, Synthesis of static converters.

Chapter 3: PWM Inverters (3 Weeks)
Single-phase PWM inverters: Structure and operating principle, full-wave and pulse-width modulation (PWM) control techniques, harmonic reduction and output voltage filtering.

Three-phase PWM inverters: Structure and operating principle, PWM control techniques, vector PWM.
- Study of harmonics in voltage inverters.
- Introduction to pollution control techniques (Active filtration)

Chapter 04: Sinusoidal Absorption AC/DC Converters (4 Weeks)
- Power factor correction (PFC): Structure, operating principle, modeling and control.

- PWM rectifiers: Structure, operating principle, modeling and control techniques.

- Current injection rectifiers: Structure, operating principle, modeling and control.

Chapter 5: PWM Dimmers (2 Weeks)
Structure, operating principle, modeling and control techniques.

Chapter 06: Multilevel Converters (2 Weeks)
Different structures of multilevel converters, operating principle, modeling and control techniques.

Evaluation method:

Continuous assessment: 40% Tutorials, Exam: 60%

Bibliographical references:

[1]- A. Cunière, G. Feld, M. Lavabre “Power electronics, from the switching cell to industrial applications. Course and exercises”, Casteilla editions, 544 p. 2012.
[2]- Technical Encyclopedia “The techniques of the engineer”, treatise on Electrical Engineering, vol. D4 articles D3000 to D3300.
[3]- H. Buhler, “Power Electronics”, Dunod Edition.
[4]- Cyril W. Lander, “Power Electronics”, McGraw-Hill Edition.
[5]- G. Séguier, “Power Electronics Converters: Volume 1: Alternating/Direct Conversion”, 1995, Lavoisier Tec & Doc Edition.
[6]- C. Rombaut, G. Séguier, “Power Electronics Converters: Volume 2: AC/AC Conversion”, Lavoisier Tec & Doc Edition.
[7]- R. Bausiere, F. Labrique, G. Séguier, “Power Electronics Converters: Volume 3: DC/DC Conversion”, 1997, Lavoisier Tec & doc Edition.
[8]- G. Séguier, F. Labrique, “Power Electronics Converters: Volume 4: DC/AC Conversion”, 1997, Lavoisier Tec & Doc Edition.
[9]- DL Dalmasso, “Switching, Electrical Energy Processing”, DIA TS Edition.
[10]- V. Leger, A. Jameau, “Energy Conversion- Electrotechnics- Power Electronics”, Ellipses Edition.
[11]- H. Sira-Ramires, R. Silva-Ortigoza, “Control design techniques in Power Electronics devices”, Springer Edition.
[12]- R. Bausiere, F. Labrique, G. Séguier, “Power electronics, Structures, basic functions, principles”, Dunod Edition.
[13]- JP Hautier, JP Canon, “Static Converters”, Editions Technip.
[14]- H. Buhler, “Static converters”, Presses Polytechniques Romandes.
[15]- M. Pinard, “Converters and Power Electronics”, Dunod Edition.
[16]- P. Costa, V. Boitier, “Power Electronics and Electrotechnics”, Ellipses Edition

SEMESTER	Subject Title	Coefficient	Credits	Code
S 7	Transport and distribution networks electrical energy	2	4	

	Course	TD,
VHH	1 hour 30 minutes	1 hour 30 minutes

Course content

Chapter 1 – Electrical Substation Architectures*(2 weeks)*

- Overall architecture of the electrical network.
- Equipment and substation configurations (bus-coupled substations, circuit breaker-coupled substations).
- Transport and distribution network topologies.

Chapter 2 – Organization of the Transport of Electrical Energy

2.1. Power transmission lines*(3 weeks)*

- Calculation of conductor cross-section.
- Insulation selection, mechanical calculation of lines.
- Steady-state and transient operation. High-voltage
- direct current (HVDC) power transmission.

2.2. Distribution Networks*(2 weeks)*

- Introduction to power distribution. Primary
- and secondary distribution networks.
- Distribution transformers.
- Reactive power compensation and reliability.

Chapter 3 – Operation of MV/LV electrical networks*(3 weeks)*

- Protection of HV/MV substations (against overcurrents,
- overvoltages). Component modeling.
- Voltage adjustment. Reactive
- power control.

Chapter 4 – Neutral Systems*(2 weeks)*

- Types of neutral: isolated, impedance-connected, grounded.
- Artificial neutral and its implications in networks.

Chapter 5 – Voltage Adjustment*(3 weeks)*

- Voltage drops in networks.
- Adjustment methods:
  - Automatic Voltage Regulation (AVR)
  - Reactive Power Compensation
  - Autotransformer Control

- Introduction to voltage stability.

Practical Exercises

TP no.	Titled	Main educational objective
TP1	Voltage adjustment by synchronous motor	Understanding the role of the synchronous motor in voltage regulation
TP2	Power distribution and calculation of voltage drops: Apply Kirchhoff's laws and calculate the distribution.	charges
TP3	Voltage regulation by reactive power compensation	Study the use of capacitors or capacitor banks
TP4	Neutral regime	Analyze the effect of different neutral grounding systems on safety and continuity of service
TP5	Interconnected networks	To study the behavior of an interconnected network under normal and disturbed conditions

Evaluation methods

- Continuous assessment:40%
  - Tutorials and mini-projects: 20%
  - Practical work and report: 20%
- Final exam:60%

Bibliographical references

1. F. Kiessling et al., *Overhead Power Lines: Planning, Design, Construction*, Springer, 2003.
2. T. Gonen et al., *Power Distribution*, in *Electrical Engineering Handbook*, Elsevier Academic Press, 2004.
3. E. Acha & VG Agelidis, *Power Electronic Control in Power Systems*, Newns, 2002.
4. Turan Gonen, *Electric Power Distribution System Engineering*, McGraw-Hill, 1986.
5. Turan Gonen, *Electric Power Transmission System Engineering: Analysis and Design*, John Wiley & Sons, 1988.

HALF	Subject Title		Coefficient	Credits	Code
S 7	Advanced electrical machinery		2	4	
VHH	Course	TP			
3 hours	1 hour 30 minutes	1 hour 30 minutes			

Course content

Chapter 1 – General Principles

- Electromechanical energy conversion.
- Esterator/rotor coupling: primitive
- machine. Windings of electrical machines.
- Calculation of magnetomotive forces.
- Basic mechanical equation.

Chapter 2 – Asynchronous Machines

- General principles, fundamental
- equations. Equivalent circuits, torque
- calculation. Characteristics and
- diagrams. Motor and generator
- operation. Starting, braking.
- Deep slot and double cage motors. Single-
- phase asynchronous motors.

Chapter 3 – Synchronous Machines

- Equational formulation of smooth-pole machines.
- Motor and alternator operation. Excitation systems,
- armature reactions. Salient-pole machines, with or
- without dampers. Diagrams: Potier, reactance,
- Blondel.
- Permanent magnet machines.
- Parallel coupling, starting.

Chapter 4 – Direct Current Machines

- Structure and fundamental equations.
- Starting modes, braking, speed control.
- Switching phenomena.
- Armature reaction, saturation. Auxiliary
- switching poles. Motor and generator
- operation.

Practical Exercises

TP no.	Titled	Educational objective

Title: Industrial Electricity *Establishment:*
Academic Year

TP no.	Titled	Educational objective
TP1	Electromechanical characteristics of an asynchronous machine	Study the torque/speed curves and the efficiency
TP2	Operation of a single-phase asynchronous motor	Identify the specific features and limitations
TP3	Asynchronous generator in autonomous operation	Understanding isolated, off-grid production
TP4	Determining the parameters of a synchronous machine	Measurement and modeling of reactances
TP5	Connecting an alternator to the grid and operating as a synchronous motor	Studying synchronous generator/motor transitions

Evaluation methods

- Continuous assessment:
  - Quizzes and supervised assignments:
  - 40% Lab report:20%
- Final exam: 40%

Bibliographical references

1. J.-P. Caron, J.-P. Hautier, *Modeling and control of the asynchronous machine*, Technip, 1995.
2. G. Grellet, G. Clerc, *Electric actuators – Principles, models, controls*, Eyrolles, 1996.
3. J. Lesenne, F. Notelet, G. Séguier, *Introduction to Advanced Electrical Engineering*, Technique & Documentation, 1981.
4. Paul C. Krause, O. Wasyzczuk, S. Sudhoff, *Analysis of Electric Machinery and Drive Systems*, Wiley, 2nd edition, 2010.
5. PS Bimbhra, *Generalized Theory of Electrical Machines* Khanna Publishers, 2008.
6. AE Fitzgerald, C. Kingsley Jr, SD Umans, *Electric Machinery*, Tata McGraw-Hill, 5th edition, 1992.

HALF	Subject Title	Coefficient	Credits	Code
S7	Industrial Automation 1	2	3	

VHH	Course	Tutorials	Practical Exercises
3 hours	1 hour 30 minutes		1:30 AM

Prerequisites

- Fundamental concepts in electricity, electronics and mechanics.
- Advanced skills in combinational and sequential logic, including decoding systems, logic equations, Karnaugh maps, and other related concepts. Furthermore, a thorough understanding of microprocessors is essential.

Goals

- To enable the student to acquire the following knowledge:
- In-depth understanding of the components of a Programmable Logic Controller (PLC).
- Mastery of PLC programming techniques.
- Proficiency in graphical representation tools for automated systems (Grafcet).
- Ability to make modifications to the automation program.
- Perform programming and configuration of programmable logic controllers (PLCs).

Content of the material

Chapter 1 Introduction to Automated Systems (3 Weeks)

- Basic concepts of automated systems. Structure of
- automated systems. Classification of automated systems.
- Automated system and industrial process. Structure of an
- automated production system (APS). Specification of
- requirements levels. Hardware and software architecture of
- an automated system. From hardwired logic to
- programmed logic.
-
- Examples of automated systems.

Chapter 2 Programmable Logic Controllers (PLCs) (4 Weeks)

- General description; The different types of PLCs. Internal
- structure and description of the elements of a PLC. The
- constituent elements of PLCs.
- Input/output interfaces.
- Digital input/output cards; Analog input/output cards; PID control cards.

- Axis control cards; High-speed counting cards. Criteria for selecting a
- PLC; Criteria for selecting a programmable logic controller (PLC).
- Different types of PLC data.

Chapter 3 Grafcet tool (4 weeks)

- Introduction.
- Sequential analysis of a system.
- Rules for establishing a Grafcet
- diagram. Basic concepts.
- Directional transitions and links.
- Rules of evolution.
- Sequence selection and simultaneous sequences.
- Organization of representation levels.
- Specific structures.

