ULT Mechatronics Engineering

Subjects Modules for S1

Semester 1 Year 1

U1.1: Engineering Tools 1
U1.1.1 Math for Engineering 1

Module designation	Engineering Tools 1
Module level, if applicable	1st year
Code, if applicable	U1.1
Subtitle, if applicable	
Courses, if applicable	**Math for Engineering 1**
Semester (s) in which the module is taught	Semester 1 (S1)
Person responsible for the module	Emna Rabhi
Lecturer	M. Slim HOUIMLI
Language	French
Relation to curriculum	Integrated course module
Type of teaching, contact hours	Lecture, 42 hours of classroom course/semester
Workload	Total 84 hours/semester (42 hours of Self-Study/semester)
Credit points	3 credits
Requirements according to the examination regulations	Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	- usual derivatives and primitives - limits - generalized integrals - simple element decomposition technique
Module objectives/intended learning outcomes	**Objectives:** This module aims to provide students with sufficient mathematical tools and techniques to tackle a variety of design engineering problems. **Learning Outcomes:** Students will be able to : 1. Understand Integration 2. Master the Fourrier, Laplace, and the Z-Translmorms.

Content	**Classroom Lecture** **I. Generalized or improper integrals:** 1. Introduction 2. Definition 3. Examples and fundamental properties: • Exponentials0 • Powers • Logarithm 4. Any functions: • Absolute convergence **II.Integration by decomposition into simple elements:** 1. Decomposition into simple elements 2. Rational fractions 3. Integration of a simple element of the first kind 4. Integration of a simple element of the second kind **III.The Laplace transformation:** 1. Laplace transform of usual functions 2. Properties of the Laplace transform 3. Inverse Laplace transform: Original of a function 4. Transform of a convolution product 5. Application of the Laplace transform to the resolution of differential equations **IV.The Fourier transform:** 1. Fourier transform of usual functions 2. Properties of the Fourier transform 3. Transform of a convolution product 4. Application of the Laplace transform to the resolution of differential and integro-differential equations 5. Parseval-Plancherel theorem 6. Inverse Fourier Transform 7. Link with the Laplace transform **V. The Z transformation:** 1. Introduction 2. Definition 3. Convergence region 4. Properties 5. Convolution Product, Initial Value Theorem, Final Value Theorem 6. Inverse transform 7. Solving difference equations
Study and examination requirements and forms of examination	Written Mid-term Exam (40%) + Written Final Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT)

Reading List	1. « Analysis Course IV : Sequences and series of functions » L. Pujo-Menjouet, Claude Bernard University, Lyon I 2. « Mathematics of the deterministic signal » POINT Nelly, ‘ MAA107’ 3. Walter Appel. Mathématiques pour la physique et les physiciens, H & K Éditions (2e édition), 2002. 4. François Roddier. Distributions et transformation de Fourier (à l’usage des physiciens et des ingénieurs) Ediscience, 1971. 5. Joel L. Schiff. The Laplace Transform: Theory and Applications. Springer-Verlag, 1999.

U1.1: Engineering Tools 1

U1.1.2: Statistics & Probability

Module designation	**Engineering Tools 1**
Module level, if applicable	Year 1, Semester 1
Code, if applicable	U1.1
Subtitle, if applicable	
Courses, if applicable	**Probability & Statistics**
Semester(s) in which the module is taught	Semester 1
Person responsible for the module	Dr Emna RABHI
Lecturer	Mme Imen BOUCHAALA
Language	French
Relation to curriculum	Compulsory module,
Type of teaching, contact hours	Lecture, 21 hours Classroom Lecture/ Semester
Workload	Total 51hours/ Semester (30 hours of Self Study)
Credit points	2
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Basic Probability and Mathematics
Module objectives/intended learning outcomes	**Objectives:** 1. Introduction of statistics fields of application 2. Understand the random variables and vector 3. Introduction to Statistics & Probability theory **Learning Outcomes:** Students will be able to : 1. Learn the main techniques of unvaried and bivariate statistics 2. Implement these techniques appropriately 3. Calculate the probability of random events in daily or professional context.

