الجمهورية الجزائرية الديمقراطية الشعبية People's Democratic Republic of Algeria

وزارة التعليم العالي والبحث العلمي

Ministry of Higher Education and Scientific Research

اللجنة البيداغوجية الوطنية لميدان العلوم و التكنولوجيا

National Pedagogical Committee of the Science and Technology field

TRAINING OFFER
L.M.D.

ACADEMIC MASTER's DEGREE

A NATIONAL REGISTRATION
2024– 2025
(1st update)

Establishment	Faculty / Institute	Department
M'Hamed Bougara-Boumerdes University	**Institute of Electrical and Electronic Engineering**	**Electrical Engineering and Automation**
Domain	**Major**	**Speciality**
Sciences and Technologies	***Control (Automatic)***	***Control (Automatic)***

Ministerial Order No. 1072 of 13 October 2015, on the accreditation of the Master of National Registration, UMBB.

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عرض تكوين
ل. م . د
ماستر أكاديمية

ذا تسجيل وطني

2024 –2025
(التحيين الأول-1-)

المؤسسة	الكلية/ المعهد	القسم
جامعة أمحمد بوقرة- بومرداس	معهد الهندسة الكهربائية و الإلكترونيك	الالكتروتقني و الالية

الميدان	الفرع	التخصص
علوم و تكنولوجيا	الآلية	الآلية

قرار وزاري رقم 1072 المؤرخ في 13 أكتوبر 2015، يتضمن تأهيل ماستر فروع تسجيل وطني، جامعة بومرداس

I – Master's identity sheet

1 - Location of the training:

Faculty (or Institute): Institute of Electrical Engineering and Electronics

Department: Electrical Engineering and Automation

References of the Master's degree (attach a copy of the order)

قرار وزاري رقم 1072 المؤرخ في 13 أكتوبر 2015، يتضمن تأهيل ماستر فروع تسجيل وطني، جامعة بومرداس

Ministerial Order No. 1072 of 13 October 2015, on the accreditation of the Master's degree in National Recruitment, UMBB.

Conditions of access

(Indicate the bachelor's specialties that can give access to the Master's degree)

Spinneret	Harmonized Master's Degree	Access Licenses Master's degree	Classification according to license compatibility	Coefficient assigned to the licence
		Electrical and Electronic Engineering	**1**	**1**
Automatic	Automatic	Automatic	**2**	**0.90**
		Electronic	**2**	**0.80**
		Electrotechnical	**3**	**0.70**
		Industrial IT	**5**	**0.60**
		Other ST Domain Licenses	**6**	**0.50**

II – Semester organisation sheets for teaching of the specialty

Semester 1

Teaching unit	Materials		Credits	Coefficient	Weekly hourly volume			Semi-Annual Hourly Volume (15 weeks)	Complementary work in Consultation (15 weeks)	Evaluation method	
	Code	Entitled			Course	TD	TP			Continuous assessment	Examination
Core UE Code: UEF 1.1.1 Credits: 12 Coefficients: 6	EE451	Digital Control Systems	6	3	3h00	1h30		67h30	82h30	40%	60%
	EE479	Advanced Mathematics for Control	6	3	3h00	1h30		67h30	82h30	40%	60%
Core UE Code: UEF 1.1.2 Credits: 12 Coefficients: 7	EE455	System Modelling and Identification	5	3	3h00			45h00	50h00	40%	60%
	EE419	Digital Signal Processing	4	2	3h00			45h00	50h00	40%	60%
	EE457	Sensors and Actuators	3	2	1h30			10h30	40h00	40%	60%
Methodological UE Code: EMU 1.1 Credits: 6 Coefficients: 4	EE451L	Digital Control Systems Lab	2	1			3h00	45h00	25h00	100%	
	EE455L	System Modelling and Identification Lab	1	1			1h30	10h30	3h00	100%	
	EE457L	Sensors and Actuators Lab	1	1			1h30	10h30	3h00	100%	
	EE429	Simulation Softwares for Control	2	1	1h30		1h00	37h30	3h00	40%	60%
Semester 1 total			**30**	**17**	**15h30**	**03h00**	**07h30**	**375h00**	**375h00**		

Semester 2

Teaching unit	Materials		Credits	Coefficient	Weekly hourly volume			Semi-Annual Hourly Volume (15 weeks)	Complementary work in Consultation (15 weeks)	Evaluation method	
	Code	**Entitled**			**Course**	**TD**	**TP**			**Continuous assessment**	**Examination**
Core UE Code: UEF 1.2.1 Credits: 9 Coefficients: 5	EE472	Applied Optimization	5	3	3h00	1h30		67h30	45h00	40%	60%
	EE456	Applied Artificial Intelligence	4	2	3h00			45h00	45h00	40%	60%
Core UE Code: UEF 1.2.2 Credits: 14 Coefficients: 7	EE452	Industrial Automation	5	3	3h00			45h00	45h00	40%	60%
	EE458	Nonlinear Systems and Control	5	2	3h00			45h00	67h30	40%	60%
	EE454	Multivariable Control Systems	4	2	3h00			45h00	67h30	40%	60%
Methodological UE Code: EMU 1.2 Credits: 5 Coefficients: 3	EE472L	Applied Optimization Lab	2	1			1h30	10h30	10h30	100%	
	EE456L	Applied Artificial Intelligence Lab	1	1			1h30	10h30	10h30	100%	
	EE452L	Industrial Automation Lab	2	1			2h30	37h30	10h30	100%	
E Transversal Code: UET 1.2 Credits: 1 Coefficients: 1	EE482	Standards and Rules of Ethics and Integrity	1	1	1h30			10h30	3h00		100%
Discovery UE Code: UED 1.2 Credits: 1 Coefficients: 1	EE652	Elective Course (select a course from the list below)	1	1	1h30			10h30	10h30		100%
Semester 2 total			**30**	**17**	**18h00**	**1h30**	**5h30**	**375h00**	**375h00**		

Semester 3

Teaching unit	Materials: Code	Materials: Entitled	Credits	Coefficient	Weekly hourly volume: Course	TD	TP	Semi-Annual Hourly Volume (15 weeks)	Complementary work in Consultation (15 weeks)	Evaluation method: Continuous assessment	Examination
Core UE Code: UEF 2.1.1 Credits: 15 Coefficients: 7	EE553	Robotics and Control	5	3	3h00			45h00	60h00	40%	60%
	EE557	Industrial Networks	5	2	3h00			45h00	60h00	40%	60%
	EE559	Adaptive & Predictive Control	5	2	3h00			45h00	60h00	40%	60%
Core UE Code: UEF 2.1.2 Credits : 8 Coefficients: 4	EE555	Advanced Control Systems	4	2	2h00	1h00		45h00	50h00	40%	60%
	EE551	Industrial Instrumentation	4	2	3h00			45h00	50h00	40%	60%
Methodological UE Code: EMU 2.1 Credits: 5 Coefficients: 4	EE553L	Robotics and Control Lab	1	1			1h30	10h30	3h00	100%	
	EE557L	Industrial Networks Lab	1	1			1h30	10h30	3h00	100%	
	EE559L	Adaptive & Predictive Control Lab	1	1			1h30	10h30	3h00	100%	
	EE551L	Industrial Instrumentation Lab	2	1			2h30	37h30	8h00	100%	
E Transversal Code: UET 2.1 Credits: 2 Coefficients: 2	EE581	Project Management	1	1	1h30			10h30	3h00		100%
	EL501	Communication Skills	1	1	1h30			10h30	3h00		100%
Semester 3 total			**30**	**17**	**17h00**	**1h00**	**07h00**	**375h00**	**375h00**		

Semester 4

Practical internship in a company is optional.