- Linking between Grafcet diagrams.
- Advanced Grafcet tool.
- Concepts of viewpoints. Hierarchical
- structures of a Grafcet. Structure of a
- sub-Grafcet.
- Structure of a task Grafcet. Forcing
- and freezing of situations. Equational
- formulation of a Grafcet.
- Materialization of a Grafcet.
- Equations of the Grafcet elements; Setting up equations.
- Practical examples.

Chapter 4 API Programming Languages (4 Weeks)

- Introduction.
- Common objects.
- The different types of programming languages.
- Ladder programming.
- Graphical and textual programming tools. Translation
- of a Grafcet into a ladder diagram.
- Transcription of specifications into Grafcet.
- Synchronization of sub-assemblies.
- Presentation of heterogeneous networks.
- Presentation of communication modules and possible gateways between different types of networks.
- Input/output addressing.
- PLC programming (logic functions, latching function, timing function,
- counting function, regulation function, etc.). Complete applications.
-

Practical Exercises

TP 1:Getting started with the software: discovering the environment and its basic tools TP 2:Automation of a lamp's ignition circuit

TP 3:Using the OR function and the AND function TP 4:Using a Timer and Creating a Counter

TP 5:Design and automation of several systems (different types of asynchronous motor starting, pump operating systems, traffic management, a three-color traffic light system, freight elevator, etc.) using SFC, FBD, LD, and IL programming languages.

Evaluation methods:Continuous assessment: 40% (20% tutorials + 20% practical work), Final exam: 60%.

Bibliographical references

[1] Industrial Automation, Gérard Boujat et al., DUNOD edition 2023.
[2] Automation and automaticity, Jean-Yves Fabert, ELLIPSES edition 2025.
[3] GRAFCET, Edmond Peulot et al., DELAGRAVE edition 2009.
[4] From GRAFCET to Petri nets, Claude Foulard et al., HERMES edition 1992.

HALF	Subject Title		Coefficient	Credits	Code
S 7	Advanced Programming in Python		2	2	
VHS	Course	Tutorials	Practical Exercises		
45h00	1 hour 30 minutes		1 hour 30 minutes		

Learning objectives
and skills targeted:

- Use of computer tools for the acquisition, processing, production and dissemination of information
- Skills in Python and project management,
- Skills in automation and data visualization.

Goals :

- To deepen mastery of the Python language and introduce students to the basics of data analysis and artificial intelligence.
- Acquire a solid foundation in computer science.
- Learn to program in Python, Excel
- Mastering task automation
- Proficiency in project management software

Materials needed:

- A computer with Python installed,
- Python libraries: NumPy, Pandas, Scikit-learn, Matplotlib, os.listdir, os.path.exists, os.mkdir, os.rmdir, Matplotlib, Seaborn, Plitly, Request, BeautifulSoup, Tkinter, PyQT, ...
- Tensorflow, PyTorch, ...

Prerequisites: Python programming,
Content of the material:

Chapter 1: Review of Python Programming (2 Weeks)

1.Introduction: Basic computer concepts and digital tools, installation of Python.
2.Introduction to the concept of an operating system: Roles, types (Linux, Windows, etc.), priority management.
3.Introduction to computer networks (Principles, IP address, DNS, internet, etc.)
4.Basic programming: Interactive mode and script mode, Variables, data types, operators. Conditional structures and loops (if, for, while).
5.Essential functions and elements: Predefined functions and function creation. Standard modules (math, random). Strings, lists, basic database manipulation.
6.Files, Lists, Tuples, Dictionaries,
7.Exercises:

- Python learning exercises
- Exercises using the libraries seen in the course (Math, Random, NumPy, Pandas,...)

Chapter 2: Programming and Automation (4 weeks)

1.Principles of Task Automation

- Python libraries for automation:
  - Pandas and NumPy.
  - Os, shutil: file and folder manipulation
  - Openpyxl or pandas: working with Excel or CSV files.
- Definitions and examples of automation (sending emails, etc.)

2.File manipulation with Python:
-Use the libraries to:

- Browse a folder (os.listdir)

- Check for the existence of a file or folder (os.path.exists)
- Create or delete directories (os.mkdir, os.rmdir)
- Visualizing data: Matplotlib, Seaborn, Plitly
- Request to interact with Application Programming Interfaces (APIs)
- BeautifulSoup for Data Scraping
- Tkinter, PyQt for visualizing graphical data.

- Copying or moving files with shutil...
- Searching, sorting, and generating simple reports. Serialization and
- deserialization (using the pickle module). Object serialization and
- processing of large files (streaming).

3. Exercises
   - Using openpyxl and pandas to read, modify, and write Excel or CSV files for:
     - Create automatic reports
     - Automatically extract data. Script
   - writing for:
     - processing text files (searching, sorting)
     - automate technical calculations
     - Managing simple reports (PDF, Excel).
   - Sorting, searching, and insertion sort
   - algorithms. Implementing a search function in a
   - list. File operations.
   - Secure browsing (simple network setup, password management)

Chapter 3: Advanced Excel Learning (2 weeks)

1.Principles of macros and creating a simple macro,

2.Pivot tables,

3.Histograms,

4.Bar charts,

5.Spider,

6.Etc.

7. ExercisesExcel...

Chapter 4: Learning Gantt Project (2 weeks)

1.Introduction to project management:
   - What is a project?
   - What are the challenges of project
   - management? Gantt Project interface

2.The tasks (creation, modification, organization)

3.Time management (project start or end dates)

4.Resource management

5. Exerciseson Gantt Project

Chapter 4: Advanced Object-Oriented Programming (3 weeks)

1.Code organization:
   - Custom functions, parameters, return value.
   - Modules, imports and packages.

2.Complex data structures:
   -Lists, tuples and dictionaries: creation, modification, deletion, traversal.

3.Fundamental concepts of Object-Oriented Programming (OOP):

- Classes, objects, attributes and methods.
- Public, private and protected attributes.

4.Special methods:

-init, str, repr, len.

5.Advanced concepts:

- Encapsulation, abstraction, inheritance, polymorphism. Advanced
- inheritance, decorators, design patterns, meta-classes.

6. Exercises

Chapter 5: Introduction to Data for AI (2 weeks)

1.Introduction to common datasets in AI:

-Iris, MNIST, CIFAR-10, Boston Housing, ImageNet.

2.Data preprocessing for Machine Learning:

- Data cleaning, normalization, encoding, separation.
- Cross-validation.

3.Feature Engineering techniques:

-Selection, feature creation, dimensioning.

4.Essential libraries for developing AI models:

-scikit-learn, Tensor Flow, Keras, PyTorch

Practical exercises:

Lab 1: Mastering the basics of Python programming

(Control structures, types, loops, simple functions)

1.Initiation
2.Read and process text files
3.Manage simple reports (PDF, Excel)

TP 02:

- Develop specifications for a mini task automation project using Python, consisting of automatically identifying and sending reports via email using Python:

1.Loading data from a file (e.g., experimental measurements),
2.Perform simple statistical analyses on the data (mean, standard deviation with interpretation),
3.Generate a graph,
4.Sending the result using Python.

TP 03:

1.Excel programming of the dashboard seen in the tutorial
2.Creating automated Excel spreadsheets
3.Simple macros,
4.Conditional formulas,
5.Research V.

TP 04:

Organizing a meeting using Gantt Project

1.Create a new project:

- Project name: Meeting
- Start date: Date and time of the meeting.
- Estimated duration: Total duration of the meeting.

2.Task definition

- Agenda items (each agenda item becomes a task) Subtasks: If an item is composed of
- subtasks, then create the corresponding subtasks Initial and final tasks (for example:
- "Welcoming participants", "closing the meeting")

3.Definition of resources:
- Participants (each participant is a resource)
- Equipment (computer, data projector...)

4.Estimated durations:
- Duration of each item: time required for each agenda item. Transition
- time from one item to the next.

5.Creating the Gantt chart:
- View the agenda.
- Identify the key points.

6.Track progress in real time (Gantt chart projection)

TP 05: Advanced Structures and Code Organization

(Custom functions, dictionaries, modules, and modular organization)

Lab 6: Advanced Object-Oriented Programming in Python

(Encapsulation, inheritance, special methods, simple design patterns)

Lab 07: File Manipulation and Data Analysis

(Reading/writing files, word processing, introduction to Pandas and NumPy)

Lab 08: Data preparation and processing for artificial intelligence

(Loading AI datasets, cleaning, transformation, feature selection)

Final Project

Title :Analysis and visualization of a dataset + simple predictive model
Skills used:Data reading, OOP, advanced structures, Pandas, Scikit-learn.Oral presentation + written report).

Assessment method: exam 60%, continuous assessment 40%

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[1] E. Schultz and M. Bussonnier (2020): Python for the Humanities and Social Sciences. Introduction to Data Programming. Presses Universitaires de Rennes.

[2] C. Paroissin, (2021): Practicing data science with R: arranging, visualizing, analyzing and presenting data. Paris: Ellipses, DL 2021.

[3]. S.Balech and C.Benavent: NLP text minig V4.0, (Paris Dauphine–12/2019): link: https://www.researchgate.net/publication/337744581_NLP_text_miningV40-une_introduction_-_cours_programme_doctoral

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[8] Cyrille, H. (2018). Learning to program with Python 3. Eyrolles, 6th edition. ISBN: 978-2212675214

[9] . Daniel, I. (2024). Learning to Code in Python, J'ailu

[10] Nicolas, B. (2024). Python, from complete beginner to object-oriented programming: Course and solved exercises, 3rd edition, Ellipses

[11] . Ludivine, C. (2024). Selenium: Master your functional tests with 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/

HALF	Subject Title		Coefficient	Credits	Code
S 7	Protection of electrical networks		2	2	
VHS	Course	Tutorials	Practical Exercises		
45 hours	1 hour 30 minutes		1 hour 30 minutes		

Course content

Chapter 1 – Introduction to protection *(4 weeks)*

- Main faults in electrical networks. Measuring
- devices (TC, TP), reduction of quantities.
- Symmetrical component filters, impedance and power measurement.
- General information: definitions, selectivity, sensitivity, speed, reliability.
- Amperometric and volumetric protection, selectivity mode.

Chapter 2 – Symmetrical Components and Fault Currents *(3 weeks)*

- Definitions, transformation of impedances into symmetrical components.
- Series impedances and equivalent single-phase circuits.
- Power in symmetrical components. Direct,
- inverse, and homopolar equivalent circuits. Study
- of different types of faults.

Chapter 3 – Elements of the protection system *(3 weeks)*

- Structural model of a protection system.
- Technology, operation and application of relays:
  - Intensity relay
  - Voltage relay
  - Differential relays
  - Directional relays
  - Distance relay
- Voltage and current transformers.