Content	**General Introduction to Probability & Statistics Theory** **Chapter I. Random variables** 1- Definition 2- Law of probability of a random variable 3- Probability density of a random variable **Chapter II. Examples of random variables.** 1. Discrete random variables 2. Continuous random variables. 3. Probability law approximation **Chapter III. Random vector** 1- Joint law of a random vector 2- Absolutely continuous random couple 3- Marginal distribution function **Chapter IV. Descriptive statistics** 1- Definition - Probabilistic interpretations 2- Double statistical series **Chapter V. Estimates** 1- Sampling 2- Ownership of statistics 3- Estimate 4- Estimation by confidence interval.
Study and examination requirements and forms of examination	Written Mid-Term Exam (40%) + Written Final Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Video projection
Reading list	✓ Pierre Dagnélie. Statistique théorique et appliquée. De Boeck Université, 1998. ✓ Sheldon M. Ross. Initiation aux probabilités. Presses polytechniques et universitaires romandes, 2007. ✓ Gilbert Saporta. Probabilités, analyse des données et statistique. Technip, 1990.

U1.1: Engineering Tools 1

U1.1.3: C Programming

Module designation	**Engineering Tools 1**
Module level, if applicable	Year 1, Semester 1
Code, if applicable	U1.1
Subtitle, if applicable	
Courses, if applicable	**C Programming**
Semester(s) in which the module is taught	Semester 1
Person responsible for the module	Dr Emna RABHI
Lecturer	Aida ben Salem
Language	French
Relation to curriculum	Compulsory module subject
Type of teaching, contact hours	Lecture, 21 hours Classroom Lecture/ Semester 21 hours for Workshop in Lab / semester
Workload	Total 84 hours/ Semester (42 hours of Self Study)
Credit points	3
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Basic Algorithmic
Module objectives/intended learning outcomes	**Course Objectives:** 1. Students will gain a broad perspective about the uses of computers in engineering. 2. Develops basic understanding of the concept of algorithm & programming technique. 3. To use of the C programming language to implement various algorithms.

Content	**Workshop & Projects :** **Chapter 1 Introduction** 1.1 Problems with programs 1.2 Introduction to the C language 1.3 Properties of a C program 1.4 Life cycle of a C program 1.5 Analysis of a problem 1.6 Program environment: - Constants, Variables - Types of variables: input, output parameters **Chapter 2 Data Types in C** 2.1 Simple types - Logic type - Type Character - Integer type - Real Type 2.2 Expressions - The operands -The operators - Types of expressions - Calculation of an expression 2.3 Priority between operators **Chapter 3 Sequential Processing - Basic Operations** 3.1 Assignment 3.2 Simple input / output instructions -Reading - writing **Chapter 4 Conditional Processing** 4.1 if statement 4.2 Instruction of multiple choices 4.3 Simplification of tests **Chapter 5 Iterative Processing** 5.1 Introduction 5.2 for statement 5.3 while statement 5.4 do while statement **Chapter 6 Tables** 6.1 Introduction 6.2 Declaration and access to an element 6.3 Basic operations: filling, displaying and adding an element 6.4 Finding an item - Sequential - Dichotomous 6.5 Multidimensional arrays 6.6 Application: sorting tables **Chapter 7 Procedures and Functions** 7.1 Definitions 7.2 Declaration of a procedure or a function 7.3 Calling a procedure or a function 7.4 Parameter passing - Formal parameters, effective parameters

	- Passage by value - Passage by address **Chapter 8 Strings** 8.1 Definition 8.2 Writing some functions - Declaration of a chain - Reading and viewing a channel - Operations on character strings (length calculation, copying, comparison, concatenation, sub-string extraction, etc.) **Chapter 9 Structured Types** 9.1 Definition 9.2 Declaration 9.3 Access to a field, modification of structure type variable, etc. 9.4 Table of structures **Chapter 10 Pointers** 10.1 Definition of a pointer 10.2 Declaration of a pointer to a variable 10.3 Allocation and release of memory space for the pointed variable 10.4 Retrieving the content of a pointed variable 10.5 Retrieving the address of a variable 10.6 Examples of use
Study and examination requirements and forms of examination	Workshop Evaluation & Oral exam (100%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Workshop in Lab Video projection
Reading list	✓ Claude Delannoy. (2014). Le guide complet du langage C. ✓ Yves Mettier. (2005), C en action ✓ HARDOUIN. (2009). HARDOUIN ✓ http://www.istia.univangers.fr/~hardouin/cours_c.pdf, ✓ Date de consultation 19 Mai 2012 ✓ Brian Kernighan, Dennis Ritchie. (1990), Le lanagage C : norme ANSI.