	VHS	Coeff	Credits
Personal work	750	17	30
Total Semester 4	750	17	30

The personal work consists of the preparation of a master's thesis which may include an internship in a socio-economic environment and/or participation in seminars. It is sanctioned by a defense.
The method of evaluation is done in accordance with the regulations in force.

III - Detailed programme by subject of the S1 semester

Semester: 1
Teaching unit: UEF 1.1
Subject 2: Digital Control Systems
VHS: 67h30 (Lecture: 3h, TD: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:

Provide the student with basic tools for the analysis and design of discrete-time linear control systems. This course can be seen as the extension of continuous-time (linear) control systems tools to the discrete-time case.

Recommended prior knowledge:

A course in discrete-time linear systems (linear systems II)

A course in linear (continuous-time) control systems

Content of the material:

Chapter 1: Introduction (3 weeks)

Sampling processes, Simplified digital control systems..

Chapter 2: Z-domain analysis (3 weeks)

Review of the Z-transform, z-transform of impulse sampled signals, frequency response of zero-order hold, pulse transfer function of closed loop systems, PID controller, direct, standard, series and parallel programming, mapping between s and z-planes, stability analysis in the z-domain.

Chapter 3: Design of discrete-time control systems (3 weeks)

Discrete-time equivalents of continuous time filters, backward difference, step and impulse invariance, bilinear transformation, matched pole-zero mapping, transient response and steady-state error analysis, root locus, deadbeat response.

Chapter 4: Frequency response methods (3 weeks)

Discrete-time LTI system response to a sinusoidal input, bilinear transformation in the W-plane, the Bode-plot method

Chapter 5: State-space methods (3 weeks)

State-space equations, partial fractions expansion methods, solution of discrete state-space equations, discretization of continuous-time systems, PTF matrix, controllability, observability, pole placement through state feedback, and observer feedback, Ackerman formula, servo-systems

Method of evaluation:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references :

1. H. Ogata, Discrete-Time control systems, 2nd Ed, Prentice Hall, 1995.
2. G.F. Franklin, J.D. Powell, M. Workman, Digital control of dynamic systems, 3rd Ed, Pearson Educations, 2005.

Semester: 1
Teaching unit: UEF 1.1
Subject 1: Advanced Mathematics for Control
VHS: 67h30 (Lecture: 3h, TD: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:

To develop, deepen and extend the concepts and tools acquired in previous linear Algebra course.

Recommended prior knowledge:

A course in calculus and a course in linear Algebra

Content of the material:

Chapter 1: Diagonalization and Jordan Forms	**(2 weeks)**
Chapter 2: Orthogonality	**(2 weeks)**
Chapter 3: Positive definiteness	**(2 weeks)**
Chapter 4: Computations with matrices	**(2 weeks)**
Chapter 5: Matrix decompositions	**(3 weeks)**
Chapter 6: Singular Value decomposition	**(2 weeks)**
Chapter 7: Principle Component Analysis	**(2 weeks)**

Method of evaluation:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references :

1. Gilbert Strang, Linear Algebra and its Applications
2. Steven Roman, Advanced Linear Algebra
3. R.L. Finney, D.R. Ostberg, R.G. Kuller, Elementary Differential Equations with Linear Algebra

Semester: 1
Teaching unit: UEF 1.2
Subject 1: System Modelling and Identification
VHS: 45h00 (Course: 3h)
Credits: 5
Coefficient: 3

Teaching objectives:

This course provides an introduction to the modeling and identification of dynamic systems. The purpose of modeling and identification is to establish empirical relationships between observed variables of a dynamical system. In this course, advanced modeling techniques necessary for simulation and control of complex systems will be introduced and then different parametric and non-parametric techniques available for linear systems identification will be explored.

Recommended prior knowledge:

A course in linear Algebra

A course in probability and stochastic processes

Content of the material:

Chapter 1: The system identification problem **(1 weeks)**

Formulation, classification, methodology.

Chapter 2: System modelling approaches **(2 weeks)**

Continuous and discrete modelling, parametric and nonparametric modelling, Input/output and State Space models, Linear and Nonlinear systems.

Chapter 3: Review on linear systems and stochastic processes **(2 weeks)**

Chapter 4: Least-squares estimation and Kalman filtering (2 weeks)

Least-squares theory, statistical properties of least-squares estimators, recursive estimation, Real-time algorithms…

Chapter 5: Maximum likelihood method **(2 weeks)**

Chapter 6: Instrumental variable methods **(2 weeks)**

Chapter 7: Nonparametric identification **(2 weeks)**

Chapter 8: Input design, Model validation **(2 weeks)**

Method of evaluation:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references :

1. Robert L. Woods and Kent L. Lawrence, "Modeling and Simulation of Dynamic Systems", 1st edition, Prentice Hall, 1997.
2. L. Ljung, System identification: theory for the user, 2nd Ed, Prentice Hall, 1999.
3. J.P. Norton, An Introduction to Identification, 1st ed., Dover Publications, 2009.
4. J.N. Juang, Applied System Identification, 1st Ed., Prentice Hall, 1993.

Semester: 1
Teaching unit: UEF 1.2
Subject 2: Digital Signal Processing
VHS: 45h (Lecture: 3h)
Credits: 4
Coefficient: 2

Teaching objectives:

The fundamental goal of this course is to introduce the student to the analysis, design, and implementation of digital filters to process digital signals.

Recommended prior knowledge:

A course in discrete-time signals and systems or linear systems II

Content of the material:

Chapter 1: Review **(1 week)**
Sequences, Fourier transform of sequences, Z-transform
Chapter 2: The Discrete and fast Fourier transforms **(3 weeks)**
Definition of the DFT, circular shift and convolution, The FFT, windowing signals…
Chapter 3: Digital filters **(3 weeks)**
Definitions, classification…
Chapter 4: IIR filter design **(2 weeks)**
Mapping from analog, direct design using optimization…
Chapter 5: FIR filter design **(2 weeks)**
The Window method, frequency sampling method, direct design using optimization…
Chapter 6: Digital filter implementation **(2 weeks)**
IIR filter structures, FIR filter structures, quantization effect…
Chapter 7: Implementation of digital filters and FFT in software and hardware (2 weeks)

Method of evaluation:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references :

1. J. G. Proakis, and D. G. Manolakis, "Digital Signal Processing, principles, algorithms, and applications", Prentice-Hall, 3rd edition 1996.
2. A. V. Oppenheim, and R. W. Schafer, " Discrete-time Signal Processing ", Prentice Hall ; 3rd edition, 2009.