Chapter 4 – Protection of network elements *(5 weeks)*

- Protection of alternators and
- motors. Protection of busbars.
- Transformer protection.
- Line protection: differential protection and distance protection.

Practical Exercises

- practical work integrated into the course (1 hour 30 minutes per week).

  Simulation exercises or manipulation on models to illustrate:
  - The behavior of the protective devices.
  - The operation of relays (current, differential, distance).
  - The reaction of equipment to different types of faults.

Evaluation methods

- Final exam: 60% Continuous assessment: 40%

Bibliographical references

1. Hadi Saadat, *Power System Analysis*, 2nd ed., 2004.
2. Turan Gönen, *Electric Power Distribution System Engineering*, 1980.
3. Christophe Prévé, *Protection of electrical networks*, Hermes Paris, 1998.
4. SH Horowitz, AG Phadke, *Power System Relaying*, 2nd ed., Wiley, 1995.
5. L. Féchant, *Low-voltage electrical switchgear – Distribution equipment*, Engineering Techniques, D 4 865.
6. S. Vacquié, A. Lefort, *Physical Study of the Electric Arc – Volume 1*, CNR edition, 1984.

HALF	Subject Title		Coefficient	Credits	Code
S7	Personalized Professional Project (PPP)		1	2	CESE7.11
VHS	Course	Tutorials	Practical Exercises		
	Additional hours outside the quota for Tutoring: 1.5 hours of practical work per week				

Goals :

This study program aims to provide a comprehensive structure to guide students in the realization of a meaningful and effective Personal Professional Project.

Content of the material:

Chapter 1: Exploring Careers and Personal Skills

- Introduction to PPP
  - Objectives and importance of the Personal Professional Project.
  - Presentation of the professions in the chosen field and specialization.
- Self-Assessment of Personal Skills
  - Self-assessment techniques for technical, social and personal skills.
  - Identification of strengths and weaknesses.

Chapter 2: Research and Documentation

- Documentary Research
  - Using online and physical resources to gather information on chosen professions.
  - Compilation of data on career prospects, required skills, necessary training, etc.
- Interviews and Exchanges
  - Interviews with industry professionals to understand their career paths, challenges, and advice.
  - Participation in networking events to broaden knowledge of trends and opportunities.

Chapter 3: Defining Professional Objectives

- Identification of Short-Term and Long-Term Objectives
  - Defining short, medium and long-term career goals. Aligning personal
  - aspirations with the requirements of the chosen profession.
- Development of a Training Plan
  - Choosing pathways that support the identified objectives.
  - Planning of further training, internships and professional experiences.

Chapter 4: Design and Implementation of the PPP

- Project Structuring

- Detailed planning of the PPP sections (Introduction, Skills Analysis, Professional Objectives, etc.).
- Choice of presentation tools (written report, oral presentation, etc.).

- Individual Support
  - Individual tutoring sessions to discuss PPP progress, resolve difficulties and refine objectives.

Chapter 5: Evaluation and Final Presentation

- Project Evaluation
  - Self-assessment and tutor feedback on the quality and relevance of the PPP. Final
  - revision based on the comments received.
- Presentation of the PPP
  - Oral presentation of the project before a committee or peers.
  - Discussions and exchanges on the conclusions and recommendations of the PPP.

Assessment method: 100% continuous assessment

Bibliographical references:

- Robert C. Reardon, Janet G. Lenz, James P. Sampson Jr., Gary W. Peterson, "CareerDevelopment and Planning: A ComprehensiveApproach"This book offers a comprehensive approach to career development, including personal and professional planning.
- Bill Burnett, Dave Evans,"DesigningYourLife: How to Build a Well-Lived, Joyful Life",This book offers practical tools for designing one's professional and personal life in an intentional and satisfying way.
- Nicholas Lore, "The Pathfinder: How to Choose or Change YourCareer for a Lifetime of Satisfaction and Success",This book guides readers through a structured process to choose a career aligned with their passions, skills, and values.
- Richard N. Bolles, "What Color Is Your Parachute? 2024: A Practical Manual for Job-Hunters and Career-Changers",This classic guide offers detailed advice on job searching, career exploration, and long-term career management.

HALF	Subject Title		Coefficient	Credits	Code
S7	Standards in electrical engineering		1	1	
VHS	Course	Tutorials	Practical Exercises		
10:30 PM	1 hour 30 minutes				

Prerequisites:

Knowledge of electrical circuits and networks, power machines and electronics, and electrical energy distribution systems.

Objective :

This program aims to provide students with a thorough understanding of electrotechnical standards, their importance in the safety and performance of electrical systems, and their practical application in various industrial contexts.

Content of the material

Chapter 1: Introduction to electrotechnical standards (2 weeks)

- History and evolution of standards in electrotechnics Importance
- and objectives of standards in the electrotechnical industry
- Standardization bodies: IEC, ISO, ANSI, IEEE, NFPA, etc.

Chapter 2: Electrical Safety Standards (2 weeks)

- Safety standards for electrical installations (NFPA 70E, IEC 60364)
- Standards for protection against electric shock (IEC 61140)
- Electrical equipment safety standards (IEC 61010)
- Earthing and equipotential bonding procedures

Chapter 3: Performance and Quality Standards (2 weeks)

- Performance standards for electric motors (IEC 60034, IEEE 112)
- Performance standards for transformers (IEC 60076)
- Electrical power quality standards (IEC 61000-4)
- Electromagnetic compatibility (EMC) standards (IEC 61000-6)

Chapter 4: Design and Installation Standards (2 weeks)

- Electrical network design standards (IEC 60287, IEC 60909)
- Photovoltaic system installation standards (IEC 62548) Energy
- storage system installation standards (IEC 62933)
- Standards for installations in specific environments (explosive, marine, etc.)

Chapter 5: Maintenance and Inspection Standards (2 weeks)

- Electrical equipment maintenance standards (IEC 60364-6)
- Electrical installation inspection standards (IEC 60364-6)
- Electrical system diagnostic and monitoring standards (IEC 60599)

Chapter 6: Standards for New Technologies (2 weeks)

- Standards for electric vehicles (IEC 61851) Standards for
- smart grids (IEC 61850)
- Standards for renewable energies (IEC 61400 for wind power, IEC 61215 for solar power)

Chapter 7: Implementation and Compliance (2 weeks)

- Certification and compliance processes; Case studies: bringing
- existing facilities into compliance; Impact of standards on
- technological development and innovation; Continuing education and
- regulatory monitoring

Evaluation method:

- Exam: 100%

Bibliographical references:

- CHARLES F. DALZIEL - Electrical Shock Safety Criteria
- JOHN D. MCDONALD - Electric Power Substations Engineering
- STEVEN MCFADYEN - Electrical Safety Engineering Of Renewable Energy Systems
- IEC - IEC 60364-1 Low-Voltage Electrical Installations - Part 1: Fundamental Principles, Assessment Of General Characteristics, Definitions
- IEEE - IEEE Standard 141-1993: IEEE Recommended Practice For Electric Power Distribution For Industrial Plants (IEEE Red Book)
- BIMAL K. BOSE - Modern Power Electronics And Ac Drives
- JAN DE KOCK, Cobus Strauss - Practical Power Distribution For Industry
- ANTHONY J. PANSINI - Electrical Distribution Engineering
- Institute Of Electrical And Electronics Engineers (IEEE) - IEEE Std 446-1995 (Emerald Book) Recommended Practice For Emergency And Standby Power Systems For Industrial And Commercial Applications
- PAUL GILL - Electrical Power Equipment Maintenance And Testing

Detailed syllabi for the subjects of the 8ththhalf

HALF	Subject Title		Coefficient	Credits	Code
S 8	Network modeling and optimization electric		2	4	
VHS	Course	Tutorials	Practical Exercises		
45 hours	1 hour 30 minutes		1 hour 30 minutes		

Course content

I. Basic modeling of electrical networks*(3 weeks)*

- Representation of sinusoidal signals.
- Component modeling: sources, lines, transformers, loads.
- Relative unit systems (per-unit).
- Graph theory applied to networks.
- Formation and inversion of admittance and impedance matrices.
- Sparse matrix techniques.

II. Calculation of fault currents*(3 weeks)*

- Review of symmetric components. Short-
- circuit analysis (Thévenin model).
- Calculation of symmetrical and asymmetrical short-circuit
- currents. Fault currents in lines, generators, motors.
- Calculation of short-circuit power.
- Phase shift readjustment.
- General algorithm for calculating defects.

III. Power Flow*(3 weeks)*

- Load distribution equations.
- Numerical solution:
  - Gauss-Seidel method,
  - Newton-Raphson method,
  - Fast decoupled method,
  - Other algorithms
- Case studies.

IV. Optimal Power Flow Distribution*(3 weeks)*

- Nonlinear optimization function.
- Production cost curves.
- Solving the OPF without constraints and with constraints.
- Economic calculation with and without losses.
- Associated numerical methods.

V. Estimating the state of an electrical network*(3 weeks)*

- Available measurements (P, Q, I, V).
- Methods for estimating state.

- Detection of faulty measurements.
- Observability, pseudo-measurements.
- Power flow constraints are integrated into the estimation.

Practical Exercises

- TP1:Modeling of transmission line parameters.
- TP2:Construction of the admittance and impedance matrices of a busbar
- set. TP3:Power flow – Gauss-Seidel method. TP4:Power flow – Newton-
- Raphson method. TP5:Calculation of fault currents on a network. TP6:
- Economic dispatching.
-

Evaluation methods

- Continuous assessment:
- 40% Final exam:60%

Bibliographical references

1. F. Kiessling et al.,*Overhead Power Lines: Planning, Design, Construction*, Springer, 2003.
2. T. Gonen et al.,*Power Distribution*, Electrical Engineering Handbook, Elsevier, 2004.
3. E. Acha, VG Agelidis,*Power Electronic Control in Power Systems*, Newns, 2002.
4. Turan Gönen,*Electric Power Distribution System Engineering*, McGraw-Hill, 1986.

HALF	Subject Title	Coefficient	Credits	Code
S8	Modeling and identification electrical machines	2	4	

VHS	Course	Tutorials	Practical Exercises
45h00	1 hour 30 minutes		1 hour 30 minutes

Course content

Chapter 1: Generalized Electric Machine Theory

- Introduction to the generalized electric machine.
- Equations of the two-phase machine.
- Coordinate axis systems (abc, dq0, αβ). Three-
- phase ↔ two-phase transformation.
- Equation of motion of the generalized machine.

Chapter 2: Modeling of three-phase asynchronous motors

- Electrical model of the asynchronous
- motor. Steady-state equations.
- Static characteristics.
- Constant velocity electromagnetic transient analysis.