U1.2: Electronics Electrotechnics EE 1

U1.2.1: Analog Electronics

Module designation	**Electronics Electrotechnics EE 1**
Module level, if applicable	Year 1,Semester 1
Code, if applicable	U1.2
Subtitle, if applicable	
Courses, if applicable	**Analog Electronics**
Semester(s) in which the module is taught	Semester 1
Person responsible for the module	Dr Emna RABHI
Lecturer	Dr. Ferid HARABI
Language	French
Relation to curriculum	Compulsory module ,
Type of teaching, contact hours	Lecture, 21 hours Classroom Lecture/ Semester 10.5 hours for Workshop in Lab/ semester
Workload	Total 52.5 hours/ Semester (21 hours of Self Study)
Credit points	2
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Basic Electricity
Module objectives/intended learning outcomes	**Objectives:** - Understand the operation of basic electronic components. - Study & Analyse electronic circuits through Workshops

Content	**Chapter 1 The Electric Quadrupoles** 1. Representation of quadrupoles (in Z, en Y ..) 2. Parameter of quadrupoles 3. Study of passive filters **Chapter 2 The diodes** 1. Notions of semiconductors 2. PN junction diodes (characteristics and equivalent electrical models) 3. Applications of diodes 4. Zener diodes 5. Thyristors. **Chapter 3 Bipolar transistors** 1. Definition and symbol 2. Network of characteristics 3. Polarization circuits 4. The fundamental amplifiers based on bipolar Transistor **Chapter 4 Field Effect Transistors** 1. Definition and symbol 2. Network of characteristics 3. The fundamental amplifiers based on Field-Effect Transistor (FET) **PRACTICAL WORKSHOP – Electronic Laboratory** **TP1** Diode-based circuits Half-wave rectifiers, half-wave rectifiers, erectors, Zener diodes **TP2** Quadrupoles Study of filters and quadrupole parameters **TP3** Bipolar transistors Bias circuits, common emitters, common collector
Study and examination requirements and forms of examination	Written Mid-Term Exam (25%) + Practical Workshop(25%)+Written Final Exam (50%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Workshop in Laboratory Video projection
Reading list	✓ Principes d'Electronique » : MALVINO P. (Ed. Mc Graw Hill) « Circuits and Devices » : MILLMAN (Ed. Mc Graw Hill) « Electronique Analogique » : GIRARD M. (Ediscience)

U1.2: Electronics Electrotechnics EE 1

UE1.2.2: Digital Electronics

Module designation	**Electronics Electrotechnics EE 1**
Module level, if applicable	Year 1,Semester 1
Code, if applicable	U1.2
Subtitle, if applicable	
Courses, if applicable	**Digital Electronics**
Semester(s) in which the module is taught	Semester 1
Person responsible for the module	Dr Emna RABHI
Lecturer	Dr. Ridha BENADLI
Language	French
Relation to curriculum	Compulsory module ,
Type of teaching, contact hours	Lecture, 21 hours of Classroom Lecture/ Semester 10.5 hours for Workshop in Lab/ semester
Workload	Total 52.5 hours/ Semester (21 hours of Self Study)
Credit points	2
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Basic Logic Functions, Binary
Module objectives/intended learning outcomes	**Objectives:** 1. Understand combinatorial systems 2. Understand Sequential Systems 3. Understand Logic functions

Content	**Chapter I- Numbering Systems, Binary Arithmetic and Codes:** 1- Binary, Octal and Hexadecimal system 2- Representation by the complement to 1 and the complement to 2 of the binary numbers. 3- Fixed point representation 4- Binary arithmetic: Addition, Subtraction, Multiplication 5- Codes: BCD and Gray **Chapter II- Combinatorial systems:** 1- Binary variable 2- Basic logic functions. 3- Morgan's theorems 4- Simplifications of logical functions by the Karnaugh Map (K-Map) 5- Combinatorial circuits: Adder, Subtractor, Comparator, Decoder, Multiplexer. 6- Arithmetic and Logic unit 7- Integrated TTL and CMOS circuits **Chapter III- Sequential systems** 1- The memory function. 2- Asynchronous rocker 3- RS, JK, D synchronous rocker. 4- Synchronous, asynchronous counters 5- shift registers
Study and examination requirements and forms of examination	Written Mid-Term Exam (25%) + Practical Workshop(25%)+Written Final Exam (50%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Workshop in Laboratory Video projection
Reading list	✓ R.MERAT. ELECTRONIQUE NUMERIQUE, NATHAN, 2000. ✓ JACQUES BOUQUET, PIERRE MAYÉ. ÉLECTRONIQUE NUMERIQUE EN 26 FICHES, DUNOD, 2004.