Semester: 1
Teaching unit: UEF 1.2
Subject 1: Sensors and Actuators
VHS: 22h30 (Lecture: 1.5 hours)
Credits: 3
Coefficient: 2

Teaching objectives:

This course equips students with a theoretical and a practical background on sensors, their working principles as well as actuators and their drive systems.

Recommended prior knowledge:

A course in Physics

A course in Electric circuits

A course in Power Electronics

Content of the material:

Chapter 1: Introduction to Sensors (1 week)
Chapter 2: Proximity sensors, Angular displacement sensors and Rotational measurement sensors. (1 Week)
Chapter 3: Force, Torque and Pressure sensors (2 weeks)
Chapter 4: Accelerometers and Gyroscopes (1 week)
Chapter 5: Temperature and Humidity Sensors (1 week)
Chapter 6: Introduction to Actuators (1 week)
Chapter 7: Electromechanical Actuators (2 weeks)
Chapter 8: Switching Devices and Motor Drive systems (3 weeks)
Chapter 9: Piezoelectric actuators. (1 week)
Chapter 10: Fluid systems and Hydraulic actuators. (1 week)
Chapter 11: Pneumatic actuators (1 week)

Method of evaluation:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references :

1. Robert H. Bishop, *Mechatronic Systems, Sensors, and Actuators*, CRC Press, 2007.
2. Andrzej M. Pawlak, *Sensors and Actuators in Mechatronics Design and Applications*, CRC Press, 2006.
3. De Silva, Clarence W, Sensors and actuators: Engineering System Instrumentation, Taylor & Francis, 2015.

Semester: 1
Teaching Unit: UEM 1.1
Material 1: Digital Control Systems Lab
VHS: 45h (TP: 3h)
Credits: 2
Coefficient: 1

Teaching objectives:

A digital control system with I/O interface is widely applied in industry, Engineering textbook do not address thoroughly their practical implementation due to the limited knowledge introduced by real-time requirements. This course addresses the practical aspects of the implementation of common digital controllers (PID, state and observer-feedback) on digital computers.

Recommended prior knowledge:

A course in digital systems is required; additionally this course is to be taken along or after the digital control systems course

Content of the material:

Lab N°1: Introduction (1 week)

Lab N°2: Embedded systems basics (2 weeks)

Lab N°3: Real-time systems basics (3 weeks)

Lab N°4: Software prototyping (3 weeks)
Simulink, LabView…

Lab N°5: I/O interfaces (2 weeks)
ADC, DAC, delays, sensors and actuator interfacing

Lab N°6: PID controller implementations (2 weeks)
Derivative noise, integral windup)

Lab N°7: State-feedback and observer feedback implementations (2 weeks)

Method of evaluation:

Continuous Assessment: 100%

Bibliographical references :

1. J. Ledin, "Embedded Control Systems in C/C++: An Introduction for Software Developers Using MATLAB", CMP books, 2003.
2. T. Wescott, "Applied Control Theory for Embedded Systems", Newnes, 2006.

Semester: 1
Teaching Unit: UEM 1.1
Subject 2: System Modelling and Identification Lab
VHS: 22h30 (TP: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

To introduce the student to the field of system identification, and explore the different parametric and non-parametric techniques available for linear systems identification

Recommended prior knowledge:

A course in linear Algebra
A course in probability and stochastic processes

Content of the material:

Lab N°1: Continuous/Discrete time modeling Implementation (2 weeks)
Lab N°2: Stochastic processes Implementation (3 weeks)
Lab N°3: Least-squares estimation Implementation (2 weeks)
Lab N°4: Maximum likelihood method Implementation (2 weeks)
Lab N°5: Instrumental variable methods Implementation (2 weeks)
Lab N°6: Nonparametric identification Implementation (2 weeks)
Lab N°7: Input design, Model validation Implementation (2 weeks)

Method of evaluation:

Continuous assessment: 100%.

Bibliographical references :

Laboratory handouts available before each Lab session

Semester: 1
Teaching Unit: UEM 1.1
Topic 3: Sensors and Actuators Lab
VHS: 22h30 (TP: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:

This is a hands-on companion module for the Sensors and Actuators course. Students will get in touch with various measurement sensors and different actuators control schemes.

Recommended prior knowledge:

This is to be taken along with the Sensors and Actuators course

Content of the material:

Lab n°1: Distance and Displacement Measurement (2 weeks)
Lab n°2: Pressure Measurement (1 week)
Lab N°3: Temperature Measurement (3 weeks)
Lab N°4: Speed Control of BLDC Motor (2 weeks)
Lab N°5: Stepper Motor Control (1 week)
Lab N°6: Servo Motor Control (1 week)
Lab N°7: Sensors Model Identification (2 weeks)
Lab N°8: DC Motor Model Identification (2 weeks)
TP N°9: Pneumatic Actuators (1 week)

Method of evaluation:

Continuous assessment: 100%.

Bibliographical references :

Laboratory handouts available before each Lab session

Semester: 1
Teaching Unit: UEM 1.1
Subject 4: Simulation Softwares for Control
VHS: 37h30 (Lecture: 1h30, TP: 1h)
Credits: 2
Coefficient: 1

Teaching objectives:

This program immerses students in the fundamentals of MATLAB for control system analysis, Simulink for dynamic system modeling, and LabVIEW for real-time control applications. By the course end, students will possess both theoretical knowledge in control engineering and practical expertise in utilizing these industry-leading tools.

Recommended prior knowledge:

A basic course in computer programming.

A course in linear control systems.

Content of the material:

Chapter 1: Matrix computations **(1 week)**

arrays, matrices, linear algebra operations...

Chapter 2: Visualization and programming with Matlab **(1.5 weeks)**

basic plotting (2d, 3d, charts..), control structures for programming, debugging...

Chapter 3: Solving equations and curve fitting **(1.5 weeks)**

manipulating polynomials, computing roots, peace-wise interpolation, least-squares interpolation...

Chapter 4: Control systems related toolboxes: **(2 weeks)**

using toolboxes for modeling, analysis, and design of control systems (control systems toolbox, symbolic...)

Chapter 5: Simulation of Dynamical Systems with Simulink: **(3 weeks)**

Chapter 6: Visualization and programming in LabVIEW (3 weeks)

tables, matrices, dynamic, wave-forme, Cluster, loops, File I/O, building VI

Chapter 7: Instrumentation and Control Applications with LabVIEW (3 weeks)

Sensors, signal conditioning circuits, PID control, Interfacing with Matlab and Simulink.....