Chapter 3: Modeling of asynchronous generators

- Modeling of self-priming in the vacuum of a circuit.
- Equations in the UV coordinate system.
- Influence of capacitance and speed on voltage/frequency.
- Operation under load.
- Asynchronous generator connected to the grid.

Chapter 4: Modeling of synchronous machines

- Electrical model of the synchronous machine.
- Expression of electromagnetic torque.
- Equivalent circuits.
- Analysis of three-phase short circuits.
- Rotational torque.

Chapter 5: Modeling of DC Machines

- Study of transient phenomena (classical methods).
- Modeling on the dq axes.
- Application of the generalized theory to different types of excitation.

Chapter 6: Parametric Identification Methods

- Identification of machine parameters:
  - Synchronous
  - Asynchronous
  - Direct current

- Determination of mechanical parameters (inertia, friction, etc.)

Practical Exercises

- TP1:Simulation of a three-phase asynchronous motor.
- TP2:Simulation of a three-phase asynchronous
- generator. TP3:Simulation of a three-phase synchronous
- motor. TP4:Simulation of a DC motor.
- TP5:Parametric identification of electrical machines.

Evaluation methods

- final exam 60%
- TP 40%

Bibliographical references

1. Abdessemed R., Kadjoudj M.,*Modeling of electrical machines*, Presses Univ. by Batna, 1997.
2. J.-P. Caron, JP Hautier,*Modeling and control of the asynchronous machine*, Technip, 1995.
3. G. Grellet, G. Clerc,*Electrical actuators: principles, models, controls*, Eyrolles, 1996.
4. J. Lesenne, F. Notelet, G. Séguier,*Introduction to Advanced Electrical Engineering*, Tec & Doc, 1981.
5. Paul C. Krause et al.,*Analysis of Electric Machinery and Drive Systems*, Wiley, 2nd ed., 2010.
6. PS Bimbhra,*Generalized Theory of Electrical Machines*Khanna Publishers, 2008.
7. AE Fitzgerald et al.,*Electric Machinery*McGraw Hill, 5th ed., 1992.

HALF	Subject Title	Coefficient	Credits	Code
S8	[Sampled servo systems	3	5	

VHS	Course	Tutorials	Practical Exercises
67h30	1 hour 30 minutes	01:30	1 hour 30 minutes

Prerequisites
Knowledge of continuous linear control systems. Fundamental concepts of signal processing, basic electronics (linear circuits). Basic mathematics (Algebra, Integral and Differential Calculus, Analysis, Complex Numbers, etc.).

Goals
Mastering the principle and structure of control loops and selecting the appropriate controller. Studying sampled systems. Analyzing discrete systems and synthesizing discrete controllers (PID, RST, and state feedback).

Content of the material

Chapter 1 Introduction to regulation (2 weeks)

- Concepts of regulation,
- Components of a control loop (industrial process, actuators, sensors, controllers, signal conditioner, setpoint, measurement, disturbance, quantities)
- Characteristics, control variables, controlled variables, disturbance variables), Diagram of
- a controlled system, Components of a control loop, symbols, functional diagrams and loops, performance criteria of a control system

Chapter 2 Correction of linear servo systems (4 weeks)

- Specifications for a servo system; Need for correction in
- servo systems; Correction (or compensation) strategy for
- servo systems; Structures of P, PI, PD, PID controllers;
-
- Phase-lead compensator and phase-lag compensator;
- Selection criteria, dimensioning methods (flat surface criterion, symmetrical criterion, Ziegler-Nichols method, etc.)
- Adjusting the regulators by imposing a tracking pattern.

Chapter 3 Analysis of sampled systems (3 weeks)

- Definitions and basic concepts. Advantages and applications of discrete control systems.
- Differences between continuous and discrete systems (Notion of sampling, Shannon's theorem and converters).
- Z-transform and analysis in the Z-domain: properties and applications,
- Sampled transfer function, Association of sampled systems, Harmonic,
- impulse and step responses
- Z-transmittance and frequency response of a zero-order hold (BOZ).
- Analysis of sampled feedback systems, sampled stability.

Chapter 4 Synthesis of sampled control systems (3 weeks)

- Stability of discrete control systems. Stability criteria (Nyquist circle, Routh-Hurwitz criterion, etc.). Analysis of the time and frequency response.
- Discrete Controller (PID), Discrete RST Controller, Synthesis in the P-plane; Digital Controllers
- Pseudo-frequency synthesis and bilinear transformation,
- Selection and sizing of controllers (Classical, modern, and empirical methods). Performance
- of sampled systems in low-frequency operation (1 week)

Chapter 5 Analysis and synthesis in state space (1 week)
-Definitions, stability, controllability, observability.

Chapter 6Applications in electrical engineering (2 weeks)

- Speed and position control of electric motors. Voltage and frequency regulation in electrical networks. Control of static converters (inverters, rectifiers, etc.)

Practical Exercises
TP 1:Pressure and/or temperature regulations
TP 2:Simulation of sampling and reconstitution operations
TP 3:Time and frequency analysis of basic sampled systems
TP 4:Control of electrical systems by digital phase-lead/phase-lag regulator TP 5:Synthesis of regulators for discrete systems
TP 6:Digital control with state feedback: Application for electrical systems

Assessment method: continuous assessment ((20%TD+20%TP),exam 60%

Bibliographical references

1. E. Dieule saint, D. Royer, Applied Automation, 2001.
2. P. De Larminat, Automatic Control: Control of linear systems. Hermes 1993.
3. KJ Astrom, T. Hagglund, PID Controllers: Theory, Design and Tuning, Instrument Society of America, Research Triangle Park, NC, 1995.
4. Datta, MT Ho, SP Bhattacharyya, Structure and Synthesis of PID Controllers, Springer-Verlag, London 2000.
5. Jean-Marie Flaus, Industrial Regulation, Hermes Editions 1995.
6. P. Borne, Analysis and regulation of industrial processes volume 1: Continuous regulation. Editions Technip.
7. T. Hans, P. Guyenot, Regulation and Enslavement, Eyrolles Publishing.
8. R. Longchamp, Numerical control of dynamic systems, automatic control course, Presses Polytechniques et universitaires romandes 2006.

HALF	Subject Title		Coefficient	Credits	Code
S 8	Industrial Automation 2		2	4	
VHS	Course	Tutorials	Practical Exercises		
45 hours	1 hour 30 minutes		1 hour 30 minutes		

Prerequisites

Basic concepts in electricity, electronics, mechanics, pneumatics and hydraulics
Industrial. Skills in combinational and sequential logic and microprocessors. Proficiency in "Industrial Automation 1". Skills in industrial pneumatics and hydraulics.

Goals

Mastering the technologies and components of automated systems.Develop a deep understanding of the components of an API.Strengthening the capacity to analyze and design automated systems.Identify the malfunctions of a complex automated system controlled by a PLC.Mastering advanced API programming techniques.Knowing how to connect a PLC and access its functionalities.Ability to make changes to the automation program.Develop the skill to perform trials and tests on modified automation.Skill in identifying and resolving operational problems.

Content of the material

Chapter 1 Technical system and basic automation concepts (2 weeks)

- What is a system? Characteristics of a system.
- Overall function of a system; Added value.
- Incoming/outgoing work material.
- Control data; Secondary outputs.
- Physical structure of an automated system; Functional structure of an automated system.

Chapter 2 Modeling a technical system (2 weeks)

- Modeling tool.
- Application examples.

Chapter 3 Functional analysis of a system (2 weeks)

- Functional analysis approach. Tools and methods.
- Top-down functional analysis method SADT; Functional analysis method FAST.
- Overview of other methods (MERISE, UML, BPMN).

Chapter 4 API programming (3 weeks)

- API programming languages.
- Transcription of specifications.
- Process automation.

Chapter 5 Control and Supervision of an Automated System (3 weeks)

- Control of an automated system. Supervision of an automated system.
- Human-Machine Interface (HMI). Control-Supervisory Integration.
- SCADA data acquisition and processing system.
- Supervisory tasks. System communication. Authentication and
- authorization. Automated system security.
- Vulnerability Management. Diagnostic Tools. Performance Monitoring. Human Intervention.

Chapter 6: GEMMA Graphical Analysis Tool (Guide to the Study of Starting and Stopping Modes) (3 weeks)

-Operation and use of GEMMA.

- Advantages of GEMMA, Basic concepts of GEMMA, Structure of GEMMA.
- Method of using GEMMA.
- Graphical representation. Concepts of viewpoints.
- Hierarchical structures of a Grafcet; Structure of a Sub-Grafcet, Structure of a task Grafcet.
-

Practical Exercises

TP1:Getting to grips with the software used, discovering the environment of each program, and becoming familiar with their basic tools

TP2:Hardware configuration and project creation, connection and injection (how to load a program), simulation and program execution

TP3:Design and automation of some industrial systems

TP4:Introduction and configuration of views via a monitoring environment

TP5:Integration of a supervisory interface into an automation project (controlling a motor in start/stop mode, reversing the direction of rotation of a motor).

TP6:Design of a GEMMA for an industrial system.

Evaluation methods:Continuous assessment: 40%, Final exam: 60%.

Bibliographical references

[1] Programmable Logic Controllers, William Bolton, DUNOD edition 2019.

[2] Programmable Industrial Automata, Gilles Michel, DUNOD edition 1993.

[3] GRAFCET: design-implementation in APIs, Simon Moreno et al, Casteilla edition 2000.

[4] Programmable Industrial Automata, Jean-Claude Humblo, Hermes edition 1993.

HALF	Subject Title		Coefficient	Credits	Code
S 8	Energy Quality and EMC		2	3	
VHS	Course	Tutorials	Practical Exercises		
45 hours	1 hour 30 minutes		1 hour 30 minutes		

Prerequisites

Physics, Field Theory, Power Electronics Goals

Understand the basic concepts of electrical power quality and electromagnetic interference. Know how to identify, measure, and analyze the various power quality parameters. Master the techniques for protecting electrical equipment against electromagnetic interference.

Content of the material

Chapter 1. Introduction to Energy Quality (2 Weeks)
- Definitions and fundamental concepts.
- The importance of power quality in electrical systems.
- Standards and regulations.

Chapter 2. Energy Disruptions (3 Weeks)
- Types of disturbances (harmonics, flicker, imbalances, transients, etc.).
- Origin and effects of disturbances.
- Measurement and analysis methods.

Chapter 3. Power Quality Correction Solutions (3 Weeks) Active and
- passive filters. Static compensators.
-
- Harmonic reduction techniques.
- Voltage regulation.