U1.3: Mechanics 1

U1.3.1: Workshop Mechatronics Systems Design 1 (CATIA V5)

Module designation	**Mechanics 1**
Module level, if applicable	Year 1, Semester 1
Code, if applicable	U1.3
Subtitle, if applicable	
Courses, if applicable	Workshop Mechatronics Systems Design 1 (CATIA V5)
Semester(s) in which the module is taught	Semester 1
Person responsible for the module	Dr Emna RABHI
Lecturer	M Bilel Ben AMMAR
Language	French
Relation to curriculum	Compulsory module ,
Type of teaching, contact hours	42 hours for Workshop in Lab/ semester
Workload	Total 56 hours/ Semester (14 hours of Self Study)
Credit points	2
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Technical Drawing
Module objectives/intended learning outcomes	**Objectives:** 1. Familiarize with computer-aided design tools using CATIA V5 2. Master the advanced functions of the Part design workshops. 3. Master the advanced functions of Assembly design workshops. 4. Design parts in 3D 5. Work on project and create parts and do assembly

Content	**CATIA V5 Basics** • Introduction to the graphic environment. • Customize the CATIA environment. • Create sketches and study the implementation of constraints. • Study of functions (extrusion, cutting, sweeping, smoothing, etc.). **TP 01** 'Design of a Double Pole Circuit Breaker' ' • Analysis of sketches, constraints, transformations ... • Design of parts: create and modify components from sketches (extrusions, holes, pockets, grooves, revolutions, multi-extrusion, parameters and limits, fillets, chamfers, shells, tapping and threads, ...) • Use transformations: General, symmetry, mirror, repetitions. **TP 02 "** Design of a Pioneer Loudspeaker ' • Production of parts (Part Design). • Assembly Design. • Drawing: definition drawing for each part. • Drawing: General drawing for assembly. **TP 03: "2D-3D conversion"** • Production of parts (Part Design). • Drawing: definition drawing. • Quotations, annotations. **TP 04: "Design of a pneumatic cylinder"** • Production of parts (Part Design). • Assembly Design. • Use of design library. • Drawing: definition drawing for each part. • Drawing: General drawing for assembly.
Study and examination requirements and forms of examination	Continuous Assessment 40% (Report for each workshop required) +Semester Workshop Exam 60 %
Media employed	Course Material (Hard/ Soft copy) for Workshop Video projection
Reading list	3DS DASSAULT SYSTEMS GUIDEBOOKS & TUTORIALS FOR CATIA

U1.3: Mechanics 1

U1.3.2 : Design Techniques

Module designation	**Mechanics 1**
Module level, if applicable	Year 1,Semester 1
Code, if applicable	U1.3
Subtitle, if applicable	
Courses, if applicable	Design Techniques
Semester(s) in which the module is taught	Semester 1
Person responsible for the module	Dr Emna RABHI
Lecturer	M Oleg TSOMAREV
Language	French
Relation to curriculum	Compulsory module ,
Type of teaching, contact hours	Lecture, 21 hours Classroom Lecture/ Semester
Workload	Total 51 hours/ Semester (30 hours of Self Study)
Credit points	2
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	- Detail and assembly drawings - The basics of reading engineering drawings
Module objectives/intended learning outcomes	**Objectives:** From a system and / or its technical documentation, the student must be able to: 1. Know how to undertake a functional analysis process which consists of researching, ordering, characterizing and prioritizing the functions of the product expected by the user; 2. Identify technical solutions and associated components; 3. Identify the components of an information chain and an energy chain. 4. Read and understand the overall drawing of a mechanical system and define one of the parts of this system either by the orthogonal projection method or from a cavalier or isometric perspective; 5. Design and manipulate a volume, represent it graphically in 2D or 3D using CAD software during the practical work sessions; 6. Define the dimension of a part.