Method of evaluation:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references :

1. C.B. Moler, Numerical computing with MATLAB, 2nd Ed, SIM, 2008
2. D.P. O'Leary, Scientific Computing with Case Studies, 1st Ed, SIM, 2008
3. A. Quarteroni, F. Saleri, Scientific Computing with MATLAB and Octave, 2nd Ed, Springer, 2006.
4. S. Sumathi, P. Surekha, LabVIEW based Advanced Instrumentation Systems, Springer, 2007

IV - Detailed programme by subject of the S2 semester

Semester: 2
Teaching unit: UEF 2.1
Material 1: Applied Optimization
VHS: 67.5h (Lecture: 3h00, TD: 1h30)
Credits: 5
Coefficient: 3

Teaching objectives:

Many problems in science, technology, economy etc. can be modeled by mathematical formulations whose exact solutions are either unknown or are computationally expensive. In these cases, a set of techniques, known collectively as Numerical Methods, produce efficiently approximate solutions to exact solutions. Optimization is a very powerful and versatile instrument which could potentially be applied to any engineering discipline. Engineers may intend to maximize or minimize some factors in their problems and they are constantly searching for optimal solutions. Several general approaches for optimization are available; the most important general one is based on numerical methods. The aim of this course is to introduce students to numerical methods and optimization, to provide the basic concepts and the implementation of some methods and algorithms.

Recommended prior knowledge:

A basic course in calculus; A basic course in computer programming

Content of the material:

Chapter 1: Roots of algebraic equations **(1 weeks)**

Introduction, The incremental search method, Newton Raphson method

Chapter 2: Solution of simultaneous algebraic equations **(1.5 weeks)**

Introduction, Gauss elimination method, Gauss- Seidel method

Chapter 3: Numerical integration **(1 weeks)**

Introduction, Riemann Sums, Trapezoidal integration, Sympson integration.

Chapter 4: Interpolation and Polynomial Approximation **(1.5 weeks)**

Introduction, Lagrange Polynomials, Spline Interpolation.

Chapter 5: Numerical Solution of Initial-Value Problems **(2 weeks)**

Introduction, Runge Kutta methods, Ordinary Higher Order Differential Equations

Chapter 7: Linear programming problems **(3 weeks)**

Definition, Graphical Method, Simplex Method, Integer Programming Problem, Assignment Problem, Network Analysis, Application problem, ...

Chapter 8: Dynamic Programming Problems **(3 weeks)**

Dynamic Programming for Discrete Cases, Multivariable Optimization, Minimum Spanning Tree Algorithm, Dijkstra's Algorithm to find Shortest Path Problem, ...

Chapter 9: Metaheuristic Algorithms **(2 weeks)**

Genetic Algorithms, Particle Swarm Optimization, Bee Colony Algorithm… etc

Method of evaluation:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references :

1. H.M. Antia. Numerical Method for Scientists and Engineers. McGraw Hill, 1995.
2. W. Dos Passos. Numerical Methods, Algorithms and Tools. Taylor and Francis Group, 2010.
3. Yang, X. S. Engineering optimization: an introduction with metaheuristic applications. John Wiley & Sons, (2010).

Semester: 2
Teaching unit: UEF 2.1
Subject 2: Applied Artificial Intelligence
VHS: 45h00 (Lecture: 3h)
Credits: 4
Coefficient: 2

Teaching objectives:

Provide an understanding of AI fundamentals, focusing on applications in control systems for electrical and electronic engineering.

Recommended prior knowledge:

Basic programming skills, linear algebra, probability, and statistics and fundamental control systems knowledge.

Content of the material:

Chapter 1: Introduction to AI and its Relevance in Engineering (1 week)
Chapter 2: Introduction to Machine Learning (2 weeks)
Chapter 3: Supervised Learning Techniques (3 weeks)
Chapter 4: Unsupervised Learning Techniques (3 weeks)
Chapter 5: Neural Networks and Deep Learning Basics (2 weeks)
Chapter 6: Optimization Techniques in AI (1 week)
Chapter 7: AI in Control Systems (2 weeks)
Chapter 8: Practical Considerations in AI Implementation (1 week)

Method of evaluation:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references :

1. Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig
2. Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.

Semester: 1
Teaching unit: UEF 2.2
Material 1: Industrial Automation
VHS: 45h (Lecture: 3h)
Credits: 5
Coefficient: 3

Teaching objectives:

The course provides fundamentals and advanced understanding of PLC hardware and programming techniques, the interaction between hardware and software in a real-time system, the necessary process to organize and complete a programmable controller project. Large system control such as SCADA and DCS are introduced as well. Upon completing the course, the students will have detailed knowledge of PLC hardware, various PLC programming languages, Industrial busses and Protocols.

Recommended prior knowledge:

A course in Electronics (analog and digital), and a course in process control and instrumentation

Content of the material:

Chapter 1: Introduction **(1 weeks)**

Definitions, types of Industrial Automation,...

Chapter 2: PLC Programming **(3 weeks)**

program structure, Structured programming, User & data type... Program blocks, Program execution and scan, Programming styles: LADDER, STL and FBD, structured text

Chapter 3: PLC Instruction Set **(3 weeks)**

Basic logic elements, Standard logic instructions, Advanced logic instructions, math and data manipulation instructions

Chapter 4: PLC Input/Outputs **(2 weeks)**

Sensors and actuators and interfacing with PLC

Chapter 5: Industrial busses and industrial protocols **(2 weeks)**

Chapter 6: Introduction to industrial plant automation systems **(2 weeks)**

DCS and SCADA

Chapter 7: Industrial robots and vision integration inn automation systems (2 weeks)

Method of evaluation:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references :

1. W. Bolton. "Programmable Logic Controllers". Newnes, 5th Ed, 2009.
2. Mr. Rabiee. "Programmable Logic Controllers: Hardware and Programming". Goodheart-Willcox 3rd Ed,2012
3. F. Petruzella, "Programmable Logic Controllers", McGraw-Hill , 3rd ed, 2004.

Semester: 2
Teaching unit: UEF 2.2
Subject 3: Nonlinear Systems and Control
VHS: 45h00 (Lecture: 3h)
Credits: 5
Coefficient: 2

Teaching objectives:

Give the student the necessary tools to analyze nonlinear dynamical systems, and presents the most relevant techniques for controlling these systems

Recommended prior knowledge:

A basic course in linear algebra

A basic course in linear control systems

Content of the material:

Chapter 1: Introduction (1 weeks)
Autonomy, Equilibrium points, nonlinear behavior.....

Chapter 2: Second order systems and phase plane analysis (3 weeks)
Phase portrait, graphical techniques, existence of limit cycles...

Chapter 3: Describing function analysis: (3 weeks)
Optimal-quasi linearization, describing functions of common nonlinearities, describing function analysis of nonlinear systems.

Chapter 4: Introduction to Lyaponov theory (2 weeks)
Stability concepts, Lyaponov's indirect method, Lyaponov's direct method, application to control design.