Chapter 4. Electromagnetic Compatibility (EMC) (3 Weeks)
- Introduction to EMC. EMC standards and guidelines.
-
- Emission and immunity to electromagnetic interference. Protection

Chapter 5. against Electromagnetic Interference (4 Weeks) Surge arresters and
- overvoltage protection devices. Electromagnetic shielding.
-
- Circuit design for EMC.

Evaluation method:CC 40%, Exam 60%

Bibliographical references

[1]. P. Degauque, A. Zeddam, “Electromagnetic Compatibility: From Basic Concepts to Applications”, Volume 1 and 2, Publisher Hermès - Lavoisier, 2007.
[2]. Alain CHAROY, "EMC – Parasites and disturbances in electronics", Volume 1: Sources, couplings, effects (2006), Volume 2: Grounds, masses, cabling (2006), Volume 3: Shielding, filters, shielded cables (2007), Volume 4: Power supply, lightning, remedies (2007), 2thDUNOD edition
[3]. A. KOUYOUMDJIAN, “Harmonics and electrical installations”, Schneider Group Edition, 1998 Jean-
[4]. Louis COCQUERELLE, “EMC and power electronics”, TECHNIP Edition, 1999.

HALF	Subject Title		Coefficient	Credits	Code
S 8	Industrial computing		2	3	
VHS	Course	Tutorials	Practical Exercises		
45 hours	1 hour 30 minutes		1 hour 30 minutes		

Prerequisites
Combinational and sequential logic; Microcontrollers and microprocessors

Goals
Acquire basic knowledge of industrial computing

Content of the material
Chapter 1 Introduction to Industrial Computing (3 weeks)

- A reminder about the different programmed circuits.
- Perceived on development and programming tools (µC, µP, assembly programming, C programming, Arduino, AVR, PIC ...).

Chapter 2 Peripherals and Interfaces (4 weeks)

- Hardware connection of peripherals to the µ-Processor (Interfacing with PC computers, etc.).
- Description of the basic functions of the peripherals.
- TOR Entry/Exit Ports
- Time management or Timers (programming, initialization, use, etc.).
- Interrupts (programming, use).

Chapter 3 Communication Bus (4 weeks)

- Digital communication and data transfer.
- Serialization and deserialization.
- Characteristics of a serial connection. Serial communication,
- RS232 serial port, RS422, RS485. I2C bus.
-
- The MODBUS.
- DHCP.
- CAN bus.

Chapter 4 Data acquisition (4 weeks)

- Analog-to-digital and digital-to-analog converters:
- Principles.
- Various achievements.

Practical Exercises
The teaching team in charge of this subject is responsible for designing 5 practical sessions, depending on the availability of equipment.
Evaluation methods:Continuous assessment: 40% (Practical work), Final exam: 60%.

Bibliographical references
[1] Dumas, Patrick, Industrial computing [printed text]: 28 practical problems with course review, Sciences Sup., 16362217, Paris 2004.

[2] Tavernier, Christian, Applications of PIC Microcontrollers, Dunod 2011.
[3] Sindjui, Cédric, The great guide to industrial control systems [printed text]: automation, instrumentation, local networks, automatic regulation, Paris: Lexitis, 2014.
[4] J Perrin and F Binet, Automation and industrial computing: Theoretical, methodological and technical bases, Nathan edition September 2004.
[5] Fernand Boéri and Frédéric Mallet, Industrial Computing and Java: Course and corrected exercises, Dunod edition September 2003.
[6] Jean-Louis Boulanger, Securing industrial computer architectures, Hermès edition April 2011.
[7] Henri Ney, Automation & industrial computing: industrial, industrial sciences and technologies, Nathan edition February 2000.

HALF	Subject Title		Coefficient	Credits	Code
S 8	Electrical Installation Sizing industrial		2	3	
VHS	Course	Tutorials	Practical Exercises		
67h30	3:00		1 hour 30 minutes		

Course content

Chapter 1: Introduction to the concept of standards

- Importance of industrial electrical standards.
- The role of standards in design, operation, and safety.

Chapter 2: Types of industrial and other electrical installations

- Study of different types of installations (industrial, tertiary, etc.). Typical
- diagrams: configurations, constraints, technical requirements.

Chapter 3: Power Supply - Medium/Low Voltage Side

- Power balances.
- TGBT (General Low Voltage Switchboard).
- Circuit breaker sizing, protection selection and settings.

Chapter 4: Calculating Cable Cross-Section

- Calculation methods according to installation conditions.
- Influence of installation method, temperature, length and voltage drops.

Chapter 5: Sizing of auxiliary equipment

- Rescue groups.
- Reactive power compensation.
- Grounding and protection of people.

Chapter 6: Study of squirrel cage induction motors

- Operating regimes, types of services.
- Study of different starting methods (direct, star-delta, variable frequency drive,
- etc.). Impact on the sizing of installations.

Evaluation methods

- Continuous monitoring 40%
- Final Exam 60%

Bibliographical references

1. Jacques-Marie Broust,*Industrial electrical equipment and installations*, New Factory Series, DUNOD Publishers, Paris, 2008. ISBN: 978-2-10-051247-8

HALF	Subject Title		Coefficient	Credits	Code
S 8	Company Internship 2		1	1	
VHS	Course	Tutorials	Practical Exercises		

Prerequisites Basic concepts in electrical engineering

Goals:

- Discover the world of work
- Put acquired knowledge into practice
- Gain professional experience
- To discover certain aspects of a profession
- Facilitating the transition from the world of higher education to the world of business

Evaluation methods:

Continuous monitoring: 100%

S 8	Elements of Applied AI		2	2	
VHS	Course	Tutorials	Practical Exercises		
45h00	1 hour 30 minutes	1 hour 30 minutes			

Skills targeted:

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

Goals :

- Proficiency in AI algorithms
- Introduction to the fundamental concepts, tools and applications of modern artificial intelligence, in emphasizing hands-on practice with Python and its libraries.
- To deepen one's knowledge of the Python language,
- Understanding AI approaches to problem-solving,

Prerequisites:Advanced Python Programming

Materials needed:

- A computer with Python installed,
- Python libraries: NumPy, Pandas, Scikit-learn, Matplotlib, os.listdir, os.path.exists, os.mkdir, os.rmdir, Matplotlib, Seaborn, Plitly, Request, BeautifulSoup, Tkinter, PyQT, ...
- Tensorflow, PyTorch, ...

Content of the material:

Chapter 1: Introduction to Artificial Intelligence (AI) (1 week)

1.Definitions and fields of application of AI.
2.Historical evolution of AI.
3.Introduction to the major areas:

- Machine Learning and Deep Learning
-

Chapter 2: Basic Mathematics for AI (1 week)

1. Linear Algebra:vectors, matrices, products, norms.
2. Probability & Statistics:
   - Variables,expectation, variance.
   - Common distributions: normal, binomial, uniform.
3. Simple linear regression:
   - Formulation, cost, optimization.
   - Implementation withScikit-learn.
4. Exercises:
   - Matrix manipulation using the NumPy library (Python)
   - Exercise on linear regression (using a Python library such as Scikit-learn, for example)
   - Explaining the Matplotlib library (Python)

Chapter 3: Machine Learning (3 weeks)

1.Key concepts: Data, Models, features, labels, generalization.
2.Phases of a learning pipeline: training, validation, testing.
3.Types of learning:

- Supervised
- Nosupervised

-Byreinforcement*(preview)*

4. Exercises:

-To delve deeper into the concepts covered in the course

Chapter 4: Supervised Classification (3 weeks)

1.Simple classification model training principle:

2.Models and algorithms:

- SVM (Support Vector Machine)
- Decision Trees

3.Performance evaluation:

-Confusion matrix, precision, recall, F1-score.

5. Exercises:

- Explain how to use Scikit-learn? Comparing
- several models on a dataset

Chapter 5: Unsupervised Learning

1.The concept of clustering.

2.Algorithms:

- K-means
- DBSCAN (Density-Based Spatial Clustering of Applications with Noise)

3.2D visualization and interpretation of results.

4. Exercises:

- Explain how to use a clustering algorithm on a dataset. Explain
- how to visualize the clusters.

Chapter 6: Neural Networks

1.Neural network architecture:

- Perception,
- Layers and hidden layers, weight, bias. Function
- activation:ReLU, Sigmoid, Softmax, ... Application
- exercises

2.Introduction toDeep Learning

- Concept of deep layers. Introduction to
- convolutional neural networks (CNNs).

3. Exercises:

- Explaining TensorFlow and PyTorch
- Analyze data and text and predict sentiment

Chapter 6: Introduction to Neural Networks

Chapter 7:**Mini project (supervised personal work outside of class):**

Creation of a complete classification or clustering model, including preprocessing, training, and visualization; choose and process one project from start to finish (to be distributed at the beginning of the semester):

- Handwriting recognition; Natural
- disaster prediction
- Develop a chatbot capable of answering a company's frequently asked questions in a natural way.
- Develop a system capable of distinguishing normal machine sounds from those indicating an anomaly (defective bearing, excessive vibration, etc.)
- Develop a system (mini AI) capable of analyzing the sentiments expressed in social media posts about a product, brand or event.

Title: Industrial Electricity *Establishment:*
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Practical exercises:

TP 01:Initialization

TP 02:

- Implementing a simple regression with Scikit-learnvisualization with Matplotlib((for example)
- Visualize the results with Matplotlib

TP 03:

- Machine learning pipeline and data separation To delve deeper
- into the concepts covered in the course

TP 04:

- Using Scikit-learn to train a simple classification model

TP 05:

- Implementing a clustering algorithm on a dataset
- Visualize the clusters:Unsupervised clustering (K-means, DBSCAN).

TP 06:

- Build a simple neural network with TensorFlow or PyTorchoukeras. Build a
- simple CNN to classify images (example: MINIST dataset).

Assessment method: Exam 60%, Continuous Assessment 40%

Bibliography:

- Ganascia, J. Gabriel (2024): AI explained to humans. Paris, France - Edition le Seuil.
- Anglais, Lise, Dilhac, Antione, Dratwa, Jim et al. (2023): Ethics at the heart of AI. Quebec Obvia.
- J. Robert (2024): Natural Language Processing (NLP): Definition and Principles – Data Science. Link: https://datascientest.com/introduction-au-nlp-natural-language-processing
- What is natural language processing? Link:https://aws.amazon.com/fr/what-is/nlp/
- M. Journe: Elements of Discrete Mathematics – Ellipses
- F. Challet: Deep Learning with Python – Eyrolles
- H. Bersini (2024): Artificial intelligence in practice with Python – Eyrolles
- B. Prieur (2024): Natural Language Processing with Python – Eyrolles
- V. Mathivet (2024): Implementation in Python with Scikit-learn – Eyrolles
- G. Dubertret (2023): Introduction to Cryptography with Python – Eyrolles
- S. Chazallet (2023): Python 3 – The Fundamentals of the Language - Eyrolles
- H. Belhadef, I. Djemal: NLP Method – Course at the University of Msila - Algeria

HALF	Subject Title		Coefficient	Credits	Code
S 8	Compliance with standards and rules ethics and integrity		1	1	CESE 8.12
VHS	Course	Tutorials	Practical Exercises		
10:30 PM	1 hour 30 minutes	/	/		

Prerequisites:

Ethics and professional conduct (the foundations).