Content	**Chapter 1: FUNCTIONAL ANALYSIS** 1. Functional analysis approach 2. Functional analysis methods - APTE method - SADT method - FAST method **Chapter 2: TECHNICAL DRAWING STANDARD AND DESIGNATION** 1. Different types of industrial designs Overall drawing Definition drawing 2. Technical drawing standards Writing Presentation Format Inscription cartridge Lettering Linework **Chapter 3: SPELLING REPRESENTATION** 1. Projection systems 2. Orthogonal projection Principle View layouts Correspondence between views Examples of views **Chapter 4: SECTIONS AND CUTS** 1. Representations of cut surfaces The cup The simple cut Half-saw and half-cut The local cut The Broken Cup The broken section with parallel planes The broken cut with oblique planes The section The output section The folded down section **Chapter 5. OUTLOOK** 1. Isometric perspective 2. The cavalier perspective 3. Construction of ellipses 4. Designation of the usual mechanical forms **Chapter 6. GRAPHIC EXECUTION OF THE LISTING** 1. Dimensional specification Extension line, dimension line and end of dimensions Position and registration of dimensions Dimensioning of a radius and diameter Serial / parallel dimensioning Dimensioning chamfers

	Dimensioning in Cartesian coordinates Rating due to lack of space Quotations of equidistant and repetitive elements 2. Applications **Chapter 7. TOLERANCES, DEVIATIONS & ADJUSTMENTS** 1. Origins 2. Principle 3. ISO system Graphic Representation Notion in the case of an assembly Examples Normal bore system Normal shaft system **Chapter 8. FUNCTIONAL RATING** 1. Condition rating 2. End surfaces 3. Bonding surfaces 4. Establishment of a chain of ratings Tracing method
Study and examination requirements and forms of examination	Written Mid-Term Exam (40%) + Written Final Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Video projection
Reading list	✓ GUIDE DE DESSINATEUR, CHEVALIER ✓ TECHNIQUE D'INGÉNIEUR - BUREAU D'ÉTUDE

U1.3: Mechanics 1

U1.3.3: Fluid Mechanics & Applied Thermodynamics

Module designation	**Mechanics 1**
Module level, if applicable	Year 1, Semester 1
Code, if applicable	U1.3
Subtitle, if applicable	
Courses, if applicable	**Fluid Mechanics & Applied Thermodynamics**
Semester(s) in which the module is taught	Semester 1
Person responsible for the module	Dr Emna RABHI
Lecturer	M Abedessatar HARBAOUI
Language	French
Relation to curriculum	Compulsory module ,
Type of teaching, contact hours	Lecture, 21 hours Classroom Lecture/ Semester 21 hours for Workshop in Lab / semester
Workload	Total 84hours/ Semester (42 hours of Self Study)
Credit points	3
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	-Basic Thermodynamics -First & Second Law
Module objectives/intended learning outcomes	**Objectives:** 1. Understand fluid dynamics and governing Laws 2. Understand fluid kinematics 3. Understand Thermodynamics and application for liquid-gas, and thermal machine 4. Practices through various workshops in Lab

Content	**PART A FLUID MECHANICS** **Chapter 1. Fluid statics:** Concept of pressure in a fluid - Law of hydrostatics, Applications: - Pascal's theorem - Pressure forces on a wall - Archimedes' theorem. **Chapter 2. Fluid Kinematics:** Velocity field - Streamlines and trajectory - Acceleration of a fluid particle - Flow rate of a flow - Conservation of mass. **Chapter 3. Incompressible Perfect Fluids Dynamics:** Euler-Theorem Bernoulli Equation -Concept of hydraulic load, *Applications:* Torricelli-Venturi Effect relationship - Pumps and turbines, useful powers ... **Chapter 4. Dynamics of viscous fluids:** Navier-Stokes -Reynolds number -Laminar and turbulent flow equation. *Applications:* Poiseuille flow in pipe -Regular pressure drops **Chapter 5. Pressure losses:** Generalized Bernoulli relation -Singular pressure losses… **PART B THERMODYNAMICS** **Chapter 1. Reminders of thermodynamics of closed systems:** energy and entropy balances. Ideal gas applications. **Chapter 2. Thermodynamics of open systems:** Enthalpy balance for an open system in steady state. *Applications:* -nozzle-turbine-heat exchanger -compressor, -Brayton engine cycle. **Chapter 3. Study of Ditherme Thermal Machines:** Engine cycle, cycles receivers: refrigerator and heat pump,