Chapter 5: Absolute stability (2 weeks)
Concepts, Popov's criterion, Circle criterion

Chapter 6: Introduction to nonlinear control techniques (2 weeks)
Feedback linearization, sliding-mode control, adaptive control.

Chapter 7: Application of nonlinear control techniques to robot manipulators (2 weeks)
Coupled and decoupled approach.

Method of evaluation:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references :

1. M. Vidyasagar, *Nonlinear Systems Analysis*, 2nd *Ed*., SIAM, 2002.
2. H.K. Khalil, *Nonlinear Systems, 3rd ed., Prentice Hall, 2001.*
3. S. Sastry, *Nonlinear Systems: Analysis, Stability and Control*, 1st Ed., Springer 1999.
4. J-J. Slotine, W. Li, *Applied Nonlinear Control,* 1st Ed, Prentice Hall, 1991.

Semester: 2
Teaching unit: UEF 2.2
Material 2: Multivariable Control Systems
VHS: 45h (Lecture: 3h)
Credits: 4
Coefficient: 2

Teaching objectives:

To presents the main analysis and design tools for the control of linear multivariable control systems described by state-space equations or rational matrices.

Recommended prior knowledge:

A basic course in linear algebra
A basic course in linear control systems

Content of the material:

Chapter 1: Review of SISO systems canonical forms: (1 weeks)
Diagonal/Jordan form, Controller form, observer form, Similarity transformations.

Chapter 2: MIMO systems representations (2 weeks)
State-space, I/O, Basic properties...

Chapter 3: MIMO systems canonical forms (2 weeks)
General form, Block form, similarity transformations...

Chapter 4: State feedback design of MIMO systems (2 weeks)
General form, Block form, Robustness...

Chapter 5: Observer design of MIMO systems (2 weeks)
General form, Block form, Robustness...

Chapter 6: Elements of matrix polynomial theory (2 weeks)
latent roots, latent vectors, right/left solvents.....

Chapter 7: Poles/zeroes of MIMO systems and compensator design (2 weeks)
Chapter 8: Minimal realization of MIMO systems (1 weeks)
Chapter 9: Model reduction of MIMO systems (1 weeks)

Method of evaluation:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references :

1. Skogestad, *Multivariable Feedback Control:Analysis and Design*, 2nd Ed, Wiley-Interscience, 2005
2. C.T. Chen, *Linear System Theory and Design*, 3rd Ed., Oxford Press, 1998.
3. P. Albertos and A. Sala, *Multivariable Control Systems: An Engineering Approach*, 1st Ed, Springer, 2003

Semester: 2
Teaching unit: UEM 1.2
Material 1: Applied Optimization Lab
VHS: 22h30 (TP: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

This is a companion laboratory course for the Numerical methods course; the objective is to put the various methods and algorithms into computer program.

Recommended prior knowledge:

Differential equations and computational methods, Matlab, C++

Content of the material:

Lab N°1: Solving for the Roots of a function	**(1 weeks)**
Lab N°2: Solution of a system of linear equations	**(1 Weeks)**
Lab N°3: Numerical integration	**(1 weeks)**
Lab N°4: Polynomial Lagrange interpolation	**(1 weeks)**
Lab N°5: Spline interpolation	**(1 weeks)**
Lab N°6: Numerical solutions of differential equations	**(1 week)**
Lab N°7: Linear programming Application	**(2 weeks)**
Lab N°8: Dynamic Programming Application	**(3 weeks)**
Lab N°9: Genetic Algorithms	**(1 week)**
Lab N°10: Particle Swarm Optimization	**(1 weeks)**
Lab N°11: Bee Colony Algorithm	**(1 weeks)**

Method of evaluation:

Continuous Assessment: 100%

Bibliographical references :

Laboratory handouts available before each Lab session

Semester: 2
Teaching unit: UEM 1.2
Subject 2: Applied Artificial Intelligence Lab
VHS: 22:30 (TP: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

To provide hands-on experience with AI algorithms and techniques. To facilitate practical understanding of AI applications in control systems through problem-solving and project-based learning. To explore the use of software tools such as Python and MATLAB for AI implementation.

Recommended prior knowledge:

Completion or concurrent enrollment in the 'Applied Artificial Intelligence' course. Basic proficiency in Python or MATLAB.

Content of the material:

Lab 1: Introduction to AI with Python/MATLAB (1 week)
Lab n°2: Data Preprocessing and Visualization (1 weeks)
Lab N°3: Implementing Supervised Learning Algorithms (2 weeks)
Lab N°4: Exploring Unsupervised Learning Techniques (2 weeks)
Lab N°5: Neural Networks and Their Applications (2 weeks)
Lab N°6: Optimization Techniques in AI (2 weeks)
Lab N°7: Advanced Topics in AI (2 weeks)
Lab N°8: Project Work (2 weeks)

Method of evaluation:

Continuous Assessment: 100%

Bibliographical references :

1. Lab manuals and resources will be provided, which will include Python and MATLAB examples relevant to the lab exercises.

Semester: 2
Teaching unit: UEM 1.2
Topic 3: Industrial Automation Lab
VHS: 37h30 (TP: 2h30)
Credits: 2
Coefficient: 1

Teaching objectives:

This is a companion laboratory course for the industrial automation course: the objective is to put the theoretical concepts into practical Implementations and discuss their potential limitations.

Recommended prior knowledge:

This course is to be taken along or after the industrial automation course

Content of the material:

Lab N°1: Burglar alarm system (2 weeks)
Lab N°2: Sequential control (traffic light, washing machine) (2 weeks)
Lab N°3: Conveyor Control (2 weeks)
Lab N°4: Elevator control (2 weeks)
TP N°5: Car park / parking controller (1 week)
Lab N°6: Security door system with keypad (2 weeks)
Lab N°7: Step motor control (2 weeks)
TP N°8 : DC motor control (1 weeks)
open loop PWM control, feedback automatic speed control)

Method of evaluation:

Continuous Assessment: 100%

Bibliographical references :

Laboratory handouts available before each Lab session

Semester: 2
Teaching unit: UET 2.1
Subject 1: Standards and Rules of Ethics and Integrity
VHS: 22h30 (lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

Develop student awareness regarding ethics and rules that govern life at both university and in the professional world. The course presents the risks and consequences of corruption that are raised by new technologies and sustainable development and eventually how to fight them.

Recommended prior knowledge:

Ethics & Integrity (**Bachelor course**)

Content of the material:

A. Compliance with the rules of ethics and integrity: (06 weeks)

1. Reminder of Ethics and Deontology of the MESRS: Integrity and Honesty. Academic freedom, objectivity and critical thinking. Equity. Rights and obligations of the student, teacher, and other staff,
2. Honest and responsible research

- Respect for the principles of ethics in teaching and research
- Responsibilities in teamwork: Professional equality of treatment. Conduct against discrimination.
- Plagiarism (definition of plagiarism, different forms of plagiarism, procedures to avoid unintentional plagiarism, etc.