Goals:

To develop students' awareness of respecting ethical principles and rules which govern life at university and in the workplace. Raise their awareness of respecting and valuing intellectual property. Explain to them the risks of moral ills such as corruption and how to combat them, and alert them to the ethical issues raised by new technologies and sustainable development.

Content of the material:

A. Respect for ethical and integrity rules,

Chapter 1. Reminder of the MESRS Charter of Ethics and Professional Conduct: Integrity and honesty.

Academic freedom. Mutual respect. Commitment to scientific truth, objectivity and critical thinking. Fairness. Rights and obligations of students, teachers, and administrative and technical staff.

Chapter 2. Integrity and Responsibility in Research

Respect for ethical principles in teaching and research
Responsibilities in teamwork: Equal professional treatment. Conduct against discrimination. Pursuit of the common good. Inappropriate conduct in the context of teamwork

Adopting responsible conduct and combating abuses: Adopting responsible conduct in research. Scientific fraud. Conduct against fraud. Plagiarism (definition of plagiarism, different forms of plagiarism, procedures to avoid unintentional plagiarism, detection of plagiarism, sanctions against plagiarists, etc.). Falsification and fabrication of data.

Chapter 3. Ethics and professional conduct in the workplace:

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

Chapter 4. Fundamentals of Intellectual Property

Industrial property. Literary and artistic property.
Rules for citing references (books, scientific articles, conference presentations, theses, dissertations, etc.)

Chapter 5. Copyright

1. Copyright in the digital environment

Introduction. Copyright of databases, copyright of software. Specific case of free software.

2. Copyright on the Internet and Electronic Commerce
Domain name law. Intellectual property on the internet. E-commerce website law. Intellectual property and social networks.

3. Patent
Definition. Rights in a patent. Usefulness of a patent. Patentability. Patent application in Algeria and worldwide.

Chapter 6. Protection and enhancement of intellectual property

How to protect intellectual property. Violation of rights and legal tools. Valuation of intellectual property. Protection of intellectual property in Algeria.

C. Ethics, sustainable development and new technologies

Chapter 7. 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).

Bibliographical references:

1. *Charter of university ethics and professional conduct, https://www.mesrs.dz/index.php/fr/ethique-etdeontologie/charte-ethique-et-deontologie/*
2. *Decree No. 933 of July 28, 2016 establishing the rules relating to the prevention and fight against plagiarism*
3. *The ABCs of Copyright, United Nations Educational, Scientific and Cultural Organization (UNESCO)*
4. *E. Prairat, On teaching ethics. Paris, PUF, 2009.*
5. *Racine L., Legault GA, Bégin, L., Ethics and Engineering, Montreal, McGraw Hill, 1991.*
6. *Siroux, D., Deontology: Dictionary of ethics and moral philosophy, Paris, Quadrige, 2004, p. 474-477.*
7. *Medina Y., Ethics, what will change in the company, Organisation editions, 2003.*
8. *Didier Ch., Thinking about the ethics of engineers, Presses Universitaires de France, 2008.*
9. *Gavarini L. and Ottavi D., Editorial. of professional ethics in training and research, Research and training, 52 | 2006, 5-11.*
10. *Caré C., Morality, ethics, deontology. Administration and education, 2nd quarter 2002, no. 94.*
11. *Jacquet-Francillon, François. Concept: professional ethics. Le Télémaque, May 2000, no. 17*
12. *Carr, D. Professionalism and Ethics in Teaching. New York, NY Routledge. 2000.*
13. *Galloux, JC, Industrial Property Law. Dalloz 2003.*
14. *Wagret F. and JM., Patents, trademarks and industrial property. PUF 2001*
15. *Dekermadec, Y., Innovating through patents: a revolution with the internet. Insep 1999*
16. *AEUTBM. The engineer at the heart of innovation. University of Technology of Belfort-Montbéliard*
17. *Fanny Rincketléda Mansour, Literacy in the digital age: copy-pasting among students, Grenoble 3 University and Paris Nanterre University, Nanterre, France*
18. *Didier DUGUEST IEMN, Citing one's sources, IAE Nantes 2008*
19. *Similarity detection software: a solution to electronic plagiarism? Report of the Working Group on Electronic Plagiarism presented to the Subcommittee on Pedagogy and ICT of the CREPUQ*
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 from the University of Montreal, Strategies for preventing plagiarism, Integrity, fraud and plagiarism, 2010.*
22. *Pierrick Malissard, Intellectual Property: Origin and Evolution, 2010.*
23. *The website of the World Intellectual Property Organization www.wipo.int*
24. *http://www.app.asso.fr/*

Evaluation methods:

Exam: 100%.

Title: Industrial Electricity *Establishment:*
Academic Year

Detailed syllabi for the subjects of 9thhalf

HALF	Subject Title		Coefficient	Credits	Code
S 9	Electric drives tuned		3	5	
VHS	Course	Tutorials	Practical Exercises		
67h30	3:00	1 hour 30 minutes	1 hour 30 minutes		

Prerequisites:

- Electrical control materials, power
- electronics materials, servo and
- regulation materials

Teaching objectives:

This course aims to equip students with the knowledge necessary to select components for an electric drive. It will also enable them to understand the challenges and available solutions in the field of electric drives for industrial electrical engineering.

Content of the material:

Chapter 1: General Information on Electrical Training (1 week)

Definition of electric drives, functional point of view, structure of an electric drive, methodology for studying an electric drive.

Mechanical characteristics of loads C(Ω): Fan load, lifting load, ascending load, tensile load, etc...

Chapter 2: Electrically regulated DC drives (2 weeks) Cascade speed/current control of a separately excited DC motor.

- Power control (constant flux) Torque
- control (variable flux)

Chapter 3: Controlled electrical drives of a stepper machine (4 weeks)

- Study and control of a 48-step-per-revolution motor; variation of position and speed.
- Study and control of a 200-step-per-revolution motor; variation of position and speed.
- Operation in full and half steps.

Chapter 4: Adjusted Electric Drives*of the asynchronous machine*((04 weeks)

- Open-loop scalar control of the induction machine; Closed-
- loop scalar control of the induction machine; Direct and
- indirect vector control of the induction machine; DTC control
- of the induction machine

Chapter 5: Adjusted Electric Drives*of the synchronous machine*((4 weeks)

- Vector control of the permanent magnet synchronous machine (PMSM) DTC
- control of the permanent magnet synchronous machine (PMSM)

Evaluation method: Continuous assessment 40%, Final exam 60%

Bibliographical references:

-Ogata, K. "Modern Control Engineering."

-Franklin, G., Powell, J., and Workman, M. "Digital Control of Dynamic Systems.

HALF	Subject Title		Coefficient	Credits	Code
S 9	Electrical network management		3	5	
VHS	Course	Tutorials	Practical Exercises		
67h30	1 hour 30 minutes	1 hour 30 minutes	1 hour 30 minutes/		

Prerequisites:
Electricity transmission and distribution networks

Goals:
The objective of this course is to cover the functions and IT architecture of data centers.
control of electrical energy transmission and distribution networks: role of control centers; real-time aspects; architecture; data acquisition and remote control; estimation and prediction of network state; centralized settings; optimization; reliability and safety; information exchange between applications and between control centers.

Content of the material:

Chapter I. General information on the production-transport-distribution system (2 weeks) Electrical system, Constitution of the electrical system, Direct current, Alternating current, Electrical energy transport, Structure of the transmission network, High voltage substations, Long-distance power lines, Prospects for direct current transmission, The Algerian electrical system.

Chapter II. Interconnection of transmission networks and voltage quality (2 (weeks)
Case of two interconnected networks, Case of several interconnected networks, Reasons for interconnections, Advantages of interconnection, Planning of transport and interconnection networks.

Chapter III. Conduct of the RPT (3 weeks)

Control centers, Production-consumption balance, Consumption forecasting and production programming, Frequency regulation, Voltage plan management on the transmission network, Control of energy transits in an interconnection network.

Chapter IV. Network Setup (3 weeks)
Frequency control (Primary, secondary and tertiary frequency control), Voltage control (Primary, secondary and tertiary voltage control), New installations – reference construction capacities.

Chapter V. Data Acquisition and Remote Control (3 weeks)
Data acquisition, Remote monitoring of the power system, Power system control or remote control, The SCADA system, The different configurations of SCADA systems, Decision support tools, Computer control systems.

Chapter VI. Electrical System Security and Defense Plans (2 weeks)
Reliability of electrical system operation, Main degradation phenomena, System safety in normal and exceptional conditions, Management of separate networks - Network reconstitution, Operation in exceptional conditions and network support, Maintaining the effectiveness of safeguarding and defense measures.

Evaluation methods: Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

1. *On Voltage and Frequency Control in Multi-Area Power, Doctoral Thesis in Electrical Engineering, Faculty of Engineering Sciences and Techniques, Swiss Federal Institute of Technology Lausanne, 2014*
2. *Final report, Gradual integration of the electricity markets of Algeria, Morocco and Tunisia into the internal electricity market of the European Union, MEDA Programme of the European Union, June 2010.*
3. *Amir Farughian, Modeling and simulation of bess-upgraded power transmission systems for frequency control, Master of Science thesis, Faculty Council of the Faculty of Computing and Electrical Engineering, Thesis, Eindhoven University of Technology, 2014.*
4. *YuryDvorkin, Operations and Planning in Sustainable Power Systems, Doctor of Philosophy, University of Washington, 2016.*
5. *Ministry of Energy, Technical Rules for Connection and Rules of Conduct of the Electricity System, 2019, https:// www.energy.gov.dz/Media/galerie/grid_code_enr_5e2eeee002101.pdf*
6. *BM Weedy; BJ Cory, N. JeNkiNs; JB ekaNayake; G.strBaC; Electric Power Systems, Fifth Edition, Fifth Edition, John Wiley & Sons Ltd, 2012.*
7. *Energy Management of Distributed Resources in Power Systems Operations*
8. *VIRLOGEUX, "Remote control systems for electrical substations", Techniques de l'Ingénieur, D4850, 1999.*
9. *Pierre BORNARD, "Management of a production-transport system", Techniques de l'Ingénieur, D4080, 2000.*
10. *Gwilherm POULLENNEC, "Discovering the electrical system", Ecole des Mines de Nantes, 2007.*
11. *RTE, "User contribution to RPT performance", Electricity Transmission Network, 2014*

HALF	Subject Title		Coefficient	Credits	Code
S 9	Design of electric drive systems		2	4	
VHS	Course	Tutorials	Practical Exercises		
45 hours	1 hour 30 minutes		1 hour 30 minutes		

Prerequisites
Prior knowledge of electrical networks, power electronics, electric motors, starting methods, as well as various types of loads, diagrams and equipment, and finally some basic knowledge of mechanics.