	Carnot cycle. **Chapter 4. Pure Substance Liquid-vapour equilibrium** Latent heat and enthalpy of vaporization - Title in vapour in a binary mixture - Clapeyron diagram and isotherms Andrews, entropy and enthalpy diagrams ... **Chapter 5. Phase change thermal machines:** thermodynamic steam cycles: - Carnot Cycle - Rankine and Hirn cycles: heat engine - Heat pump and system single compression refrigeration unit. **Practical workshop in Laboratory** **Exercise 1:** Venturi tube **Exercise 2:** Determination of pressure drop in pipes… **Exercise 3:** Isotherms of a pure Substance **Exercise 4:** Refrigeration cycle with simple mechanical compression ...
Study and examination requirements and forms of examination	Written Mid-Term Exam (25%) + Practical Workshop(25%)+Written Final Exam (50%)
Media employed	Workshop Handbook in Lab Video projection
Reading list	1. Mécanique des fluides - 3e édition, Cours, 70 exercices corrigés, Sakir Amiroudine, Jean-Luc Battaglia, 2017 2. Mécanismes hydrauliques et pneumatiques, Jacques Faisandier, Michel Blot, Serge Grand, Daniel Hubert, Jean-Pierre Lecerf et al., 2016

U1.4: Mechatronics Elements 1

U1.4.1: Linear Systems Regulation & Servo Control

Module designation	**Mechatronics Elements 1**
Module level, if applicable	Year 1, Semester 1
Code, if applicable	U1.4
Subtitle, if applicable	
Courses, if applicable	**Linear Systems Regulation & Servo Control**
Semester(s) in which the module is taught	Semester 1
Person responsible for the module	Dr Emna RABHI
Lecturer	Dr Emna RABHI
Language	French
Relation to curriculum	Compulsory module ,
Type of teaching, contact hours	Lecture, 42 hours of Classroom Lecture/ Semester 21 hours for Workshop in Lab/Semester
Workload	Total 98 hours/ Semester (42 hours of Self Study)
Credit points	4
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Backgrounds in Math and Linear Algebra
Module objectives/intended learning outcomes	**Objectives :** 1. Introduce the concepts and tools necessary to model and analyse a controlled system 2. Understand the Modelling technique of Linear Time-Invariant systems (LTI systems) 3. Understand characteristics, input-output stability, etc. **Learning Outcomes:** Students will be able to : 1. Analyse the control of the studied system (stability, precision, dynamic characteristics, ...) 2. Design & Implement correction of linear servo systems.

Content	**CHAPTER 1: Modelling of Linear Systems: Notion of Transfer Function** 1.1Introduction 1.2 Concept of signal 1.3 Notion of signal 1.4 Concept of open loop / closed loop a. Open loop system b. Closed loop system 1.5 Concept of Model a. Mathematical model b. Laplace transform c. Application to the resolution of differential equations 1.6 Notion of Transfer Function 1.7 Block diagrams and diagram algebra *Tutorial1* **CHAPTER 2: Temporal study of first and second order systems** 2.1 Study methods and definitions 2.2 Study of first order systems a. Equation b. Response to a Dirac impulse c. Step response d. Response to a ramp entry 2.3 Study of second order systems a. Equation b. Impulse response c. Step response *Tutorial2* **CHAPTER 3: Frequencial study of first and second order systems** a. Bode diagram b. Nyqyuist diagram **CHAPTER 4: Stability of linear servo systems** 3.1 Mathematical criterion of stability a. Statement of Stability Criterion b. Disadvantages of the mathematical criterion 3.2 Routh algebraic criterion a. Principle b. Example *Tutorial3* **CHAPTER 5: PERFORMANCE OF LOCKED LINEAR SYSTEMS** 4.1 General issue 4.2 Precision of a controlled system 4.3 Speed of regulated systems 4.4 Limitation of overshoot 4.5 Influence of static open loop gain on closed loop performance 4.6 Case study *Tutorial4*

	Chapter 6: Correction of linear servo systems 5.1 Specifications of a control 5.2 General principle of the correction of a system 5.3 Basic corrective actions a. Proportional corrector b. Integral corrector c. Derivative action corrector 5.4 Integral proportional action-phase delay corrector 5.5 Derivative proportional action-Phase advance corrector *Tutorial5* **Practical Workshop using MATLAB in Laboratory** -Familiarisation with Matlab Toolboxes & Simulink -Temporal study of first of Linear System -Frequencial study of Linear system -Stablity study using simulink
Study and examination requirements and forms of examination	Written Mid-Term Exam (25%) + Practical Workshop(25%)+Written Final Exam (50%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Video projection
Reading list	✓ H. BOURLES, SYSTEMES LINEAIRES : DE LA MODELISATION A LA COMMANDE, HERMES. ✓ F. ROTELLA ET I. ZAMBETAKIS, AUTOMATIQUE ELEMENTAIRE, HERMES ✓ S.LE BALLOIS, P.CODRON, AUTOMATIQUE : SYSTEMES LINEAIRES ET CONTINUS, DUNOD ✓ P.GUYENOT, T. HANS, REGULATION ET ASSERVISSEMENT. ELEMENTS DE COURS ET PROBLEMES RESOLUS ; EYROLLES. ✓ MATHWORKS.COM