3. Ethics and deontology in the professional life: Legal confidentiality in business. Loyalty to the company. Responsibility within the company, Conflicts of interest.

B. Intellectual Property: (04 weeks)

1. Fundamentals of intellectual property
2. Copyright
3. Protection and enhancement of intellectual property

C. Ethics, sustainable development and new technologies: (05 weeks)

Link between ethics and sustainable development, energy saving, bioethics and new technologies (artificial intelligence, scientific progress, humanoids, robots, drones

Method of evaluation:

Review: 100%

Bibliographical references:

1. Consult the two links : www.wipo.int, and http://www.app.asso.fr/
2. Orders No. 933 of 28 July 2016 laying down the rules relating to the prevention and fight against plagiarism
3. D. Carr, "*Professionalism and Ethics in Teaching*". New York, NY Routledge. 2000.

Semester: 2
Teaching unit: UED 1.2
Subject: Subject 1 of your choice (Elective course)
VHS: 22h30 (lecture: 1h30)
Credits: 1
Coefficient: 1

Remark

Members of Automatic "Control" engineering's curriculum committee are requested to select a course from the list proposed in this document. Selection of one course or more depends on the need and priority.

Proposal of some discovery materials

Semester: 2
Teaching unit: UED 1.2
Subject 1: Electrical Systems Analysis and Design
VHS: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

This course intends to give students a practical background in the analysis and design of electrical installations along with components selection in the industry.

Recommended prior knowledge:

Basic course in Electric circuits and Electrical machines.

Content of the material:

Chapter 1: Review of AC Circuits **(1 week)**

Power in single phase AC circuits, Complex power, Conservation of power, Three phase circuits, Delta-Wye transformations...

Chapter 2: Electric Installations Devices **(3 weeks)**

Contactor and Circuit breakers, C.B rating and Cable Sizing, Electric Switches and Fuses, Electrical Relays, Types of faults for Electrical Motors, Protection Devices, Overload Relays...

Chapter 3: Variable Frequency Drives **(3 weeks)**

Chapter 4: Load Estimation **(3 weeks)**

Demand Factor and Diversity Factor, Load Estimation Different Methods, Transformer Room Dimensions Sizing Generator, Room Dimensions Sizing, Voltage Drop (V.D) Calculations, Short Circuit (S.C) Calculations...

Chapter 5: Electrical systems analysis **(3 weeks)**

Load flow analysis, Voltage Drop analysis, Short circuit analysis, Power Factor correction...

Chapter 6: Cables and Earthing Systems design **(2 weeks)**

Classification of Cables, Conductor Types, Insulation Levels, Types of Armouring in Cables, Selection of Neutral Conductor & Earthing Cross-Sectional Areas, Cable Design, Effect of Current on Human Body, Types of Electric Hazards, Classification of Earthing Systems, Components of Earthing System...

Method of evaluation:

Continuous assessment: 100%.

Bibliographical references :

Robert E. , and Henry PE, *Models for Design: Electrical Calculations for Industrial Plants*, CRC Press, 2017

Semester: 2
Teaching unit: UED 1.2
Material1: Printed Circuit Board Design and Technologies
VHS: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

Printed Circuit Boards (PCB) are widely used by electronics and electrical engineers in different applications. Generally the first step in a given electronic card production is making the PCB. This course provides the skills necessary to effectively design and implement a PCB. The course covers all the necessary aspect to design a PCB from an idea to a product by describing the steps involved in PCB Design and Fabrication process.

Recommended prior knowledge:

Experimental Labs of fundamental courses (Electricity, Active devices, Digital).
Some chemistry and physics principles.

Material content:

1. **Introduction to PCB** (Definition and Relevance of PCB, Background and History of PCB, Classes of PCB Design)
2. **PCB Design Process** (PCB design rules and constraints, Steps involved in layout design, Designing of Multi-layer Boards, Design for manufacturability)
3. **PCB Fabrication & Assembly** (Steps involved in fabrication of PCB, PCB Fabrication techniques-single, double sided and multilayer, Etching: chemical principles and mechanisms, PCB component assembly processes, Soldering, Inspection and electrical testing)
4. **PCB design Software tools** (Give in general the best PCB design software programs : KiCad, EasyEDA, Eagle..)
5. **PCB design: Practical examples +Project for the students**

Evaluation method:

Continuous assessment: 100%.

Bibliographical references:

1. J. Goldberg, "How to make printed circuit boards", McGraw-Hill Book Company, 1980.
2. D. L. Jones, PCB Design Tutorial, June 29th 2004, *https://www.scs.stanford.edu/~zyedidia/docs/pcb/pcb_tutorial.pdf.*

Semester: 2
Teaching unit: UED 1.2
Subject1: Introduction to Renewable Energies
VHS: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

This course aims to provide a comprehensive understanding of renewable energy systems and their integration into power systems. Students will explore various renewable energy sources, including solar, wind, hydropower, and ocean energy, with a focus on the technological, control, and power engineering aspects.

Recommended prior knowledge:

A course in Electric Circuits
A course in Power Electronics

Material content:

1. **Introduction to Renewable Energies** (Fundamentals and key characteristics of wind, solar PV and hydro energy sources.)
2. **Solar Energy Systems** (Fundamentals of solar cells, Types of solar devices, Modelling Power electronics for PV systems, Maximum Power Point Tracking...)
3. **Wind Energy Systems** (Principle of operation, turbine types, power train, cost of energy, turbine modelling and control, wind turbine reliability...)
4. **Integration of Renewable Energy in Power Systems** (Renewable energy models, Power flow analysis, Dynamic simulations, Energy Storage Systems, Optimal Power Flow (OPF)...)
5. **Sizing of PV Systems (**Components selection, battery design, Controller design, Invereter design, ...)
6. **Hydropower Energy (**Types of hydropower plants, Control, Environmental considerations...)

Evaluation method:

Continuous assessment: 100%.

Bibliographical references:

1. Leon Freris, David Infield, "Renewable energy in power systems", John Wiley & Sons, 2008.

V - Detailed programme by subject of the S3 semester

Semester: 3
Teaching unit: UEF 3.1
Subject 1: Robotics and Control
VHS: 45h00 (Course: 3h)
Credits: 5
Coefficient: 3

Teaching objectives:

This course serves as an introduction to robotic systems and their control.

Recommended prior knowledge:

A course in Linear Control Systems
A course in Systems Modelling
A course in Differential equations

Content of the material:

Chapter 1: Introduction **(1 week)**
Robots, categories, characteristics…
Chapter 2: Theoretical background (3 weeks)
Rigid motions, Kinematics, Velocity kinematics
Chapter 3: Kinematics modelling **(3 weeks)**
Denevit-Hartenberg convention, Forward kinematic model, Inverse kinematic model
Chapter 4: Velocity Kinematics modelling **(3 weeks)**
The jacobian, Inverting the jacobian, Static force computation
Chapter 5: Dynamics modelling **(2 weeks)**
Dynamic model, Euler-Lagrange equations, Iterative Newton –Euler method
Chapter 6: Control **(3 weeks)**
Joint position control, Path planning, Software architecture….