Goals
Acquire the principles of appropriate sizing of an electric drive system.
This involves considering a multitude of factors and a thorough understanding of all system components, such as the electrical grid, the driven machine, environmental constraints, motors and variable speed drives, and mechanical power transmission components.
Investing time in accurate sizing can translate into significant technical and economic advantages.

Content of the material:
Chapter 1: Electrical drives and transmission mechanisms (4 weeks)
- Construction of electrical drives. Mechanical
- characteristics of electric motors. Mechanical
- characteristics of driven machines.
- Calculation of the parameters of the load referred to the motor shaft (C1, N1 and J1).
- Perform an initial motor selection for the established speed (preliminary selection).
- Mechanical transmission.
- Transmit without speed change (Couplings). Transmit
- with speed change.
- --Gear reducers
- --Worm gear system
- --Transmission via a gear train
- --Transformation of rotary motion into rectilinear motion
- --Rack and pinion system
- --Pulley and belt system

Chapter 2: Verification of the engine choice (4 weeks)
- Correct the choice of motor to suit the operating
- conditions. Types of electric motor service.
- Engine check.
- Life cycle cost of an electric motor.

Chapter 3: Sizing of variable speed drives (4 weeks)
- Criteria for choosing a motor-
- variator: Starting electric motors
- Starting via wired technology (direct, star/delta)
- Starting via PLC-programmed technology Starting
- via variable speed drive

-Calculating the power of a variable speed drive for an electric drive

Chapter 4: Industrial Applications (3 weeks)

- Industrial sizing of a drive system: electric motor, mechanical reducer and speed variator.
- Sizing of an electrical cabinet intended for an electric drive.

Practical Exercises
Lab 1: Simulation of a speed reducer using Simulink/Multibody
Lab 2: Simulation of the control of a centrifugal pump
Lab 3: Simulation of Elevator Control using Simulink/Flowchart Laboratory 4:
Simulation of an Electric Vehicle using Simulink/Vehicle Dynamics Blockets

Evaluation methods:

Continuous assessment: 40% (TD: 20% and TP: 20%); Final exam: 60%.

Bibliographical references

[1] Denis MARQUET, Didier Mignardot, Jacques SCHONEK, "Guide to electrical installation 2010 - International IEC standards and French national NF standards", Schneider Electric, 2010.
[2] Dominique SERRE, "Low Voltage Electrical Installations - Electrical Protections", Technique. De l'ingénieur, D5045, 2006.
[3] Catherine Le Trionnaire Vade-mecum electrotechnics networks production machines industrial systems electrical engineering level A. Release date: September 25, 2010.
[4] Philippe LE BRUN "Asynchronous machine", Technology, selection and power supply of asynchronous machines Lycée Louis ARMAND.
[5] Electric Motors Gear Reducers Gear Motors Variable Speed Drives, A Publication Of Marathon Motors, 2013.
[6] Joseph Beretta, Automotive Electricity, John Wiley & Sons, Inc. 2010.
[7] E. Francis, ''Mechanical Construction: Power Transmission'', Volumes 1, 2 and 3

HALF	Subject Title		Coefficient	Credits	Code
S 9	Monitoring and diagnostics of systems electric		2	4	
VHS	Course	Tutorials	Practical Exercises		
45 hours	1 hour 30 minutes		1 hour 30 minutes		

Prerequisites

Electrical machines, modeling of electrical systems, signal processing

Goals

Deepen your knowledge in the monitoring and diagnosis of electrical systems. Master the various techniques and tools used for monitoring and diagnosis. Learn to use monitoring equipment and software. Analyze and interpret data to diagnose faults and propose solutions.

Content of the material

Chapter 1: Introduction to Electrical System Monitoring (2 weeks)

- Basic concepts; Importance of monitoring
- Types of electrical systems monitored (generators, transformers, distribution networks, etc.)

Chapter 2. Monitoring Techniques (2 weeks)

- Online vs. Offline Surveillance
- Measurement methods (current, voltage, temperature,
- vibration) Use of sensors and transducers

Chapter 3. Electrical System Diagnosis (4 weeks)

- Diagnostic techniques (signal analysis, spectral analysis, time-domain analysis)
- Failure models and symptoms
- Fault location methods

Chapter 4. Monitoring Tools and Equipment (2 weeks)

- Multimeters; Oscilloscopes, measurement units; Network and power analyzers;
- Monitoring and diagnostic software

Chapter.5. Data analysis and interpretation (2 weeks)

- Data collection and processing
- Data analysis methods (statistics, artificial intelligence)

Chapter.6. Predictive and proactive maintenance (3 weeks)

- Predictive maintenance concepts;
- Algorithms and prediction models;
- Implementation of proactive maintenance

Practical Exercises

TP.1Transformer monitoring and diagnostics

TP. 2Monitoring and diagnostics of rotating electrical machines - Analysis of stator and rotor currents - Vibration monitoring TP.3 Monitoring of distribution networks

Monitoring of transmission lines; Detection of cable faults;

Monitoring of protective equipment

Evaluation methods:
Continuous assessment: 40% (TD: 20% and TP: 20%); Final exam: 60%.

Bibliographical references
[1] JD Glover, MS Sama, TJ Overbye, “Power Systems Analysis and Design”, 4th Edition, Thompson-Engineering.
[2] Robert Radvanovsky and Jacob Brodsky, Handbook of SCADA/Control Systems Security, Second Edition, CRC Press; 2016
[3] D. Brown, D. Harrold, R. Hope, Control System Power and Grounding Better Practice, Elsevier, 2004.
[4] P. Tavner, L. Ran, J. Penman, and H. Sedding, Condition Monitoring of Rotating Electrical Machines, 2 ed. London, United Kingdom: Institution of Engineering and Technology, 2008.
[5] Jean-Claude Trigeassou, Diagnostics of electrical machines, Hermes Science Publications, 2011

HALF	Subject Title		Coefficient	Credits	Code
S 9	Intelligent electrical systems		2	3	
VHS	Course	Tutorials	Practical Exercises		
45 hours	1 hour 30 minutes		1 hour 30 minutes		

Prerequisites

Electrical networks 1, 2, modeling of electrical systems.

Goals

The objective of this course is to introduce the development of the smart electrical grid of tomorrow, which will be communicative, interactive and multidirectional thanks to the use of new information and communication technologies.

Content of the material

Chapter 1 Introduction to Smart Grids (2 weeks)

- Reminders about electrical networks
- Intelligent electrical systems technology,
- Introduction to the energy transition and integration of renewable sources.

Chapter 2 Intelligent electrical systems architecture (2 weeks)

- Architecture of microgrids and smart grids
- Communication in smart networks, standards and protocols
- Embedded systems and sensor networks, data storage and security.

Chapter 3 Automation, control and protection of networks (3 weeks)

- SCADA Systems
- Wide-area monitoring & control
- Wide-area protection.

Chapter 4 Management and control of electrical networks (5 weeks)

- Optimal Microgrid Management
- Energy management (EMS, VPP ...)
- Demand-side management, pricing

Chapter 5 Developments and services related to intelligent systems (3 weeks)

- Artificial intelligence in network management
- load forecast
- Real-time measurement, counting and pricing.
- Smart buildings

Practical Exercises

Practical exercises, which can take the form of mini-projects, allow students to better understand smart grids and their various applications. These include the design and simulation of smart grids using different simulation tools. These practical exercises can be adapted according to available resources.

TP.1Implementation of energy management systems using TP.2 microcontrollers, sensors and smart meters to collect real-time data.

TP.3Using data mining and machine learning techniques for smart grid data analysis.

TP.4Setting up a communication network for a microgrid. TP.5
Design of a smart microgrid for a tertiary system.

Assessment method: Continuous Assessment (TC+TP) 40%, Exam 60%

Bibliographical references

[1]. N. Simoni, “From smart grids to the new generation of services”, Hermès, 2007

[2]. Stuart Borlase, Smart Grids: Infrastructure, Technology, and Solutions, CRC press, 2017

[3]. Stephen F. Bush, Smart Grid: Communication-Enabled Intelligence for the Electric Power Grid, Wiley, 2014.

HALF	Subject Title		Coefficient	Credits	Code
S 9	Electronic Design power		3	5	
VHS	Course	Tutorials	Practical Exercises		
67h30	1 hour 30 minutes		3 hours		

Prerequisites

Power Electronics 1, 2 and Advanced, Fundamental Electronics, Heat Transfer

Goals

Mastering the concept of power circuit design, component sizing, sizing and selection of cooling circuits, and the use of CAD software and PCB manufacturing software.

Content of the material

Chapter 1. Introduction to CAD in Power Electronics (1 Week)

Chapter 2. Sizing and selection of power electronics components (3 weeks) Chapter 3. Sizing and selection of heat sinks (3 weeks) Chapter 4. Power Converter Design Methodology (2 Weeks)

Chapter 5. Power Circuit Design for Rectifiers, Choppers and Inverters (3 Weeks)

Chapter 6. Control Circuit Design for Rectifiers, Choppers and Inverters (3 Weeks)

Practical Work

TP1:Design of a Controlled Full-Wave Rectifier (Power and Control Circuit).

TP 2:Design of a Buck Boost Chopper (Power and Control Circuit).

TP3:Design of a Three-Phase Inverter based on MOSFETs (Power and Control Circuit). TP4: Design of a Three-Phase Inverter based on IGBT (Power and Control Circuit).