U1.4: Mechatronics Elements 1

U1.4.2: Microcontrollers Architectures

Module designation	**Mechatronics Elements 1**
Module level, if applicable	Year 1 , Semester 1
Code, if applicable	U1.4
Subtitle, if applicable	
Courses, if applicable	Microcontrollers Architectures
Semester(s) in which the module is taught	Semester 1
Person responsible for the module	Dr Emna RABHI
Lecturer	M Hafedh Nefzi
Language	French
Relation to curriculum	Compulsory module ,
Type of teaching, contact hours	21 hours for Workshop in Lab / semester
Workload	Total 51 hours/ Semester (30 hours of Self Study)
Credit points	2
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Basic knowledge in Algorithmic, Electronics
Module objectives/intended learning outcomes	**Objectives:** The aim of this module is to: 1-Understand the architecture of microcontrollers. 2-Develop programs in Assembler and C and test them on the simulator.

Content	**Chapter 1 Microcontrollers Architectures:** 1. Internal architecture of the PIC 16F877 microcontrollers. 2. PIC 16F877 Memories and Memory Map 3. PIC 16F877 Registers their operations. **Chapter 2. PIC16F877 Microcontroller Memories** 1. Logical organization of memory 2. Memory organization of the Mid-range family of PIC 16F877: Memory organized in page 3. Program memory addressing: Reading and writing of data 4. RAM data memory: Addressing of the data memory 5. Addressing modes **Chapter 3. The Programming Instruction** 1. The structure of an instruction a. Instructions specifications b. Instruction formats c. Instruction groups *Tutorial 1* **Chapter 4. The Inputs / Outputs of the PICs** 1. Register addresses a. Electronic inputs / outputs b. Input / output configuration registers c. Basic components (LED diodes, 7-segment display with common anode and cathode, LCD displays, switches) *Tutorial 2* **Chapter 5. External interruptions** 1. Principle of an interruption 2. Interruptions in the PICs 3. Control register for external interrupts: INTCON 4. Role of INTCON bits in interrupt programming 5. Programming an interruption 6. Saving and restoring the environment 7. End of interruption: RETFIE *Tutorial 3*
Study and examination requirements and forms of examination	Oral+Practical Workshop (100%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Workshop Handbook in Lab Video projection
Reading list	1. **Embedded Systems** Architecture A Comprehensive Guide for Engineers and Programmers: Tammy Noergaard, Linacre House, Jordan Hill, Oxford UK, 2005 2. **La Programmation des Pics** Par Bigonoff, La gamme Mid-Range par l'étude des pics 16F87X (16F876-16F877) 3. **Programmation des Pics** Par Bigonoff, Première partie – PIC16F84 – Révision 6

U1.5 : Languages & Social Science 1

U1.5.1 : English 1

Module designation	**Languages & Social Science 1**
Module level, if applicable	Year 1, Semester 1
Code, if applicable	U1.5
Subtitle, if applicable	
Courses, if applicable	**English 1**
Semester(s) in which the module is taught	Semester 1
Person responsible for the module	Dr Emna RABHI
Lecturer	Mme Lilia zine edine
Language	Anglais
Relation to curriculum	Compulsory module , - Soft Skills
Type of teaching, contact hours	Lecture, 21 hours Classroom Lecture/ Semester
Workload	Total 42hours/ Semester (21 hours of Self Study)
Credit points	1.5
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Basic English
Module objectives/intended learning outcomes	**Objectives:** 1. Provide students with the necessary vocabulary related to their field of study 2. Develop and integrate the use of language skills: Reading, Listening, Speaking and Writing 3. Encourage students to examine the lessons critically and make improvements