Method of evaluation:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references :

Asada, H., and J. J. Slotine. *Robot Analysis and Control*. New York, NY: Wiley, 1986.

Semester: 3
Teaching unit: UEF 3.1
Material 2: Industrial Networks
VHS: 45h00h (Course: 3h)
Credits: 5
Coefficient: 2

Teaching objectives:

1. To provide a background on the principles of networking.
2. Investigate the various industrial communication protocols employed in automated systems and instrumentation.

Recommended prior knowledge:

The student should have an insight about numbering systems, basic numbering systems, basic boolean algebra and computer architecture.

Content of the material:

Chapter 1: Introduction to Networking
Chapter 2: Network Protocols and Communications
Chapter 3: IPv4 Addressing and subnetting
Chapter 4: Network Access layer and Ethernet
Chapter 5: Network Layer and Routing protocols
Chapter 6: Transport Layer
Chapter 7: Industrial Communications Protocols
Chapter 8: OPC Servers

Method of evaluation:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references :

1. Cisco CCNA V4.1, *Official Exploration Course*. 2011-2012
2. A. Tanenbaum & al, *Computer Networks, 5th Edition.* Prentice Hall, 2010
3. R. Zurawski, The industrial communication technology handbook, Boca Raton, Taylor & Francis, 2005.

Semester: 3
Teaching unit: UEF 3.1
Subject 3: Adaptive & Predictive Control
VHS: 45h (Course: 3h)
Credits: 5
Coefficient: 2

Teaching objectives:

Gain insight into the principles and characteristics of control systems where the control function autonomously adapts in real-time to variations in the targeted process. Develop an understanding of the theoretical underpinnings and constraints associated with such controllers, including essential attributes like stability and robustness. Acquire the proficiency to design, adaptive and predictive controllers applicable across diverse domains.

Recommended prior knowledge:

A course in Optimization
A course in Linear Control Systems
A course in Nonlinear Control

Content of the material:

Chapter 1: Introduction into time-varying systems (1 weeks)
Chapter 2: Model Identification (1 weeks)
Chapter 3: Principles of predictive controllers (1.5 weeks)
Chapter 4: Predictive control of linear systems (2 weeks)
Chapter 5: Stability and robustness of predictive control systems (1 weeks)
Chapter 6: Predictive control of nonlinear systems (2 weeks)
Chapter 7: Principles of adaptive control (1.5 weeks)
Chapter 8: Self-tuning adaptive controllers (2 weeks)
Chapter 9: Model reference-adaptive control (2 weeks)
Chapter 10: Gain Scheduling (1 weeks)

Method of evaluation:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references :

1. Edoardo Mosca, Optimal, predictive, and adaptive control, Prentice Hall, 1995.
2. J.A. Rossiter, Model-Based Predictive Control: A Practical Approach, CRC Press, 2003.

Semester: 3
Teaching unit: UEF 3.2
Material 1: Advanced Control Systems
VHS: 45h (Lecture: 2h00, TD: 1h00)
Credits: 4
Coefficient: 2

Teaching objectives:

This advanced-level course is designed to provide students in-depth understanding of cutting-edge control techniques that go beyond the basics. The course is divided into four main modules, each focusing on essential aspects of advanced control systems: Nonlinear Techniques, Optimal Control, and Intelligent Control and PID tuning techniques.

Recommended prior knowledge:

A course in Linear Control Systems
A course in Nonlinear Systems

Content of the material:

Chapter 1: Nonlinear Control Techniques **(4 weeks)**
Chapter 2: Introduction to Optimal Control **(3 weeks)**
Chapter 3: Linear Quadratic Regulator **(2 weeks)**
Chapter 3: Intelligent Control Techniques (4 weeks)
Chapter 4: PID Tuning Techniques **(2 weeks)**

Method of evaluation:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references :

1. J-J. Slotine, W. Li, *Applied Nonlinear Control,* 1st Ed, Prentice Hall, 1991.
2. Donald E. Kirk, *Optimal Control Theory: An Introduction*, Dover Books on Electrical Engineering, 1970
3. Nazmul Siddique, *Intelligent Control: A Hybrid Approach Based on Fuzzy Logic, Neural Networks and Genetic Algorithms*, Springer International Publishing, 2014

Semester: 3
Teaching unit: UEF 3.2
Material 2: Industrial Instrumentation
VHS: 45h (Lecture: 3h)
Credits: 4
Coefficient: 2

Teaching objectives:

This course provides the fundamentals of industrial instrumentation. Topics range from basic measurements, analog and digital information processing, analog and digital transmission, to virtual instrumentation and smart sensors.

Recommended prior knowledge:

A basic course in instrumentation and process control (analog)

Content of the material:

Chapter 1: Measurements and instrumentation principles (2 weeks)
Instruments characteristics, Measurements, characteristics and conditions...
Chapter 2: Review of Measurement sensors (1 week)
Optical, level, flow, PH sensors, advanced sensors ...
Chapter 3: Instrumentation Diagrams (2 weeks)
Chapter 4: Signal processing and Measurement systems design (2 weeks)
Analog and digital filtering, Measurement systems characteristics, analysis and design..
Chapter 5: Sensor Calibration (2 weeks)
Chapter 6: Introduction to data acquisition and virtual instruments (2 weeks)
Principle and characteristics of data acquisition, data acquisition and virtual instruments...
Chapter 7: Analog and digital information transmission (2 weeks)
Analog voltage and current transmission, V/F and F/V transmission, digital transmissions....
Chapter 8: Introduction to smart sensors (2 weeks)

Method of evaluation:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references :

1. L. M. Thompson. "Industrial Data Communications", ISA, 4th, 2007
2. B. Mihura, "*LabVIEW for Data Acquisition*", Publisher: Prentice Hall, 2001
3. W. Boyes, "*Instrumentation Reference Book*", Butterworth-Heinemann, 4th ed, 2009.

Semester: 3
Teaching Unit: UEM 3.1
Subject 1: Robotics and Control Lab
VHS: 22h30 (TP: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

Students will dive into the design and control of Robotic systems using the different toolboxes available on Matlab. A project is to be realized by students at the end of the course to deepen the acquired knowledge on robotic systems.

Recommended prior knowledge:

This is to be taken along with the Robotics and Control course.

Content of the material:

Lab n°1: Introduction to Matlab Robotic Toolbox (1 week)
Lab N°2: Robot Manipulators Design (2 weeks)
Lab N°3: Trajectory Generation for Robotic Manipulators (2 weeks)
Lab N°4: Jacobian and Velocity Kinematics on Matlab (2 weeks)
Lab N°5: Articulated Robots Design (3 weeks)
Lab N°6: Control Design Techniques (5 weeks)

Method of evaluation:

Continuous assessment: 100%.