Assessment method: Continuous Assessment 40%, Exam 60% Bibliographical references

[1]. MicroSim Corporation, PSpice Manual, Irvine, CA, 1992.
[2]. W. Blume, Computer circuit simulation, Byte, 11(7), 1986, 165.
[3]. Cadence Design Systems, PSpice 9.1 Student Version, San Jose, CA, 2001. http://www. cadencepcb.com/products/downloads/PSpicestudent/default.asp.
[4]. Cadence Design Systems, Orcad 9.2 Demo, San Jose, CA, 2001. http:// www.cadencepcb.com/products/downloads/orcaddemo/default.asp.
[5].Cadence Design Systems, PSpice Design Community, San Jose, CA, 2001. http://www. PSpice.com

HALF	Subject Title		Coefficient	Credits	Code
S 9	Reverse Engineering		2	2	
VHS	Course	Tutorials	Practical Exercises		
45h00	1 hour 30 minutes	1 hour 30 minutes - Workshop			

Teaching objectives

- Understanding the principles and objectives of Reverse Engineering (RE) in the field of science and technology (ST),
- To become familiar with the tools and methods of RE in the relevant specialty.
- To understand the value and ethics of RE principles in the design, manufacturing, and quality assurance of products,
- Encouraging critical thinking, technical curiosity, reasoned reverse engineering, and innovation,
- Learn to analyze, document and model an existing system without initial documentation.

Skills targeted

- Decompose and analyze an existing system,
- Accurately reproduce a technical diagram or 3D model from an existing product;
- apply diagnostic and simulation tools.
- Working in a group on an exploratory project,
- Identifying the legal limits of reverse engineering

Prerequisites -Fundamental knowledge in the specialty.

Content of the material

1. Introduction to Reverse Engineering
   - History, legal and ethical issues of the RE,
   - Definitions and fields of application: Approaches (hardware, software, processes, etc.) Areas
   - of expertise: maintenance, remanufacturing, cybersecurity, competitive intelligence

2. General Methodology
   - Analysis of a “black box” system:
   - Functional decomposition
   - Block diagrams, input/output diagrams, energy or information flow diagrams

3. Hardware Reverse Engineering
   - Electrical Device – Electronic Board: visual inspection, component identification.
   - Use of tools: multimeter, oscilloscope, logic analyzer
   - Electrical diagram recognition

   -Reconstructing schematics using KiCad / Fritzing / Proteus/EPLAN Electric P8/ QElectroTech

4. Reverse engineering software
   - Static analysis of binaries (e.g., .exe, .hex)
   - Decompilation, disassembly (introduction to Ghidra, IDA Free, or
   - Hopper) Observing behaviors: sniffing, monitoring (e.g., Wireshark)
   - Microcontroller cases: flash memory reading, firmware extraction

5. Mechanical Reverse Engineering
   - 3D scanning: scanning, manual measurements.
   - Reproduction of CAD models from existing parts. Software
   - used: SolidWorks, Fusion 360

6. Security and intrusion detection
   - Reverse engineering in cybersecurity: malware detection, vulnerabilities, software
   - signing, protections against reverse engineering (obfuscation, encryption)

7. Real-world case studies
   - Analysis of an obsolete or unknown product (mouse, power supply, Bluetooth module,
   - etc.) Example of reverse engineering of a mechanical part or simple system (fan, case)

Examples of practical work (based on the 4 Geniuses)

- Electrical Engineering
- Reverse engineering an electrical device without a schematic
- Example: Time delay relay, Electrical cabinet, Variable speed drive, Electric machine, Automation system.
- Objectives: to identify the operation, draw the diagram, and propose an improved variant.
- Identification of components (ICs, transistors, resistors, capacitors, etc.).
- Use of tools: multimeter, oscilloscope, logic analyzer. Reading
- and extracting firmware from a microcontroller. Introduction to
- the detection of electronic counterfeits.

- Mechanical Engineering :
- Reverse engineering a simple mechanism
- Examples: hand pump, torque wrench, mini press. Mechanical
- dismantling of a system (pump, gear, cylinder...).

-Measurements and reconstruction of plans or 3D models with CAD software (SolidWorks, Fusion360).

- Identification of materials and manufacturing methods.
- Functional simulation based on the recreated model.

- Civil Engineering:
- Analysis of existing structures without plans (walls, slabs, structures,
- etc.). Examples: metal staircase, window sill, formwork.
- Study and reverse engineering of an existing structural element.
- Identification of materials, connections, and constraints. Modeling of the
- structure using Revit, AutoCAD, or SketchUp. Study of the rehabilitation or
- reproduction of existing structural elements.

- Process Engineering
- Reverse engineering of a laboratory module
- Examples: simple instruments, distillation, filtration, heat exchanger, reactor... Analysis of
- existing industrial systems (distillation column, heat exchanger, reactor...). Reconstruction
- of PFD and PID diagrams from observation of an installation. Identification of sensors,
- actuators, and control devices.
- Study of mass/energy flow in a process.

Evaluation method:

- practical techniques
- Mini reverse engineering project (report + presentation)

- Final exam (multiple-choice questions + case study):
- Exam: 60% and Practical Assessment: 40%

Bibliographical references:

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

HALF	Subject Title		Coefficient	Credits	Code
S 9	Documentary research and design from memory		1	1	
VHS	Course	Tutorials	Practical Exercises		
10:30 PM	1 hour 30 minutes	/	/		

Prerequisites

Writing methodology, Presentation methodology.

Goals

To equip students with the necessary tools to find relevant information and effectively utilize it in their final year project. To guide them through the various stages of writing a scientific document. To emphasize the importance of communication and teach them how to present their work rigorously and pedagogically.

Content of the material

Part I: Documentary Research:

Chapter 1: Defining the Subject

- Subject title
- List of keywords related to the topic
- Gather basic information (acquisition of specialized vocabulary, meaning of terms, linguistic definition)
- The information sought
- To take stock of one's knowledge in the field

Chapter 2: Selecting Information Sources

- Types of documents (Books, Theses, Dissertations, Journal articles, Conference proceedings, Audiovisual documents...)
- Type of resources (Libraries, Internet...)
- Evaluate the quality and relevance of information sources

Chapter 3: Locating the documents

- Search techniques and
- search operators

Chapter 4: Processing Information

- Work organization; Initial
- questions; Summary of selected
- documents; Links between
- different parts
- Final plan for the literature search

Chapter 5: Presentation of the bibliography

-Bibliography presentation systems (The Harvard system, The Vancouver system, The mixed system...)

- Presentation of documents.
- Citation of sources

Part II: Memory Design

Title: Industrial Electricity *Establishment:*
Academic Year

Chapter 1: Plan and stages of the dissertation

- Defining and delimiting the subject (Summary)
- Problem statement and objectives of the dissertation
- Other useful sections (Acknowledgments, Table of Abbreviations...)
- The introduction (Writing the introduction last)
- State of the specialized
- literature; Hypothesis
- formulation; Methodology
- Results; Discussion; Recommendations; Conclusion and perspectives;
- Table of contents; Bibliography; Appendices

Chapter 2: Writing Techniques and Standards

- Formatting. Numbering of chapters, figures, and tables. The title
- page
- Typography and punctuation
- Writing. Scientific language: style, grammar, syntax.
- Spelling. Improvement of general language skills in terms of comprehension and expression.
- Back up, secure, archive your data.

Chapter 3: Workshop: Critical Study of a Manuscript

Chapter 4: Oral Presentations and Defenses

- How to present a poster
- How to present an oral communication.
- Dissertation defense

Chapter 5 How to avoid plagiarism? (Formulas, sentences, illustrations, graphs, data, statistics,...)

- The quote
- The paraphrase
- Provide the full bibliographic reference

Evaluation method: Exam: 100%

Bibliographical 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. A. Mallender Tanner, ABC of technical writing: user manuals, instructions for use, online help, Dunod, 2002.
4. M. Greuter, Writing your thesis or internship report well, L'Etudiant, 2007.
5. M. Boeglin, Reading and Writing at University: From the Chaos of Ideas to Structured Text. L'Etudiant, 2005.
6. M. Beaud, The Art of the Thesis, Casbah Editions, 1999.
7. M. Beaud, The Art of the Thesis, La Découverte, 2003.
8. M. Kalika, The Master's Thesis, Dunod, 2005.

HALF	Subject Title		Coefficient	Credits	Code
S 9	Industrial hygiene and safety		1	1	
VHS	Course	Tutorials	Practical Exercises		
10:30 PM	1 hour 30 minutes				

PrerequisitesBasic concepts of electricity.

Goals

The objective of this course is to inform future engineers about electrical accidents, rescue techniques for victims of electrical accidents, and to provide them with the necessary knowledge to properly size protection devices for equipment and personnel involved in industry and other areas of use of this equipment.

Chapter 1 History and statistics of electrical accidents (1 week)

- History of electricity
- Legend and history of electrical hazards;
- Statistics on workplace accidents;
- Statistics on electrical accidents

Chapter 2 Dangers and factors influencing the effects of electric current (2 Weeks)

- Why is electric current dangerous?
- Danger thresholds of electric current
- Effects of electric current on humans; Factors
- influencing the effects of electric current;
- Voltage ranges
- Effects of electromagnetic fields and radio waves;
- Effects of fires and explosions of electrical origin;
- Procedures to follow in the event of an electrical fire

Chapter 3 Regulations, Standards and Authorization (3 Weeks)

- Definitions and purpose of electrical safety:
- Prevention and Education
- Regulations – Official Texts
- Standardization and Legal Aspects
- Authorization
- Work organization and
- electrical work procedures

Chapter 4 Protective equipment (3 weeks)

- Personal Protective Equipment (PPE)
- Personal Safety Equipment (PSE)
- Collective Safety Equipment (CSE)

Chapter 5 Protective measures and safety distances (4 weeks)

- Electrical contacts
- Protection against direct contact
- Protection against indirect contact
- Electrical appliance insulation classes
- Protection ratings
- Premises Reserved for Electricians (LRE)

- Environmental zone
- Minimum Approach Distance (MAD) and
- Neighborhood Limit Distances
- Work area
- Work near power lines
- Distances to be respected around a transmission and distribution line

Chapter 6 Basic First Aid (2 Weeks)

- What to do after an electrocution?
- First aid
- Monitoring
- Example of basic first aid intervention in the event of a domestic electrical accident

Assessment method: Examination
100% Bibliographic references

[1]. C. ATLANI and S. DOMINIQUEe, "Prevention of electrical accidents in operation", Les Techniques de l'ingénieur, Electrical Engineering D 5103, 2014
[2]. D. HILAIRE and J. POYARD, "Electrical Safety: Protection of Persons", Les Techniques de l'ingénieur, Electrical Engineering SL6181, 17p, 2009
[3].LG Hewitson, Guide to the Protection of Electrical Equipment, Dunod, 2007
[4]. S. DOMINIQUE, "Low Voltage Electrical Installations - Protection against Direct Contact", Les Techniques de l'ingénieur, Electrical Engineering, Reference D5043, 2006
[5]. Operations on electrical works and installations and in an electrical environment. Prevention of electrical risk, NF C 18-510 January 2012