Content	**Technical English for mechatronics engineers** **Chapter I General introduction to the mechatronics field** 1. Mechatronics : basic vocabulary 2. Grammar : simple present…/Present continuous **Chapter II-Technology in use** 1. Describing technical functions and applications 1- Emphasising how technology works 2- Simplifying and illustrating technical explanations 3. Grammar: Simple past/Past continuous. **Chapter III- Materials Technology** 1. Describing specific materials 2. Categorising materials 3. Grammar : simple future **Chapter IV- Components and assemblies** 1. Describing components…shapes 2. Features. 3. Scale 4. Explaining jointing and fixing techniques 5. words to describe machining 6. verbs and nouns to describe jointing and fixing 7. Grammar : Present Perfect 8. Engineering design 9. vocabulary: phrases related to tolerance 10. verbs for describing stages of a design process 11. verbs and nouns for describing design problems
Study and examination requirements and forms of examination	Written Mid-Term Exam (40%) + Written Final Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Video projection
Reading list	✓ Cambridge English for Engineering

U1.5 : Languages & Social Science 1
U1.5.2 : Communication Techniques

Module designation	**Communication Techniques**
Module level, if applicable	Year 1, Semester 1
Code, if applicable	U1.5
Subtitle, if applicable	
Courses, if applicable	**Communication Techniques**
Semester(s) in which the module is taught	Semester 1
Person responsible for the module	Dr Emna RABHI
Lecturer	Mme Lamia Siala
Language	French
Relation to curriculum	Compulsory module subject – Soft Skills
Type of teaching, contact hours	Lecture, 21 hours Classroom Lecture/ Semester
Workload	Total 42hours/ Semester (21 hours of Self Study)
Credit points	1.5
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Basic Communication & good French expression
Module objectives/intended learning outcomes	**Objectives:** 1. Make students aware of the communication aspects in daily life, workplace, and within project team, etc. 2. Provide appropriate techniques to facilitate exchange within a given framework.

Content	**Chapter 1: Take into account the communication situation** 1. Define the informative or argumentative aim of the message to be produced 2. Gather and organize the pieces of information according to the message 3. Choose the appropriate means of expression **Chapter 2: Written communication** 1- Writing the CV and the cover letter 2- Writing a professional email **Chapter 3: Group communication** 1- Meeting facilitation and collaboration 2- Debates **Chapter 4: the job interview** 1- Candidate profile 2- Recruiter's profile *Applications:* the NASA game, the dove clinic, the collegial decision
Study and examination requirements and forms of examination	Written Mid-Term Exam (40%) + Written Final Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Video projection
Reading list	✓ DELMOTTE Axel, DUHAME Sabine, Le grand livre du CV, Studyrama, 2010. ✓ DUTERME Claude, La communication interne en entreprise : l'approche de Palo Alto et l'analyse des organisations, Deboeck, Bruxelles, 2002 ✓ GUITTET André, L'entretien : techniques et pratiques, Armand Colin, Paris, 2008.

U1.6: Project 1

U1.6.1: Supervised Project 1

Module designation	**Project 1**
Module level, if applicable	Year 1, Semester 1
Code, if applicable	U1.6
Subtitle, if applicable	
Courses, if applicable	**Supervised Project 1**
Semester(s) in which the module is taught	Semester 1
Person responsible for the module	Dr Emna RABHI
Lecturer	Core Faculty Members
Language	French
Relation to curriculum	Compulsory module ,
Type of teaching, contact hours	21 hours of Supervision on Campus/ semester
Workload	Total 51 hours/ Semester (30 hours of Self Study)
Credit points	2
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Solidworks, Catia, Matlab, RDM6,
Module objectives/intended learning outcomes	This is an exercise that will help student to apply knowledge's & Skills to work and present a basic project. **Objectives :** 1. Sizing and choice of solution 2. Project studies: functional and structural analysis, design (preparation of technical files) 3. Design Simulation using appropriate software & tools
Content	Theme of the projects: terrestrial robots 2019-2020 Project 1: Study and design of a robot for collecting tennis balls Project 2: Study, design and Modelling of a demining robot Project 3: Study and design of a vertical robot Project 4: Study, design and Modelling of a drawing arm Project 5: Study and Modelling of an IOT robot farmer Project 6: Study and design of a smart greenhouse

Study and examination requirements and forms of examination	Projects - 100% (Evaluation of the final report of project)
Media employed	On Campus & Remote Supervision Video projection
Reading list	DOCUMENT & REFERENCES ARE GIVEN BY SUPERVISORS DEPENDING ON EACH PROJECT