Bibliographical references :

Laboratory handouts available before each Lab session

Semester: 3
Teaching Unit: UEM 3.1
Subject 2: Industrial Networks Lab
VHS: 22h30 (TP: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

This is a companion laboratory course for the industrial networks course; the objective is to put the theoretical concepts into practical Implementations.

Recommended prior knowledge:

This is to be taken along the industrial networks course.

Content of the material:

- **Introduction to Packet Tracer and GNS3.**
- **Router Configurations used in LANs.**
- **Switch configuration used in LANs (VLAN configuration)**
- **LANs interconnections (MANs or/and WANs).**
- **TCP-IP Utilities**
- **Modbus TCP**
- **Ethernet IP Configuration**
- **Integration of Modbus and Ethernet IP Devices**
- **OPC Servers**

Method of evaluation:

Continuous assessment: 100%.

Bibliographical references :

Laboratory handouts available before each Lab session

Semester: 3
Teaching Unit: UEM 3.1
Subject 3: Adaptive & Predictive Control Lab
VHS: 22h30 (TP: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

This is a companion laboratory course for the adaptive and predictive control course; the objective is to put the theoretical concepts into simulation examples using Matlab platform.

Recommended prior knowledge:

This course is to be taken along or after the adaptive and predictive control course

Content of the material:

Lab N°1: Create and test a model predictive controller (2 weeks)
Lab n°2: Model Predictive Control of a Single-Input-Single-Output Plant (2 weeks)
Lab N°3: Model Predictive Control of Multi-Input Single-Output Plant (2 weeks)
Lab N°4: DC Servomotor with Constraint on Unmeasured Output
Lab N°5: Model Predictive Control of a Multi-Input Multi-Output Nonlinear Plant (3 weeks)
Lab N°6: Adaptive Cruise Control Using Extremum Seeking (2 weeks)
Lab N°7: Model Reference Adaptive Control (2 weeks)
Lab N°8: Indirect Model Reference Adaptive Control of First-Order System (1 week)

Method of evaluation:

Continuous assessment: 100%.

Bibliographical references :

Laboratory handouts available before each Lab session

Semester: 3
Teaching Unit: UEM 3.1
Material 4: Industrial Instrumentation Lab
VHS: 37h30 (TP: 2h30)
Credits: 2
Coefficient: 1

Teaching objectives:

This is a companion laboratory course for the industrial instrumentation course; the objective is to put the theoretical concepts into practical Implementations and discuss their potential limitations.

Recommended prior knowledge:

This course is to be taken along or after the industrial instrumentation course

Content of the material:

Lab N°1: Using Sensors for physical variables measurement **(2 weeks)**

Lab n°2: Signal processing **(2 weeks)**

Level and span adjustment, filtering, sample/hold....

Lab N°3: Analog and digital signal transmission **(2 weeks)**

Current trans. V/F & F/V trans. Digital trans.

Lab N°4: Introduction to data acquisition system **(3 weeks)**

Signal process, Labview data acquisition

Lab N°5: Virtual instrumentation **(3 weeks)**

Virtual to visual measurement

Lab N°6: Introduction to smart sensors and data transmission **(3 weeks)**

Method of evaluation:

Continuous assessment: 100%.

Bibliographical references :

Laboratory handouts available before each Lab session

Semester: 3
Teaching unit: UET 3.1
Subject 1: Project Management
VHS: 22h30 (lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

1. Understand and apply the sequential steps of the project management framework.
2. Understand the importance and function of project management and apply the project process of initiating, planning, executing, controlling and closing the project.

Recommended prior knowledge:

Ethics & Integrity (**basics**)

Content of the material:

Chapter 1: Initiating a project	**(02 weeks)**
Chapter 2: Planning of project activities	**(02 weeks)**
Chapter 3: Project execution activities	**(03 weeks)**
Chapter 4: Closing down the project activities	**(03 weeks)**
Chapter 5: Application and case studies:	
• Representing and scheduling project steps activities	**(02 weeks)**
• Use of software program : Primavera activities	**(03 weeks)**

Method of evaluation:

Review: 100%

Bibliographical references:

1. P. Lewis, Fundamentals of Project Management, James, ISBN: 9780814408797
2. Harold, KerznerProject Management: A Systems Approach to Planning, Scheduling, and Controlling, (ISBN-10: 0471741876/ISBN-13: 978-0471741879).

Semester: 3
Teaching unit : UET 3.1
Subject 2: Communication skills
VHS: 22h30 (lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

This is a 'service English' communication course intended to prepare the students to communicate and function in English (Lab reports, Industrial experience reports and end of study cycle project reports). The course outline presented in this document is divided into two parts: a first part (first five units) which is considered as a link between the students' previous work in the first two semesters; and a second part consisting of eleven units which will present the students with discourse behaviours and discourse means to communicate and function in English. Other items are treated throughout the program: mechanics of writing (punctuation, numbering of chapters and sub-chapters, labelling of visuals, quotations...).

Recommended prior knowledge:

Student must attend all English courses

Content of the material:

Part One: **(06 weeks)**

1. Transition from sentence production to the development of continuous prose,
2. Devices for linking ideas and sentences: logical, grammatical and lexical connectors,
3. Concepts of reference,
4. Paragraph Development: Producing pieces of coherent discourse,
5. Different types of paragraphs (analysis, description, comparison/contrast, analogy, definition ...)

Part Two: **(09 weeks)**

6. Definition: Explaining what something is,
7. Instructions and Process: Explaining how to do something,
8. Description of a Mechanism: Explaining how something works,
9. Analysis through Classification and Partition: Putting things in order,
10. Analysis through Effect and Cause: Answering Why,
11. The Summary: Abstracting and Getting to the heart of the matter,
12. Using the Library: Getting acquainted with resource materials,
13. Visuals: Seeing is convincing,
14. Report Writing: Telling it like it is,
15. Oral communication: Saying it clearly,
16. Business Letters: Sending a Message through the mail

Method of evaluation:

Review: 100%

Bibliographical references:

1. Rob Biesenbach, "*Unleash the Power of Storytelling: Win Hearts, Change Minds, Get Results*", Eastlawn Media (February 13, 2018).
2. Carmine Gall, "*Five Stars: The Communication Secrets to Get from Good to Great Hardcover*", St. Martin's Press (June 5, 2018)
3. Mark Goulston , "*Just Listen: Discover the Secret to Getting Through to Absolutely Anyone*", AMACOM; Reprint edition (March 4, 2015)
4. Celeste Headlee, "*We Need to Talk: How to Have Conversations That Matter*," Harper Wave (September 19, 2017).
5. Jerold Panas and Andrew Sobel , "*Power Questions: Build Relationships, Win New Business, and Influence Others*", Wiley; 1st edition (February 7, 2012)